ANNUAL TECHNICAL REPORT OF THE COUNCIL FOR GEOSCIENCE

FOR THE YEAR ENDED 31 MARCH 2005

Council for Geoscience
LEADING EARTH-SCIENCE SOLUTIONS

Council for Geoscience

Cover: Strachan's Bay; a pocket beach near Mtakatye river mouth, Eastern Cape.
Photograph by Michael Rohwer.

Strachan's Bay, 35 km southwest of Port St Johns, is one of the features that makes the Wild Coast famous. The sandy beach at the head of the cove displays a typical summer profile consisting of a thin layer of sand overlying the winter profile which consists of cobbles and boulders. Wave fronts entering the cove are curved as a result of wave refraction, and this wave shape has erosively controlled the long-term shape development of the cove. Large winter-storm waves entering the cove rework deposits on the beach, and rip currents flowing seaward along the relatively sheltered edges of the cove, selectively carry away the sand and leave only the cobbles. Under subdued summer-wave conditions, as shown in the image, the waves carry sand into the cove.

The rocky shoreline is composed of Katberg Formation sandstone. An extensive coastal monocline causes the strata to dip seaward at about 30° toward the Agulhas-Falkland fracture zone that lies a few kilometres offshore. Stratigraphic relationships at Mngazana estuary mouth, 22 km to the northeast, show that this monocline already existed in the Early Cretaceous (about 135 million years ago), while Gondwanaland was still breaking up.

A raised marine terrace that probably dates back to the Pliocene (5–1,7 million years ago) is evident at the top right of the frame as a flat surface along the skyline that lines up with the horizon. Pronounced crustal elevation along the Wild Coast, including elevation of the marine terrace on the image, has produced its typically rugged coastline.

The Council for Geoscience is a statutory body established in terms of the Geoscience Act (Act No. 100 of 1993).

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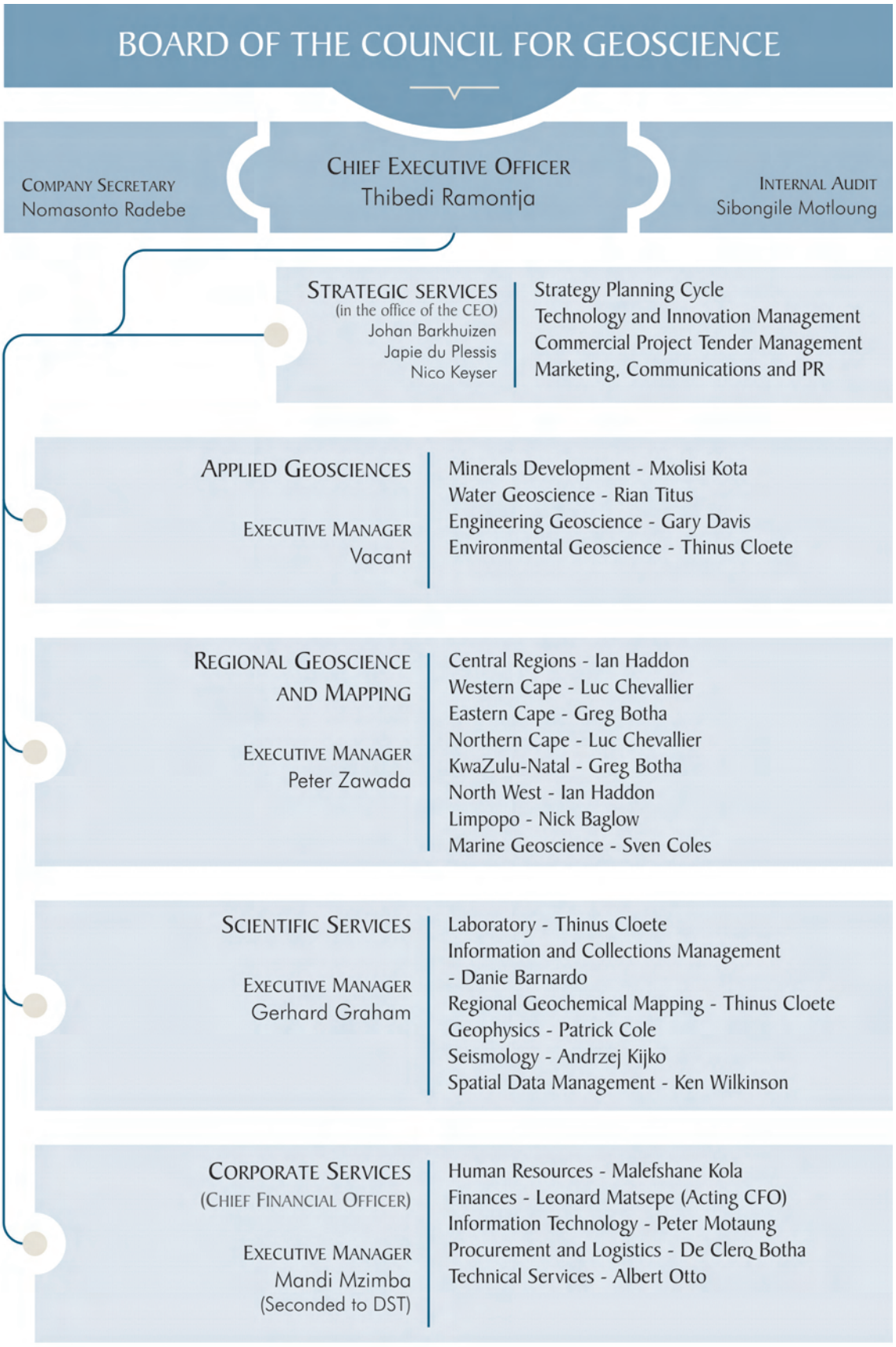
ORGANISATION CHART



FOREWORD

The Council for Geoscience (CGS) publishes the findings of all research which has been supported through public funding in Reports (distributed as photocopies), Bulletins (short publications), Memoirs (major academic works), Handbooks (manuals covering broad or very specialised topics) and maps (geological, geophysical, geotechnical and metallogenic, each of which is accompanied by an explanation), as well as the Popular Geoscience Series which aims at bringing geoscience to the broader public. The Annual Technical Report describes research projects on which work was carried out during the financial year, and lists ongoing activities which do not have a specific termination date.

A geological map of the SADC region is in preparation which will make geological information on the SADC region more accessible to exploration companies and researchers in the fields of hydrogeology, geodynamics and transboundary development.

A World Bank project aimed at revising the geological maps of Mozambique is being managed by the CGS with input from the British, Norwegian, and Finnish Geological Surveys, as well as geologists from Mozambique. During the year, mapping was carried out on the Nampula/Ilha de Mozambique and the Meconte/Monapo sheets.

The CGS has developed characteristic indices for water supply schemes which take into account factors that affect the status of the schemes in different hydrological regions. A pilot study has been started in the Mzimvubu–Keiskamma Water Management Area to establish the importance of four different indices in the area, and a decision support tool has been developed to assist in focussing national water management strategies, after which a systematic study of the remaining Water Management Areas will be carried out.

The South Africa-India Karoo correlation project, in cooperation with the Geological Survey of India, will compare the Karoo Supergroup of South Africa and the Gondwana Sequence of India in order to evaluate potential economic deposits, particularly of coal, on which both countries are dependent for power generation and steel manufacture. Correlation of the Karoo-Gondwana strata will assist in identifying exploration opportunities for other commodities, such as uranium and heavy minerals, and will improve our understanding of Southern Hemisphere coal. This is the first attempt to correlate Karoo-type strata between East and West "Gondwanaland".

The CGS develops and maintains one of the 60 infrasound stations of the International Monitoring System of the Comprehensive Test-Ban-Treaty Organisation (CTBTO). The technology of infra-sound — very low-frequency sound waves — is important in the detection of atmospheric nuclear explosions, and complements other technologies in monitoring adherence to the Comprehensive Nuclear Test Ban Treaty of 1996.

These highlights indicate the extent to which the CGS has evolved to meet the needs of a changing society which requires the implementation of solutions to basic human needs — water, employment and security.

T. Ramontja
CEO

1 INTERNATIONAL COLLABORATION

0487 STRATIGRAPHIC CORRELATION BETWEEN THE KAROO SUPERGROUP OF SOUTH AFRICA AND THE GONDWANA SEQUENCE OF INDIA

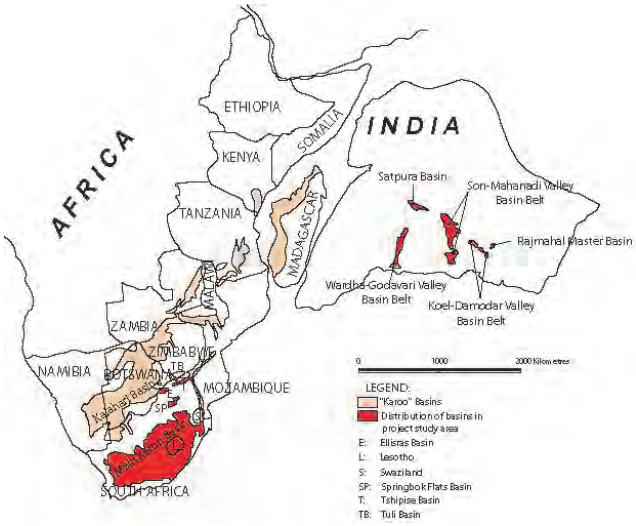
Project leader: D.I. Cole, Ph.D.

Project team: CGS: J. Neveling, Ph.D.
GSI: S.G. Mukhopadhyay, B.Sc., S.S.K. Mukhopadhyay, B.Sc., S.P.K. Parui, B.Sc., M.R. Choudhuri, Ph.D.

Objectives: to (i) produce a detailed correlation at formation level between the Karoo Supergroup in South Africa and the Gondwana Sequence in India from the Carboniferous to the Jurassic, (ii) evaluate potential economic deposits, particularly coal.

Duration: 1999/2000–2005/2006.

Budget: Total: R600 000;
2004/2005: R137 000.



Reconstruction of central Gondwana during Permo-Triassic times showing distribution of basins investigated within the Correlation Project.

Motivation

The project commenced in November 1999, following meetings at ministerial level between the Department of Minerals and Energy (DME) and the Indian Department of Mines, with the aim of establishing collaborative projects, and was to be undertaken by geologists from the CGS and the Geological Survey of India (GSI). The importance of the project is directly related to the dependence of South Africa and India on Permian coal as a source of energy and for use in the manufacture of steel. Correlation of the Karoo-Gondwana strata will assist in identifying new exploration opportunities for coal and other commodities, such as uranium and heavy minerals, and will lead to a better understanding of southern hemisphere coal.

Progress

The project leader visited India during November 2004 for an excursion to the Satpura Basin in order to compare the Karoo Supergroup of South Africa with the Gondwana Sequence of India. Progress and products were discussed, and a detailed layout of the memoir and diagrams was finalised. The main chapter, on stratigraphy, was completed, with correlation between South Africa and India being based on common anchor points. The following divisions were delineated:

Pre-Sakmarian (mostly glacial sediments prior to the widespread Gondwanide glacio-eustatic flooding event)

Sakmarian marine highstand to Kazanian marine highstand (mostly shallow marine and deltaic-shoreface sediments)

Kazanian marine highstand to Permo–Triassic boundary (regressive sediments from shallow marine to terrestrial)

Early to Middle Triassic (terrestrial sediments with reptile fossils used for correlation)

Middle to Late Triassic (terrestrial sediments with reptile fossils used for correlation following an extensive late Middle Triassic (Ladinian) lacuna)

Late Triassic to Early Jurassic (terrestrial sediments ending with aeolian deposits in South Africa only)

Early to Middle Jurassic (widespread lavas in South Africa; terrestrial sediments in India)
Late Jurassic to Early Cretaceous (no sedimentation in South Africa; terrestrial sediments in India terminated by extrusion of Deccan lavas at the end of the Cretaceous).

Detailed lithological profiles using the South African Committee for Stratigraphy's format, on a scale of 1:1 000, were completed.

Conclusions

The project has reached its final stages, and is the first attempt to correlate Karoo-type strata between East and West Gondwana.

Future activities

The project is to be completed during 2005/2006 and will be published as a Memoir of the CGS.

0499 INDO-SOUTH AFRICAN BILATERAL PROJECT NO. 3: PRECAMBRIAN CRUSTAL EVOLUTION AND METALLOGENY OF PENINSULAR INDIA AND EASTERN SOUTHERN AFRICA

Project leaders: S. Frost-Killian, M.Sc., N. Rajendran, M.Tech. (Applied Geology) (India).

Project team: CGS: G.S. de Kock, Ph.D., L.G. Wolmarans, B.Sc.Hons., C.B.A. van der Westhuizen, GSI: N. Rajendran, M.Tech., S.K. Biswas, Ph.D., D. Ganguly, M.Sc., M.W. Haque, M.Sc., J.L. Narang, M.Sc.

Objectives: to produce an integrated 1:5 000 000-scale tectono-metallogenic map, explanation and an associated three-layer GIS database (geology, metallogeny and tectonic features) of the entire study area, with the Precambrian geology restored to its original Gondwanaland break-up position.

Duration: 2002/2003–2005/2006.

Budget: 2004/2005: R59 640.

Motivation

This project is one of the earth-science collaborative efforts entered into between the GSI and the CGS as part of a wider programme of cooperation between the two countries. The project has involved the collaboration of Indian and South African scientists in developing a tectono-metallogenic framework for the Precambrian crusts of India and Africa, which were once joined to form part of the Gondwanaland Supercontinent.

Indian participants at an outcrop near Panchmarhi in the Satpura Basin, India. Planar cross-bedded sandstone (fluvial channel bars) of the Early Triassic Panchmarhi Formation are conformably overlain by red mudstone (floodplain muds) of the Denwa Formation.

This study will serve as a basis for the development of future mineral exploration programmes in the Indo-African region, and will lead to a better understanding of the tectonic settings and metallogeny of the Indian and African cratonic areas.

Progress

Good progress has been made on the project. In October–November 2004, N. Rajendran and D. Ganguly from the GSI visited the CGS for approximately 10 days. Various aspects of the project were discussed and finalised, including changes to the legends for the tectonic and the metallogenic (mineral deposits) themes. All necessary changes were made to a detailed document concerning the GIS-related specifications. It was hoped that the data sets could be integrated using GIS, but problems encountered with the GIS data sets of the two organisations made this impossible. Further problems have

KwaZulu-Natal field trip.
Photo: N. Rajendran.

been experienced with the rotation parameters used to orientate the continental fragments to their pre-break-up positions in Gondwanaland. It was hoped that the data sets would be ready for integration by the end of March. Most of the required data layers have been prepared.

The GSI team visited the Natal Mobile Belt in order to make comparisons with the Eastern Ghat Province. Discussions were held on the different aspects of the draft document and final report, with consensus reached on a draft contents page. Provisional agreement was reached on a deadline for the project, and it was agreed that members of the CGS team would visit India to facilitate the integration of the various data sets.

Conclusions

The project has proceeded on schedule for most of 2004/2005. Owing to unforeseen problems, the project will run over into the next year.

The cooperation between the two organisations has been excellent, and it is hoped that this study will serve as a basis for the development of future mineral exploration programmes within the Indo-African region.

Future activities

The project will be completed during the first half of 2005.

2 COLLABORATION WITH SADC COUNTRIES

0380 1:2 500 000-SCALE GEOLOGICAL MAP OF THE SADC COUNTRIES

Project leader: F.J. Hartzer, Ph.D.

Project team: L. Chevallier, Ph.D.

Objectives: to compile a geological map of the various SADC countries, on a 1:2 500 000 scale, with a single legend and incorporating stratigraphic correlations across the international boundaries, using the SADC Stratigraphic Chart as a guideline.

Duration: 1998/1999–2005/2006.

Budget: 2004/2005: R 22 000.

Motivation

The Stratigraphic Committee of the Geology Subcommittee of the SADC countries identified the need for a map in order to compare the geology of the countries in the region. The 1:2 500 000-scale geological map is seen as a further step in making the geological knowledge of the SADC region more accessible to exploration companies and researchers. Applications are many, and include hydrogeology, metallogeny, geodynamics, integrated studies on catchments, and transboundary development.

Progress

The geological compilation has been completed and the four sheets were redrafted onto stable bases and sent to the Spatial Data Management Unit to be processed. A coded legend was established.

Conclusions

The project is progressing according to plan.

Future activities

Cartographic work will be completed and published during the coming year.

0723 MOZAMBIQUE GEOLOGICAL MAPPING

Project leader: G.H. Grantham, Ph.D.

Project team: P. Macey, Ph.D., M. Roberts., Ph.D., G. de Kock, Ph.D., B. Ingram, M.Sc., M. Cronwright, B.Sc.Hons., R. Opperman, B.Sc.Hons., J.C. Nolte, B.Sc.Hons.

Objectives: to produce geological maps with explanations of 1:250 000-scale sheets 1433 Furancungo/Ulongue, 1439 Meconte/Monapo, 1539 Nampula/Ilha de Mocambique, 1537 Murrupula/Alto Molecue and 1437 Mulevale/Gile/Angoche.

Duration: 2001/2002–2006/2007.

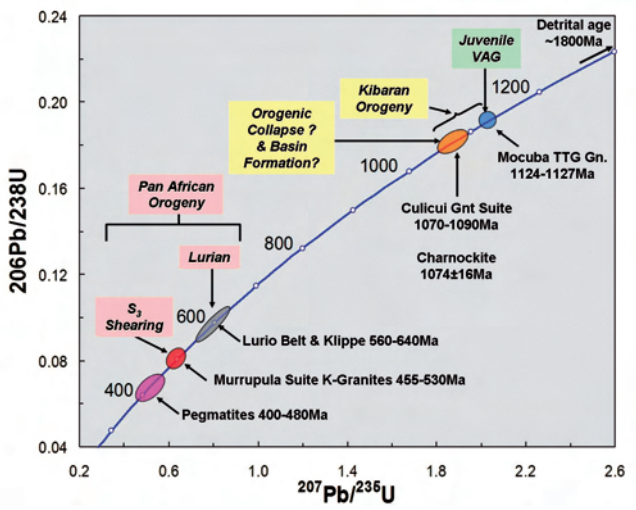
Budget: Total: R11 300 000; 2004/2005: R3 500 000.

Motivation

This project forms part of a World Bank programme, managed by the CGS, to revise the geological maps of Mozambique. Additional work is being carried out by the Geological Surveys of Great Britain, Norway, Finland and Mozambique.

Progress

During the year under review mapping was completed on sheet 1539 Nampula/Ilha de Mozambique and approximately 80 per cent of sheet 1439 Meconte/Monapo was completed. Provisional map compilations for sheets 1537 Murrupula/Alto Molecue and 1437 Mulevale/Gile/Angoche were completed with approximately 50 per cent of sheet 1433 Furancungo/Ulongue being mapped. To date approximately 250 whole-rock major- and trace-element analyses of rock units have been completed in support of the mapping. Geochronological calibration of the lithostratigraphy has been supported by 22 new SHRIMP U/Pb zircon dates, nine Ar/Ar dates and one Rb/Sr date.



Geological evolution of the Nampula and Zambezia Provinces, Mozambique.

Areas being mapped in Mozambique. Areas completed are shaded.

The geological field mapping of the 1:250 000-scale sheet 1537 Alto Molocue-Murrupula is nearing completion, with only a few areas needing revision mapping. A total of 1 360 observation stations have been visited, from which 1 346 structural readings have been measured and 436 rock samples collected. Thin sections of all lithological varieties, 363 in total, have been prepared, and to date about one third have been described. Approximately 100 samples have undergone whole-rock major, trace and REE analyses. Oxygen- and hydrogen-isotope analyses have been completed on 60 mineral separate and whole-rock samples, and 11 samples have been dated by U-Pb SHRIMP analyses.

The lithological and structural field data have been compiled on 1:100 000-scale field sheets. Using these data in conjunction with the geophysical, geochemical and geochronological LANDSAT and DEM data, an interpretive geological map (100% outcrop-type) and map legend have been compiled.

Conclusions

The Zambezia–Nampula Provinces in Northern Mozambique are underlain by six main groups of rocks (see figure). The migmatitic polydeformed TTG VAG gneisses of the **Mocuba Gneiss** represent the oldest rocks in the area and were dated at ~1 125 Ma. These gneisses were intruded at ~1 075 Ma by the voluminous leucogranites and porphyritic granites of the **Culicui Suite** which were subsequently deformed and are now represented by augen and streaky augen gneisses. The **Molocue Group** comprises a sequence of metapelitic, calc-silicate and mafic to ultramafic gneisses which were deposited on the Mocuba Basement. The Mesoproterozoic rocks were intruded by Neoproterozoic Pan-African K-granites and pegmatites of the **Murrupula Suite** (~532–455 Ma). The granites and gneisses are unconformably overlain by Karoo-age Mesozoic lavas of the **Angoche Group** and Cenozoic superficial deposits.

Future activities

The mapping and correlation of the geology across sheet boundaries will be completed in the 2005/2006 winter field season, after which final map compilation and preparation of map descriptions will be completed. Final digital map compilation and completion of map descriptions are planned for the end of 2006.

0903 TRI-NATIONS KAROO BASIN CORRELATION PROJECT

Project leader: J. Neveling, Ph.D.

Project team: I. Haddon, M.Sc., (CGS), B.N. Modie, M.Sc., L.V. Ramokate, M.Sc. (Botswana Geological Survey), unnamed collaborators from the Namibian Geological Survey.

Objectives: to investigate and compare the Karoo-age sequences in South Africa, Botswana and Namibia through a collaborative project involving the geological surveys of the three countries.

Duration: 2004/2005–2008/2009.

Budget: R139 559.

Motivation

Namibia, Botswana and South Africa face similar socio-economic challenges, so it is in our collective interest to pool our knowledge of natural resources. All the coal reserves of the SADC region, as well as industrial minerals, diamondiferous kimberlites and aquifers, are hosted by Karoo strata. It is therefore important that the current understanding of the tectonic framework and development of the Karoo basins be developed. The identification of mineral potential will form an important component of this study. Not only will this project improve our understanding of the distribution of mineral resources and nature of aquifers, but it will also strengthen scientific ties between participating countries and provide an opportunity to develop scientific capacity.

Progress

The project is still in its development stages. The geological surveys of Botswana and Namibia were approached to determine their availability and willingness to become involved in this project, with positive responses. This was followed up by a meeting between staff members of the CGS and Botswana Geological Survey Department in Lobatse, during December 2004. The outline of the project was subsequently developed and presented to a scientific delegation from Botswana and the DST, with all role players expressing support for this project. The report was then circulated to co-workers in the Namibian Geological Survey and Botswana Geological Survey Department for their input and additions, and for the approval by the relevant authorities.

Conclusions

All the proposed participants have supported the proposed project and further planning and initiation of this project will continue.

Future activities

The project will proceed in two stages. Phase 1 will primarily utilise existing information and focus on basic correlative work. This will consist of an extensive literature study, and compilation and comparison of standardised borehole logs. The primary aim will be to improve and expand on the current models for correlation and the basic stratigraphic framework for the region. It is envisaged that this will form the basis for more extensive work in phase 2.

3 CENTRAL REGIONS UNIT

0014 THE GEOLOGY OF THE MOROKWENG AREA

Project leader: F. Gabbrielli, Ph.D.

Objectives: to investigate the geology, stratigraphy, geochronology, structure and hydrogeology of the area of the 1:250 000-scale map 2622 Morokweng.

Duration: 2002/2003–2004/2005.

Budget: Total: R800 000; 2004/2005: R30 000.

Motivation

To produce an updated 1:250 000-scale geological map for sheet 2622 Morokweng to replace the 1974 edition.

Progress

The Morokweng sheet area is located on the southern margin of the Kalahari and includes parts of the North West and Northern Cape Provinces. The main lithologies observed are Archaean granite, gneiss and amphibolite forming the basement; Archaean to Proterozoic sedimentary, volcanic and intrusive rocks; and Phanerozoic sediments and intrusives. Topics studied in detail include the banded iron-formation north and south of Heuningvlei, the dolomite succession northwest of Morokweng township, the sedimentary rocks of the Karoo Supergroup northeast of Severn, the stratigraphy of the Kalahari Group and the hydrogeology of the map area.

Information gathered during the course of the project has improved the existing knowledge of the stratigraphy and chronology of the area, and will serve as a basis for mineral exploration. It is envisaged that the geological map will assist and support government policy and decision makers, the mining industry and investors, development agencies, local communities and small entrepreneurs. Editing is in progress, and the products will be published during 2005/2006.

0614 TAXONOMY AND DISTRIBUTION OF THE CYNODONT GENUS *TRIRACHODON*

Project leader: J. Neveling, Ph.D.

Project team: F. Abdala, Ph.D. (University of the Witwatersrand), J. Welman, Ph.D. (unaffiliated).

Objectives: to describe new fossil material collected by various South African institutions since 1990 and to re-assess the taxonomy of the Cynodontia, a group of mammal-like reptiles from which mammals evolved.

Duration: 2002/2003–2004/2005.

Budget: R700 for vehicle costs.

Motivation

Very little detailed work has been done on the cynodont (mammal-like reptile) fossils collected from the northern Free State since their discovery in 1990. These fossils were at first assigned to the genus *Trirachodon*, although it was evident that they differed from this taxon. The stratigraphic distribution of these new trirachodontid cynodonts (a poorly studied group which were the first ancestors of the mammals to develop postcanine teeth capable of chewing) supported the subsequent stratigraphic subdivision of the *Cynognathus* Assemblage Zone (Beaufort Group, Karoo Supergroup). In this project new material has been described and, based on this information, the taxonomy of non-mammalian cynodonts has been re-assessed.

Progress

The results of the description of the fossil material and taxonomic assessment have been submitted as a paper to be published in the Memoirs of the Linnaean Society.

Conclusions

This work described the recently discovered fossil material and showed that it belongs to

a new genus called *Langbergia modisei*. This new form is the world's oldest gomphodont cynodont, which means that it was the first in the long ancestral line leading to mammals to have expanded cheek teeth, and therefore the ability to chew. It is closely allied to the better known *Trirachodon berryi*, type genus of the trirachodontids, the group of fossils to which these two genera belong (and which the authors have shown to be a natural monophyletic assemblage). Fossils of this extinct group of animals have been known for more than 100 years, but to date a detailed description of any specimen is lacking, impeding any palaeontological studies. The detailed description of *Langbergia* in this work has addressed this oversight and will serve as a comparative standard for future work.

In addition, a table detailing the most important anatomical characters of several important cynodont groups has also been included, and can now be used in further cladistic analyses and research of cynodonts. The authors identified the Early to Mid-Triassic as a period of a marked increase in cynodont diversity, and their work indicated that the taxa *Traversodon* and *Andescynodon* may represent a link between the Olenekian-to-Anisian and Ladinian-to-Norian traversodontids.

0668 LITHOSTRATIGRAPHIC DESCRIPTION OF THE LONELY AND MOKALANEN FORMATIONS IN THE TYPE AREAS

Project leader: F Gabbrielli, Ph.D.

Objectives: to identify and describe the Lonely and Mokalanen Formations in the type areas.

Duration: October 2004 to the end of April 2005.

Budget: Total: R70 000; 2004/2005: R40 000.

Motivation

The Lonely and Mokalanen Formations have not yet been approved as formal lithostratigraphic units by the South African Committee for Stratigraphy (SACS). Rocks provisionally assigned to the Lonely and the Mokalanen Formations are widespread in the southeastern margin of the Kalahari region, but the relationship of the formations to the underlying and overlying strata is uncertain. Lithological units of the two formations and even lithological units within the same formation are somewhat similar in places, making it difficult to determine whether outcrops should be assigned to the Lonely Formation or the Mokalanen Formation. A detailed lithostratigraphic description of the formations in the type areas, combined with information from well-documented successions in other parts of the Kalahari, will define these units and will be a reliable reference for the identification and stratigraphic correlation of outcrops. In addition, results of this research project may also have relevance in the assessment of mineral-exploration targets and agricultural studies. Calcretes of the Lonely and Mokalanen Formations are widely used for gravel road base, and some of the calcretes may be suitable for cement manufacture or as a source of lime in agriculture.

Progress

Sediments of the Lonely Formation are exposed along the bank of the Kuruman River on the farm Lonely 174, which lies 25 km to the west of Vanzylsrus township near Kuruman. The sediments were deposited during a humid period in the Late Quaternary and consist of lacustrine limestone characterised by a remarkably low density due to the high content of skeletal remains of diatoms. The site is also rich in gastropods, ostracods and the remains of aquatic plants. Species identified include the fresh-water gastropods Paludina, Planorbis and Ancylus. The Mokalanen Formation is well exposed along the Molopo River on the farm Mokalanen 175, north of Lonely 174, underlies the Lonely Formation, and consists mostly of sandstone which appears to be a typical reddish or yellow desert rock deposited both as dunes and sand sheets. Thick layers of calcrete and calcrete breccia occur at some horizons. Mounds and burrows of termites, silicified tree trunks and branches of trees are common in the sandstone.

It is expected that results of these studies will provide accurate models upon which to identify and interpret other less well-preserved successions of the two formations.

Future activities

Fieldwork is almost complete, but some follow-up work may be required.

0702 JOHANNESBURG 2628AA 1:50 000-SCALE GEOLOGICAL MAPPING AND BIBLIOGRAPHY

Project leader: R. Opperman, B.Sc.Hons, (Geology and Geography).

Project team: M. van der Neut, M.Sc., A. Swanepoel, M.Sc., R. Grow, B.Sc.Hons., D. van Tonder, B.Sc. Hons., A.W.C. Marais, B.Sc.Hons.

Objectives: to produce a 1:50 000-scale geological map and a bibliography for sheet 2628AA Johannesburg.

Duration: 2002/2003–2004/2005.

Motivation

Production of the 1:50 000-scale geological map 2628AA Johannesburg is essential background work for the corresponding sheet of the geotechnical map series. The aim of this project is to produce a geological map and to summarise geological articles and geotechnical reports relating to the Johannesburg map area which are listed on the SAGEOLIT and ENGEODE databases.

Diabase dyke intruding granite in the Braamfontein Spruit, Craighall.

Progress

Journal articles relating to geological features outside the map area were included in the bibliography where they would enhance the understanding of the local geology. Summaries of relevant reports were obtained and a map showing the localities of features discussed in these summaries was also included.

Problems relating to the geology and the legend of the map were solved. The geology and stratigraphy were matched to the adjacent sheets to the north and east, and the chronar and overlays were redrawn. All the overlays of the map have been finished and the map is currently being digitised. The bibliography was submitted as a report in January 2005, after changes were made to the layout and format.

Conclusions

The northern part of the map is underlain by basement granite, forming mildly undulating country, which intruded older greenstones. Shear zones in the granite often result in linear topographic features such as that at Chloorkop in the east. The Witwatersrand Supergroup, outcropping on the southern part of the sheet area, comprises quartzite, shale and subordinate conglomerate, diamictite and some mafic lava flows, generally striking east–west and dipping to the south. The Witwatersrand Supergroup is subdivided into a lower West Rand Group and an upper Central Rand Group, separated by an unconformity.

In the study area the Venterspost Formation, or Ventersdorp Contact Reef, consists of a basal diamictite with a dark-green, fine-grained, chlorite-rich matrix overlain by a poorly sorted, matrix- to clast-supported conglomerate with minor sandstone and siltstone horizons. The Ventersdorp Supergroup strikes approximately east–west through the central part of the

Johannesburg sheet area, and consists mainly of mafic to intermediate volcanic rocks with smaller clastic sedimentary rock units.

The Transvaal Supergroup rests unconformably on basement rocks in the northeast of the map area. The Transvaal Supergroup is represented by quartzite and conglomerate of the Black Reef Formation and dolomite of the Oaktree and Monte Christo Formations of the Malmani Subgroup in the extreme northeastern and southeastern corners of the map area.

Thin basin-like occurrences of Dwyka Group and of the Vryheid Formation occur in the southeastern and southwestern sectors.

The contact between the basement rocks and the overlying successions is marked by intense faulting and overturning. This has resulted in prominent topological features such as the east–west-striking Bezuidenhoud Valley graben, and the Langerman's Kop and Rietfontein Gold Mine fault blocks. Bezuidenhoud Valley is bounded in the south by the Rietfontein Fault, while the northern slope is formed by smaller faults resulting in West Rand Group and basement rocks being juxtaposed against the Ventersdorp Supergroup in the graben. Further south, rocks of the Witwatersrand Supergroup are occasionally displaced by north–south-trending faults and dip to the south at about 20–30°.

0761 THE GEOLOGY OF THE GEMSBOKVLAKTE AREA

Project leader: F. Gabbrielli, Ph.D.

Objectives: to produce a geological map of the 1: 50 000-scale sheet 2524DC Gemsbokvlakte and to investigate the distribution, petrology, stratigraphy and structure of the Kraaipan Group rocks of the area.

Duration: 2003/2004–2004/2005.

Budget: Total: R220 000;
2004/2005: R90 000.

Motivation

The Kraaipan Group ranks amongst the oldest rock units in southern Africa. Although the group occurs in various parts of the North West Province, occurrences are rather scattered, so little is known about the relationship between the various formations and lithological types. The area was originally mapped by A.L. du Toit in 1908, and a 1:250 000-scale geological map was published in 1991. The present study is aimed at studying the Kraaipan Group in the area and collating information on potential mineral deposits, as Kraaipan rocks associated with gold mineralisation occur to the south and southwest, outside the Gemsbokvlakte map area.

Progress

The Archaean sedimentary and volcanic rocks of the Kraaipan Group form a discontinuous north–northwest-trending belt. The sedimentary rocks include banded iron-formation, jaspilite and chert, while the volcanics are represented by rocks of basaltic composition and subordinate rhyolites. The project focussed mainly on a geophysical interpretation of the mapped geology, combined with structural and petrographic studies. Magnetic anomalies point to the existence of an elongated deep-seated fold with an axis trending towards the north-northwest, while petrological features suggest that unconformities may occur in the lower zones of the Kraaipan Group. Gold analyses on rock and soil samples have been disappointing, but the investigation has provided data which will serve as a reference for further research into the geology and economic potential of the Kraaipan Group. The geological map and the report were submitted for editing, and it is envisaged that they will be published during the coming year.

0781 PALAEONTOLOGY AND PALAEOECOLOGY OF THE ELLIOT AND CLARENS FORMATIONS

Project leader: J. Neveling, Ph.D.

Project team: M. Bonning, Ph.D. (Western Illinois University), A. Yates, Ph.D., P.J. Hancox, Ph.D., F. Abdala, Ph.D., R.J. Damiani, Ph.D. (University of the Witwatersrand).

Objectives: to investigate the palaeontology and palaeo-environment of the Elliot and Clarens Formations.

Duration: 2004/2005–2006/2007.

Budget: R32 000.

Motivation

Although the Elliot Formation contains some of the earliest dinosaur and mammal fossils in the world, very little is known about its fossil fauna, especially in the lower part of the formation. Recent palaeontological research have yielded at least four new dinosaur taxa, stimulating new research on this interval. The discovery of scientifically important dinosaurs, the possible presence of the Triassic–Jurassic boundary, lack of knowledge on the localised palaeo-environmental conditions and new basin development theories make this investigation very relevant.

Progress

Visits were made to the Senekal and Ladybrand Districts. New dinosaur and cynodont material was excavated and collected in both areas, and the supporting geological data recorded. A collaborative paper on the discovery of new cynodont material from the lower Elliot Formation was submitted to the Journal of Vertebrate Paleontology.

Conclusions

A large number of South African dinosaurs from the Elliot and Clarens Formations have been incorrectly identified, and the diversity of fossil faunas is much higher than previously anticipated. The detailed sedimentology and taphonomy at individual fossil finds are still poorly understood, and need to be researched.

Biostratigraphic and sedimentological information support the presence of a stratigraphic break between the upper and lower Elliot Formation (possibly correlating to the Triassic–Jurassic contact), but indications are that this break is not always characterised by easily identifiable features, and the research team places it at a horizon different to some other researchers. Future work should also focus on the tectonic influences on deposition.

Future activities

Initial work has yielded promising results and, given the nature of the work, the likelihood of more new forms being discovered and the multidisciplinary approach of the research team, future work is expected to yield good results. Fieldwork will be expanded to the southern parts of the basin, and documenting of additional geological data around Ladybrand and excavations at Senekal will continue. Preparation of these large fossils may have an impact on progress during the latter stages of the project.

0795 1:50 000-SCALE GEOLOGICAL MAP 2926AB MASELSPOORT

Project Leader: P.J.A. Bosch, M.Sc.

Objectives: to produce a 1:50 000-scale geological map and explanation for sheet 2926AB Maselspoort.

Duration: 2003/2004–2005/2006.

Motivation

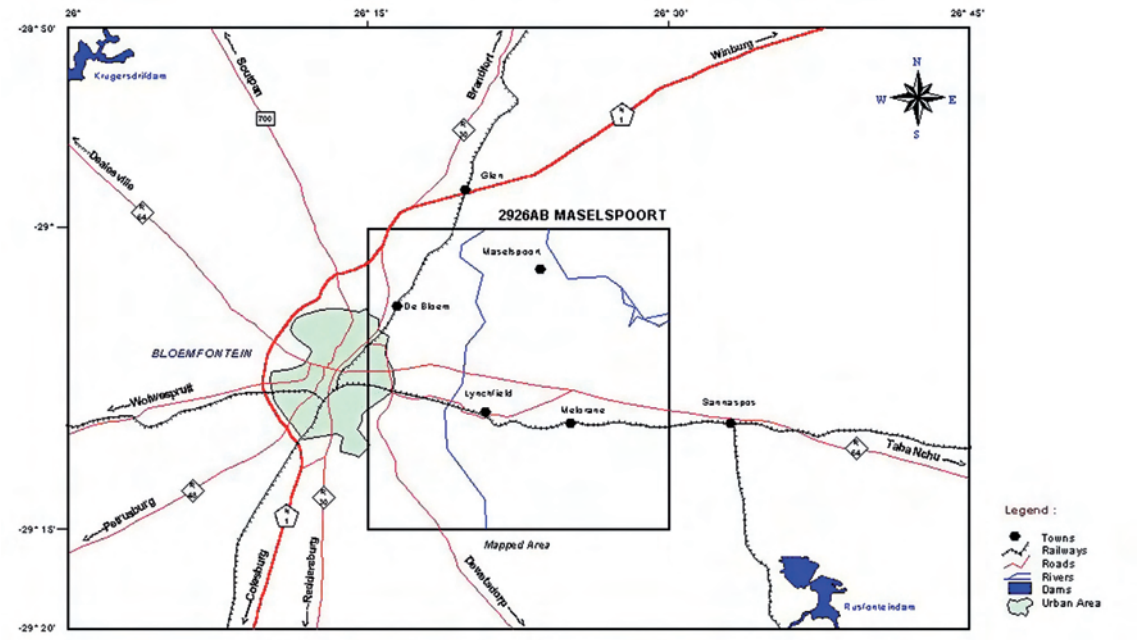
This project is part of the CGS's geological mapping programme in the Free State (see figure). Initially the area between Bloemfontein and Thaba Nchu was targeted because of its locality on the Bloemfontein–Maseru development node, but it was also found that this area needed remapping as the previous map edition was produced from aerial photography, with limited field inspection, and no detailed geological explanation was available. The area to the east of Bloemfontein is also experiencing increasing pressure from urban expansion, and there is a rising need for natural building-material resources. This map will therefore aid in the development of the area by providing a basis for development planning and managed utilisation of natural resources. The scientific community will also benefit from new information on fossil localities, sedimentary structures and geological profiles. Structural data will aid in the search for groundwater in the area.

Progress

The map and explanation have been completed, but the manuscript is still to be edited. The map will be coded for GIS processing.

Conclusions

The explanation provides detailed descriptions dealing with the topography, drainage patterns, vegetation, sedimentary rocks and dolerite, Swazian granite, Quaternary deposits, geochemistry, structural geology, economic geology and environmental geology.



Locality and infrastructure of the 2926AB Maselspoort 1:50 000-scale geological map.

Interpretation of sedimentary structures, palaeocurrent analyses and profiles measured through the sedimentary successions suggests the deposition of sediments in meandering streams and overbank areas, and a braided fluvial system was recognised for the arkosic Musgrave Member. The Musgrave Member (not yet approved by SACS) correlates with Theron's "Northern Beaufort Formation" and the Rooinek Member of the Normandien Formation.

The explanation contains petrographic descriptions, photomicrographs, major and trace analyses of sediments and dolerite, and XRD-analyses of shale and dolerite. The element concentrations of the dolerite were plotted on discrimination diagrams to show their classification and possible tectonic setting. The sediment analyses were compared with those of adjacent areas and elsewhere.

Joint and dyke orientations were measured, and were plotted on rose diagrams and interpreted using a Riedel diagram. It was postulated that the area was influenced by the Transkei-Lesotho-Northern Karoo Domain of dyke swarms and partially by the east–west-oriented, right-lateral shear zone of the Western Karoo Domain. The apparently randomly oriented dykes and joints or compressional directions might also be due to an oblique compressional stress field formed between the major east–west right-lateral shear zone of the Karoo dolerite province and the postulated northeast-trending right lateral shear zone of the Transkei-Lesotho-Northern Karoo Domain. The postulated right-lateral shear zone is initially associated with the north-eastern arm of the Weddell triple junction and later with the Agulhas transform fault.

A geophysical model of the area showed the presence of a possible ring dyke structure in the area and also supported the presence of a high in the granite floor from which feldspar-

Southeastern view with the wooded Maselspoort Aventura Holiday Resort in the background. Note the hills, characteristically capped by dolerite.

rich material was eroded during deposition of the Musgrave Member.

The nature of shale deposits used for brick-making purposes was described. The problem with regard to uncontrolled dolerite mining for use as aggregate was outlined.

Future activities

The map and explanation will be edited and prepared for printing.

0864 THE TECTONOSTRATIGRAPHY AND SEDIMENTOLOGY OF THE LATE CHUNIESPOORT GROUP TO EARLY PRETORIA GROUP WITH SPECIAL REFERENCE TO THE FORMATION OF KARST ON DOLOMITIC LAND IN GAUTENG

Project leader: P.J.A. Bosch, M.Sc.

Researcher: P. Eriksson, Ph.D. (University of Pretoria).

Objectives: to study the tectonostratigraphy and sedimentology of the late Chuniespoort Group to early Pretoria Group with special reference to the formation of karst on dolomitic land in Gauteng.

Duration: 2004/2005–2008/2009.

Budget: 2005/2006: R324 160.

Motivation

The period from the Chuniespoort Group to Timeball Hill Formation deposition is poorly understood and problematic, and marks a change from deposition of primary chemical sediments of the Chuniespoort Group to clastic sediments of the Timeball Hill Formation. These changes are related to tectonic subsidence, tilting of the craton, folding, erosion and related unconformities, faulting and volcanic extrusions. This period encompasses the Duitschland Formation, chert breccia, Rooihoogte Formation, and basal Timeball Hill Formation and Bushy Bend lava (name not approved by SACS). New information suggests that the Duitschland Formation, currently regarded as part of the Chuniespoort Group, might be a correlate of the Rooihoogte Formation, deposited some time during the period of more than 80 Ma between the Chuniespoort Group and the Timeball Hill, as there are unconformities at the base of the Duitschland and Rooihoogte Formations. This needs to be clarified because it has significant implications for geological maps covering this stratigraphic interval.

There is uncertainty with regard to the identification and age of various chert breccias associated with the Chuniespoort Group. The study will include a description of the different types of chert breccia and regolith associated with the Chuniespoort Group, and their genesis. This will be a very valuable tool for engineering geologists in making informed decisions for developmental purposes.

This study will benefit the scientific community in the following ways:

1. It will increase the scientific knowledge of this important period in our geological history; it is also important internationally because it will record and report a period of earth history not well developed elsewhere in the world. Its international importance, for example, is highlighted by the discovery of halite imprints and salt blisters which contribute to our understanding of the sea and atmosphere during this period.

2. Improve geological maps of the Transvaal Basin.

3. Achieve a better understanding of the Transvaal Basin and its structure and history, which will help to generate future exploration targets, and hence economic growth, employment and rural development.

4. Contribute to understanding geological structures, lithologies and their spatial distribution which will aid in the development of models to be used in the prediction of geological hazards, especially sinkholes. The characterisation of the structures and underlying lithologies will aid engineering geologists and developers in recognising areas with problem rocks and soil.

Progress

Three profiles through a portion of the Rooihoogte Formation were measured in the vicinity of Zeerust, and a short summary of periods of dolomite exhumation resulting in karst formation in Gauteng was written. Four areas

earmarked for urban development on dolomitic land were visited in conjunction with engineering-geological consultants. At Acorn Hill a palaeosinkhole was identified by the author and a geological model was developed for an area near Heuweloord, where faulting and folding complicated the demarcation of the subsurface geology. A map depicting the dolomitic land in Gauteng, which includes areas where dolomite is present less than 100 m from surface, was also developed by the author in conjunction with the Engineering Geology Unit of the CGS.

Conclusions

From the literature research it is apparent that the dolomite was exhumed during various periods during which karst might have formed. These periods include the pre-Pretoria Group, pre-Waterberg Group, pre-Karoo Supergroup and Tertiary to Recent. This is supported by the presence of sinkholes filled with Rooihoogte Formation sediments, Karoo Supergroup sediments, Tertiary Cave deposits and modern Terra Rossa soils. The fact that this work has already aided engineering geologists in the demarcation of urban areas for development indicates that this research is of value to the community.

Future activities

Future work will aim to measure and draw profiles through the Rooihoogte Formation and describe further outcrops. It is also envisaged to do more site-specific investigations in conjunction with consulting engineering geologists.

0872 THE PETROLOGY OF THE TROMPSBURG COMPLEX

Project leader: G.H. Grantham, Ph.D.

Project team: W.D. Maier, Ph.D. (University of Pretoria).

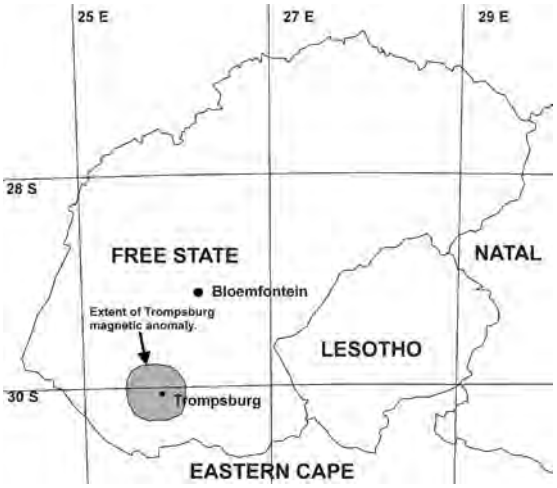
Objectives: to study the petrological evolution of the complex using whole-rock major- and trace-element chemistry, mineral chemistry and radiogenic isotope chemistry.

Duration: 2004/2005–2006/2007.

Budget: Total: R180 000; 2004/2005: R80 000.

Motivation

The Trompsburg Complex, located in the southern Free State at the town of Trompsburg, is overlain by ~450 m of Karoo Supergroup sedimentary rocks. Its existence was recognised from magnetic and gravity data which resulted in six boreholes being drilled in the late 1940s to ascertain the origin of the geophysical anomalies. A recent study of zircons from core from one of the boreholes drilled into the Trompsburg Complex (Maier et al., 2003) has shown that a minimum age for the complex is ~1,9 Ga, similar to the 2 050 Ga age of the Bushveld Complex, and not ~1 370 Ma as was previously thought. Previous studies on the Trompsburg complex were done in the 50s and 70s (Ortlepp, 1959; Davies et al., 1970), when the range of analytical techniques was limited. With current analytical techniques it is planned



Locality of the Trompsburg Complex.

OBSERVED TOTAL FIELD AEROMAGNETIC DATA

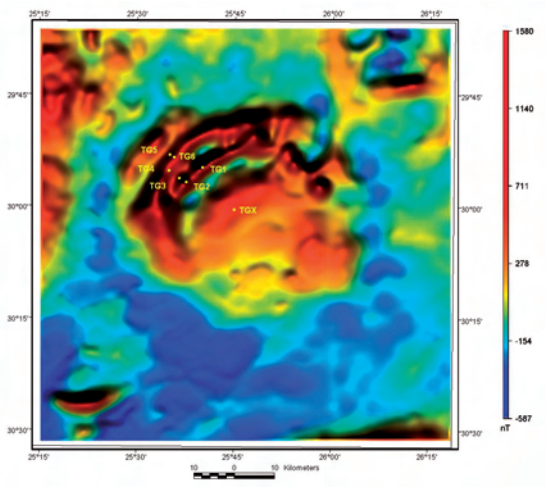


Image of the magnetic anomaly defining the extent of the Trompsburg Complex under the Karoo Supergroup.

that a deeper understanding of the petrogenesis of the complex will provide indications as to the possible presence of mineral deposits, specifically those which are commonly associated with large layered igneous intrusions, e.g. Cr, Ni and Pt-group elements.

Progress

Initiation of the analytical chemical component of the project was delayed because a parallel study involving measuring the geophysical properties (magnetic susceptibility and densities) on all the available drill core had not been finalised — see Maré and Cole (2004) for a preliminary analysis of the geophysical data.

Polished sections have been prepared to facilitate analysis of the mineral phases useful in identifying fractionation (e.g. olivine, pyroxene and plagioclase). However, a failure of the computer on the CGS's electron microprobe delayed the completion of these analyses. Petrographic study of the polished sections shows that significant portions of the complex have suffered low-grade metamorphic hydration, with less than half the core fragments preserving pristine igneous mineralogy. Whole-rock powders have been submitted to an external laboratory for major- and trace-element analyses utilising an ICP method because of the extremely limited amount of material available for analysis.

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0880 STRATIGRAPHY, SEDIMENTOLOGY AND PALAEO-ECOLOGY OF THE BURGERSDORP FORMATION: INTERPLAY OF CLIMATE AND TECTONICS

Project leader: J. Neveling, Ph.D.

Project team: P.J. Hancox, Ph.D. (University of the Witwatersrand).

Objectives: to document and interpret the stratigraphy and sedimentology of the Burgersdorp Formation (Beaufort Group).

Duration: 2004/2005.

Budget: R17 000.

Motivation

The Burgersdorp Formation has been the focus of much research activity during the last decade, resulting in several new models and data regarding the stratigraphy, sedimentology, palaeo-environments and basin development of this formation. This information, which has had far-reaching consequences as to how we understand the Karoo Basin, has not yet been documented and published. In this project we aim to collate and compare the collected data and present a single, integrated model on the sedimentology, stratigraphy and basin development of the Burgersdorp Formation.

Progress

Fairly substantial data sets are available from the work of J. Neveling, P.J. Hancox and G.H. Groenewald. Additional stratigraphic data were collected during fieldwork conducted during the 2004/2005 financial year. These data have been collated and compared, and are currently being prepared for publication. Writing up the results has commenced, but is not yet complete.

Conclusions

Substantial stratigraphic distribution has been documented in the Burgersdorp Formation, with the lower parts of the formation extending throughout the basin, but the middle and upper parts limited to the southern and central areas. The distribution of the latter also appears to be controlled by the distribution of the Kaapvaal Craton's southern margin. An arenaceous horizon in the middle Burgersdorp

Formation has been traced throughout the southern and central parts of the basin. Sedimentological data show stratigraphic variation, with smaller, more ephemeral channels present in the lower Burgersdorp changing to a more perennial meandering fluvial environment higher in the succession.

Future activities

The project will be completed during the 2005/2006 financial year. Little, if any, additional fieldwork will be required.

0881 INVESTIGATION OF THE CHANGES IN FOSSIL FLORA AND ASSOCIATED INSECT FAUNA ACROSS THE PERMO–TRIASSIC BOUNDARY

Project leader: J. Neveling, Ph.D.

Project team: H. Sims, Ph.D. (University of Iowa), C. Labandeira, Ph.D., C. Looy, Ph.D. (both of the Smithsonian Institution), B. Gestaldo, Ph.D., S. Gray (both of Colby College, Maine), M. Bamford, Ph.D. (Bernard Price Institute for Palaeontology), R. Adendorff, Ph.D. (Albany Museum, Grahamstown).

Objectives: to investigate changes in the fossil flora and associated insect fauna during the Permian to Triassic stages, in fossil record of the Karoo Supergroup.

Duration: 2004/2005–2006/2007.

Budget: R5 000.

Motivation

Much international research attention has been focussed on the mass extinction coinciding with the Permo–Triassic boundary. The Karoo Basin in South Africa contains the best record in the world of the terrestrial expression of this extinction event. Work on this horizon increased after parallels were recently drawn between the causal mechanisms responsible for the Permo–Triassic extinction and the modern-day global warming. Although this horizon has been intensively researched for more than a decade, little is known about the palaeobotanical data and fossil changes across this boundary. Against this background the U.S. National Science Foundation (NSF) agreed to partially fund a multinational multidisciplinary research team to investigate the changes in fossil flora and associated insect fauna across the Permo–Triassic boundary.

Progress

Three field seasons have thus far been undertaken, during which various new fossil localities were identified, and new and known localities excavated. Geological and stratigraphic data have been recorded at each locality. Plant fossils are currently being processed and researched in the laboratory. One paper comparing the taphonomy of the different plant-fossil localities has been submitted to the journal Palaios, while three talks and one poster were presented at two conferences (Geoscience Africa, Geological Society of America Annual Meeting) on the provisional results of this project.

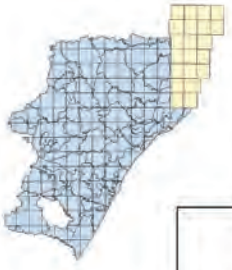
Conclusions

The project is still in its initial phases, but early data indicate that the detailed sedimentological setting and taphonomic signature of Permian and Triassic fossil localities differ substantially. This influences the nature of the preserved plant fossil record, skewing the palaeo-environmental and biodiversity assessments. In addition, the first Early Triassic plant material from South Africa was collected during this project.

Future activities

The early results have been promising and support continuation of the project. More fieldwork, visiting known fossil localities, is planned, with the aim of collecting more material and additional geological data. The bulk of the work will focus on the processing of material already collected.

4 KWAZULU-NATAL UNIT



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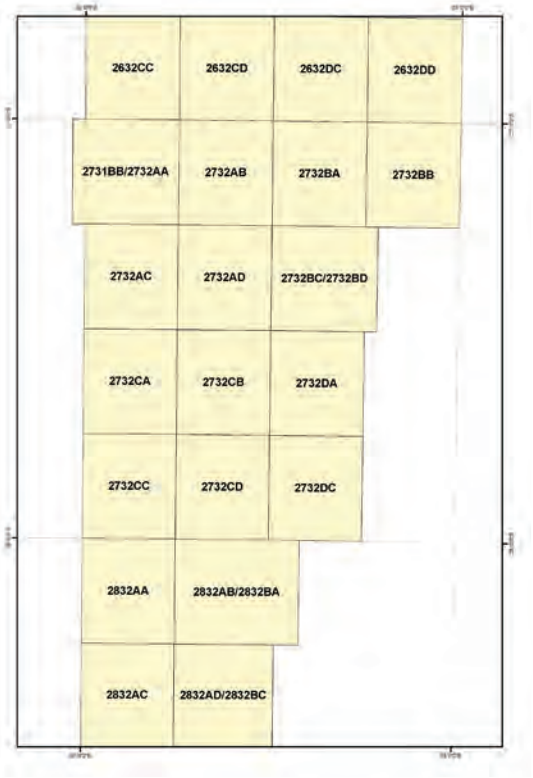
MAPUTALAND GEOLOGICAL MAPPING



0069 REGOLITH GEOLOGY OF THE MAPUTALAND COASTAL PLAIN

Project leader: G.A. Botha, Ph.D.

Project team: N. Porat, Ph.D. (Geological Survey of Israel).

Objectives: to map the regolith geology of the Maputaland coastal plain region, review the Cenozoic stratigraphy, differentiate and date the dune systems, characterise the weathering profiles, and define recent sea-level changes in Lake St Lucia and adjacent coastline.

Duration: 2002/2003–2004/2005.

Budget: 2004/2005: R118 036.

Raised shorelines at Sengwane point on the eastern shores of the St Lucia lagoon represent periods of higher lake levels. The water level has receded over the last 5 000 years, leaving these beach ridges.

Motivation

The Maputaland region hosts the Greater St Lucia Wetland World Heritage Site, and diverse habitats containing endemic fauna and flora. An understanding of the geology of this region is paramount to sustainable management of the present ecosystems. The unconsolidated Quaternary sediments require specialised research techniques to characterise, map and describe these regolith deposits. An understanding of how the dune systems, wetlands and coastal lakes have responded to dramatic environmental changes in the past will be compiled from palaeoenvironmental interpretations of the diverse regolith materials.

Progress

During the past year the project focussed on adding value to the vast quantity of data already accumulated. Mapping of the beachrocks along the coast was hampered by the ban on vehicles driving on beaches which has been strictly enforced in the Maputaland marine reserves. Investigations have revealed geological indicators of relatively recent, high sea levels along the beaches. These represent more sensitive indicators of sea levels than the beach ridges mapped around Lake St Lucia. A poster presented at the 32nd International Geological Congress highlighted the difficulties in differentiating absolute sea-level change, due to changing climates, from the uplift of the earth's crust generated by deglaciation and ice-mass unloading of the polar regions. The multidisciplinary research findings and maps have been compiled for publication in a Memoir. Manuscripts summarising the luminescence-dating geochronology of the dune systems, and the use of soil-development indices to characterise and differentiate soil developed in dunes sands of different ages, have been submitted to international journals for review. The project continued to receive financial support from the Norwegian-sponsored, NUFU research programme.

Conclusions

This long-term research programme has produced a new geological map, regolith-landform map and comprehensive report detailing all aspects of the regolith geology of the Maputaland region. The project has developed the use of mineralogical, magnetic susceptibility, luminescence dating, ground-penetrating radar and soil-profile analysis techniques to assist the regional mapping of regolith materials. The interpretation of geological responses to cyclical climate changes during the Pleistocene provides a basis upon which to model the projected responses of the dune systems and wetlands to global climatic changes in the future.

Future activities

The project has fulfilled the goals originally defined, and the research has identified many avenues that can be followed in order to provide guidelines for the management of this region, which includes the Greater St Lucia Wetland Park World Heritage Site. A popular geoscience series publication that can be used to highlight sites of geological heritage, or provide an overview of the geological evolution of the region to support geotourism initiatives is proposed.

0718 GEOLOGICAL MAPPING OF 1:50 000-SCALE SHEET 2930DD AND 2931CC DURBAN

Project leader: G.A. Botha, Ph.D.

Researchers: B.M. Clarke, B.Sc.Hons., M.W. Kota, M.Sc., G.A. Botha, Ph.D., F.N. Ngcobo, B.Sc.Hons.

Objectives: to map on a scale of 1:10 000 the geology of the area covered by 1:50 000-scale map 2930DD and 2931CC Durban.

Duration: 2002/2003–2004/2005.

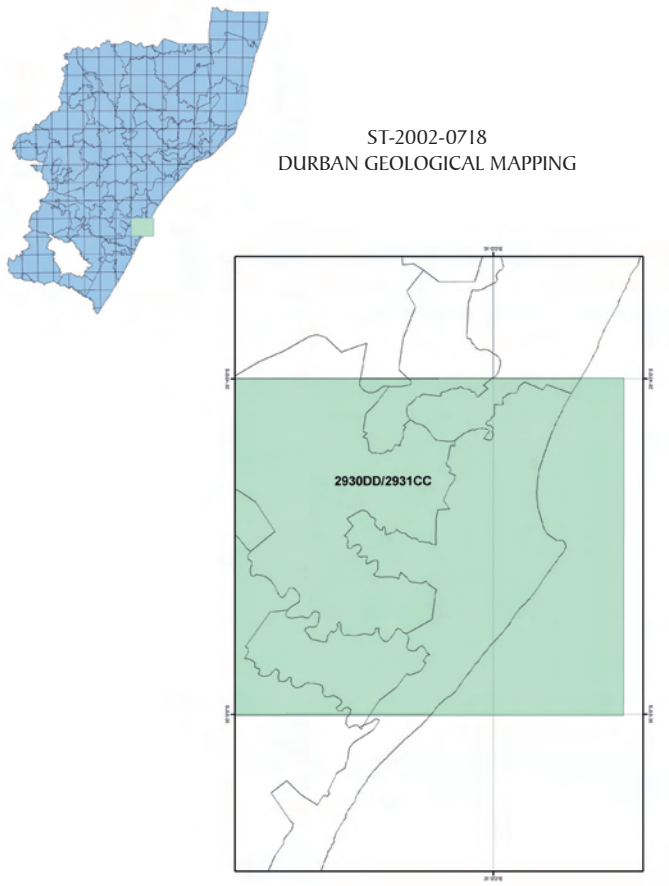
Budget: 2004/2005: R171 448.

Motivation

Rapid urbanisation and growth around the greater Durban development node, and high demands for construction materials in the municipal area, have resulted in a need for accurate geological data on a scale larger than is currently available. The last geological mapping was carried out before 1964 and it was necessary to revise the map to reflect the significant advances in the understanding of the geology of this region. The geological mapping also provided the background data for compilation of the geotechnical map of the same region.

Progress

Mapping of the area on a scale of 1:10 000 has been completed, and reduction of this map



data for publication on a scale of 1:50 000 has been finalised. The map and geological legend reflect the latest lithostratigraphic subdivisions, and the detailed map explanation incorporates much new data on most geological units. The granitoid basement rocks, previously depicted as a single lithostratigraphic unit, have been subdivided into five units, while the overlying, previously undifferentiated Natal Group is now subdivided down to member level (five members in two formations). In addition, the Dwyka Group has been subdivided into three mappable units, compared with the single unit depicted on the 1964 geological map. The controversial Neogene stratigraphy has been elucidated.

Where available, unpublished reports and borehole logs have been compiled to provide a high level of detail on unexposed deposits underlying Durban city and port area. Much of the eastern part of the map between the Berea and Bluff ridges, and the low-lying areas from the Mgeni River to the Prospecton industrial area, are underlain by complex variable, river and estuarine sand and mud. Detailed cross-sections and isopach maps have been compiled from available borehole records to provide an assessment of the distribution and variability of these materials. Detailed mapping of the coastal outcrops of the Isipingo Formation has revealed indicators of sea-level change, and the lithological subdivision of these rocks represents a basis for the reassessment of similar rocks along the southern and western coasts.

Conclusions

The newly compiled geological map of the greater Durban municipal area will support expansion of the urban areas for many years to come. As the demand for suitable land for housing, cemetery and waste-disposal sites grows, the reliance on this detailed geological mapping will increase. The level of geological and structural detail provided will assist with identification of potential groundwater resources or facilitate the assessment of pollution of aquifers in the urbanised areas.

Future activities

The project has culminated in the completion of the geological map and explanation booklet. Specialist studies of specific rock units could unlock potential development of new construction material sources. The location of plastersand deposits is particularly important as the cost of this essential commodity is being driven up by the cost of transport from distant sources, and poor planning and rapid development of housing has sterilised some sources close to the city. Inadequate outcrop of Quaternary deposits has limited the description and interpretation of these sediments. A series of stratigraphic boreholes would provide permanent records and assist with additional suboutcrop mapping. Much of the Durban CBD is constructed on saturated unconsolidated sediments, which represent a potential risk of significant damage should a seismic event occur. There is a need to model the seismic risk of different parts of the city using the isopach maps of unconsolidated sediments and borehole data. Specialist publications on some aspects of the geology of Durban are planned. The need for production of a Popular Geoscience Series document on the geology of this area must be evaluated.

0762 GEOTECHNICAL MAPPING OF THE 1:50 000-SCALE MAP SHEET 2930DD AND 2931CC DURBAN

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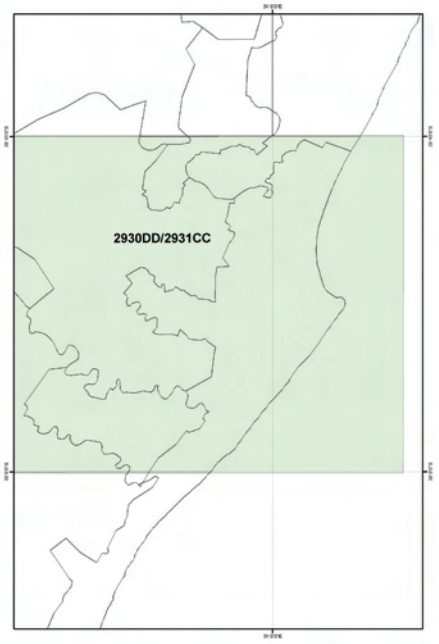
DURBAN GEOTECHNICAL MAPPING



Project leader: N.P. Richards, Ph.D.

Objectives: to compile a detailed geotechnical map of the Durban 1:50 000-scale map area. All geological and geotechnical constraints to development are included on the map. The most important of these are inundation, slope instability, excavation conditions and active soils. A detailed explanation, including site specific information, accompanies the geotechnical map.

Duration: 2002/2003–2004/2005.

Budget: 2004/2005: R151 457.

Motivation

Regional long-term development-planning initiatives rely, in part, on accurate geotechnical data. In order to supplement the detailed 1:10 000-scale geological mapping of the Durban area a regional geotechnical mapping programme was implemented. The field mapping has focussed on delineating areas where hazardous geological or geomorphic conditions could impose environmental constraints or elevated cost implications on future infrastructure development, including water and fuel pipeline routes, road upgrading, development of low cost housing and service-related infrastructure. In addition to the mapping, various 3D-visualisation models have been developed to highlight the major geological and geomorphological features in the area.

Progress

Mapping and collation of geotechnical data on a scale of 1:10 000 have been completed. The 1:50 000-scale geotechnical map has been compiled, and the explanation is complete and awaiting final edits.

Conclusions

The geological and terrain morphological diversity of the Durban area has resulted in highly complex geotechnical constraints to development. Mapping has shown that slope instability associated with all bedrock types is one of the major factors influencing development potential in the Durban area. In many circumstances, where both informal and formal development has taken place, problems related to slope instability and groundwater seepage are common. There are many occurrences where informal structures constructed on steep slopes with inadequate, structurally unsound retaining walls have collapsed, causing destruction of property downslope. Numerous landslides of varying scales have been identified, some occurring in developed areas. In areas underlain by shale of the Pietermaritzburg Formation, numerous slope failures have occurred in situations where the dip and direction of shale bedding (regionally dipping to the east and southeast) is concordant with slope dip and direction, with failure often occurring at or near the soil/rock interface.

The granite terrain areas are generally characterised by deeply weathered saprolitic soils that are potentially highly erodible and may possess a collapsible fabric. Poorly consolidated soils result from insufficiently compacted granite fill material. Steep gradients underlain by Natal

Sunken pit latrines in an area of collapsing soils in poorly drained landslide debris, Umlazi, Durban.

Group sandstone often exhibit partially weathered sandstone and blocky talus where excavation problems are imposed on development. In areas of thick soil mantles, the erodibility of soils becomes a key environmental concern.

The predominant geotechnical constraint to development in areas underlain by Dwyka Group bedrock is excavatibility. In slope crest areas, weathered tillite bedrock is found at depths of generally less than 0,5 m and mechanical methods may have to be employed for foundation excavations. Residual tillite soils in bottom slope positions may exhibit expansive properties. Excavation problems also arise in areas of Pietermaritzburg Formation shale bedrock where thin soil mantles occur in crest and mid-slope areas. Other constraints to development associated with the shale areas are activity or expansiveness in the residual soils. Silty clays on dolerite bedrock, or Pietermaritzburg Formation shale under poorly drained conditions, exhibit active or expansive properties.

The "Berea-type" red sand is characterised by a number of constraints to development including possible collapse potential, high erodibility and slope instability. The CBD and harbour areas of Durban are underlain by unconsolidated, interstratified, estuarine and alluvial deposits, ranging in texture from sands to silty clays. These deposits often comprise extensive lenses of highly compressible soft silty clay, which impose structural constraints on large building structures.

0767 STRUCTURAL MAPPING OF THE EASTERN BUSHVELD COMPLEX MARGIN

Project leader: B.M. Clarke, B.Sc.Hons.

Project team: R. Uken, Ph.D. (University of KwaZulu-Natal), J. Reinhardt, Ph.D. (University of KwaZulu-Natal), T.V. Gerya, Ph.D. (University of Bochum, Germany).

Objectives: to elucidate the structure of the Bushveld Complex contact aureole in the vicinity of Steelpoort and Burgersfort, Mpumulanga Province. Documentation and quantification of macro- and microfabrics within the metasedimentary aureole rocks, combined with metamorphic studies, will enable the thermomechanical evolution of the aureole and the igneous pile to be understood. Research is focussed on domal aureole structures, which truncate and attenuate economically important horizons within the mafic-ultramafic Rustenburg Layered Suite (RLS) of the Bushveld Complex.

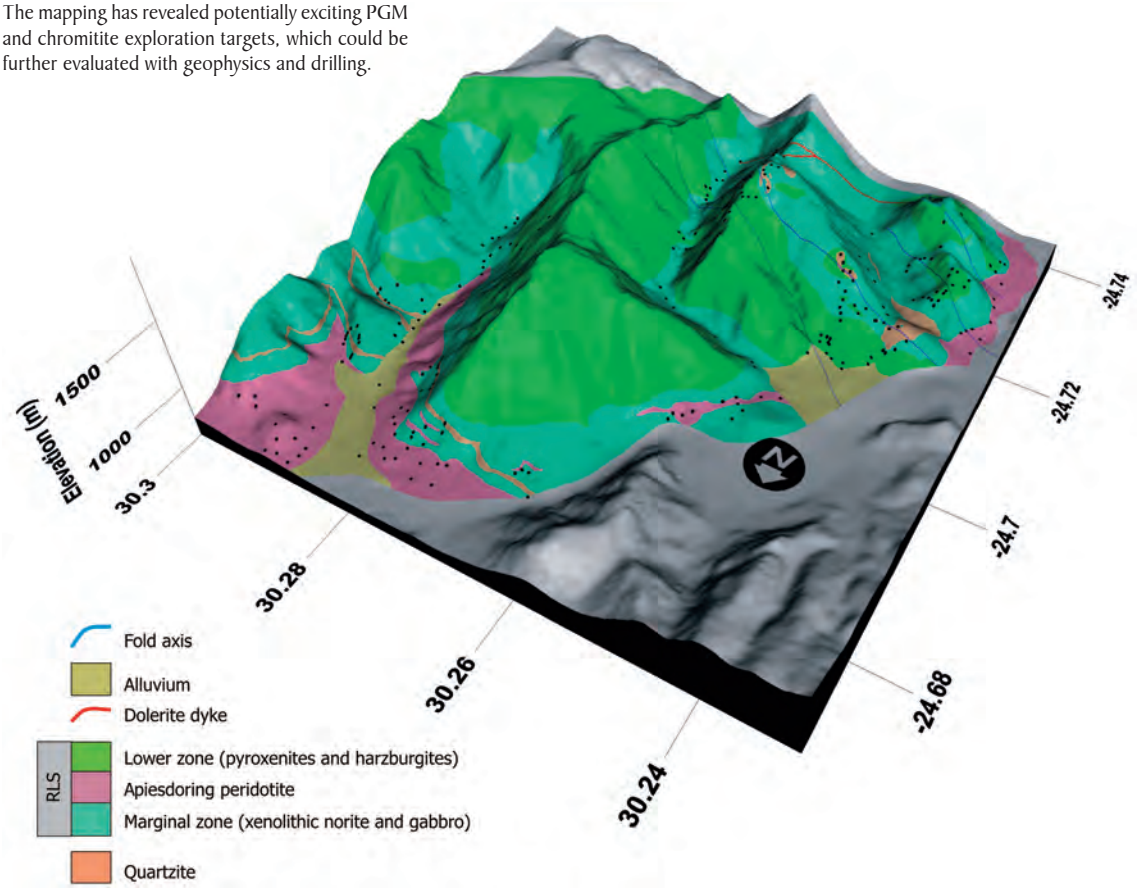
Duration: 2003/2004–2005/2006.

Budget: 2004/2005: R79 177.

Motivation

This project was initially conceived as a skills-development project and the project leader registered for an M.Sc. degree, combining structural mapping with more "cutting-edge" techniques, such as computerised image analysis and anisotropy of magnetic susceptibility (AMS) for fabric quantification. The project has subsequently grown into a Ph.D. opportunity, encompassing additional fields of research such as igneous and metamorphic microstructural investigation and thermomechanical modelling. Deformation within the contact aureole also has significant economic implications on the RLS and potentially exciting exploration targets have been identified, which may be of assistance to the Minerals Development thrust of the CGS. In addition, the project has also given the researcher the opportunity to develop considerable proficiency in digital terrain-visualisation techniques, which have significant educational value not only to other scientists but also to members of the public.

The mapping has revealed potentially exciting PGM and chromitite exploration targets, which could be further evaluated with geophysics and drilling.



Progress

ST-2003-0767
BUSHVELD STRUCTURAL MAPPING

Mapping and the collation of field data have been completed. Three key structural domains, namely the Steelpoort pericline, the Burgersfort "bulge" and the Spekboom River domain, have been identified and characterised. The most recent field mapping season revealed the presence of strongly deformed igneous rocks adjacent to the Steelpoort pericline, providing independent evidence for a diapiric origin for the pericline and other similar floor domes. These findings have been documented and interpreted, and submitted to the South African Journal of Geology for publication, and are also in the process of being integrated into a computerised thermomechanical model to further constrain the syn- and post-emplacement evolution of both the aureole and the RLS. A paper on thermomechanical modelling also appeared in a Special Publication of the Geological Society of America.

The mapping has revealed potentially exciting PGM and chromitite exploration targets, which

could be further evaluated with geophysics and drilling.

Conclusions

Mapping results have added weight to the diapiric model of deformation proposed for the domal aureole structures. High-strain zones are found in the RLS adjacent to these domes that are characterised by folds and magmatic shear zones that originated owing to diapiric expansion and uplift. Variations in RLS deformational styles adjacent to the Steelpoort pericline are controlled by variations in lithology and syn-deformational competency. It is therefore likely that a deformational chronology is preserved in the marginal rocks. These deformational zones represent potentially strong exploration targets because of lithological duplication.

Future activities

The final phase of this project will involve the petrographic and microstructural study of both aureole and layered suite rocks. Deformational fabrics will, where possible, be quantified, and the metamorphism of the aureole rocks will be investigated within an established tectonic framework. Deformation within the igneous rocks will be evaluated in thin sections to determine the rheological state of the RLS during aureole deformation. It is envisaged that three international papers could be forthcoming from this project for the following year, and that the completed thesis will be submitted for examination.

0800 REGOLITH-LANDFORM MAPPING FOR 1:250 000-SCALE MAP 2426 THABAZIMBI

Project leader: M.W. Kota, M.Sc.

Project team: G.A. Botha, Ph.D., R.G. Grow, B.Sc.Hons. and F.N. Ngcobo, B.Sc.Hons.

Objectives: to (i) produce an integrated interpretation of geophysical and multispectral data sets for the compilation of a regional-scale regolith-landform map of the Thabazimbi region, (ii) provide a systematic description of the spatial relations between the regolith deposits and their associated landforms within the study area, and (iii) provide information on the regolith-landform associations applicable to a wide range of applications including mineral exploration, environmental monitoring and land-management issues.

Duration: 2002/2003–2004/2005.

Budget: R95 875.

Motivation

In order to add value to the information contained in the CGS's Regional Geochemical Map Series it is necessary to provide systematic information on the regolith-landscape evolution of the 2426 Thabazimbi area so as to elucidate the mechanisms of formation for any geochemical anomalies that might be recognised. This information will assist mineral-exploration efforts and will be critical in assessing environmental pollution and formulating appropriate land-management strategies.

Progress

Progress achieved on the project during the 2004/2005 project year includes the production of various spectral ratios, principal-component analysis and RGB composite images using Landsat ETM+ data, compilation of available aeromagnetic and radiometric images, as well as interpretation of all available aerial photographs covering the Thabazimbi map area. The aerial-photograph interpretations have been compiled on 1:50 000-scale maps, and these will be refined after targeted "ground truthing" field investigations have been completed.

Conclusions

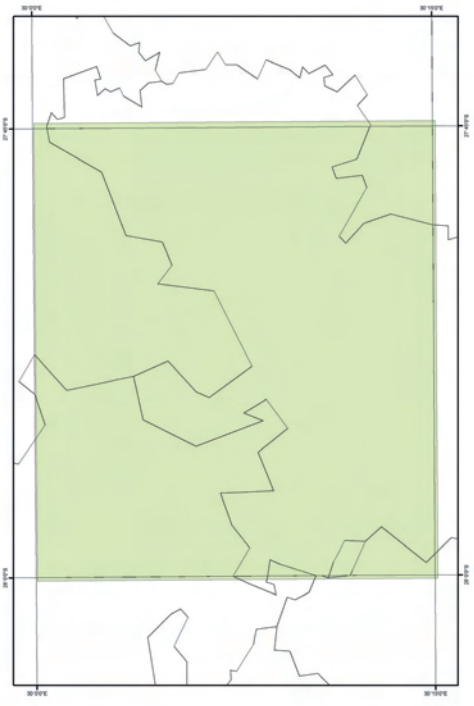
The completion of this project has been unavoidably delayed, but this study represents a new and exciting research direction at the CGS, and it is hoped that it will assist in providing the stimulus for the re-evaluation of previously explored areas in the map area in the light of the new data.

Future activities

It is expected that the project will run over into 2005/2006.

0816 GEOTECHNICAL MAPPING OF THE 1:50 000-SCALE SHEET 2730CC OZISWENI

ST-2004-0816
OSIZWENI GEOTECHNICAL MAPPING



Project leader: N.P. Richards, Ph.D.

Research team: C.A. Willard, B.Sc.Hons.

Objectives: to compile a detailed geotechnical map for the 1:50 000-scale sheet 2730CC Ozisweni.

Duration: 2004/2005.

Budget: R141 516.

Motivation

During the initial phases of development planning initiatives, regional geotechnical mapping represented a screening mechanism for identifying problematic areas. In order to supplement the detailed 1:10 000-scale geological map of the Ozisweni area, a regional geotechnical mapping programme was implemented. The field mapping focussed on areas where hazardous geological or geomorphic conditions could impose environmental constraints or elevated cost implications on future infrastructure development, including water- and fuel-pipeline routes, road upgrading, development of low-cost housing and service-related infrastructure.

Progress

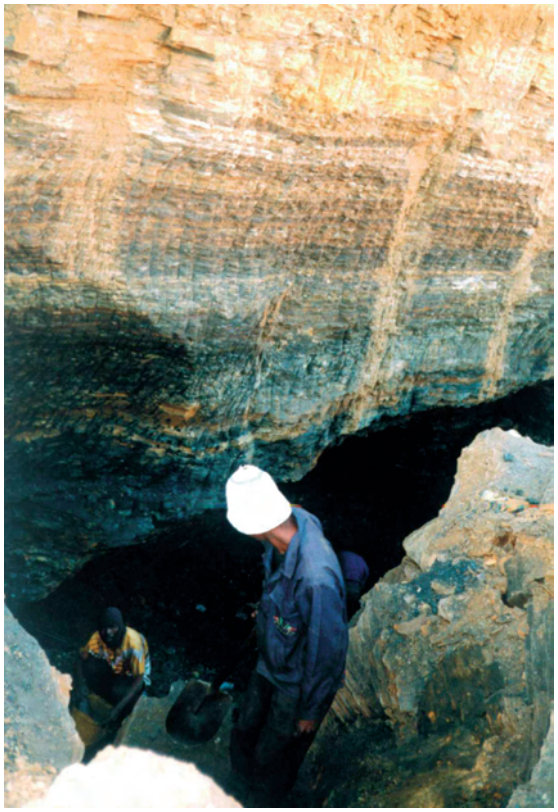
Mapping, the collation of geotechnical data, and transfer of the data to 1:10 000-scale field sheets have been completed. Compilation of the 1:50 000-scale geotechnical map and explanation is underway.

The legend incorporates a wide range of geological and geotechnical constraints to development, and the map can therefore be interpreted in the context of any type of development. The most important of these potential geohazards are erodible soils, excavatibility problems, inundation and shallow water tables, slope instability and active soils.

Conclusions

The geotechnical mapping has shown that the most widespread geotechnical constraint to development in the Ozisweni area is excavatibility. This problem arises in areas of dolerite outcrop, and areas underlain by Vryheid Formation sandstone and shale or ferricrete, where shallow soils overlie hard bedrock. Mechanical methods may therefore have to be employed for foundation excavations, which imposes high financial risks on low-cost housing developments. In many areas sand has been excavated for use as construction material, resulting in exposed bedrock and surfaces susceptible to erosion. The foot slopes below dolerite scarps are characterised by deeply weathered saprolitic soils and thick colluvial deposits that are highly erodible, resulting in the development of numerous deep dongas.

Another constraint to development associated with areas underlain by shale or dolerite is the presence of active or expansive residual soils on lower hill slopes. Although the map comprises vast flat areas, towards the western boundary of the area there are steep high-lying areas underlain by dolerite. Slope instability is a prominent geotechnical factor that could constrain development of these steep slopes.



Informal coal excavations on a portion of the farm Struisvogel Kop 4275, south of Ozisweni, where coal mining results in potential hangingwall collapse.

Coal mining is prominent in the Ozisweni area, and the spoil heaps are areas of potential slope instability, erodibility and poorly compressible soils. A key environmental issue is acidic soils associated with mining areas that may also impose limitations on future agricultural activities. Inadequate safety precautions at sites of informal coal mining have created unsafe working conditions due to the potential collapse of the hangingwall in mined-out areas.

Future activities

The project is complete, but it is possible that the local authority could request extension of the mapping into adjacent areas.

0850 MASS MOVEMENT MAPPING AND LANDSLIDE INVENTORY

Project leader: G.A. Botha, Ph.D.

Researchers: R.G. Grow, B.Sc.Hons., N.P. Richards, Ph.D.

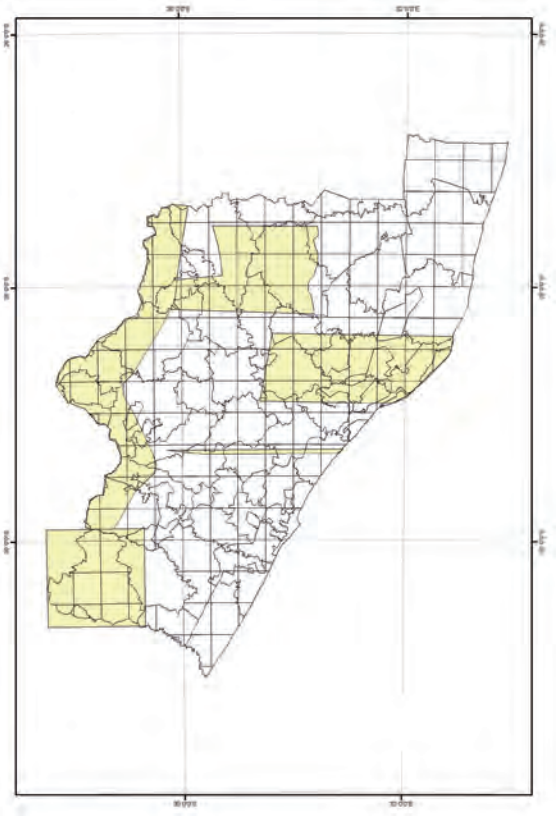
Objectives: to map and classify mass-movement deposits related to slope instability in the KwaZulu-Natal Province. These indicators of unstable slopes are widespread and often represent a significant geohazard to urban developments and linear infrastructure or communication routes.

Budget: 2004/2005: R119 889.

Motivation

Unconsolidated landslide-debris deposits are often associated with disturbed groundwater zones, resulting in concentrated groundwater seepage. Slope instability and associated unconsolidated debris deposits are potentially major geohazards. Areas associated with mass movements represent a negative impact on urbanisation and should therefore be one of the determining factors in land-use zonation for town and land-use planning. This research project entails mapping and classification of different slope instability features to develop a landslide classification and inventory system, based on international schemes, suitable for KwaZulu-Natal. Data modelling using spatial-analysis software, regional digital elevation

ST-2002-0767
MASS MOVEMENT MAPPING AND
LANDSLIDE INVENTORY



A very large landslide on Mount Currie near Kokstad showing typical hummocky topography and angular blocks in the debris.

data and bedrock geology, allows the distribution and terrain morphological context of different forms of slope instability to be assessed statistically. This data can be used to produce maps showing landslide vulnerability, susceptibility, probability and risk classification in various terrain conditions and climatic zones. The project is oriented towards staff skills development and is also an M.Sc. project opportunity for Ms Grow.

Progress

Sites initially identified on aerial photographs were targeted for detailed site investigations with the intention of testing the landslide classification system. Aerial photograph interpretations have been completed for the Mount Currie–Cedarville–Kokstad region in the southwest, the Ladysmith–Dundee–Vryheid–Utrecht region in the northwest and the Drakensberg region along the western border of KwaZulu-Natal. A poster entitled "Mass movement deposit mapping and slope instability" was presented at Geoscience Africa 2004. A paper entitled "Mass movement classification and slope instability mapping in KwaZulu-Natal, South Africa — preliminary observations" was submitted for publication in a special volume based on the landslide workshop held during the 32nd IGC in Florence, Italy.

Initial mapping of the areas of steep slopes and high relief has revealed widespread, large-scale landslides, localised failures of river valley slopes, shallow-based failures, large extensive areas of rock falls and talus deposits. The catastrophic nature of these landslides and their impact on the lower hill slopes is indicated by river diversions at many sites.

Conclusions

Widespread hummocky topography on steep slopes in high-relief areas suggests that mass movement is one of the most fundamental mechanisms responsible for landscape development in KwaZulu-Natal. Although mass movements are associated with all bedrock types within the study regions, there are definite associations with dolerite intrusions for the majority of these slope failures. The various

mass-movement deposits identified during the initial phase of the project occur in a range of climatic and topographic settings and have shown that the mass movement classification system derived is suitable for application nationwide. Further improvements or adaptations of the landslide classification system may be introduced as a result of ongoing investigations.

Future activities

Detailed mapping of specific landslides will be undertaken in order to highlight different mass-movement mechanisms. Radiocarbon dating of organic material deposited on landslide topography since the mass-movement event will provide the first minimum-age estimates for these events. An index that characterises landslide surface degradation will be developed as a means of relative dating. Estimates of movement timing can be derived from correlation with landslides that have similar morphologies. It is envisaged that at least one manuscript will be submitted to an international journal next year, and that the completed map and explanation will be published.

0869 GEOHAZARDS PROGRAMME

Project leader: N.P. Richards, Ph.D.

Project team: P.K. Zawada, Ph.D., K.J. Wilkinson, Nat.H.Dip., L.G. Wolmarans, B.Sc. Hons., H.J. Brynard, Ph.D., E.R. Dixon, N.Dip.Cartography, N.Y.G. Trollip, B.Sc.Hons., P.J. van Rooyen, B.Sc.Hons.

Objectives: to develop and implement a simple internet-based geohazard query system based on the Geotechnical Map Series that is available to the public using the geoscience internet portal.

Duration: 2004/2005.

Budget: 2004/2005: R 81 754.

Motivation

The geotechnical mapping programme has seen the completion of a significant number of 1:50 000-scale maps and a considerable amount of geotechnical information has been collected. However, it is recognised that dissemination of this information solely as maps is not the most efficient method. The development of a commercially available internet-based geohazard system, supplied as a GIS, will add further value to the Geotechnical Map Series.

Progress

The geohazards programme has been developed to a stage where a simple, understandable report can be generated by querying the geotechnical data in an ARCIMS format. The report contains a list of the geohazard conditions and severity ratings, a description of the geohazard conditions and their implications, and recommendations for further action.

Conclusions

This simple geohazard system, based on the Geotechnical Map Series, will enable the public to query the geotechnical data and receive a simple informative report indicating geohazards present in the area of interest, and actions to be taken with respect to those geohazards. The system will form an initial structure around which further geohazards would be included, for example seismic risk. The reports will be of considerable value to municipalities, project managers, bankers and insurers involved in infrastructure projects from the single-dwelling scale to large low-cost housing developments. The data could be used in the context of Phase 1 geotechnical reports.

Future activities

This project will provide valuable input into the development of a national geohazards inventory and analysis project, the principal objective of which is to develop a detailed plan (technical, financial, resources), whereby the CGS can use its large amount of geological information covering South Africa for the development of a commercially profitable geohazard system.

0886 MINE ENVIRONMENTAL PLANNING WORKSHOP

Project leader: G.A. Botha, Ph.D.

Researchers: N.P. Richards, Ph.D., B.M. Clarke, B.Sc.Hons, R.G. Grow, B.Sc. Hons, C.A. Willard, B.Sc.Hons.

Objectives: to provide a basis for improving skills in mine environmental planning in terms of the new legisla-

tion and environmental reporting requirements, and to facilitate communication to provide for closer working relationships between staff with specialised skills.

Duration: Two weeks.

Budget: 2004/2005: R33 212.

Motivation

The KwaZulu-Natal Unit has undertaken numerous environmental-planning and rehabilitation assessments for diverse mines and quarries. The promulgation of the Mineral and Petroleum Resources Development Act of 2002 introduced a range of new environmental-planning reports required as part of the application and authorisation process for prospecting and mining. To provide a wider range of skills and to ensure utilisation of specialists in other units around the country, there was a need to bring together all in-house expertise in this field. The goal of providing commercial consulting support to mines in other provinces dictated collaboration between scientists based in regional units. A workshop in which the CGS could evaluate the full range of scientific expertise, facilitate improved communication, and evaluate the demands imposed by the new mining legislation, was motivated.

Progress

The workshop took place over a five-day period and was hosted by the KwaZulu-Natal Unit in its Pietermaritzburg offices. Scientists from the Limpopo, Northern Cape, Eastern Cape, Environmental Geosciences and Water Geosciences Units attended and contributed. The evaluation of the requirements of environmental legislation pertaining to mining formed the basis of the first part of the workshop, after which staff with specialist hydrogeological, geochemical and geotechnical skills addressed the delegates. The capabilities of staff who had recently undergone training in specific aspects of environmental planning were also presented. A range of speakers was invited to deliver presentations on subjects such as vegetation dynamics, earthworks, aquatic systems, dust monitoring and rehabilitation management. The final days were devoted to conducting site investigations for the preparation of a scoping report, environmental impact assessment and compilation of an environmental management programme for a quarry.

Conclusions

The workshop presented an opportunity for CGS staff to familiarise themselves with the legislation covering the requirements for environmental planning and reporting in all mines. The collaboration of a wide range of specialists from within the CGS has demonstrated that the organisation has the capabilities to undertake larger environmental investigations, and operate in every province in the country. Incorporation of specialist hydrogeological and water chemistry skills can add value to most of the mine-planning projects undertaken. The incorporation of GIS mapping techniques, 3D modelling and intervisibility-analysis techniques has improved these aspects of the environmental reports to reach a high standard.

Future activities

The workshop identified some gaps in knowledge and experience within the business units of the CGS. These areas should be targeted for specialist training. The potential for interregional collaboration should be pursued through identification of projects in provinces other than KwaZulu-Natal where working relationships can be cemented and skills honed to provide a high level of support to the mining sector.

Environmental degradation caused by an abandoned coal mine near Dundee, KwaZulu-Natal. Legislation prescribes environmental impact assessment and management programmes that commit the mine to rehabilitate before closure.

5 EASTERN CAPE UNIT

0371 GEOLOGICAL MAPPING OF THE 1:50 000-SCALE SHEET AREAS 3326BC GRAHAMSTOWN, 3226BD TRAPPE'S VALLEY, 3226DB PORT ALFRED, 3226CA SPRINGMOUNT, 3226CB AND CD ALEXANDRIA, AND 3226DA AND DC BOESMANSRIVIERMOND

Project leader: M.H. Rohwer, B.Sc.Hons.

Project team: M.L. Goedhart, M.Sc., J.S.V. Reddering, Ph.D., L.B. Majokweni, B.Sc.

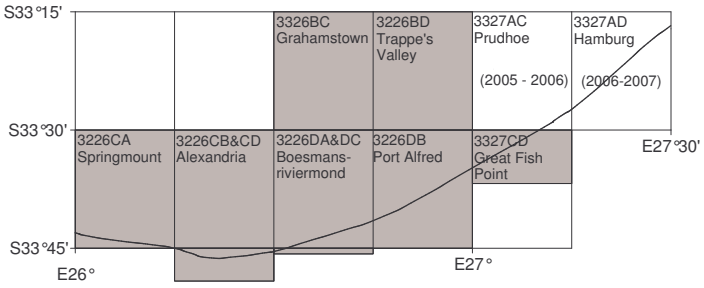
Objectives: to produce a geological map of the coastal area and hinterland from Springmount to Port Alfred, extending northward to Grahamstown.

Duration: 2004/2005.

Budget: 2004/2005: R80 965.

Motivation

The area covered by the map set was identified by the government as the Great Fish Spatial Development Initiative (SDI). The mapping of this area also focuses on the identification of mineral deposits suited to the construction and ceramics industries, in accordance with the poverty alleviation programme implemented by government, as the identification of economically viable mineral deposits may promote the development of the small-scale mining sector. A greater understanding of the structural geology of this area will also increase the potential for identification of aquifers.



Progress

Initiated several years ago when much of the work was completed, the mapping of several problem areas, with regard to the structural geology, was incomplete. The mapping of these remaining areas has now been completed, and the deadline for compilation of the map and explanation is the end of March 2006. The mapping delineated the stratigraphy and structural characteristics of the area, as well as Quaternary cover deposits. A set of closely spaced geological cross-sections provided a detailed interpretation of the structural complexity of this area.

Conclusions

The mapping has improved the understanding of the distribution of lithostratigraphic subdivisions and the structural controls on the different units. The distribution of the kaolin deposits has been elucidated.

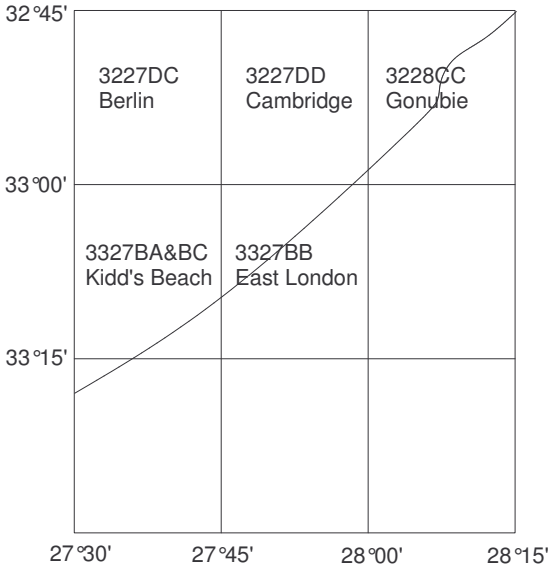
Future activities

With the completion of the map set, the map explanation is to be produced during the 2005/2006 project year, so as to provide a comprehensive, scientifically sound, geological interpretation of the map areas to the public.

0595 GEOLOGICAL MAP OF THE EAST LONDON AREA (1:50 000-SCALE SHEETS 3227DC BERLIN, 3227DD CAMBRIDGE, 3228CC GONUBIE, 3327BA and BC KIDD'S BEACH AND 3327BB EAST LONDON) AND EXPLANATION

Project leader: J.S.V. Reddering, Ph.D.

Project team: P.E. Brönn, B.Sc.Hons., M.L. Goedhart, M.Sc., W.C. le Roux, B.Sc. Hons., L.B. Majokweni, B.Sc., M.P. Roberts, Ph.D., M.H. Rohwer, B.Sc.Hons., M.S. Rynhoud, B.Sc.Hons.



Objectives: to provide revised geological data for the coastal 1:50 000-scale map sheets covering the Buffalo City metropole.

Duration: 1995–2004/2005.

Budget: Nil. This project is a carry-over.

Motivation

This map set forms part of the 1:50 000-scale coverage of major urban areas of South Africa, provides geological information on aggregates of the area, and significantly updates the geoscientific data of the area.

Progress

1995 to 1997: the high development priority areas of all map sheets were mapped on a scale of 1:10 000 to provide base maps for engineering-geological mapping of the areas. A patchwork of lower-priority areas was not mapped.

1999/2000: completed mapping coverage of the 3227DC Berlin, 3227DD Cambridge, 3327 BA and BC Kidd's Beach and 3327BB East London 1:50 000-scale sheets.

2000/2001: completed mapping coverage of the 3228CC Gonubie 1:50 000-scale sheet.

During the scientific audit in 2004, it was decided to tie up loose ends and complete this project by the end of the 2004/2005 project year. The map set was a patchwork of half-completed maps and reports left after the mapping in the mid-1990s when the responsible geologist resigned. The map coverage was completed, first by mapping the East London area (2000) and in a subsequent year (2001) that of the Gonubie sheet area. The project was again left in limbo after the resignation of personnel. Complications arose when the coded map sheets were found to be in the wrong format, and the explanation required rigorous review, including rewriting of the structural geology sections. The document has been reviewed externally and edited accordingly. The maps were redrawn and resubmitted. Electronically produced copies of the maps produced by the Spatial Data Management Unit were corrected and approved.

Conclusions

The project has now been completed.

Future activities

Review the production process of maps and explanation.

0742 1:50 000-SCALE GEOLOGICAL MAP OF SHEET 3227CD KING WILLIAM'S TOWN

Project leader: L.B. Majokweni, B.Sc.

Project team: J.S.V. Reddering, Ph.D., M.P. Roberts, Ph.D., L. Nhlenko, B.Sc.Hons., C.J.S. Fourie, M.Sc.

Objectives: to produce a geological map of the local development node west of East London.

Duration: 2004/2005.

Budget R22 281.

Motivation

Mapping on a scale of 1:50 000 is necessary as a tool for infrastructure development in urban and peri-urban areas such as those covered by this map, including the towns of King William's Town and Bisho, the capital of the Eastern Cape Province.

Progress

The objective of the mapping was to define the lithostratigraphy, delineate intrusive dolerite contacts and map the Quaternary cover deposits. The map area is underlain by the Permian

Adelaide Subgroup (Beaufort Group, Karoo Supergroup), which is intruded by Jurassic Karoo dolerite. Alluvium is present in the river valleys. Suitable construction materials and potential mineral deposits were identified.

Conclusions

The mapping, map compilation and explanation have been completed.

0750 GEOLOGICAL MAP OF THE WILD COAST AREA (1:50 000-SCALE SHEETS 3129BC LUSIKISIKI, 3129CB TOMBO, 3129CC and CD COFFEE BAY, 3129DA PORT ST JOHNS) AND EXPLANATION

Project leader: J.S.V. Reddering, Ph.D.

Project team: P.E. Brönn, B.Sc.Hons., M.L. Goedhart, M.Sc., W.C. le Roux, B.Sc. Hons., L.B. Majokweni, B.Sc., M.P. Roberts, Ph.D., M.H. Rohwer, B.Sc.Hons.

Objectives: to provide thoroughly revised geological data for the coastal 1:50 000-scale sheets in the Wild Coast Spatial Development Initiative (SDI) from Mbotyi in the northeast to Coffee Bay in the southwest.

Duration:

2000/2001 3129 CB Tombo, 3129 CD Coffee Bay, 3129 DA Port St. Johns

2001/2002 3129 BC Lusikisiki

2002/2003;

2003/2004 3129 CC Coffee Bay

During the scientific audit in 2004, it was decided to complete this project by the end of the 2004/2005 project year.

Motivation

The Wild Coast area has been identified as a growth area in the Government's development plans for South Africa. The Wild Coast SDI makes provision mainly for tourism growth. As the area is poorly developed, the establishment of infrastructure will require construction materials, including building sand and concrete aggregates. The functioning of coastal and terrestrial environments will need to be considered during conservation of the tourist-environmental ambience of the area. The project addresses these and other issues, and has substantially improved the basic geoscientific knowledge of the Wild Coast.

Progress

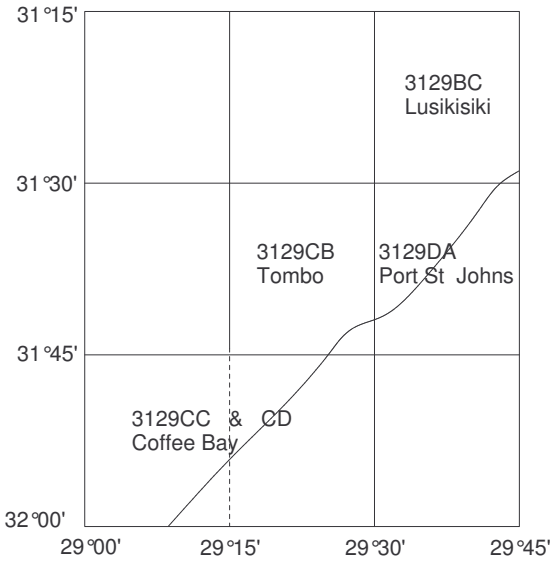
This project has had a patchwork development. It started as a project around Port St Johns, Tombo and the eastern sector of the Coffee Bay sheet area, to which was added the Lusikisiki area and subsequently the western sector of the Coffee Bay area. After each map was added to the project, the scope of the map explanation was expanded to include information from the new area. In this, the final stage of the project, the maps were compiled as a uniform set, and the map explanation thoroughly reviewed and edited accordingly.

Conclusions

The project has now been completed, and the only further contribution of the unit will be to review the production process of maps and explanation.

Future activity

There is potential for the production of a simplified map and explanation of the geological features of the region to cater for interest from the growing geotourism market.



0884 1:50 000-SCALE GEOLOGICAL MAP OF SHEET 3327CD GREAT FISH POINT

Project leader: M.H. Rohwer, B.Sc.Hons.

Project team: M.L. Goedhart, M.Sc., J.S.V. Reddering, Ph.D., L.B. Majokweni, B.Sc.

Objectives: to produce a 1:50 000-scale geological map of the coastal area from south of Kleinemonde to the Great Fish River.

Duration: 2004/2005.

Budget: R116 512.

Motivation

The area covered by the map set was identified by the government as the Great Fish Spatial Development Initiative (SDI). The mapping aimed to identify mineral deposits of economic benefit in accordance with the government's poverty alleviation programme to promote the development of the small-scale mining sector. An improved understanding of the structural geology may increase the potential for new groundwater supplies; this is a vital consideration for the identification of potential aquifers and the siting of new boreholes.

Progress

Mapping concentrated on defining the stratigraphy and structural characteristics of the area, as well as delineating Quaternary deposits. Completion of the mapping of the Great Fish Point map sheet and accompanying cross-section concludes the project, and this will be merged with the new Great Fish River map sheet during 2005.

Conclusions

Sheet 3327CA Great Fish Point and sheet 3327AC Prudhoe to the north have, since the beginning of this project, been combined as sheet 3327AC and CA Great Fish River. The already completed mapping will thus be combined with the new Great Fish River map as part of the statutory programme in 2005. An explanation for the new map will also be produced during 2005.

Future activities

In 2005, the northern portion (3327AC Prudhoe) of the new Great Fish River sheet will be mapped to complete the set and a map explanation will be produced to cover both of the map coverages, to be added to the Hamburg sheet during the 2006/2007 project year.

6 WESTERN CAPE UNIT

0257 1:250 000-SCALE GEOLOGICAL MAPPING OF SHEET 3218 CLANWILLIAM

Project leader: J.H.A. Viljoen, Ph.D.

Project team: D.I. Cole, Ph.D., D.L. Roberts, Ph.D., P.H. Macey, Ph.D.

Objective: to revise the mapping of thirty 1:50 000-scale maps comprising the Clanwilliam map, to compile a new 1:250 000-scale geological map and explanation.

Duration: 2002/2003–2006/2007.

Project Budget: Total: R 222 292, 2004/2005: R49 792.

Motivation

The 1:250 000-scale Clanwilliam map was one of the first geological maps to be published on this scale. The old stratigraphic terminology was used on this map, and it lacked a separate explanation booklet (a short explanation was printed on the reverse). The mapping was carried out between 1954 and 1969, prior to the introduction of standard lithostratigraphic nomenclature. Requests were made by the Department of Water Affairs and Forestry at the end of 2002 for geological information on part of the area, and a report and maps were prepared for them for groundwater research. From this work it became clear that the existing map needed revision. Requests from the Botanical Society to correlate geology and plant commodities also make revision mapping necessary.

Progress

Seventeen of the thirty 1:50 000-scale maps comprising the Clanwilliam map have been revised up to date.

Conclusions

Progress is in accordance with the Annual Technical Programme.

General view of Somerset West and Hangklip mountains.

0768 GEOLOGICAL MAPPING OF SHEETS 3418BB SOMERSET WEST AND 3418BD HANGKLIP ON A SCALE OF 1:50 000

Project leader: H.P. Siegfried, Ph.D.

Researchers: L. Nhleko, B.Sc.Hons., L. Gibson, M.Sc.

Objective: to produce a detailed geological map of the area with an explanation.

Duration: 2003/2004–2004/2005.

Budget: Total R 97 000, current year: R65 458.

Motivation

The entire coastline of the Western Cape is mapped on a 1:50 000 scale, with the exception of two maps. Biodiversity studies are important along the coastline and detailed geological maps enhance these investigations. Towns along the coastline experience ample housing development. Municipalities need spatial development plans and the geology, especially of industrial minerals, is important.

Progress

The project is complete. The geological mapping covered units ranging from the Neoproterozoic Malmesbury Group and Cape Granite Suite (including various granites of the Kuilsrivier-Helderberg and the Stellenbosch

Plutons), Palaeozoic sediments of the Table Mountain Group, and Cenozoic sediments. The maps, overlays and explanation have been completed.

Conclusions

The project has been completed, with the exception of editing by the SPU and printing.

0770 GEOLOGY AND ECOSYSTEMS OF THE WESTERN CAPE

Project leader: D.I. Cole, Ph.D.

Project team: L. Chevallier, Ph.D., H.A. Viljoen, Ph.D., A. Agenbacht, M.Sc.

Objectives: to understand the role of geology in the spatial distribution of plant species and toxicity in plants, to assist environmentalists and developers in sustainable development, mining and conservation measures, and to develop capacity in a new field of research and contribute to a larger multidisciplinary project.

Duration: 2003/2004–2004/2005.

Budget: Total: R50 000;
2004/2005: R13 500.

Motivation

Biodiversity and development are important issues that will bring serious social clashes if the problems are not addressed in good time. Geological information and investigations will help decision makers and the population to plan ahead. Present and future mining activities can, for example, be integrated into development and conservation schemes if planned in advance.

Progress

The team has taken part in three projects in partnerships with different research groups:

(1) Succulent Karoo Ecosystem Plan (SKEP) with Conservation International. Papers were published and conferences attended.

(2) Cape Fynbos Biodiversity Region (CFBR) with the Botanical Society, as we are part of a draft proposal for establishment of a SAEON fynbos node that was submitted to the DST.

(3) The De Hoop Nature Reserve with the Nature Conservation. 1:50 000-scale geological maps were digitised and used as a support for conservation planning.

Conclusions

Progress is according to plan.

Future activities

The study of a Fynbos node will be started.

0797 1:250 000-SCALE METALLOGENIC MAP OF SHEET 3118 CALVINIA

Project leader: D.I. Cole, Ph.D.

Objectives: to (i) draft a geological background map, (ii) capture commodity data on SAMINDABA, (iii) compile a mineral deposit overlay and (iv) compile a metallogenic map explanation.

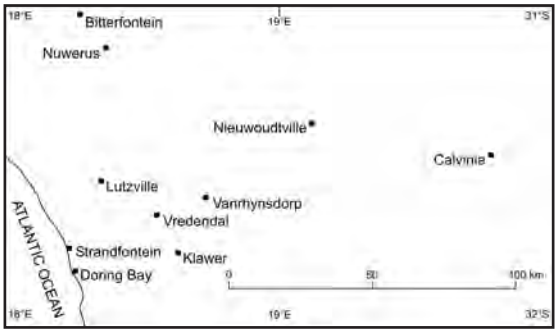
Duration: 2003/2004–2005/2006.

Budget: Total: R240 000;
2005/2005: R101 228.

Motivation

The area covered by the Calvinia sheet is well endowed with mineral deposits, including diamonds, and by delineating metallogenic provinces, the prospectivity of certain areas will be highlighted and the discovery of new deposits stimulated. The compilation of a database of all known mineral deposits is useful for organisations interested in land-use, exploration and resource-management studies. This is particularly pertinent for small-scale mining ventures by previously disadvantaged persons.

Locality map of the Calvinia Metallogenic Sheet (3118).



Mine located 24 km west of Lutzville that exploits diamonds from a marine terrace gravel, which dips seawards from the beach to 2 m below mean sea level. The gravel can be seen in the left foreground and a coffer dam constructed of sand enables mining to take place below sea level.

Progress

Addition of data to the SAMINDABA database was completed. This comprised an inventory of the locality, exploration history, exploitation, host rock, ore characteristics, geochemistry, literature references and synopsis including genesis of 260 mineral deposits; 33 had been added in the previous year, making a total of 293 deposits. Data capture was achieved from a desk-top study of published and unpublished information by liaising with exploration and mining company personnel, and from field investigations and sample analyses of 68 mineral occurrences and deposits, where existing information was sparse or uncertain.

Conclusions

Several commodities are either currently mined or have economic potential, including diamonds mined from marine gravels at sea level using coffer dams, marble in the Van Rhynsdorp region, sandstone (dimension stone) in the Nieuwoudtville region, gypsum in the Knersvlakte, limestone or dolomite in the Vredendal area and building sand near the urban centres. There is a potential for heavy-mineral sand mining from beaches west of Lutzville, and silica from quartz veins near Nuwerus. Sepiolite and dolomite occur at two sites northwest and southwest of Vredendal, but further investigations are required to assess their potential.

Future activities

The project is scheduled to be completed during 2005/2006, when the metallogenic map and sheet explanation will be compiled and published.

0804 THE ENGINEERING GEOLOGY OF BELLVILLE AND ENVIRONS

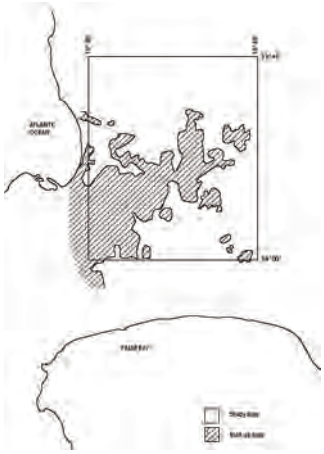
Project leader: F.D.J. Stapelberg, B.Sc. Hons., M.B.A.

Project team: L. Gibson, M.Sc., C. Dondo, M.Sc.

Objectives: to (i) record geotechnical data in the northeastern part of the Cape Metropolitan area, (ii) compile a geotechnical map, with an explanation.

Duration: 2003/2004–2004/2005.

Budget: Total: R65 000; 2004/2005: R50 800.



Bellville geotechnical map location and built-up areas.

Motivation

The project is part of an initiative to provide information to engineering geologists, geotechnical engineers, town planners, developers, and the general public on geotechnical conditions in and around the major metropolitan areas in the country, specifically to indicate the favourability of certain areas for development of structures with relatively low foundation load and founded at shallow depth, such as residential housing. In the Cape Town metropolitan area it is the fourth area to have been mapped for this purpose.

Progress

The project is 90 per cent complete. The desk-study and data-gathering, field-work, and laboratory-analysis phases are completed. The compilation of the map on a scale of 1:50 000 is complete, but the chronar still needs to be drawn. The explanation is 80 per cent complete.

Conclusions

The map indicates that vastly differing engineering geological conditions occur in the northeastern and southwestern parts of the mapping area. Clayey soils with minor long-term consolidation and low or medium swell potential, as well as steeply inclined topographical conditions, occur over parts of the northeastern areas, while loose sands with shallow water tables occur in the southwest.

Future activities

About two months are still needed for completion of the outstanding work.

0882 PLEISTOCENE HUMAN AND OTHER VERTEBRATE FOSSIL FOOTPRINTS IN SOUTH AFRICAN COASTAL AEOLIANITES

Project leader: D.L. Roberts, Ph.D.

Objectives: to create a database of the localities (using a GPS), species representation, palaeoecological significance and taphonomy of Pleistocene human and other vertebrate fossil footprints in coastal aeolianites, particularly to promote ecotourism and education.

Duration: 2004/2005–2006/2007.

Budget: Total: 54 000;
2004/2005: R32 000.

Motivation

The intense global public interest aroused by the Langebaan fossil human footprints (highlighted in an article in National Geographic, and in numerous local and international newspaper articles, TV and radio programmes) shows their potential for ecotourism and education. Their palaeoecological significance is enhanced by the lack of Pleistocene body fossils along the southern coast. The major and unique new discoveries of many species at Stilbaai are unique in a global context and merit a systematic, thorough and properly funded study.

Progress

Eight samples of fossil footprint-bearing aeolianite were submitted for luminescence dating. An Optically Stimulated Luminescence (OSL) date of 120 ka was obtained for the Nahoon footprints. A fossil-footprint display was set up at Geelbek, at the West Coast National Park and at the Bellville regional office. Assistance was given in the establishment of a Fossil Footprint Park at Buffalo City, where funding of R6 million was obtained. A database of fossil footprints at Langebaan, False Bay, Stilbaai and Buffalo City was set up, and a cast of a rhino trackway at False Bay was made. A paper in collaboration with geochronologists from the University of Sheffield is nearing completion.

Conclusions

Excellent progress was made in terms of the stated aims of the project, with ecotourism, education and the academic aspect all proceeding ahead of schedule.

Future activities

It is envisaged that all the stated aims of the project will be on schedule.

Pleistocene (~100 000 years b.p.) elephant footprint in aeolianite from Stilbaai. This is the southernmost record of *Loxodontia Africana*.

7 NORTHERN CAPE UNIT

0378 1:250 000-SCALE GEOLOGICAL MAP 2816 ALEXANDER BAY

Project Leader: H.F.G. Moen, M.Sc.

Project team: P.M.W. Botha, B.Sc. Hons., H. Minnaar, B.Sc. Hons., P. Macey, Ph.D.

Objectives: to map and revise the 1:50 000-scale maps covering the Alexander Bay 1:250 000-scale map area, and to compile a new 1:250 000-scale geological map and explanation.

Duration: 2002/2003–2006/2007.

Budget: R324 760.

Motivation

The mapping of the 1:50 000-scale sheets on the Alexander Bay 1:250 000-scale map form part of the statutory commitment of the CGS to produce high-standard reliable maps and explanations of the whole country for the public. This map forms an integral part in understanding the geology of the Northern Cape and Namaqualand. During the mapping of these 1:50 000-scale sheets we hope to identify some mineral deposits in this arid and isolated area. These will create opportunities for the local communities to diminish their poverty by mining and possible ecotourism. Some of the richest alluvial diamond deposits are encountered along the Orange River which forms the northern border of the Alexander Bay sheet area. A study of the surrounding geology and gravels may help to understand the various depositional environments better, and may be of further use to the local community in uplifting themselves. The area is one of extreme geological interest, with complex and fascinatingly diverse geology dominating the Richtersveld. The opportunity for geotourism and related fields is important in this otherwise barren landscape. The indigenous people will benefit from the explanation and proper documentation of the geology.

The area is ideal for groundwater studies, and the discovery of possible aquifers. A study can be incorporated into the geological investigation, and become a project that will ease the water shortage problem of the communities.

Progress

Eleven of the 1:50 000-scale maps making up the Alexander Bay 1:250 000-scale map area have been finished to date. The project is up to date and is following the programme.

Conclusions

The Richtersveld is underlain by rocks which vary in age from Palaeoproterozoic to Recent. The oldest rocks are those of the Orange River Group (2 000 Ma), which comprises a succession of volcanic rock types with compositions varying from mafic to felsic, with a subordinate portion of metasedimentary rock types (mainly of the Rosyntjieberg Formation). This volcanic succession is intruded by granitic batholith of the Vioolsdrif Suite. The Namaqua-Natal Metamorphic Belt experienced its last high-grade metamorphic imprint approximately 1 030 Ma ago.

The Gariep Granitoids of the Richtersveld Igneous Complex — a series of alkali granite and syenite bodies — were emplaced post-tectonically into the Namaqua-Natal Belt. The mafic dykes of the Gannakouriep Suite were emplaced towards the end of the intrusive phase of the Richtersveld Igneous Complex.

The Gariep Belt is part of a network of orogenic belts in western Gondwanaland, and comprises metasedimentary and metavolcanic rocks of the allochthonous Marmora Terrane and parautochthonous continental Port Nolloth Zone. The Gariep Belt rests, in most instances tectonically, on the basement of the Namaqua-Natal Metamorphic Belt. The Nama Group comprises arenaceous and argillaceous sedimentary rocks which were deposited in a peripheral foreland basin between the Kalahari craton in the east and the Gariep Belt in the west during late Proterozoic to early Cambrian times. Late-orogenic intrusive bodies of alkali-granite and

syenite cross-cut the main tectonic fabric, as well as lithological contacts in older units. They form part of the Kuboos–Bremen line and in the study area are represented by the Kuboos Batholith, the Swartbank and Tatasberg Plutons, and the Grootpens Island Complex. Dune sand, calcareous deposits, and river alluvium and gravel are deposits of recent age.

0748 METALLOGENIC MAPPING OF 1:250 000-SCALE SHEET 2918 POFADDER

Project leader: A.L.D. Agenbacht, M.Sc.

Duration: 2002/2003 to July 2005.

Objectives: to produce a 1:250 000-scale metallogenic map and explanation for sheet 2918 Pofadder.

Motivation

The CGS has a mandate to document mineral occurrences in South Africa in its databases and publications. The Pofadder area possesses a large mineral wealth, and mining activities are a very important part of the development of the region. Metallogenic mapping is an important tool in giving assistance and advice to clients such as small miners. The potential exists for generating targets that may lead to job creation and alleviation of poverty.

Progress

The localities of the commodity occurrences have been captured using a GPS, and the data have been loaded onto the SAMINDABA database. The map and explanation have been compiled, and about half of the commodity descriptions have been written and edited for the explanation.

Future activities

The map and explanation will be submitted for editing by end of July 2005.

8 LIMPOPO UNIT

0822 1:50 000-SCALE GEOLOGICAL MAP 2429AC ZEBEDIELA WEST AND 2429AD ZEBEDIELA EAST

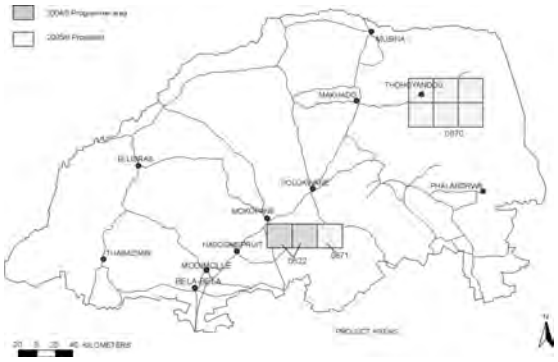
Project leader: N. Baglow, B.Sc.Hons.

Project team: M. Dippenaar, B.Sc.Hons.

Objectives: to compile a 1:50 000-scale geological map for sheet 2429AC Zebediela West and 2429AD Zebediela East with an explanation.

Duration: 2004/2005.

Budget: R69 600.



Motivation

The project area is adjacent to 1:50 000-scale sheets Mokopane and Tswene, which were mapped in previous years, and completes the mapping of the western development (along the Strydpoort Range) of the Malmani dolomites, a unit of hydrogeological significance. The project supports the focus on Rural Development and Poverty Alleviation by addressing groundwater issues and building-materials resources in a rural area that has seen significant community growth.

Progress

The project is complete.

Conclusions

The Zebediela area consists of two main physiographic regions; a northern mountainous area and the southern flat country (part of the Springbok Flats). The two are separated by the Zebediela Fault which forms part of the craton-scale Thabazimbi Murchison Lineament. The high ground is underlain by sediments of the Wolkberg, Chuniespoort and Pretoria Groups, with the dolomites, forming a typical karstic scenery, being of particular importance as they host a significant groundwater resource. The Springbok Flats is a low-lying featureless area covered by surficial deposits overlying units of the Karoo Supergroup and the Bushveld Complex. Access to company exploration boreholes has allowed for a study of the Letaba Formation basalts in particular. Interpretation of the CGS airborne geophysical data has led to the recognition of a number of fault features and the interesting dispersion pattern in the Quaternary sediments (see figure). Mining activity includes diamonds and platinum (Klipspringer and Messina mines) and brick-making clays, and there is further potential in the construction material commodities.

Future activities

Follow-up work on clay potential will be undertaken as a capacity-building project.

0870 MINERAL POTENTIAL (GOLD) OF THE GIYANI GREENSTONE BELT

Project leader: M. Dippenaar, B.Sc.Hons.

Project team: H. Ndindani, B.Sc.Hons.

Objectives: to assess the mineral potential of the Giyani greenstone belt and surrounding area.

Duration: 2004/2005–2006/7.

Budget: Total: R169 407;
2004/2005: R47 000.

Motivation

The project covers six 1:50 000-scale map sheets in the Giyani area which are being investigated in order to determine the mineral development potential. In addressing the Rural Development focus, areas of interest are to be

delineated, targets assessed and a database of gold mineralisation in the belt compiled.

Progress

The project is in its first phase, with the completion of the airborne geophysical survey over the whole area and the preliminary interpretations undertaken.

Conclusions

Early indications are that there is a correlation between observable structures and the mineral deposits of the Giyani greenstone belt. However, the surprisingly high overall density of dykes revealed by the aeromagnetics tends to obscure other features, particularly within the greenstone belt terrain.

Future activities

The project will continue in the next programme year, with the aim of identifying potential target areas.

0871 1:50 000-SCALE GEOLOGICAL MAP 2429BC LEBOWAKGOMO

Project leader: N. Baglow, B.Sc.Hons.

Project team: M. Dau, B.Sc.Hons.

Objectives: to compile a 1:50 000-scale geological map of sheet 2429BC Lebowakgomo with an explanation.

Duration: 2004/2005–2005/2006.

Budget: Total R85 590, 2004/2005: R 36 990.

Motivation

The map sheet is adjacent to the Zebediela project area and areas mapped in previous programmes. The project aligns with the focus areas of Rural Development and Poverty Alleviation in terms of addressing dolomite and groundwater issues and building-materials resources in a rural area around the seat of the Provincial Legislature. Capacity building and training in terms of GIS applications are an integral component of the project.

Progress

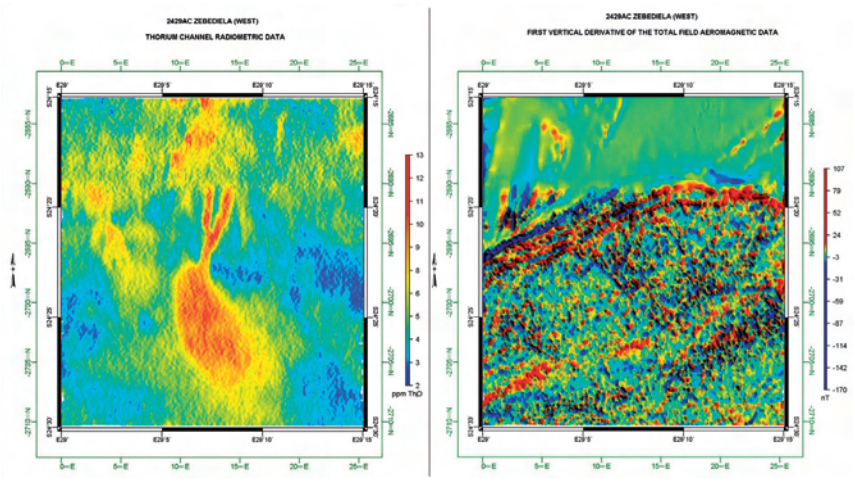
The project is in its first phase, with the completion of the airborne geophysical survey and the preliminary interpretations undertaken.

Conclusions

The Lebowakgomo area is underlain by rocks of the Transvaal Supergroup in the north, and the Rustenburg Layered Suite and Lebowa Granite Suite in the south. The aeromagnetic data have, combined with satellite data interpretation, assisted with the elucidation of the east–west layering in the stratigraphy and the main structural elements.

Future activities

The work will be completed in the next programme year, with field geological mapping and the addition of hydrogeological and mineral-resource components to the project.



Contrast between radiometric and magnetic data over sheet 2429AC Zebediela West. The Th-channel radiometric data clearly indicate surface drainage and recent sedimentation features, while the magnetics indicate the trace of the Zebediela fault zone forming the northern margin of the Springbok Flats Basin.

9 SOUTH AFRICAN COMMITTEE FOR STRATIGRAPHY

0055 TEXTBOOK OF SOUTH AFRICAN GEOLOGY

Project leader: M.R. Johnson, Ph.D.

Project team: C.R. Anhaeusser, Ph.D. (University of the Witwatersrand), R.J. Thomas, Ph.D. (BGS).

Objectives: to provide a comprehensive reference work on the geology of South Africa for both students and practising geologists.

Motivation

The need for a new book on the geology of South Africa had arisen, as the most recent book covering this topic was published in 1982 and is becoming outdated. The Geological Society of South Africa entered into an agreement with the CGS to publish this textbook, in terms of which the CGS will be responsible for redrafting the figures, writing the index, preparing the layout and undertaking the final printing, as well as sharing the editorial function.

Progress

Editing of the Phanerozoic and Proterozoic parts of the book (24 chapters out of a total of 33), for which the project leader is directly responsible, have been completed.

Future activities

Certain chapters in the Archaean section, as well as the index, still have to be finalised before the book can go to press.

0449 SACS PUBLICATIONS

Project leader: M.R. Johnson, Ph.D.

Project team: A. van Heerden, B.A.

Objectives: to provide definitive, standardised descriptions of all formally approved lithostratigraphic units recognised in South Africa.

Duration: Ongoing.

Motivation

The published lithostratigraphic descriptions will provide a published source of information on the stratigraphy of southern Africa to enable geologists to identify and map all stratigraphic units during fieldwork, and to provide essential information for use in reports and publications.

Progress

SACS Lithostratigraphic Series No. 41: Lithostratigraphy of the Koeris Formation (Aggeneys Subgroup, Bushmanland Group): Editing completed.

SACS Catalogue Vol. 10, containing descriptions of the Banke Granodiorite, Bantamberg Granite, Burtons Puts Granite, Koelmanskop Metamorphic Suite, Mesklip Gneiss, Modderfontein Gneiss, Nababeep Gneiss, Polisiehoek Gneiss, Schuitdrift Gneiss, Swartmodder Gneiss, Uilklip Granite, Yas Gneiss: Editing completed.

Future activities

As only 25 per cent of all South African stratigraphic units have yet been published as SACS publications — 350 out of a total of about 1400 — much work still remains to be done.

0473 SACS DATABASE

Project leader: M.R. Johnson, Ph.D.

Project team: S. Tucker, Dip.S.B.M. (Damelin), R. Smith, B.Sc.Hons.(GIS).

Objectives: to store information on stratigraphic units recommended for use on maps, and in reports and publications of the CGS. A summary table based on the database has been posted on the Internet.

Duration: Ongoing.

Budget: Part of GEODE budget.

Motivation

It is necessary that standard names and map labels are used by the geological community in reports and publications, particularly maps.

Progress

During the year 148 lithostratigraphic units were added to the database, or updated. The number of records in the database is shown in the following table:

Unit Rank	Approved	Historical	Informal	Not applicable	Not yet approved	Unnecessary
Batholith			7			
Bed	4				1	1
Complex	33				8	2
Formation	446	11		1	177	41
Group	58	4			17	6
Member	106	1	2		36	16
None	154		7	5	183	31
Pluton			7			
Reef			62			
Subgroup	48				9	4
Subsuite					13	
Seam			254			
Supergroup	10	1				1
Suite	42			1	26	3
Zone			19			

Future activities

This project will be ongoing.

0519 SACS SECRETARIAL FUNCTIONS (INCLUDING MEETINGS AND FIELD TRIPS)

Project leader: M.R. Johnson, Ph.D.

Project team : P.K. Zawada, Ph.D., N. Keyser, M.Sc., G.A. Botha, Ph.D., J.S.V. Reddering, Ph.D., P.H. Macey, Ph.D., C.H. de Beer, M.Sc., H.P. Siegfried, Ph.D., L. Chevallier, Ph.D., D.I. Cole, Ph.D., D.L. Roberts, Ph.D., J.H.A. Viljoen, Ph.D., A.L.D. Agenbacht, Ph.D., H.F.G. Moen, Ph.D., P.M.W. Botha, B.Sc.Hons., G. Brandl, Ph.D., N. Baglow, M.Sc., P.J.A. Bosch, M.Sc., G.S. de Kock, Ph.D., J. Neveling, Ph.D.

Objectives: to assist in making recommendations concerning stratigraphic classification and nomenclature in South Africa and the formal approval of new units by organising and/or attending meetings and field trips of SACS and its task groups, as well as refereeing and editing manuscripts submitted to SACS for publication. As an organisational member of the ISSC (International Subcommission for Stratigraphic Classification), SACS also makes an input and receives feedback at an international level.

Duration: Ongoing.

Motivation

The Geological Survey of South Africa and its successor, the CGS, have provided logistical and financial support for the activities of SACS, as all stratigraphic names used by the geoscience community should conform to the South African Code of Stratigraphic Terminology and Nomenclature.

Progress

The main SACS committee, as well as the Task Groups for Alkaline Complexes and the Cape Granite Suite (two meetings and field trips), met during the course of the year.

Future activities

This project will be ongoing.

0622 SACS LITHOSTRATIGRAPHIC DESCRIPTIONS

Project leader: H.P. Siegfried, Ph.D.

Project team: J. Viljoen, Ph.D., A.L.D. Agenbacht, Ph.D., L. Chevallier, Ph.D., P.M.W. Botha, B.Sc.Hons.

Objectives: to produce SACS catalogue descriptions for the following units:
Kuruman Kimberlite
Premier Kimberlite (revision)
Kuilsriver–Helderberg Pluton
Peninsula Granite
Bloukop Granite, Kliphoek Granite, Taaiboshoek Granite
Nababeep Gneiss,

	Modderfontein Gneiss, Mesklip Gneiss.
Duration:	2003/2004 to April 2006.
Budget:	Total: R15 000; 2004/2005: R5 000.

Motivation

The description of South African lithostratigraphic units is a core function of the CGS, and is a major contribution to South African earth science.

Progress

All of the planned lithostratigraphic descriptions have been completed.

Future activities

The descriptions are still to be edited.

0879 1:2 000 000-SCALE CHRONOSTRATIGRAPHIC MAP OF SOUTH AFRICA

Project leader:	M.R. Johnson, Ph.D.
Project team:	L.G. Wolmarans, B.Sc.Hons.
Objectives:	to provide a map showing the distribution of rocks falling within the 12 main geological time intervals in South Africa.
Duration:	2003/2004–2004/2005.
Budget:	Nil.

Motivation

A chronostratigraphic map forms an essential part of the CGS's publications on the geology of South Africa and serves as a basic tool in geological education, complementing the lithostratigraphic maps already published.

Progress

The project has been completed.

10 MINERAL RESOURCES DEVELOPMENT UNIT

0092 SMALL-SCALE MINING SUPPORT

Project Leader: P.E. Wipplinger, M.Sc.

Objectives: to assist small-scale miners to reach an objective and scientifically founded evaluation of their prospects.

Duration: Ongoing.

Budget: Funded by the National Steering Committee of Service Providers to the Small-Scale Mining Sector (NSC).

Motivation

To select prospects with economic merit from those projects for which assistance is requested, and to investigate these (with the help of the CGS's sister organisations in the field, CSIR-Miningtek, Mintek and IDC) so that an entrepreneur can obtain financial assistance.

Progress

The CGS currently sits on two forums, the National Steering Committee of Service Providers to the Small-Scale Mining Sector (NSC) and the Technology Demonstration Centre - Zenzele (TDC).

Besides the NSC and TDC activity, the CGS also serves individuals and companies who request assistance directly. This also includes other governments (e.g. a peat quality investigation for the Republic of Congo) and companies from other countries (e.g. Australia and Canada).

During the year about 100 applications were processed. Of these, 12 were selected for a site investigation and four merited further investigative work. Intensive laboratory-scale tests were conducted on one of these, namely the Batlhabine Brick Project; the tests returned favourable results and, together with a market study conducted by MEPC, indicate that the project should be viable provided that issues concerning ownership are resolved speedily and a proper business-management structure is developed.

Conclusions

Only a very small proportion of projects for which assistance is requested have the potential to become economically viable. Most projects are based on a resource that is too small, or one that is inaccessible owing to factors such as depth below surface and unresolved ownership issues.

Future activities

Currently the CGS has three projects for which geological work proposals have been submitted. If accepted, these will be implemented during the coming year.

0854 THE EVALUATION OF SELECTED PEGMATITE DEPOSITS AND THEIR ECONOMIC POTENTIAL FOR THE DEVELOPMENT OF SMALL-SCALE MINING ACTIVITIES

Project leaders: R.N. Hansen, B.Sc.Hons., P.E. Wipplinger, M.Sc.

Objectives: to evaluate selected pegmatite deposits, focussing particularly on mining practices, in order to advise on more effective methods of pegmatite mining, and on the pegmatite industrial-mineral potential and the industries to which the minerals can be offered in terms of mineral quality.

Duration: 2004/2005.

Budget: Total: R254 122.

Motivation

The project is designed to assist in alleviating the poverty conditions of the Northern Cape by promoting the known mineral-resource potential for small-scale miners and junior mining companies.

Numerous small-scale open-cast mining operations exploiting a pegmatite operation. Photo: R.N. Hansen.

Progress

The project report is complete.

Conclusions

The large Northern Cape pegmatite belt contains a number of high-quality minerals including feldspar, mica, spodumene and beryl, among others. To date, the exploitation of these pegmatites has been restricted by the severe shortage of water, the long distance to markets and lack of viable transport facilities. Because of these constraining factors, it is concluded that selective mining of the pegmatites restricts their economic viability; wall-to-wall mining, with the purpose of extracting all of the mineral endowment of the pegmatites is likely to improve the viability of economic exploitation of these pegmatite deposits.

Future activities

A follow-on project on the Namaqua pegmatites has been proposed for 2005/2006. This project will focus on the genesis of the pegmatite deposits which will assist in predicting the mineral potential of specific pegmatites.

0861 INDUSTRIAL MINERALS MAP OF SOUTH AFRICA

Project Leader: G.F.J. Horn, M.Sc.

Objectives: to capture information concerning industrial-mineral mines, deposits and occurrences on the databases of the CGS in order to produce industrial-mineral maps for South Africa, as well as other products that will assist small- and medium-size mining companies in establishing new mining ventures and lowering risks for new investors into the mining economy of South Africa.

Duration: 2004/2005–2008/2009.

Budget: 2004/2005: R174 000.

Motivation

It necessary that the CGS
identifies new industrial-minerals mining opportunities, especially for small- and medium-scale mining companies, and provides information on the presence of deposits to development agencies;
contributes to the understanding of industrial-mineral deposits and occurrences;
proactively warns against the sterilisation of mineral resources by infrastructure and construction;
assists in optimising the use of mineral resources, and assists in import replacement and development of services to the growing South African industrial-product manufacturing industry;
uses acquired technical and scientific knowledge in projects where knowledge transfer can assist in the establishment of a sound and viable small-scale mining sector;
participates in commercial and research programmes in NEPAD/SADC related projects, and
creates products that lower the risks of would-be investors in South Africa's minerals industry.

Progress

The aims of the first phase of this project, to be finished by April 2005, are to identify data to be collected from mines, deposits and especially occurrences, to compile a working legend and to provide working maps for geologists capturing data during 2005/2006.

A preliminary list of minerals to be included in the map was compiled. It is accepted that there are mineral commodities that only occur in certain provinces, e.g. kyanite in KwaZulu-Natal, and that in certain provinces, such as Gauteng,

Small-scale mining of marble in the Limpopo Province. The beneficiated mineral products are used as fillers.

construction materials — sand, brick-making clay and aggregate — would comprise the most important mineral commodity, to such an extent that it would not be feasible to present these mineral occurrences on a map. In other provinces, such as the Northern Cape, the same commodities would be thinly spread. It was decided to exclude certain mineral commodities from the project because of their frequent occurrence in a particular province, and that the list of minerals should not exceed 20 mineral commodities.

A map legend was compiled to allow each mineral commodity and each mineral deposit's or occurrence's characteristic to be indicated on the map with a unique symbol. A list of scientists taking part in this project was compiled.

Conclusions

In addition to the symbolised locality indication of mineral occurrences and deposits, information on infrastructure (water supply, electricity networks, roads) as well as the simplified regional geology, should be indicated on the map as industrial minerals are dependent on these parameters.

Initiation of the project in the Free State and subsequently in the Eastern Cape would assist in establishing a working rhythm and addressing practical issues as they occur.

The SAMINDABA Database could provide 1:250 000-scale base maps for the different provinces on which all known industrial-mineral occurrences and deposits would be indicated. Information obtained during fieldwork will be compiled on 1:50 000-scale sheets. Certain important deposit characteristics, including locality, exploration data, stratigraphy and ore-body information (dimensions, ore-body attitude, depth, overburden, structure and texture, mineralogy and host-rock–ore-body relations) that are part of the SAMINDABA input forms, will be strictly adhered to during the capturing and accumulation of information from literature and field visits for each occurrence or deposit. The correlation of characteristics between deposits is important because it will allow identification and definition of mineral provinces.

Limited sampling will be done per deposit or occurrence depending on the accessibility of the ore body. Any analytical data would be used to characterise to a limited extent the mineral commodity under investigation. This information could also be used to augment other databases, including the laboratory's geochemistry database.

Basic techniques used in regional and metallogenic mapping would also be used during the compilation of the industrial-minerals map.

Future activities

The work to be conducted on the Industrial Minerals Map project will deliver products that will enable the CGS to carry out national resource estimations, publish maps as contributions to commodity surveys and exploration programmes, and assist with developing exploration models, contribute to due-diligence reporting, assist with optimised mine development and mining, contribute to successful strategic decisions of national and provincial government agencies and local authorities with regard to the development of infrastructure, housing and dams in avoiding the sterilisation of mineral deposits, contribute to the establishment of small- and medium-size mining companies, and assist with transfer of scientific knowledge.

0865 MINERAL RESOURCES FOR SUSTAINABLE DEVELOPMENT IN THE SOUTHERN AFRICAN CONTEXT

Project leader: S. Frost-Killian, M.Sc.

Project team: J. Cole, M.Sc., P. Cole, M.Sc.

Objectives: to (i) improve existing knowledge of mineral deposits in the SADC region and contribute towards better understanding of the deposits, particularly their genesis and modes of occurrence, (ii) define modelling criteria and classify deposits in terms of their prospectivity, with special reference to their small-scale mining potential, (iii) delineate possible prospective terrains for selected minerals, and (iv) contribute to capacity building.

Duration: 2004/2005–2008/2009.

Budget: 2004/2005: R43 286.

Motivation

Members of the SADC have collaborated in several geoscience projects during the past few years. The development of the mining and mineral industries (in particular the small-scale mining sectors) of the SADC countries could contribute significantly to NEPAD's current priorities of achieving sustainable development and alleviating poverty.

In South Africa, the CGS has several databases, including the African Minerals database which was designed for the compilation of the International Metallogenic Map of Africa on a scale of 1:5 000 000. SAMINDABA has been compiled as a result of the South African metallogenic-mapping programme. One way to ensure sustained upkeep of these databases is through innovative manipulation and interrogation of the existing and new data, using mathematical and statistical methods to produce prospectivity maps and to advance our knowledge of the genetic modelling of mineral deposits.

The project falls within the African development focus and represents a new and exciting research direction for the CGS. It can contribute considerably towards the NEPAD and South African goals of sustainable development and poverty alleviation.

Progress

Very little progress has been made on this project. Preliminary discussions have been held with the USGS concerning participation in the Global Mineral Resources Assessment Programme (GMRAP). The project, limited initially to eight commodities (Cu, Au, Pb, Ni, PGM, Zn, Phosphates and Potash), allows for the identification of prospective future mineral-resource areas using a combination of statistical methods, existing information, known mineral deposits and occurrences, and deposit modelling. The results are presented on prospectivity maps, with a confidence rating for the possibility of finding new deposits within a particular geological zone (e.g. the Zambian Copper Belt). This GMRAP project would provide quick initial results on potential prospectivity areas within the SADC region. A further benefit is the methodology, which involves holding workshops where experts from the entire SADC region will have the opportunity to exchange knowledge and expertise for the preparation of the maps, making it a multinational effort. The results of the GMRAP project could be incorporated into this project, i.e. mineral resources for sustainable development in the Southern African context.

Conclusions

The project is of critical importance to the future development of the minerals industry, both in South Africa and in Africa as a whole. The CGS has access to large, relevant databases, as well as good cooperation with several of the geological institutions. The project represents a new and exciting research direction for the CGS and can contribute considerably towards the NEPAD and South African goals of sustainable development and poverty alleviation.

Future activities

The project will get under way during 2005/2006.

METALLOGENIC MAPPING PROGRAMME

The Geoscience Act (Act 100 of 1993) mandates the CGS to promote the search for and exploitation of minerals in South Africa, to undertake research in the field of geoscience and to provide specialised geoscientific services. The Metallogenic Mapping Programme commenced in 1988, soon after the establishment of SAMINDABA in 1986, as the principal means of gathering new data and verifying existing information. SAMINDABA is the national inventory of all mineral occurrences in South Africa, and is one of the cornerstones in the promotion of mineral exploration and exploitation in the country.

The primary objective of the Metallogenic Mapping Programme is to contribute to the optimal use and efficient exploitation of South African mineral resources by releasing commodity information, mainly from SAMINDABA, in an effort to stimulate investment by both local and international investors. The discovery of economically exploitable mineral deposits leads to the opening of new mines, creating wealth and providing employment. However, mining is a depleting activity, and resources have to be continually discovered in order that economic development be sustainable. The Metallogenic Mapping Programme, represented by the following metallogenic mapping projects, plays an increasingly vital role in the discovery of ore deposits.

0140 1:250 000-SCALE METALLOGENIC MAP 2526 RUSTENBURG

Project leader: D.L. Ehlers, B.Sc.Hons.

Project team: W.R. Oosterhuis, B.Sc.Hons.

Objective: to provide a synthesis of the information on the geology and mineralisation trends in the study area.

Duration: 2004/2005.

Budget: R141 410.

Motivation

Since this project was initiated prior to 1999 a wealth of new information has become available. It was therefore necessary to modify the map, verify the existing information and add the new information to ensure that the map is an accurate reflection of the current state of knowledge of the geological and mineral deposit information. The information will be extremely useful in providing further insight into the mineralised trends for target identification and other investigations.

Progress

A wealth of information continues to become available owing to the rapid pace of greenfields exploration and mining activities on the western Bushveld Complex. As a result improvements have been made in the understanding of the structure of the Bushveld Complex and its associated mineralisation. Two new mines, the Kroondal and Marikana Platinum Mines, were established by Aquarius Platinum. Lonplats also expanded production with the addition of a number of open-pit operations for the extraction of platinum ore.

The Marikana deposit is of particular interest because it is located in a subbasin structure which protrudes from the main Bushveld Complex basin, where no platinum mineralisation was expected according to existing 1:250 000-scale geological maps. It measures approximately 1,5 by 3,1 km, and has a maximum depth of 190 m with its long axis having a north-northwest trend.

Recently discovered changes in the mineralised reef suboutcrops, structural information, localities of new mining activities and geological subdivisions, especially in the vicinity of the Spruitfontein inlier were incorporated into the metallogenic map. The relevant explanation to the metallogenic map, including the diagrams, has been modified together with the relevant commodity data.

Conclusions

The metallogenic information contained in this map has been significantly upgraded, and the map and accompanying explanation will be ready for publication in the next financial year.

Future activity

The project will be concluded at the end of the reporting period.

0142 1:250 000-SCALE METALLOGENIC MAP 2426 THABAZIMBI

Project leader: D.L. Ehlers, B.Sc.Hons.

Project team: W.R. Oosterhuis, B.Sc.Hons.

Objective: to produce a synthesis of the geology and mineralisation in the Thabazimbi area in a format that will be of practical use to stakeholders in the minerals industry.

Duration: 2002/2003–2005/2006.

Budget: Total: R95 625 excluding manpower costs.

Donkerpoort West pit, Thabazimbi iron ore mine.

Motivation

The Thabazimbi Metallogenic Sheet was compiled during the 2002/2003 programme year, but not all aspects of the task were delivered as the revised geological map of Thabazimbi, a prerequisite for the metallogenic map, is yet to be completed.

Progress

As considerable progress has already been made in the compilation of the map — it is about 85 per cent complete — it is expected that the map and explanation will be completed during the 2005/6 year. Although good progress has been made with respect to the compilation of the revised 1:250 000-scale geological map 2426 Thabazimbi, it has not yet been finalised.

0459 1:250 000-SCALE METALLOGENIC MAP 3324 PORT ELIZABETH

Project leader: S. Frost-Killian, M.Sc.

Project team: J.S.V. Reddering, Ph.D., M.L. Goedhart, M.Sc., L.B. Majokweni, B.Sc., W.R. Oosterhuis, B.Sc.Hons.

Objectives: to (i) produce a 1:250 000-scale map showing all mineral deposits, with emphasis on construction and industrial minerals, (ii) supplement and update mineral-deposit data on SAMINDABA, and (iii) design a database from which derived maps and client reports can be produced.

Duration: 2000/2001–2005/2006.

Reporting year: 2004/2005.

Budget: R39 237.

Motivation

Some of the information for sheet 3324 Port Elizabeth was available on SAMINDABA and had recently been updated for inclusion in the 1:1 000 000-scale Metallogenic Map of South Africa, but information on industrial minerals and construction materials had not been updated. The need for a comprehensive, updated and accessible database on the mineral deposits of the Eastern Cape, starting with the Port Elizabeth region, was identified. The Department of Minerals and Energy in Port Elizabeth also indicated their need for mineral-deposit maps of the region, and eventually of the Eastern Cape Province.

Progress

The project has progressed during the 2004/2005 project year. The compilation of the explanation has progressed, with some work done on the mineral-deposit/occurrence chapter(s). The GIS preparation of the background geology, including the geotectonic environment, has been completed. The mineral-deposit data to be included on the map have been provisionally captured and added to the SAMINDABA database.

Conclusions

The completion of this project has been unavoidably delayed because of other project com-

Moregrove Quarry. Photo: J.S.V. Reddering.

mitments. It is hoped that the final product will serve as a tool to encourage further development of small- to medium-scale mining within the Port Elizabeth sheet area. It is essential that the potential mineral deposits be identified, as much of the area is being sterilised by the development of the Greater Addo Elephant Park, as well as other Game Reserves (e.g. Shamwari). Furthermore, important sources of brick clay have been sterilised by the Coega/Ngqura Industrial Development Zone. With the development of the Port of Ngqura, and the related expected growth in the region, it is critical that future reserves of construction and industrial minerals be identified and reserved to meet the needs of the expanding Nelson Mandela Metropole and surrounding areas.

Future activities

The project will be finalised early in the 2005/2006 project year.

0760 1:250 000-SCALE METALLOGENIC MAP 2628 EAST RAND

Project leader: D.L. Ehlers, B.Sc.Hons.
Project team: G. Henry, Ph.D.
Objective: to produce a 1:250 000-scale metallogenic map with an explanation.
Duration: 2002/2003–2004/2005.
Budget: 2004/2005: R127 600.

Motivation

The CGS produces a series of 1:250 000-scale metallogenic maps covering South Africa. Each 1x2-degree sheet is accompanied by a printed explanation, and each mineral deposit shown is listed on SAMINDABA. The final product will be a synthesis of the geology and mineralisation of the East Rand map-sheet area.

Progress

The precise locations of 401 mineral occurrences in the East Rand map-sheet area have been verified. There are 92 occurrences for which the main commodity is gold. Of the others, 118 are coal, 5 refractory clay, 17 semi-refractory clay, 34 shale and brick clay, 2 dolomite, 8 iron, 19 gas, 1 heavy-mineral sand, 3 dimension stone, 1 nickel, 1 ochre, 3 lead, 30 building sand, 1 silica, 50 stone aggregate, 12 torbanite, 1 vanadium and 1 zinc. The updated mineral-occurrence data have been captured on SAMINDABA, and the metallogenic map and explanation have been completed and are being prepared for printing.

Conclusions

Precise documentation of South Africa's mineral occurrences plays an invaluable and indispensable role in the development of the country's natural mineral resources. The East Rand sheet area includes part of the Central Rand gold field, as well as the East Rand and Evander gold fields, which form part of the world's largest known gold repository. Although most of the shallow gold deposits have been worked out in the 119 years since the first discovery, there nevertheless remain significant deep — 2,5 to 5 km — gold resources that could be developed in the future.

The bulk of South Africa's coal production is located in this area and, as reserves become

Rietspruit Quarry.

depleted, further exploration needs to be conducted to locate new resources.

The Metallogenic Mapping Programme was initiated to promote mineral development by facilitating exploration, and will continue to serve to do so as a vital component of the CGS's mandate.

Future activities

All previously unrecorded mineral occurrences discovered in the East Rand sheet area will be captured on SAMINDABA and made available to the public on request.

DATABASES

0166 SAMINDABA (SOUTH AFRICAN MINERAL DEPOSITS DATABASE)

Project leader: C.J. Vorster, M.Sc.

Objective: to capture and manage information on mines, mineral deposits and occurrences in South Africa, and to disseminate this information to the public.

Duration: Ongoing.

SAMINDABA has been in operation since 1985, and is an ongoing project in its 19th year.

Budget: 2004/2005: R387 294.

Motivation

SAMINDABA is a strategic database of South African mineral deposits, occurrences and mines for the use of role players in the minerals industry. SAMINDABA is also used in the compilation of metallogenic maps, which are designed to facilitate mineral reconnaissance exploration by assisting with ore-deposit modelling and target identification, and to stimulate investment in the mining industry in general.

Progress

During the year, SAMINDABA-derived mineral maps, with simplified geological backgrounds, were compiled for the Sekhukhune, Eastern Municipality, North East, Ugu, Umzinyathi and Central Karoo areas. These maps represent integrated rural development-node mineral maps for selected districts or municipal areas. In addition, SAMINDABA was used to provide mineral-deposit information for both 1:50 000-scale geological and construction maps and 1:250 000-scale metallogenic maps. In the process 878 new database records were captured, 570 were updated and 550 checked, providing information for both internal and external enquiries on South Africa's mineral deposits, as well as for maps and other products. There are now 16 584 records in the database.

SAMINDABA is being used in the compilation of the first Industrial Minerals Map of South Africa on a scale of 1:1 000 000, as well as in the study of the "Alluvial Diamond Gravels of the North West Province" (project 0783). The webpage for SAMINDABA has been further updated and enhanced to increase the general awareness and usage of the database by illustrating the functions, services and products available. SAMINDABA also participated in the Deep Space Array-Based Network (DSAN investigation): a report on the mineral economic potential for possible sites was compiled, as well as a mineral map.

Conclusions

SAMINDABA continues to play an important and strategic role in the study of mineral deposits of South Africa and in stimulating further investment in the minerals industry.

Future activities

SAMINDABA will be accessed by the Geodata Portal, a facility that will provide the interface required to make the Council's various databases accessible to the public.

SAMINDABA will become part of the National Mining Promotion System. The system, which is primarily designed to administer mining and prospecting licences in terms of the new Minerals and Petroleum Resources Development Act, forms part of the overall National Mining Promotion System of the Department of Minerals and Energy.

0167 SOUTH AFRICAN COAL DATABASE

Project leader: M.M. Schalekamp.

Project team: N. McIlrae, M. Solomon, P. Brummelkamp.

Objective: to prepare, capture and manage information on coal deposits derived from borehole core logs, and to make this information accessible to a wide range of stakeholders.

Duration: Ongoing.

Budget: Included in unit overheads.

Motivation

The CGS maintains a coal database in terms of current legislation. In addition, the database is interfaced with systems allowing easy access to users.

This facility enables a centralised point of collection for most of the data available on coal deposits of South Africa. The user interfaces allow the information to be disseminated in various formats, enabling further research work on South African coal deposits, as well as facilitating planning for the optimal use of the country's coal resources and land management.

Progress

During the year 679 logs were prepared, 837 header details were coded and captured, 12 231 lithologies for 496 boreholes were captured, 6 554 logs with 26 2415 lithologies were electronically converted and added to the database. The coal database now lists 100 553 boreholes with 2 594 555 lithologies and 1 409 749 analyses.

Conclusions

The coal database forms part of the corporate database of the CGS, GEODE. It is strategically important as it enables further research into the geology of coal deposits in Southern Africa.

Future activities

The coal database will be accessed by the planned Geodata Portal, which will make GEODE data accessible to users outside the CGS's headquarters.

0168 COREDATA DATABASE

Project leader: M.M. Schalekamp.

Project team: M. Solomon, N. McIlrae, P. Brummelkamp.

Objective: to archive geological information from borehole core logs.

Duration: Ongoing.

Motivation

The CGS maintains a database of borehole core logs in terms of current legislation. In addition, the database is interfaced with systems which allow easy access to users.

Progress

For the current reporting year 347 logs were prepared for capture into the database, while 425 headers were coded and captured; 3 285 lithologies were captured from 421 borehole core logs. COREDATA now contains 84 684 records.

Conclusions

The borehole core database is one of the modules of the corporate database of the CGS, GEODE. It is of strategic importance as it plays an important role in enabling research work on the geology of South Africa and it facilitates planning for the optimal use of the country's mineral resources.

Future activities

Future exploration and engineering-geology drilling will increase the amount of information contained in this database.

0133 INTERNATIONAL METALLOGENIC MAP OF AFRICA 1:5 000 000 — DATABASE MAINTENANCE

Project leader: S. Frost-Killian, M.Sc.

Project team: W.R. Oosterhuis, B.Sc.Hons.

Objectives: to (i) improve existing knowledge of mineral deposits of the SADC and NEPAD by updating the database, (ii) improve the reliability of the data by verification and editing, (iii) contribute towards capacity building and improving

knowledge of genetic models of ores in Africa, and (iv) contribute information to other projects.

Duration: Ongoing.

Budget: 2004/2005: R 3 645 (excluding manpower).

Motivation

The Africa Minerals Database was designed as part of the compilation of the International Metallogenic Map of Africa on a scale of 1:5 000 000. In view of the thrust directions of the CGS and the use of the data for a variety of current and future projects, it is important that the data be up-to-date and relevant. This is particularly important for the innovative manipulation and interrogation of the data in the production of a variety of products including exploration-target maps, as well as the advancement of our knowledge of the genesis of mineral deposits.

Progress

The 1:5 000 000-scale International Metallogenic Map of Africa was published by the CGS in June 2002 under the auspices of the CGMW with support from UNESCO. The ß-version of the digital International Metallogenic Map of Africa was released in 2003. Continuous updates have been made to the format of the digital product and comments have been received from current users. Sales of the digital data have been continuous through the 2003/2004 project year. The map and associated digital data have been used for the production of both country-specific and more regionally derived maps and reports. Clients include the large mining houses, mining juniors, consulting companies, other science councils, university libraries, and import-export companies. Many of the current clients are from the USA, Canada and Australia.

Published copies of the 1:5 000 000-scale International Metallogenic Map of Africa, as well as the digital mineral-deposit data set for each country, were sent to the Geological Surveys or equivalent institutions of most of the countries in Africa and the Middle East that were involved, in fulfilment of an obligation made by the CGS when it commenced compilation of the map in 1994, and to thank the various institutions which, through excellent cooperation, made the map possible. An effort has been made to establish contacts with the Geological Surveys of the various African countries in an effort to establish an Africa-wide network of professionals who are in a position to assist potential mineral investors.

Maintenance and updating of the database have continued, and at least 1 500 deposit entries have been updated, with ownership and ore-reserve information added where possible. A further 180 deposits, occurrences and targets have been added to the database — a reflection of the growing trend in successful exploration on the African continent.

Assistance was given to various units within the CGS for various projects currently in progress or in preparation for researchers throughout Africa.

In partnership with Mining Review Africa and other sponsors, an A1-sized 1:15 000 000-scale map of the most important mineral deposits and occurrences in Africa has been produced, and will be published in Mining Review Africa.

Conclusions

The release of the digital data set has generated interest within the mining community at large. It is hoped that the publication of the map and digital data set will serve to promote interest and investment in the mineral industries of Africa.

Future activity

The maintenance of the African Minerals Database is seen as an ongoing task. It is hoped that the database will be further improved, updated and expanded within the next project year.

11 MARINE GEOSCIENCES UNIT

STRATEGIC HARBOUR-APPROACH SURVEYS

0680 MARINE GEOLOGY AROUND ROBBEN ISLAND

Project leaders: P. van den Bossche, B.Sc.Hons., S.K.P. Coles, B.Sc.Hons.

Project team: W. Kupido.

Objectives: to provide a geophysical map to investigate the sea-floor geology around Robben Island.

Duration: 2001/2002–2005/2006.

Budget: 2004/2005: R71 910.

Motivation

This project will complement the sea-floor mapping programme undertaken by the Marine Geoscience Unit, and is aligned with the geoscience mapping thrust of the CGS. The mapping of the sea floor around Robben Island has already attracted the interest of organisations such as the NPA (National Ports Authority), CSIR, SAHRA (South African Heritage and Resources Agency), IZIKO Museums, MCM (Marine and Coastal Management — formerly Sea Fisheries Research Institute), and also the Robben Island Museum (RIM), which provides a wide variety of information to the South African public and tourists alike.

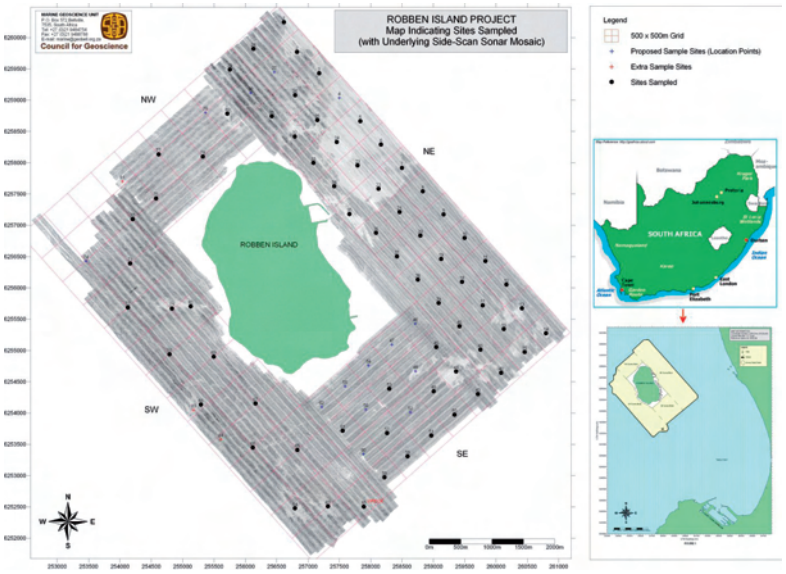
The addition of geological knowledge of the sea floor surrounding Robben Island is considered likely to provide valuable, stimulating and interesting information of importance to the museum. Although much of the island is well documented, little is known of the surrounding sea floor, as no detailed geophysical surveys have been conducted there. Since the island is a recognised World Heritage site, there is further significance in providing information pertaining to the local sea-floor geology.

Progress

Overall progress on the Robben Island project has been slow. Progress has, however, been made on the sediment-sample analyses aspect of the project (specifically sediment grain-size distribution, carbonate content, mud fraction, wet/dry bulk density and specific gravity), the findings of which have been documented, as well as the production of a poster detailing the geophysical results. This has added to the data already processed for this project, which now include the geophysical data (side-scan sonar, bathymetry and shallow-penetration seismics) and sediment-sample analyses. Rock samples from the survey still require thin-section analysis for determination of lithology and, potentially, their age.

Conclusions

A total of 52 sediment samples were analysed for sediment grain-size distribution, carbonate content, mud fraction, wet and dry bulk density, and specific gravity. Rock samples still require thin-section analysis for the



Robben Island survey/sampling area.

Sediment sample analysis preparation.

determination of lithology and age. The sediment grain-size distribution varies from fine to coarse (typically consisting of a quartz- and bioclast-rich assemblage), with certain areas consisting of conglomeratic sediment (pebble-to-cobble size).

Although a bulletin on the results of the project was planned for this report year, this was postponed and will probably be linked with an intended M.Sc. programme for one of the project researchers (P. van den Bossche), beginning in October 2005. This would result in the expected completion of the M.Sc. and Bulletin in 2006/2007. Although the overall progress on this project has been slow, the coupling of the project with the M.Sc. programme will allow more time to be dedicated to this project.

Future activities

Rock samples will be submitted for thin-section analysis. Final interpretation and assimilation of the geophysical, ground-truthed and laboratory data results will be conducted as part of the M.Sc. thesis, and in order to produce a final report and bulletin, and a GIS-based product outlining the surficial sea-floor geology around Robben Island.

0753 STRATEGIC HARBOUR-APPROACH SURVEYS — GEOPHYSICAL SURVEY OF THE APPROACHES TO SALDANHA BAY HARBOUR (ON BEHALF OF THE INSTITUTE FOR MARITIME TECHNOLOGY AND SOUTH AFRICAN NAVY)

Project leader(s): S.K.P. Coles, B.Sc.Hons., P. van den Bossche, B.Sc.Hons.

Project team: D. Murrell, B.Sc.Hons., Z. Madotyeni, B.Sc. Hons., W. Kupido.

Objectives: to map the sea floor for the strategic Naval defence of South African commercial harbours.

Duration: 2001 to date and ongoing.

Budget: 2004/2005: R112 737.

Motivation

Historically harbour approaches have been, and remain, strategic areas in a country's national defence programme, especially with respect to harbour security. For this purpose, detailed information on the local oceanography, sea-floor and subsea-floor geology, as well as bathymetry, is required for defence research purposes conducted by the Institute for Maritime Technology, on behalf of the SA Navy. This research is important for safe naval manoeuvres, mine detection and strategic mine countermeasures. This ultimately ensures the continuation of safe commercial shipping traffic in and out of South Africa's harbours, which contributes significantly to South Africa's GDP.

Progress

In fulfilment of the primary sea-floor mapping objective, high-resolution side-scan sonar, seismic and bathymetric data were acquired in the approaches to Saldanha Bay Harbour during

IMT's survey vessel "Sea Lab 1". Junior scientist operating side-scan sonar system.

October 2004. The data were subsequently processed, interpreted, mapped and reported. The final product was provided to IMT/SA Navy.

The project was also used as a training and capacity-building opportunity for a junior member of the Marine Geoscience Unit, as well as for one of IMT's cadet students.

Additional sea-floor mapping was also conducted at the request of IMT/SA Navy during 2004/2005, which included a detailed side-scan sonar survey of a small area within Saldanha Bay in order to map seabed-mounted monitoring equipment, and a detailed side-scan sonar survey of a small area in Table Bay to locate a target for the SA Navy.

As part of this programme the performance and suitability of a multibeam (swath) bathymetry system for use in nearshore surveying was also undertaken. Owing to the technical nature of this assessment, it has been treated independently from the primary Saldanha approach survey. The evaluation was based on the mapping of two sea-floor areas within Saldanha Bay, using a RESON 8125 multibeam system, which was mounted on a 6,5 m survey vessel (ski-boat).

A side-scan sonar mosaic, bathymetric contour map and sediment isopach (thickness) map of the study area, were compiled as a result of the marine geophysical survey.

Results of the performance and suitability of a swath bathymetry system for use in nearshore surveying, indicated that the system is complex in its overall setup, requires a stable platform from which to perform at its best, and can often be time consuming with regard to data processing. The equipment also occupies a significant amount of valuable space on a small vessel, and therefore restricts the installation and use of additional marine-geophysical equipment at the same time. The data acquired by this system, however, surpass that of any conventional echo-sounder system, both in resolution and data sounding density, and also provide the most detailed and complete image of the sea floor in terms of bathymetry. Latest advances in this method allow for "pseudo-side-scan sonar" data acquisition, but this methodology requires additional evaluation. Finally, although the system is relatively expensive in terms of purchase and rental, many clients now favour its use over conventional, single-beam echo-sounders and are demanding it in their terms of reference for contracts.

Conclusions

The Strategic Harbour Approach Survey progressed very well, and exceeded the initial sea-floor mapping product target for 2004/2005, with additional sea-floor mapping undertaken for IMT/SA Navy. The project further served as a capacity-building platform for staff of both the CGS's Marine Geoscience Unit and the Institute for Maritime Technology.

Evaluation of a multibeam (swath) bathymetry system for nearshore surveying concluded that this bathymetric surveying methodology is not suited to all small survey craft, primarily because of vessel stability and space limitations. Provided that the system is used aboard a suitable small-craft platform (such as a catamaran hull design), it would serve very well for nearshore surveying applications.

Future activities

In order to provide the SA Navy with up-to-date geophysical sea-floor information, the programme is likely to continue in following years, with additional sea-floor investigations to be conducted in the approaches to South Africa's primary commercial harbours.

MARINE SURVEY TECHNOLOGIES

0460 MARINE SURVEY TECHNOLOGIES — EVALUATION OF EXISTING MARINE GEOPHYSICAL SUITE

Project Leaders: P. van den Bossche, B.Sc. Hons., C. Bosman, B.Sc.Hons.

Project team: R. Leuci, B.Sc.Hons., D. Murrell, B.Sc.Hons., Z. Madotyeni, B.Sc.Hons.

Objectives: to develop and evaluate marine geophysical systems and software.

Duration: ongoing.

Budget: 2004/2005: R80 439.

Motivation

This ongoing project provides continued research and evaluation of, as well as modifications to, the marine geophysical acquisition and

The MGU's new Octopus 760D seismic acquisition system.

postprocessing systems and software of the Marine Geoscience Unit, allowing the MGU to keep up with marine technology developments, and to ensure that the CGS maintains a competitive position in the marine survey industry.

Progress

The most significant advances in the marine surveying systems reviewed were observed in multibeam echo-sounder technology (swath bathymetry systems). These systems have begun to dominate the modern survey industry and in many instances are replacing conventional, single-beam echo-sounders. After reviewing many of the current geophysical systems on the market, it became clear that the CGS's marine geophysical equipment is becoming technologically outdated, particularly with respect to its side-scan sonar and shallow penetration seismic systems. In order to remain competitive in the field, this situation was highlighted for attention. In addition to this, an urgent need for the MGU to offer multibeam echo-sounder services was identified. Subsequent to the equipment review, the CGS purchased an upgraded seismic acquisition system (Octopus 760D), and also commissioned the trial of a RESON 8125 multibeam system as part of project 0753 (Strategic Harbour Approach Surveys). Attention is now being focussed on upgrading the increasingly outdated side-scan sonar systems operated by the MGU.

The MGU's side-scan sonar processing software was upgraded during the year to provide a single, primary processing module. The aim of this was to consolidate and simplify the various software modules used previously for processing, and to therefore allow for greater control of version upgrades. In addition to this, the upgrade included support of multiple sonar data-acquisition formats, as well as support for multiple-region data acquisition.

Conclusions

This programme proved most successful during 2004/2005. A shallow-penetration seismic acquisition system was purchased, a multibeam system was tested, and an upgraded side-scan sonar-processing software suite was introduced. An evaluation of the marine survey equipment highlighted instrumentation that required urgent attention in terms of age and technological level such as the side-scan sonar system.

Future activities

The unit will continue to assess new marine geophysical surveying technology as it becomes available, as well as future requirements within the MGU.

0462 THE MARINE GEOLOGY OF THE DURBAN BIGHT

Project leaders: A. Richardson, B.Sc. Hons., R. Leuci, B.Sc.Hons., C. Bosman, B.Sc.Hons.

Project team: P. Young, Nat.H.Dip. Elec. Eng., W. Kidwell.

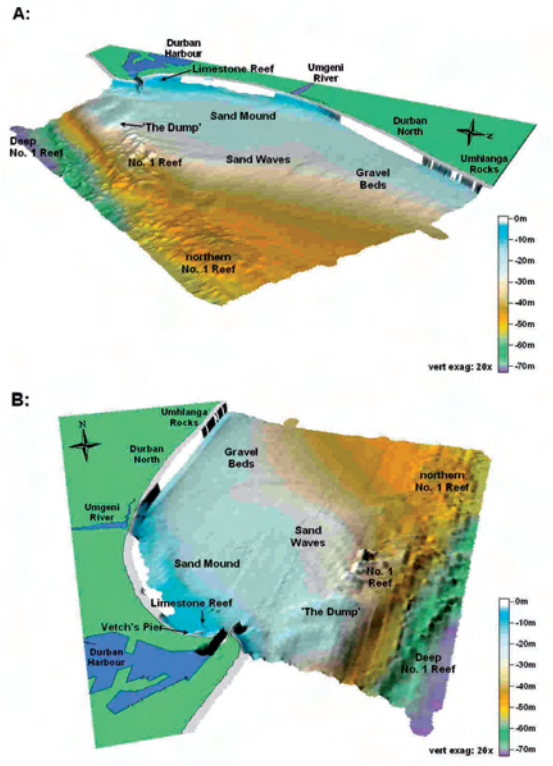
Objectives: to describe and interpret the dominant sedimentary features occurring and processes operating within the Durban Bight in order to understand the complex geological and oceanographic dynamics of the survey area in terms of the regional Quaternary geological evolution of the KwaZulu-Natal continental shelf.

Duration: 2003/2004–2004/2005.

Budget: 2004/2005: R157 742.

Motivation

Very little was known about the Durban Bight sea floor prior to the start of this project, de-



Digital terrain model of Durban Bight.

spite its importance as an outer anchorage for Durban Harbour and its forming the floor of both harbour approach routes. The study area is also a popular recreational area for fishermen, SCUBA divers, kayakers and yachtsmen. This represents the first detailed study of the Durban Bight and will greatly assist the understanding of regional geological and oceanographic processes operating off the KwaZulu-Natal coastline.

Progress

The geophysical data set was processed, and various geophysical maps produced. Interpretation of the geophysical data set allowed for a detailed sediment-sampling programme (including SCUBA diving and ship-based grab sampling) to be conducted. Selected reef samples were extracted for further petrographic and geochronological studies. Detailed laboratory analyses and petrographic descriptions were performed on all samples.

All the geophysical and sedimentological data were analysed, allowing for detailed interpretations of the various sedimentological and oceanographic processes within the bight (figure). A detailed review of previous geological work conducted within the area has also been compiled to allow comparison with the results of this project. Anthropogenic influences or modifications have also been analysed.

Conclusions

The reef systems within the survey area are remnant palaeodune cordons that developed during a period of lower sea levels during the Pleistocene Epoch. Subsequent sea-level still-stands have been etched into the reef outcrop and preserved as terraces. Sediment dispersal within the Durban Bight indicates complex oceanographic currents operating within the bight. Anthropogenic influences on the near-shore sea-floor environment are minimal in comparison with natural oceanographic and sedimentological processes operating.

Future activities

Future work proposed for the Durban Bight project includes "Boomer" seismic profiling and detailed SCUBA diving investigation, and petrographic analysis of No. 1 Reef.

0463 MARITIME WRECK SURVEYS

Project leaders: P. van den Bossche, B.Sc. Hons., S. Coles, B.Sc.Hons.

Project team: D. Murrell, B.Sc.Hons., Z. Madotyeni, B.Sc. Hons., W. Kupido.

Objectives: to conduct archaeological preservation shipwreck surveys on the Cape Peninsula shipwreck route, or in the greater Cape coastal area, on behalf of SA Heritage Resources Agency (SAHRA) and/or South African Maritime Museum/IZIKO Museums.

Duration: ongoing.

Budget: 2004/2005: R21 059.

Motivation

Assistance is rendered to SAHRA (South African Heritage Resources Agency) and IZIKO Museums in the form of surveys of selected archaeologically important and sensitive wrecks along the Western Cape coastline. Such geophysical surveys aid in the mapping of wreck sites, and enable the sites to be positively identified, and will ultimately lead to their archaeological protection and preservation.

SeaSPY magnetometer used during "Meermin" Survey.

Progress

A marine magnetometer search for the wreck of the "Meermin", a Dutch East India Company slave ship believed to have been wrecked in Struisbaai in 1766, was undertaken in May 2004. The magnetometer and bathymetric data were processed subsequent to the survey, and a report was submitted to Mr Jaco Boshoff of IZIKO Museums.

Additional shipwreck-related investigations were undertaken during 2004/2005, including a side-scan sonar survey of wrecks in Simon's Bay (near Simon's Town) and a magnetometer susceptibility test, using actual shipwreck artefacts buried in a beach.

In the search for the "Meermin", a 0,99 km^2 (or 3 600 m long by 275 m wide) area of sea floor was mapped using a marine magnetometer, but no obvious magnetic anomalies attributable to the shipwreck were observed in the area. Unfortunately, owing to the high wave energy in close proximity to the shore, the survey could not extend closer inshore than 200 m from the beach.

High-resolution side-scan sonar imagery of the wreck of the "Clan Stuart", and what is believed to be the wreck of the "Brunswick", were acquired.

Conclusions

Although the wreck of the "Meermin" was not located using the marine magnetometer in this initial survey, the shipwreck programme for 2004/2005 was a success, as it has provided valuable information to the archaeological researchers involved in this project.

Future activities

Additional surveys are planned in the search for the "Meermin", especially because of its historic importance for South African archaeological research.

The wreck programme will continue on an annual basis, in order to conduct searches and surveys on behalf of the institutions promoting the preservation of shipwrecks on the Cape Peninsula shipwreck route, and in the greater Cape coastal area.

0612 MARINE GEOLOGY OF THE ALIWAL SHOAL

Project leaders: C. Bosman, B.Sc.Hons.

Project team: R. Leuci, B.Sc.Hons., P. Young, Nat.H.Dip. Elec. Eng., W. Kidwell.

Objectives: to undertake a geological and geophysical study of the continental shelf in the vicinity of the Aliwal Shoal.

Duration: 2002/2003–2005/2006.

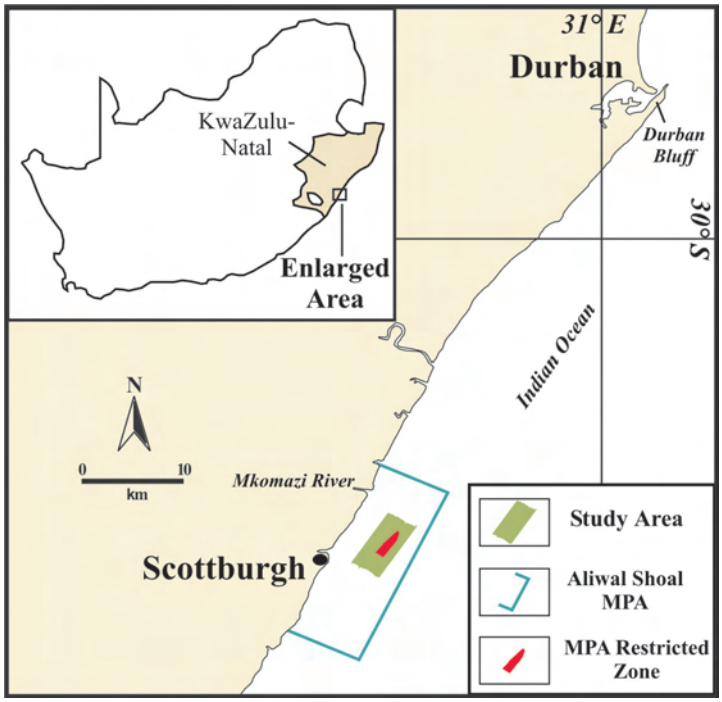
Budget: 2004/2005: R228 901.

Motivation

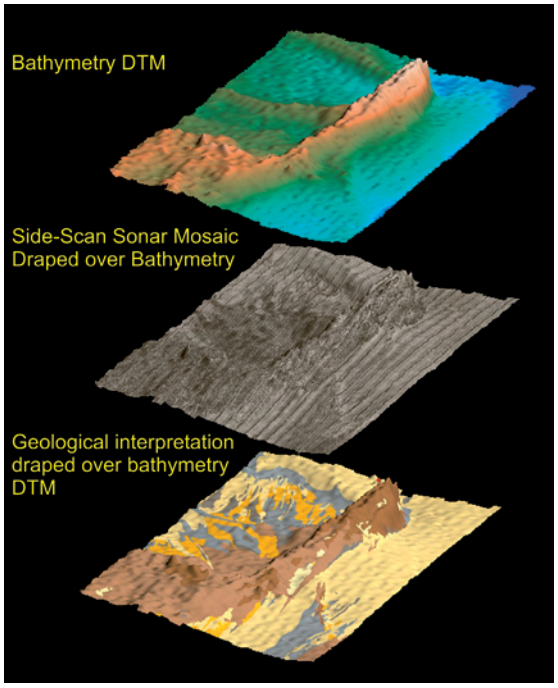
This is the first detailed investigation of the Late Quaternary evolution of the continental shelf in the vicinity of the Aliwal Shoal. The research area is 19 km^2 in extent and located off Scottburgh (see figure). After Sodwana Bay, the Aliwal Shoal is the best known and most popular SCUBA-diving destination in South Africa. Sea-floor maps produced by this study provide detailed information on the nature of the sea floor and enable the authorities to accurately delineate the boundaries of the "Restricted Zone" of the newly proposed Marine Protected Area (MPA) around the reef complex. This is critical to any MPA as it forms the baseline data set on which other data types (biology, ecology, oceanography) can be modelled. The integration of all the data sets will facilitate the development of an environmental management plan which is vital for the sustainable development of this natural resource.

Progress

Three geophysical techniques were employed to survey the sea floor — echo-sounding, side-scan sonar and boomer seismic profiling — which



Locality of the study area showing the survey area and the Restricted Zone of the MPA.



Multilayer, multivariable modelling of the geophysical data set.

resulted in the collection of 498 line-kilometres of geophysical data. A comprehensive SCUBA-diving programme has been completed to ground truth the remotely-sensed data and to sample the various acoustic facies identified. To date, 70 rock samples, 51 sediment samples and 10 dating samples have been collected from the continental shelf. Petrographical and sedimentological analyses are almost complete. Geochronological analyses of the sea-floor samples are currently in progress at the laboratories of the Open University Uranium Series Facility in the United Kingdom and at Quadru in Pretoria.

Conclusions

Collection of different types of geophysical data sets was central to the project, as it provided a baseline or framework on which other data types could be plotted and modelled. Geophysical data are spatially referenced to a high degree of accuracy, allowing for different data types to be related in the same coordinate space (figure). Geophysics, combined with sample analyses, revealed that the Aliwal Shoal forms part of an extensive submerged shallow, coast-parallel palaeodune complex representing Late Pleistocene palaeocoastline events. The Aliwal Shoal is morphologically very similar to the Durban Bluff, a fact illustrating their common origin as carbonate-cemented aeolianite beachrock systems. The Aliwal Shoal thus originated as a coastal dune which underwent lithification approximately 60 000 years ago during a sea-level low, approximately 30–40 m lower than at present. The lowering of the sea level was a direct result of a change in global climates to the glacial conditions of the Last Glacial period (Oxygen Isotope Stage 2) which peaked 18 000 years ago as the Last Glacial Maximum (LGM), with sea level regressing to 120 m lower than at present. A rapid rise in sea level to its present level consequently drowned the Aliwal Shoal. This sea-level transgression superimposed younger coastal facies onto the pre-existing aeolianite/beachrock units during several sea-level stillstands approximately 8 000 to 10 000 years ago.

Future activities

The geochronological results will be used to further constrain the sea-level curve for the south-east African continental margin. Integration of boomer seismic data for the survey area will assist in interpreting the stratigraphy and evolution of the continental shelf in the vicinity of the Aliwal Shoal.

0867 AFRICAN CONTINENTAL SHELF (EEZ)

Project leader: S.K.P. Coles, B.Sc.Hons.

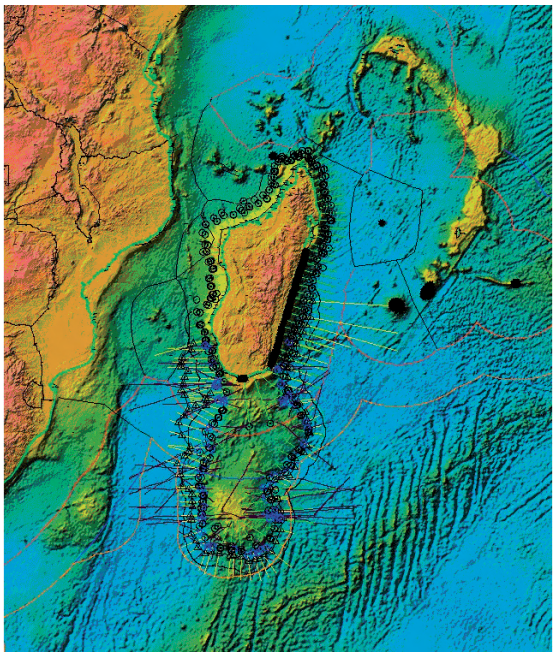
Project team: A.S. Faull, B.Sc.Hons., Z. Madotyeni, B.Sc.Hons.

Objectives: to raise the awareness in coastal African nations of this once-off chance to extend their 200-nautical-mile Exclusive Economic Zone (EEZ), in the interest of present and future generations, and to offer assistance to African coastal states that are considering submitting shelf claims.

Duration: 2004/2005–2006/2007.

Budget: ~R5 m per annum.

Motivation



Initial results of the preliminary assessment of Madagascar using the CarisLOTS shelf claim-dedicated software. The backdrop image is the public domain data ETOPO 2 bathymetric grid. There are indications that a claim to the south of the island is possible, if "natural prolongation" of the submarine ridge can be proven.

Representatives from Senegal and the CGS have been mandated by the African Mining Partnership (AMP) to initiate the African Continental Shelf EEZ project, in alignment with the South African Government's broader NEPAD initiative and the United Nations Convention on Law of the Sea (UNCLOS) 1982, Article 76.

Progress

A proposed scope of work and budget for the remainder of the year, accepted by the CGS, was sent to Senegal in September, and supporting verification was received on 4 November. In response, the Marine Geoscience Unit proceeded with the following:

Workshop: 25 invitations were sent by the CGS to African countries. The initial response to the invitations was very slow. A draft workshop schedule (14–18 March) has been drawn up, the venue has been finalised and a workshop facilitator has been requested.

The CarisLOTS assessment for Senegal's potential claim needs to be reviewed, as time constraints precluded the inclusion of the GEODAS public-domain data set in a previous brief assessment.

Conclusions

The overall project completion is estimated at ~21 per cent. It is envisaged that a successful workshop will lead to a greater understanding of the issues around shelf claims in an African context, and will empower delegates with the necessary information and knowledge exchange.

Future activities

The MGU will continue to conduct preliminary, software and public-domain data-based assessments for a number of African coastal states over the next year. The results will be presented in a complete and extensive shelf claim-dedicated information pack.

As assessments conducted previously for 13 African coastal states excluded the GEODAS ship tracks, these will need to be reviewed to incorporate this important public-domain data set. It is also envisaged that the working group — which is proposed to be established at the workshop — will provide a practical and useful locus for the provision of relevant services to states accessing it, in terms of advice, assistance, consultancy and other services, and will facilitate effective networking opportunities.

0885 ENVIRONMENTAL MAPPING OF DURBAN HARBOUR

Project leader: R. Leuci, B.Sc.Hons.

Project team: C. Bosman, B.Sc.Hons., P. Young, W. Kidwell.

Objectives: to map the physical and geochemical status of the Durban Harbour.

Duration: 2004/2005.

Budget: R334 391.

Motivation

Heavy-metal contamination within aquatic systems has received much attention over the past few decades, especially with respect to toxicity levels. Estuaries, harbours and nearshore marine environments are particularly prone to heavy-metal enrichment as they receive various anthropogenic and natural inputs. Mapping the physical and geochemical nature of Durban Harbour will aid in highlighting the degree of heavy-metal pollution within the harbour, the sources of the contaminants, as well as any physical, chemical and biological factors influencing pollution patterns. An advantage of analysing sediments is that they record a contaminant's enrichment history and help locate sources of pollution.

Progress

High-resolution bathymetric data were acquired within the Durban Yacht Basin, and an intensive sediment sampling programme was designed using the bathymetric map produced. A total of 104 sediment samples were collected by SCUBA divers. The samples were analysed for grain size, and preliminary geochemical analyses have been carried out on several of these samples.

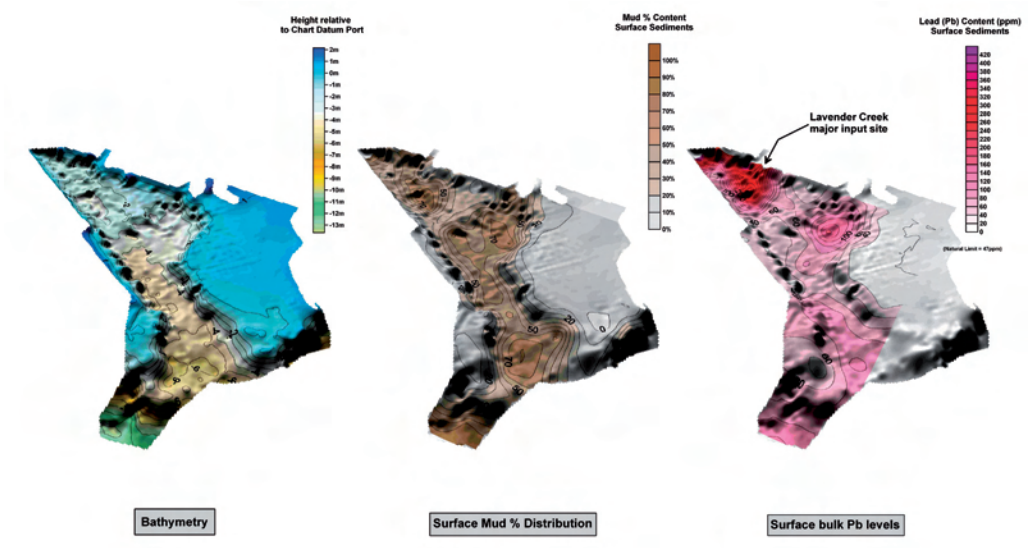
Sedimentological and geochemical data were integrated with the bathymetry to produce a series of three-dimensional maps of the sediment and heavy-metal distributions within the Durban Yacht Basin.

Conclusions

A significant relationship exists between the morphology of the Durban Harbour Yacht Basin and the sediment grain-size distribution within the basin. These parameters influence the contamination patterns within the Yacht Basin. In addition, local input sources have been identified.

Future activities

Bathymetric data collection and sediment sampling will be continued throughout the rest of the Durban Harbour, in order to produce a series of sedimentological and geochemical maps for the entire harbour.



Digital terrain models of the Durban Yacht Basin showing the relationship between basin morphology, sediment grain-size distribution and heavy-metal contamination distribution.

12 ENGINEERING GEOSCIENCES UNIT

Clanwilliam Dam in the Western Cape. Engineering geological investigations, which included the drilling of a number of boreholes, have been conducted to confirm founding conditions.

5420 PROJECTS FOR THE DEPARTMENT OF WATER AFFAIRS AND FORESTRY

Project leader: G.N. Davis, B.Sc.Hons., G.D.E.

Project team: T. Mogadime, B.Sc.Hons., N. Mpateni, B.Sc.Hons., G. Heath, B.Sc.Hons.

Objectives: to provide engineering geological services to the Department of Water Affairs and Forestry.

The Engineering Geosciences Unit has a very close working relationship with the Department

of Water Affairs and Forestry, as well as with consultants appointed by that Department, and provides the engineering geological expertise required for the development of the country's surface water resources.

Personnel of the Unit were involved in a number of water schemes under construction, including the Nandoni Dam near Thohoyondou and the raising of Flag Boshielo Dam near Marble Hall, both in Limpopo Province, as well as improvements to the Bulshoek Dam on the Olifants River, the Misverstand Weir and the Berg Water Project, all in the Western Cape.

New schemes investigated in the period under review include the proposed De Hoop Dam located near Steelpoort, and the proposed Rooipoort dam site near Mafef. Engineering geological investigations are also underway for the proposed raising of the Clanwilliam Dam in the Western Cape.

The main focus during the year has been the engineering geological investigation of existing dams, part of the ongoing dam safety inspection programme in which state-controlled dams across the country are assessed.

The following dams were appraised:

North West Province: Bospoort, Roodekopjes, Vaalkop, Lindleyspoort, Boskop and Lakeside Dams
Mpumalanga: Bronkhorstspruit, Tzaneen, Heyshope, Jericho and Westoe Dams
Western Cape: Clanwilliam, Voëlvlei, Kogelberg, Rockview, Greater Brandvlei, Elandkloof, Duivenhoks and Oukloof Dams
Eastern Cape: Kommandodrift, Sandile, Cata, Rooikrantz, Xonxa, Waterdown, Bushman's Krantz, Oxkraal, Ncora and Mtata Dams
KwaZulu-Natal: Inanda, Hazelmere, Ntshingwayo and Klipfontein Dams
Free State: Knellpoort, Vaal and Armenia Dams.

0685 EAST RAND DOLOMITE HAZARD SUSCEPTIBILITY MAP

Project Leader: C. Forbes, B.Sc.Hons.

Objectives: to prepare a 1:250 000-scale map portraying five hazard classes, with an explanation.

Duration: 2001/2002–2004/2005, for data collection.

Budget: 2004/05: R575.

Motivation

Late in 1998 the then director, C. Frick, mooted the idea of a regional dolomite-risk map, a product which had not yet been attempted in South Africa; with the availability of GIS technology and improved data coverage, it was considered appropriate to research and develop this map. A better understanding of inherent instability and its formation had the potential to provide planners with a guiding tool towards safer urban development.

Progress

The East Rand region, covered by sheets 2628AA, AB, AC, AD, BA and BC, was selected as the focus area in 2001, after preliminary research and data collection over other dolomitic areas (namely Bakerville, Irene, Groblersdal [1999] and Springs [2000]).

Thin weathered remnants of Karoo sediments overlying residual recemented chert breccia of the Malmani Dolomite at Bapsfontein, Gauteng Province. The palaeo-breccia capping and younger sediment covering masks void development in the dolomite, which has manifested as sinkholes, in the immediate area.

Concentrated surface runoff from gravel roads has included a series of small to medium sinkholes. The latent instability is associated with a prominent northeast-trending magnetic dyke 350 m to the south, and obtuse-cutting lineaments. Carletonville and the heavily mined Gatsrand lie to the south, in the background.

The outstanding Karoo isopach layer was completed during December 2004 and incorporated into the weighted overlay process that is generated by ArcView GIS Model Builder software. Factors considered pivotal to karst area subsidence manifestation, and evaluated in this model, include lineaments, surface morphology (slopes — crests, side slopes, foot slopes, valley bottoms), groundwater depth, Karoo cover thickness, elevation, chert-breccia presence and soil type. Once established for the dolomitic areas, individual layers were converted to reclassed grids (20-m cell) with class values assigned according to a semiquantitative evaluation of hazard potential, as indicated by sinkhole incidence within each parameter considered.

Individual parameter weightings within the trial models run were based on published expert opinion as modified by the outcome of a histogram analysis of sinkhole incidence for individual layers. Subsequent iterative vertical integration of the parameter layers, with weighting adjustments and some class-range corrections, facilitated an examination of model sensitivity and general reliability as a predictive tool of dolomite-subsidence susceptibility.

A strong correlation between sinkhole occurrence and certain weighting combinations was found to exist, with an emphasis on elevation, slope class and land types. It is expected that refinements in the analysis will lead to revisions of this first version East Rand regional dolomite-hazard map.

Conclusions

This map adds to the CGS's achievements in recent years, in the field of applied dolomite research, and guidance to practitioners and local authorities.

Future activities

The map will be circulated throughout the dolomite investigative community and local authorities during 2005 in order to elicit comment and suggestions.

0851 1:50 000-SCALE GEOTECHNICAL MAPPING OF CARLETONVILLE 2627AD

Project Leader: C. Forbes, B.Sc.Hons.

Objectives: This project continues the ongoing systematic programme of regional geotechnical mapping instituted by the CGS in 1998, in which the spatial distribution of geotechnical problems and constraints on development are recorded and described. For year one of this project, commencing in August 2004, tasks included the collection of GIS data sets, site reconnaissance, trenching, soil sample testing and reporting.

Duration: 2004/2005–2005/2006.

Budget: R40 669.

Motivation

Carletonville and environs have experienced a long history of dolomite instability, accelerated since the early 1960s by intensive gold-mining dewatering and associated infrastructural developments. Coupled with this has been an exponential growth in the demand for low-cost housing and extensive growth of existing townships, such as Khutsong. Its unfavourable location on dolomite exhibiting unstable conditions has necessitated massive local government spending to repair and mitigate sinkhole damage over the last 20 years. A decision in

2002/2003 to relocate the entire township, with central government funding assistance, was accompanied by extensive and detailed studies by consultants of selected areas.

The current regional geotechnical mapping programme will incorporate all prior and recent studies in a GIS format, over the entire 2627AD sheet, establishing a baseline reference for town planners regarding the geohazards (sinkholes to problem soils) for areas underlain by both dolomite and other lithologies.

Progress

Various raw data sets and derivatives have been archived from purchases, or sourced in the Geoscience corporate database GEODE, or produced in Arc View GIS and include: geology (GEODE), slope (dem derived), aspect (dem derived), relief (dem derived), groundwater (Department of Water Affairs and Forestry), subsidences (ENGEODE reports and project fieldwork), soils (Binomial system — Institute for Soil, Climate and Water (ISCW)), terrain types (ISCW), exploration boreholes (GEODE), mineral occurrences (SAMINDABA), stability/geotechnical report boundaries (ENGEODE reports), aeromagnetic data (raw scans and interpreted lineaments). 1:10 000-scale orthophoto maps were scanned and georeferenced for use as a base map to aid local feature identification, while 1:30 000 panchromatic aerial photographs allowed interpretation of outcrops and subsidence identification.

Shallow "backactor" trenching was conducted at 64 sites in October and November to facilitate soil profiling and sampling. Thirty-nine disturbed samples were tested for foundation-indicator properties in January. A progress report was prepared which included all data sets collected in both hard copy and digital format, as well as a provisional engineering-geological map with explanation, and profiling and soil-testing results.

Conclusions

The data collection and analysis process has unravelled some dolomite-instability issues, while fieldwork results are still to be fully assessed.

Future activities

Year two of the project (2005/2006) will entail data integration and final map preparation according to current presentation format (namely unique polygons with all dominant and subordinate properties listed).

13 LABORATORY UNIT

ANALYTICAL CHEMISTRY

Staff: L.J. Jordaan, M.Sc., H. Maritz, B.Sc.Hons., M.T. Lehaha, B.Tech., F.A. Delport, B.Tech., R.M. Papo, M. Vuma, R.H. Sello.

An Inductively Coupled Plasma Mass Spectrometer with Dynamic Reaction Cell was installed and is now fully operational, and has proved to be extremely stable and capable of remarkably low detection limits. It excels in the analysis of water and has the capacity to suppress a significant amount of interference, a feature not present in previous models. Very low concentrations of Arsenic, Iron, Calcium and Selenium can easily be detected in samples when interference generated in the Argon plasma is suppressed. Similar suppression of interference is possible for many other elements when their concentrations have to be determined in complex matrices. The purchase of the new instrument has significantly increased the capabilities of the laboratory, and maximum production should be reached when the upgrading of the sample-preparation laboratories is completed.

PETROGRAPHY

Staff: F. Roelofse, B.Sc.Hons. (Geology), B.Sc.Hons. (Metallurgy), C. Joubert, B.Sc.Hons., S.D. Kgaditse, S.T. Monyayi, A. Dikgomo.

The section provides a petrographic sectioning service to both internal and external clients, as well as a wide range of petrographic analyses of a scientific nature, mainly to external clients, including mining companies, foreign geological surveys, civil engineers, clients from the secondary sector and small-scale miners. The section conducts work on a wide variety of natural and synthetic earth materials, including rocks, ores, soils, aggregates and glasses, for the benefit of clients and the economy as a whole. The section produced about 1 300 thin sections for internal use during the period under review.

X-RAY DIFFRACTION

Staff: M. Atanasova, M.Sc., T. Roelofse, B.Sc.Hons., K. Reddy, B.Sc.Hons.

The X-Ray Diffraction facility provides mineralogical evaluation and analysis on the whole spectrum of geological materials, as well as synthetic products. Routine phase analyses are performed on whole-rock powder and oriented clay preparation in reflection mode, while minute quantities of material are analysed in transmission mode using glass capillary tubes. Typical applications include qualitative phase identification and semiquantitative evaluation of XRD traces. Geological and geotechnical interpretation of mineralogical data is provided to assist clients in evaluation of the data.

One diffractometer is set in reflection mode and runs 24 hours a day, 7 days a week, for most of the year in order to accommodate the large inflow of work. This instrument is over 20 years old and is becoming costly to maintain. In the past year the 40-position sample changer failed to such an extent that it is beyond repair, as the manufacturer no longer holds spares, and a temporary changer was installed. The second X-ray diffractometer is set in transmission mode and uses capillary tubes, and is used to analyse environmental dust samples, other small-volume particulate matter samples, crystal structures and rare collector's specimens. It is 13 years old, in excellent condition and produces high-quality results.

About 2 023 samples were analysed for their mineral composition during the year.

SCANNING ELECTRON MICROSCOPY

Staff: M. Atanasova, M.Sc.

A scanning electron microscope equipped with an energy-dispersive analytical system enables the unit to exploit various types of imaging — secondary electron, electron backscatter, cathodoluminescence, X-Ray element mapping

and microanalyses. It allows users to analyse microscopic particles, and carry out automated image analysis, and is mainly used by researchers. In conjunction with other analytical techniques, SEM is a critical tool for solving problems concerning mineralogical, petrological and industrial applications.

X-RAY FLUORESCENCE SPECTROMETRY AND CRUSHER SECTIONS

Staff: H.C.C. Cloete, B.Sc.Hons., J. Friedland, B.Sc.Hons., K.I.G. Burger, M.E. Tsaagane, INTEC Dipl. (Analytical Chemistry), M.J. Matji, S.T. Mabena, M.J. Sejake.

The XRF-section continued to provide professional services to the CGS and the private sector despite difficulties presented by ageing instrumentation. It provided services involving major- and trace-element analyses of geological specimens with a value of about R361 000. About 3 000 samples were handled by the crusher and milling staff, and the value of the services amounted to about R47 000.

The Lithogeochemical Database Project involves the storage of samples from statutory projects and any relevant data, such as chemical composition, mineralogy and geophysical data. As the transfer of the samples to the Donkerhoek Storage Facility is not yet complete, the samples are currently stored in Silverton. During this financial year the structure of the database has been developed in-house and is being populated.

For analytical job-costing purposes an in-house software package LABLIMS was developed. During the year, the focus was on greater accessibility to the database to provide access to simultaneous users, greater user friendliness and improve report generation. The data now span two financial years, providing an excellent querying tool for unit management.

ELECTRON MICROPROBE

Staff: D. de Bruin, Ph.D., J.E. Walliser, B.Tech.

The electron probe is extensively used both for kimberlite exploration programmes and for the evaluation of the diamond-bearing potential of specific kimberlites, by examining the mineral chemistry of indicator minerals such as garnet, chromite, ilmenite and clinopyroxene. Pressure and temperature calculations based on electron probe analyses of clinopyroxenes show whether kimberlites have traversed the diamond stability field and could therefore be considered to be of economic value. Analyses are also provided for statutory research projects, including mapping projects in Polokwane and Mozambique, as well as research into the composition of garnets associated with alluvial diamond deposits.

RADIOGENIC ISOTOPE LABORATORY

Staff: H. Coetzee, M.Sc., M. Rademeyer, B.Tech., M.E. Nkosi.

The radiogenic isotope section of the Laboratory Unit started the 2004/5 year with a visit by a member of staff to the University of Texas in Dallas. Following this, a major software upgrade and hardware service was undertaken on the Finnigan MAT261 mass spectrometer, which has been used for the determination of the isotopic composition of lead and strontium isotopes in water and other samples, including hair samples of children from the West Rand. Geochronological support has also been provided to the team mapping in Mozambique.

RESEARCH PROJECTS

0860 THE ANALYSIS OF HEAVY MINERALS FROM ALLUVIAL DIAMOND DEPOSITS ON A REGIONAL SCALE

Project leader: D. de Bruin, Ph.D.

Project team: P. Wipplinger, M.Sc.

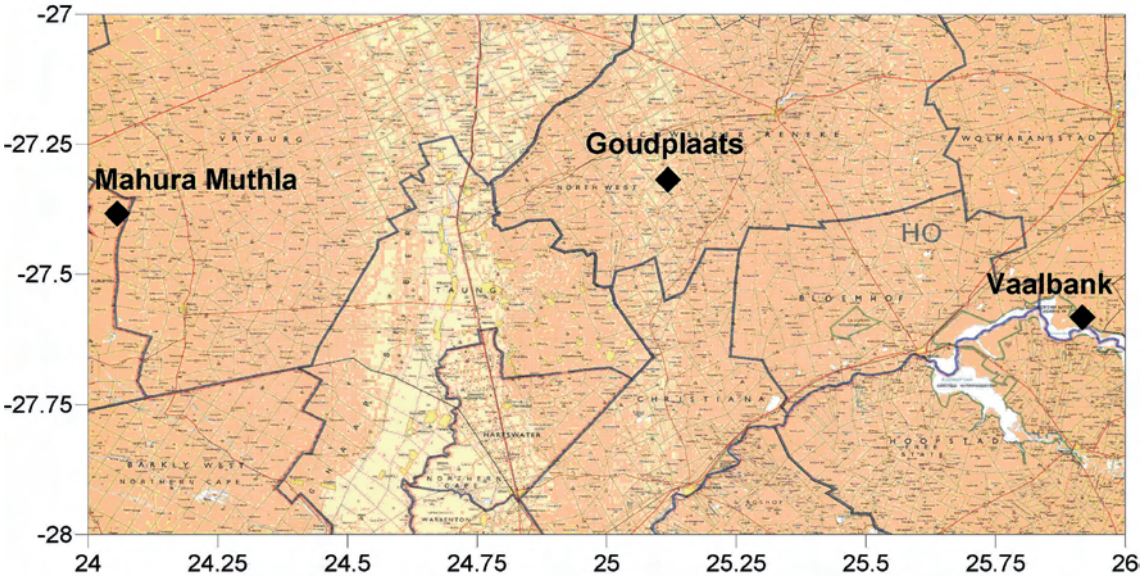
Objectives: to investigate the chemical composition of heavy minerals associated with alluvial diamonds.

Duration: 2004/2005–2006/2007.

Budget: R151 289.

Motivation

Very little is known about the primary source origins and subsequent distribution of alluvial diamond deposits which have been exploited from numerous localities within the Vaal and



Locality of the alluvial deposits Mahura Muthla, Goudplaats and Vaalbank on the 1:250 000-scale map 2724 Christiana.

Orange River systems. The mineral chemistry of heavy minerals, such as garnet and ilmenite, deposited with the alluvial diamonds, can be used to characterise their origin, which in turn can lead to a greater understanding of the source areas of the diamonds.

Progress

Garnet xenocrysts from alluvial deposits at Mahura Muthla, Goudplaats and Vaalbank were analysed. Those from Mahura Muthla are indicative of a diamond-bearing mantle-derived source. A harzburgite diamond source for the xenocrysts predominates and a subsidiary eclogitic source represented by a single sample is present. Other mantle associations present are Cr-poor megacrysts, high- and low-temperature lherzolites and Group II eclogites. The abundance of Cr-poor megacrysts and high-temperature lherzolite garnets could be indicative of a Group I kimberlite origin for the garnet xenocrysts.

Garnets of kimberlitic origin constituted 35 per cent of the sample at Goudplaats. The xenocrysts are consistent with having a kimberlitic source that sampled material from the diamond stability field. The diamond source is dominated by the harzburgite/G10 association with a smaller contribution from an eclogite source. Other mantle sources represented by the xenocrysts include Group II eclogite, low-chrome megacrysts, and lherzolite. The non-mantle spessartine-rich garnets could originate from the underlying Kraaipan granite-gneiss terrain.

The mineral chemistry of garnet xenocrysts from Vaalbank is consistent with a kimberlitic source that sampled material from the diamond stability field. The diamond source that was sampled is dominated by Group I eclogite inclusions. No samples are present from the G10/harzburgite diamond source. Other mantle sources represented by the xenocrysts include Group II eclogite, low-chrome megacrysts, G9/lherzolite and G9/lherzolite-HighTi.

Future activity

Samples will be collected from additional localities, analysed and compared with the existing data.

Percentages of different mantle rock types reflected by xenocrysts from different alluvial deposits

	Mahura Muthla	Goudplaats	Vaalbank
G10/Harzburgite	6 %	16 %	-
G9/Lherzolite	55 %	33 %	21 %
G9/Lherzolite High Ti	16 %	20 %	18 %
Eclogite DI	0.5 %	2 %	12 %
Eclogite II	13 %	16 %	12 %
Megacryst	10 %	11 %	36 %

0857 ORIGIN AND ENVIRONMENTAL IMPACT OF THE CHROME AND VANADIUM POLLUTION AT WITBANK

Project leader: D. de Bruin, Ph.D.

Project team: M. Anatasova, M.Sc., H. Coetzee, M.Sc., H. Maritz, B.Sc.Hons.

Objectives: to determine the source of pollution caused by industrial processes in the Witbank area.

Duration: 2004/2005–2005/2006.

Budget: R754 945.

Motivation

To mitigate pollution and safeguard the health and safety of the population of the Witbank area.

Progress

The Regional Geochemical Mapping Programme highlighted Cr and V anomalies near steel production plants in the Witbank area. A sampling methodology was established to determine the environmental pathways of the contaminants, which in the case of industrial pollution could be:

(1) dust fallout as a result of processing Cr and V ores used for steel production,
(2) smoke-stack emission fallout, or
(3) groundwater plume related.

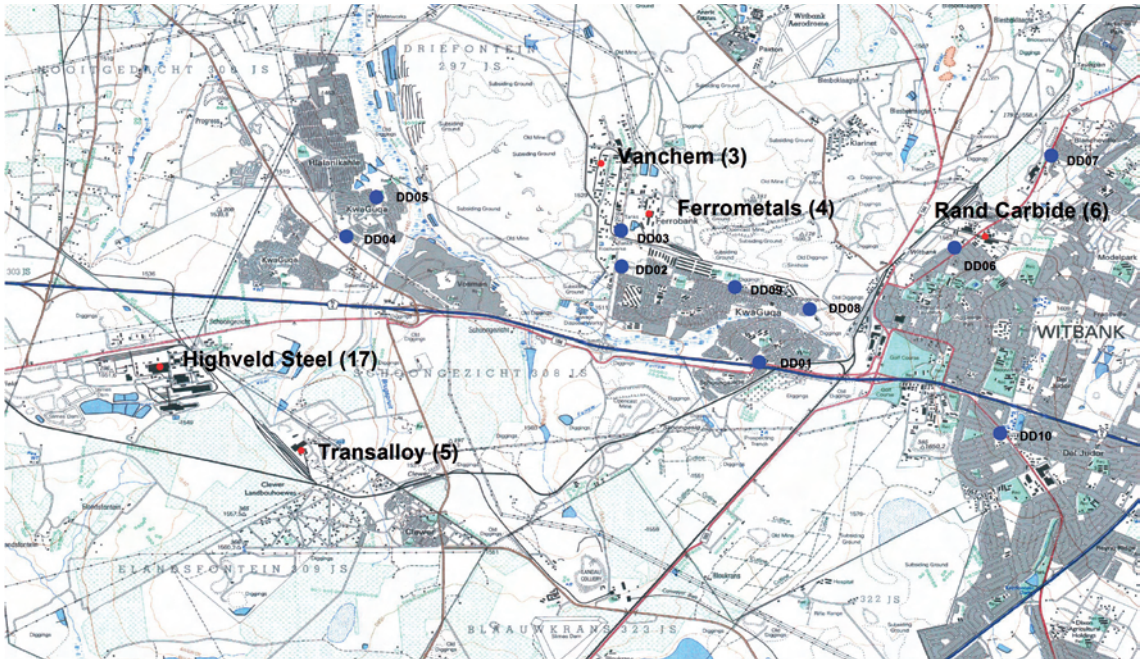
The main guidelines in the sampling strategy were to determine the:

types of emissions and wastes produced as a result of various production processes;
types of metals, metal oxides, alloys and related products that are produced;
collection methods for emissions and wastes, e.g. scrubbers, precipitators;.
control measures that are utilised and date of installation;
storage and disposal localities for emission products.

Thirty-seven samples were collected from the steel mills in the study area between July and October 2004. Sample localities were selected according to the production processes and were subject to availability and accessibility. Samples of steel-mill raw materials, smelter emissions, slag, precipitator dust, scrubber dust and various bag-house dusts were obtained with an aim to understand contaminant sources. Ten domestic-dust samples were collected from various public places in the study area in December 2004.

Future activity

Further work will include more domestic-dust sampling, as well as collection of blank samples outside the affected area. The samples will be analysed for major- and trace-element contents and the mineralogical components during the following study period.



14 GEOCHEMISTRY UNIT

0905 REGIONAL GEOCHEMICAL SAMPLING OF THE 1:250 000-SCALE SHEET 2628 EAST RAND

Project leader: T.O. Petso, B.Sc.Hons.

Objectives: to compile a geochemical database to aid in exploration activities, environmental studies and geological mapping in areas of poor outcrop. The regional geochemical sampling programme will eventually cover the entire country.

Duration: 2004/2005.

Budget: R30 000.

Motivation

The CGS is mandated by the Geoscience Act (Act 100 of 1993) to conduct geological mapping of South Africa. The geochemical mapping of the East Rand is important from an environmental and industrial-contamination point of view.

Progress

A geochemical sampling programme was planned for the suburban areas covering the 1:250 000-scale sheet 2628 East Rand. Soil samples were taken on foot and by using a 4X4 vehicle, as the use of a helicopter in urban areas for this purpose is prohibited. One-kilometre-spaced grids were projected onto the 1:50 000-scale topocadastral map 2628AB Benoni to guide the navigating geologist to the sampling positions. A total of 236 samples was taken from this 1:50 000-scale sheet area during 2004/2005.

Future activities

In order to complete the sampling of the map area, a further 460 samples will be taken.

0713/0716 REGIONAL GEOCHEMICAL MAPPING: XRF ANALYSES AND COMPILATION OF SHEETS 2430AC MECKLENBERG, 2430CA STEELPOORT, 2430CB BURGERSFORT, 2430CC KENNEDY'S VALE, 2430CD BUFFELSVLEI, 2530AA DRAAIKRAAL AND 2530AC DULLSTROOM

Project leader: J.H. Elsenbroek, M.Sc.

Objectives: to compile a geochemical database to aid in exploration activities, environmental studies and geological mapping in areas of poor outcrop. The regional geochemical sampling programme will eventually cover the entire country.

Duration: 2003/2004–2004/2005.

Motivation

The CGS is mandated by the Geoscience Act (Act 100 of 1993) to conduct geological mapping in South Africa. The geochemical mapping of the Bushveld Complex is important from a mineral exploration and environmental baselining point of view.

Progress

A geochemical mapping programme was planned for the western-most part of the area covered by the 1:250 000-scale sheets 2430 Pilgrim's Rest and 2530 Barberton in order to complete the geochemical sampling programme for the Bushveld Complex. Access to sample sites using a helicopter was planned for areas which have outcrops of Bushveld Complex lithologies. A one-kilometre-spaced grid was projected onto the 1:50 000-scale topocadastral maps to guide the geologist navigating the helicopter to the sampling positions.

Sampling had been conducted from 23 June to 2 August 2002. Seven 1:50 000-scale topocadastral sheets were covered, 2530AC

Dullstroom (3UE), 2530AA Draaikraal (3UA), 2430CC Kennedy's Vale (3OM), 2430CA Steelpoort (3OI), 2430AC Mecklenberg (3OE), 2430CB Burgersfort (3OJ) and 2430CD Buffelsvlei (3ON). The total number of soil samples collected was 4 789. The GPS coordinates of these samples were recorded on Garmin II+ GPS and the coordinates have a random error of less than 6 m.

The samples were dry sieved and the coarse organic matter (twigs, grass, etc.) removed. A powder briquette was pressed from the -75 micron fraction by using a PVA binder. The remainder of the sieved samples was retained for future use. Orientation studies suggested that most of the elements of interest are concentrated in the fine fraction (-75 micron), that is, above the detection limit for the analytical technique used. The sampling programme was thus standardised on a sampling density of 1 km^2 and analysis of the -75 micron fraction.

Samples were analysed on a Philips PW 1606 Simultaneous X-ray Fluorescence Spectrometer (SXRF) for the following elements: Sc, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Rb, Sr, Y, Zr, Nb, Sn, Sb, Ba, W, Pb, Th and U. A drift correction was made after the analyses of every 10th unknown sample, with the aid of an internal glass-disc monitor, to correct for any instrumental drift. The resulting stability of analyses was checked on a daily analysis, per batch of 300 samples analysed.

Examples of results for stability or precision can be seen on the following published Geochemical Map Series: 2326 Ellisras, 2328 Pietersburg, 2426 Thabazimbi, 2428 Nylstroom, 2526 Rustenburg, 2528 Pretoria, 2816 Alexander Bay, 2916 Springbok and 3018 Loeriesfontein.

The XRF analyses for the Sc, TiO_2%, V, Cr, MnO%, Fe_2O_3T%, Co, Ni, Cu, Zn, As, Rb, Sr, Y, Zr, Nb, Sn, Sb, Ba, W, Pb, Th and U have been completed. Geochemical maps for the 1:50 000-scale topocadastral sheets were compiled: 2530AC Dullstroom (3UE), 2530AA Draaikraal (3UA), 2430CC Kennedy's Vale (3OM), 2430CA Steelpoort (3OI), 2430AC Mecklenberg (3OE), 2430CB Burgersfort (3OJ) and 2430CD Buffelsvlei (3ON).

0836 REGIONAL GEOCHEMICAL MAPPING: Pt, Pd AND Au ANALYSES OF SOIL SAMPLES FROM THE RUSTENBURG LAYERED SUITE, BUSHVELD COMPLEX

Project leader: T.O. Petso, B.Sc.Hons.

Objectives: to compile a database of Pt, Pd and Au values over the Rustenburg Layered Suite from which geochemical maps may be compiled for exploration and geological mapping purposes.

Duration: 2004/2005.

Budget: R60 000 for analysis costs.

Motivation

The geochemical mapping of the Bushveld Complex is important as it forms part of South Africa's systematic scientific mapping coverage, and is significant from a minerals-exploration point of view.

Progress

Samples from the following 1:50 000-scale sheets, covering the Rustenburg Layered Suite, have been sent to the Henan Laboratory, Peoples Republic of China: 2428BB Tinmyne, 2428BD Haakdoring, 2429AD Zebediela Oos and 2429BC Lebowakgomo.

15 ENVIRONMENTAL GEOSCIENCES UNIT

In April 2004 the Environmental Geosciences Unit was launched with the aim of developing and applying environmental scientific expertise within the CGS. During the year the Unit focussed on environmental investigations, primarily in mining areas. As part of a project funded by the Swedish International Development Agency and Water Research Commission, a leach testing facility was established. Projects undertaken during the year included a study of wetlands contaminated by mining in the Witwatersrand, a study of the mobility of heavy metals in a tailings dam at Grootvlei Mine, and a study of the mobility of hazardous elements in natural groundwater. The Unit also supported the Laboratory in their investigation of contamination in the Witbank area.

Contamination of wetlands draining the Witwatersrand goldfields

A suite of sediment samples was collected from wetlands draining the gold-mining areas of the Central, East and West Rand. These were analysed for their bulk composition, and a number of leach and extraction tests were carried out. These allow the determination of the total degree of contamination, as well as the fractions of various contaminants which can be mobilised under different geochemical conditions. Elevated heavy-metal concentrations were identified in a number of samples, the leach tests indicating that these metals may be remobilised.

In the early phases of the project, the possibility of small-scale exploitation of the gold trapped in these wetland sediments was investigated together with an environmental NGO. The experience of other projects attempting to exploit this gold suggests that there are both metallurgical problems, related to the high organic content of the sediments, and legal obstacles to be overcome, which complicate the mining of these deposits.

0859 MOBILITY OF HEAVY METALS IN GROOTVLEI TAILINGS DUMP AND SURROUNDINGS

Project leader: G.M. Ntsume, B.Sc.Hons.

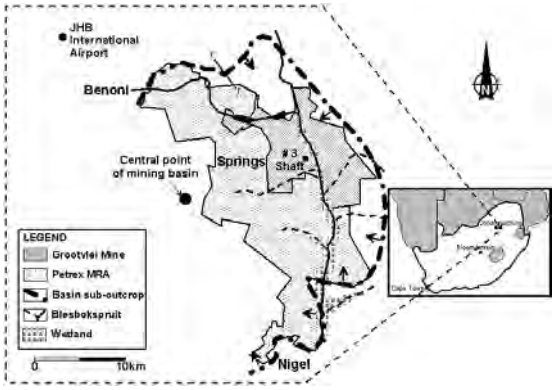
Objectives: the concentration of ions in water exposed to tailings results from the competing reactions of precipitation and solution, adsorption and desorption, complexation and decomplexation, which take place as a consequence of the acting equilibrium constants. As the dump ages there will be a change of the global equilibrium and a transfer of elements from one form to another, while the system tends towards a new equilibrium state.

Duration: 2004/2005–2007/2008.

Budget: R45 830.

Motivation

South Africa has vast economically exploitable mineral reserves with an extensive mining establishment. Gold-mining activities in the Gauteng Province are polluting the surrounding environment through an increase in acidity, salinisation and heavy-metal content of soils, sediments and groundwater bodies. The greatest threat posed by mining in the province is the uncontrolled release of acid mine drainage (AMD). Soil sys-



tems are affected by increased acidity, with a corresponding increase in metal mobility.

Progress

Water and sediment samples were taken and analysed, and the source of pollution in this area was identified. A paper on the project was presented in China (Beijing) at the Institute of Geophysical and Geochemical Exploration at the end of the training course on Geochemical Exploration and Mapping in November 2004.

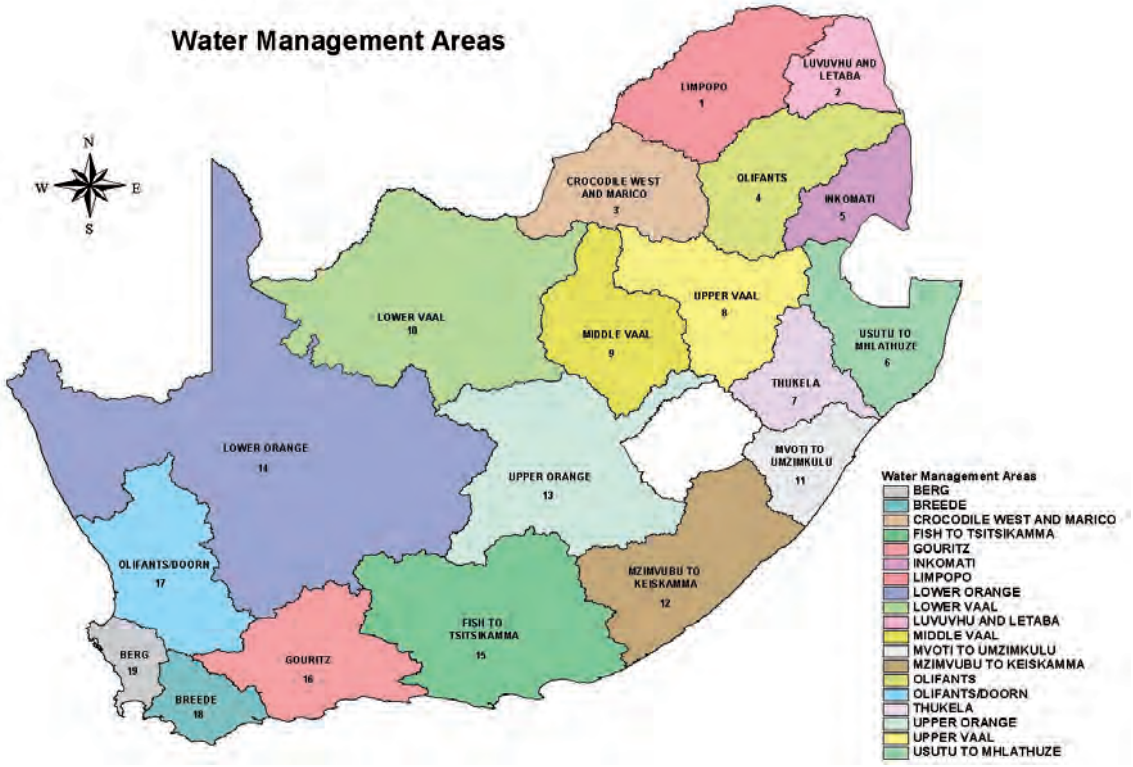
Conclusions

This study revealed that phytotoxic contaminants such as Cu, Ni, Zn, Fe, Mn, Pd and Cr could complicate rehabilitation measures, as they limit the soil function. The study further highlighted that the groundwater in mining and industrial areas is heavily polluted and acidified as a result of oxidation of pyrite (FeS_2) deposited in tailings, and contains concentrations of heavy metals. Most of the metals found in the Blesbokspruit are iron and manganese precipitated as a result of oxidation, and some heavy metals are being removed by coprecipitation.

Future activities

The first publication will appear in 2005/2006.

16 WATER GEOSCIENCES UNIT



0846 CHARACTERISTIC INDICES FOR WATER-SUPPLY SCHEMES

Project leader: L.K.C. Strachan, B.Sc.Hons.

Project team: A.F. Smit, B.Sc.Eng. (Civil Eng.), A. Kijko, Ph.D., H.J. Brynard, Ph.D.

Objectives: to collect data and develop a decision-support tool to assist in focussing national strategies in water management. Depending on the results, a systematic study of the remaining 18 WMAs in South Africa will be completed, ensuring a complete coverage of the country.

Duration: 2004/2005.

Budget: R363 500.

Motivation

Once grading of the relative importance of an index is determined, the calibration (weighting of indices) of the assessment tool can be achieved with relative confidence. National strategy planning by DWAF can then be targeted to address weaknesses and counteract factors which prevent water-supply schemes from functioning optimally. At the same time, targeted national strategies for maintaining or improving identified strengths that cause water-supply schemes to flourish can also be achieved. These national strategies will then be used to develop interventions, including poverty alleviation and job creation, and for the refurbishment of the existing infrastructure. The project outputs will be of use to the Department of Water Affairs and Forestry (DWAF).

Progress

The CGS has developed an assessment methodology for arriving at specific characteristic indices for water-supply schemes (Economic Index, Functionality Index, Social Index, and Sustainability Index). It is recognised that factors affecting the status of water-supply schemes have varying importance in different geographical regions. As a strategic-management approach, a project has been initiated in a selected water-management area (WMA 12 — Mzimvubu to Keiskamma, Eastern Cape) to establish the relative importance of the four different indices in a pilot study.

The project is in the late stages of data analysis and manipulation. The final report will be completed in the coming year.

Conclusions

A model for evaluating functionality, sustainability, economic and social status has proven in this research study to be an invaluable tool for conducting audits of water-services schemes in a selected water-management area in South Africa. The software assessment tool used, SusIT (Sustainability Indexing Tool), successfully modelled the characteristic indices of interest. The methodology used was one involving vigorous adherence to scientific principles, proven numerical optimisation algorithms, including the Analytical Hierarchy Process (AHP), and Analytical Neural Networks (ANN). AHP was used to provide the network inputs using an expert system of paired comparisons of input parameters. The Analytical Neural Network (ANN) algorithm was used to rank the parameters (key performance indices) from the most significant in terms of the overall status of operations to the least significant, thus allowing targeted interventions to be implemented. Thereafter, the model is trained to predict, using ANN, the future functionality (or sustainability) of both existing and new schemes.

The present study modelled the data of 62 water-service schemes from the Amatola District Municipality in Water Management Area 12 — Mzimvubu to Keiskamma in the Eastern Cape Province of South Africa.

The key characteristic indices related to water services that were studied and modelled comprised the following:

- Functionality (Operational) Index
- Sustainability Index
- Economic Index
- Social Index

It emerged after modelling that more than 70 per cent of schemes evaluated had sustainability problems requiring interventions.

After plotting the spatial distribution of these schemes in order to establish whether clusters or groups of schemes would emerge requiring different interventions that could be applied on a subregional scale, it was found that no such clustering occurred.

This leads to the main conclusion of this study — that the schemes are diverse in character despite sharing some common subregional situations. In view of the diversity of the schemes and their differing (on a subregional scale) diagnoses of state of vigour, one can only conclude that interventions or Best Practices must be applied specifically at individual scheme level and that "blanket" interventions would not, in the long term, be beneficial.

0848 HYDROMETRIC STATION GAPS

Project leader:	L.K.C. Strachan, B.Sc.Hons.
Project team:	A.F. Smit, B.Eng.Hons. (Civil).
Objectives:	to address the problem of gaps in data in the records of the hydrometric station network in South Africa.
Duration:	2004/2005.
Budget:	R310 450.

Motivation

For various reasons a significant number of gaps, both temporal and spatial, exist in the records of the hydrometric station network in South Africa. In order for useful planning and risk analysis — for example, for flood prediction — to be achieved, the missing data have to be simulated.

A numeric model that uses existing stream flow, rainfall and evaporation to calculate missing data values has been designed. The concept and methodology used in the development of the model is not specific to the data, but can also be used for any temporally varying parameters such as post-mine-closure flooding (water levels), mine-water decant predictions (rise in water level), seismological-station gaps (wave velocities), or mine-pumping statistics (volume per day).

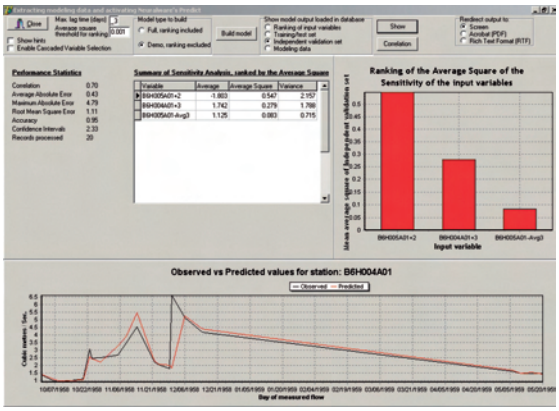
The outcome of this research is of immediate interest to the Department of Water Affairs and Forestry (DWAF) for simulation of missing data in its hydrometric station-network records.

Progress

Completed except for the documentation (concepts and software manuals).

Conclusions

The database-driven Neural Network MODELING is production ready and giving exceptionally good results.



Output of modeling results from HYDROGAP software.

Future activities

The documentation will be completed during the next year. It is possible to transform the system to create a generalised database-driven neural network MODELING system, where the neural network model, MODELING data and MODELING results are saved in the database for future auditing.

0874 THE APPLICATION OF GROUNDWATER VULNERABILITY ASSESSMENTS AT WATER MANAGEMENT AREA (WMA) LEVEL

Project Leader: K.A. Majola, B.Sc.Hons.

Project team: R. Titus , Ph.D.

Objectives: to evaluate the applicability of available groundwater vulnerability assessment methods, and to apply these methods at a Water Management Area (WMA) level.

Duration: 2004/2005.

Budget: R262 227.

Motivation

The strategic importance of groundwater continues to grow in South Africa because about two-thirds of the rural population depends on these resources, especially in drier parts of the country. Government institutions have recognised this trend and are implementing programmes and taking measures to adequately manage and protect these resources. This project will contribute to the improvement of aquifer-vulnerability assessment methods, especially in industrial urban areas. There is an urgent need to test and evaluate various methods for vulnerability assessment to determine which methods are most appropriate in different hydrogeological environments at different levels. The area of study is the Cape Flats region with large residential and industrial development and intensive agriculture. Thus multiple potential sources of pollution exist within the study area and the general population is relatively poor, often with inadequate basic water supply and sanitation facilities in certain areas.

The project will also form the basis of an M.Sc. programme to be completed in 2006.

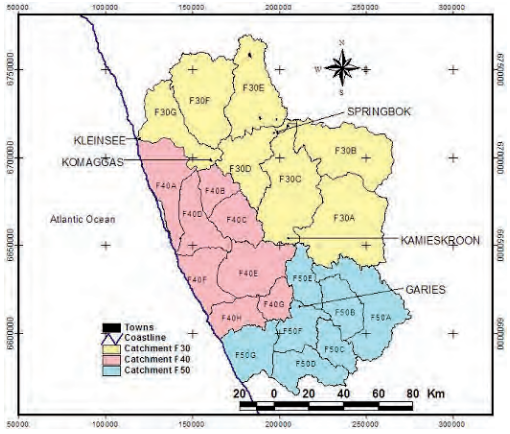
Progress

The first phase of this project is currently in the finishing stages of data compilation, data formatting and analysis.

Future activities

The data compiled will be used in the production of maps depicting certain factors that, when

overlaid, will collectively produce a groundwater-vulnerability map on the appropriate scale. The factors will be ranked according to their contribution to the vulnerability of the aquifer system. Maps will be included in the final report that will be produced from this project.



The study area showing secondary drainage catchments F30, F40 and F50.

0875 INVESTIGATION OF THE RELATIONSHIP (WATER-ROCK INTERACTION) BETWEEN THE GROUNDWATER CHEMISTRY AND RADIOACTIVE ELEMENTS (URANIUM, THORIUM and ASSOCIATED DAUGHTER ISOTOPES) IN THE PRECAMBRIAN ROCKS OF NAMAQUALAND

Project leader: J.T. Shongwe, B.Sc.Hons.

Project team: R. Titus, Ph.D.

Objectives: to study the behaviour of radioactive elements, the controls on radioactive-element distribution and concentrations, the associated trace-element occurrences, and to understanding the relationship between groundwater chemistry and radioactive-element occurrences.

Duration: Eight months (August 2004–March 2005).

Budget: R161 589.

Motivation

The demand for groundwater in South Africa has increased over the years, mainly in the arid, semi-arid and rural areas of the country where there is a lack of surface water. Groundwater is generally considered as a safe and viable option compared with untreated surface water, but this is not always the case, as groundwater may be contaminated by hazardous trace and radioactive constituents. The presence of these constituents in groundwater at elevated concentrations can cause a threat to public health. Hazardous constituents may include radioactive elements (Uranium, Thorium and associated daughter elements) and trace elements (Chromium, Arsenic, Fluoride, Molybdenum, Selenium). This study will focus on naturally occurring radioactive minerals with the potential for having an impact on the groundwater resources of Namaqualand.

These elements are introduced into the groundwater through weathering processes, dependent on parent rock characteristics, as well as through anthropogenic activities. Weathering and leaching of trace-element-rich geological formations and mining wastes result in high concentrations of these constituents in groundwater in several parts of the world. Namaqualand is known for its mining activities.

Namaqualand is classed as a semi-arid to arid region and groundwater is a strategically important resource for water supply to the communities. Therefore, this project aims to investigate the relationship between groundwater chemistry and quality and radioactive elements (U, Th and associated daughter isotopes). The findings will include water–rock interaction and associated health risks.

Namaqualand consists of seven communal areas, including the northern Richtersveld, southern Richtersveld, Steinkopf, Concordia, Komaggas, Pella and Leliefontein. Groundwater is the sole water resource for most rural communities. The Namaqualand area is classified by three physiographic regions according to topography, altitude and landforms. These regions are the higher lying Bushmanland Plateau to the east, the Namaqualand highlands (i.e. the escarpment zone), and the lower-lying coastal area to the west.
The study area falls in the tropical desert arid, hot (BWh) climatic region of South Africa, ac-

cording to the Koeppen classification and can be classified as arid to semi-arid. Rainfall occurs mostly during the winter months, while snow in the Kamiesberg Mountains is not uncommon during the summer months. Potential evapotranspiration can be as high as 12 to 15 times the precipitation.

Progress

A literature review on Uranium and Thorium in the natural environment was finalised, incorporating the following aspects:

the occurrences of uranium and thorium in the natural geologic environment;
their radioactive decay series and daughter elements;
their physical/chemical behaviour in the environment, including the geochemistry and mobility of these elements under certain conditions;
the release mechanisms from source rock into solution and/or their deposition in other environments, including the aqueous speciation of these radionuclides.

The project is primarily a desk-top study with fieldwork planned for the second phase of this project. However, data were acquired from various sources and a database was developed. The final phase of the current project is the analyses of the acquired data to characterise the groundwater in terms of the dominant species for uranium and its associated complexes.

Future activities

The data will be analysed, plotted and presented in a report.

0877 SUSTAINABLE DEVELOPMENT IN THE WATER GEOSCIENCES

Project leader: U.A. Rust, B.A., B.Sc., Dip.Comm.Dev.

Objectives: to create greater understanding of the link between water geosciences and sustainable development by setting out a proposed framework for relating general issues of sustainable development (including globalisation) to water geoscience projects.

Duration: 1 September 2004–31 March 2005.

Budget: Total: R10 934.

Motivation

In order to address the challenges of environmental degradation and poverty alleviation it has become necessary for scientists to have an understanding of sustainable development. This is borne out by the fact that the purely scientific component of projects is generally becoming smaller, while there is an increased demand for the ability to use science to address issues of societal development, such as poverty alleviation. In the CGS, the need to relate science to issues of sustainable development is particularly relevant for the water geosciences.

In the water geosciences, attention has been focussed on quantification and characterisation of water sources, and it is now necessary to integrate that knowledge with broader issues relating to socio-economics, institutional capacity and environmental protection. The primary aim of this project is thus to propose a framework for relating general issues of sustainable development to water-geoscience projects.

Progress

A framework has been proposed to capture the complex links between water-geoscience projects and general issues of sustainable development (e.g. socio-economics, institutional capacity and environmental protection). A survey has been conducted of the sustainable-development literacy among managers and senior scientists in the CGS. Selected clients of the CGS were interviewed to understand their broad expectations of the CGS in terms of sustainable development. Additional attention has been devoted to a discussion of the relevance of globalisation to the water-services sector. Literature references for and definitions of sustainable-development terms have been captured. This information has been integrated into the proposed sustainable-development framework for water-geoscience projects.

Conclusions

The ecology within which the water geosciences operate is characterised by complexity, and clients of the CGS are increasingly expecting the CGS to integrate science, society and the en-

vironment. There is thus a need to bolster the sustainable-development literacy among managers and scientists in the CGS. Geologists and hydrogeologists have a fair grasp of how the natural sciences relate to sustainable development, but need to become knowledgeable about socio-economic aspects. Aspects that have an impact on sustainable development in the water sector can be categorised as follows:

- natural and physical environment
- socio-economic environment
- water-services infrastructure
- legislative and institutional environment, and
- information dissemination and communication.

During the planning stage of projects a structured approach must be followed to ensure cognisance of all these factors. Projects planned in this manner are likely to have a positive impact on sustainable development.

Future activities

Building on the foundation of the sustainable-development framework, the research will be broadened to investigate the strategic alignment of institutions in the water-services sector with regard to the application of appropriate technology. This phase will be conducted in the 2005/2006 project year.

Pit latrines 8 m from a leaky concrete reservoir, GaMashashane.

17 GEOPHYSICS UNIT

Cutting samples for physical property analysis.

0174 PHYSICAL PROPERTIES DATABASE

Project leader:	L.P. Maré, M.Sc.
Project team:	L.R. Tabane, V. Hallbauer-Zadorozhnaya, Ph.D., K.R. Beare, H.Nat.Cert.(UK), M. Kotzé, B.Sc. Hons., A. Graham, Nat.Cert.(IT).
Objectives:	to collect samples and expand the database.
Duration:	ongoing.
Budget:	R3 000.

Motivation

The South African Geophysical Atlas, Volume IV, "Physical Properties of South African Rocks", is a compilation of non-confidential physical properties of South African rocks. The aim of the Atlas is to provide geoscientists with a quick reference to physical property information, as well as a comprehensive set of source references.

Progress

During 2004/5 the Physical Properties Database was converted from a Microsoft Excel-based system to the CGS's corporate database GEODE. This conversion involved careful planning and design of the necessary Oracle tables and forms which included information not available in the existing database. A test data set was constructed, incorporating all 81 new fields to be added, and was loaded onto the Oracle database where the programs were tested and adjusted to suit the user. Useful tables that were added included information on equipment and suppliers, as well as information on scientists and institutions that regularly supply samples to the laboratory. Data are being added from archived files and publications. Until the Oracle database is interactively available on the internet, the old database will be kept up-to-date. This is necessary as a PDF download is still offered — as it has been for the past four years — on the internet.

During 2004 the Physical Properties Laboratory acquired a PICO PC oscilloscope for use with the PUNDIT (portable ultrasonic non-destructive indicating tester) that will enable the measurement and calculation of accurate P-wave seismic velocities. This will enable the much-needed expansion of the database in this field.

In collaboration with the Geochemistry Unit, samples from the geochemistry database are undergoing physical-property analyses, so that a database of rock properties for all stratigraphic units in South Africa will be constructed.

Conclusions

The conversion of the database to Oracle is contributing to making the database readily available and searchable by all users.

Future activities

The long-term aim of this project is to expand the database until it contains physical property information for all the stratigraphic units of South Africa, and to make this database available for interactive searching on the internet, which would increase its value tremendously and benefit scientists worldwide.

In the short term (2005/2006) the aim is to expand the database by measuring the seismic velocities of existing samples in the laboratory storeroom, as well as cores from the National Core Library. The continued supply of samples from the geochemistry database will assist in increasing the data coverage of the database.

0679 UPKEEP AND DEVELOPMENT OF DATABASES

Project leader: M. Kotzé, B.Sc.Hons.

Project team: P. Cole, M.Sc., A. Graham, Nat.Cert.(IT), D. Kruger.

Objectives: to maintain and expand geophysical databases, including GIS coverages.

Duration: 2004/2005.

Budget: R2 000.

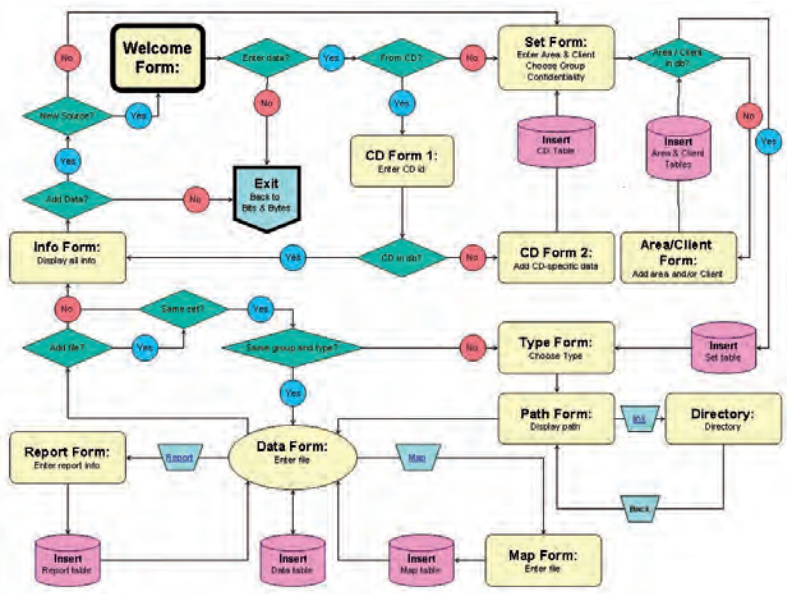
Motivation

The Geophysics Unit has vast amounts of data which need to be properly stored, backed up and catalogued. Data that are easily accessible result in greater work efficiency and better productivity.

Progress

The main objective for 2004/2005 was to populate the database created during 2003/2004. A web-based front end was created for use by staff to capture the data. The database was altered to keep a record of all entries made through this front end along with the time and date of capture. The total number of files added to the database since implementation of the data-capture front-end (30 August 2004) stands at 5 000.

Data captured during 2004/2005:
Airborne data
Radiometric data (high and low resolution)
Magnetic data (high and low resolution)



Flow chart for data-capture process.

Regional gravity data
Unpublished reports
  2004 and 2003 reports
Figures, photographs and diagrams
  Graphical images relating to geophysical methods, surveys and research
Georeferenced data images
Digital terrain model data
Interpretational maps.

Conclusions

The database has helped the Geophysics Unit to perform certain tasks faster and much more efficiently, as it enables any employee to locate a data set immediately from his or her computer. A complete record of the data in the Geophysics Unit is readily available and data duplication is no longer a major concern.

Future activities

Future activities of the project will include addition of all the unpublished reports to the database. New data will be added to the database as they are collected and the interface will be continuously updated to suit the needs of users.

0673 AIRBORE HIGH-DENSITY GEOPHYSICAL SURVEYS

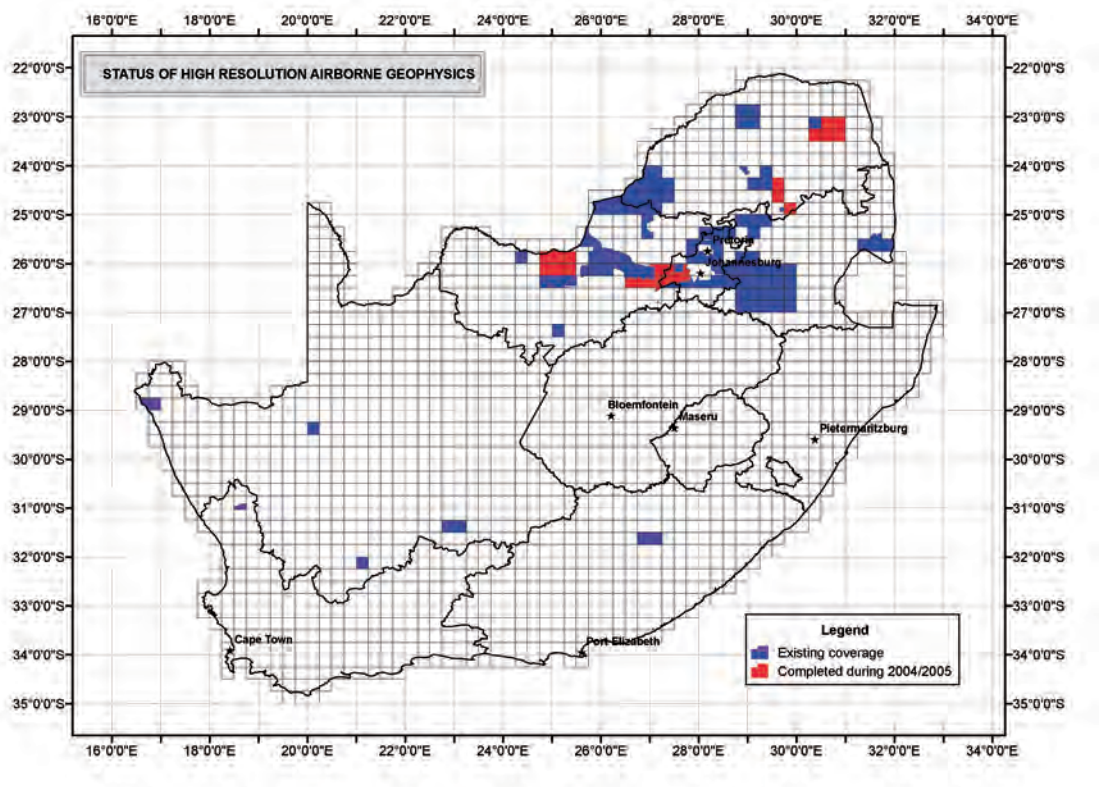
Project leader: P. Cole, M.Sc.

Project team: J. Cole, M.Sc., M. Kotzé, B.Sc.Hons., K.R. Beare, H.Nat.Cert.(UK), Southern Exploration Surveys.

Objectives: to produce geophysical coverages and interpretations for sheets 2330AB Levubu, 2330AD Hildreth Ridge, 2330BA Tlangelane, 2330BB Shangoni, 2330BC Bend, 2330BD Nsama, 2429BC Lebowakgomo, 2626BA Ga-Motlatla, 2626BB Swartplaas, 2626BC Makokskraal, 2626BD Ventersdorp, 2627AA Mathopestad, 2627AB Syferbult, 2627AC Reismierbult, 2627AD Carltonville, 2524DD Gemsbokvlakte, 2525CA and CC Phitsane, 2525CD Ga-Modimola, 2624BB Mosita, 2625AA West End, 2625AB Mareetsane and others.

Duration: Ongoing.

Budget: 2004/2005: R3 788 500.



Status of high-resolution airborne geophysics.

Motivation

This project maps the total magnetic-field intensity and radiometrics, producing magnetic, digital terrain model, potassium, thorium and uranium data sets. These data sets are inexpensive to acquire, and contribute significantly to groundwater exploration, geological mapping, environmental projects and mineral exploration. They support other projects in the CGS, as well as vital sectors of the earth-science industry.

Progress

All maps planned for in 2004/2005 were flown, but budgetary cuts excluded additional maps from being flown. The data were interpreted and reports were completed. The map shows completed high-resolution surveys. Areas shown in red were flown during the year.

Conclusions

The data will be used in mineral-exploration projects, groundwater-targeting projects, as well as small-scale mining projects.

Future activities

The remaining portions of the country that have not been flown at this resolution will continue to be flown. Priority will be given to areas most in need of surveys.

0844 COMPILATION OF A HIGH DENSITY AEROMAGNETIC MAP FOR THE NORTH WEST PROVINCE — INTERPRETATION OF DATA FOR THE DETERMINATION OF GROUNDWATER TARGETS

Project leader: C.J. de W. Raath, B.Sc.Hons.

Project team: C.J.S. Fourie, M.Sc.

Objectives: to produce an aeromagnetic map and a report.

Duration: 2004/2005.

Budget: R10 000.

Motivation

A large part of the North West Province is covered by Kalahari sand, so the main purpose of the aeromagnetic data interpretation is to delineate possible water-bearing structures to assist farmers, local municipalities, the Department of Water Affairs and Forestry (DWAF) and small rural communities by targeting potential borehole sites for water sources for agricultural and household purposes. The maps will also be used to estimate the size of potential aquifers and the potential for successful boreholes.

Progress

The interpretation of the high-density magnetic data of the 2624 Vryburg 1:250 000-scale sheet has been completed. The most obvious groundwater-target lineaments were depicted and special attention was given to possible dykes and faults. Borehole positions from the DWAF Database were used to obtain possible localities of the boreholes and their yields. The conductivities of the boreholes were also plotted to gain some idea of the water qualities.

Conclusions

The geophysical data correlate well with the known geology of the area. The geology under the sand cover can only be estimated using the high-density magnetics and the DWAF borehole information. The high-density magnetic data made it possible to identify more and better possible groundwater targets than the old regional data. The existing borehole positions for the area, obtained from the National Groundwater Database of DWAF, were plotted on the target map and many of the boreholes drilled on faults, geological contacts and dykes were better yielding than the boreholes drilled at random and away from targets.

0783 POSSIBLE ALLUVIAL-DIAMOND OCCURRENCE MAP WEST OF TLARING (SMALL-SCALE MINING OPPORTUNITY)

Project leader: J. Cole, M.Sc.

Project team: M. Adlem, B.Tech.

Objectives: to produce maps showing diamond occurrences, with a report.

Duration: 2004/2005.

Motivation

This project forms part of the poverty-alleviation programme of the CGS. The aim was to

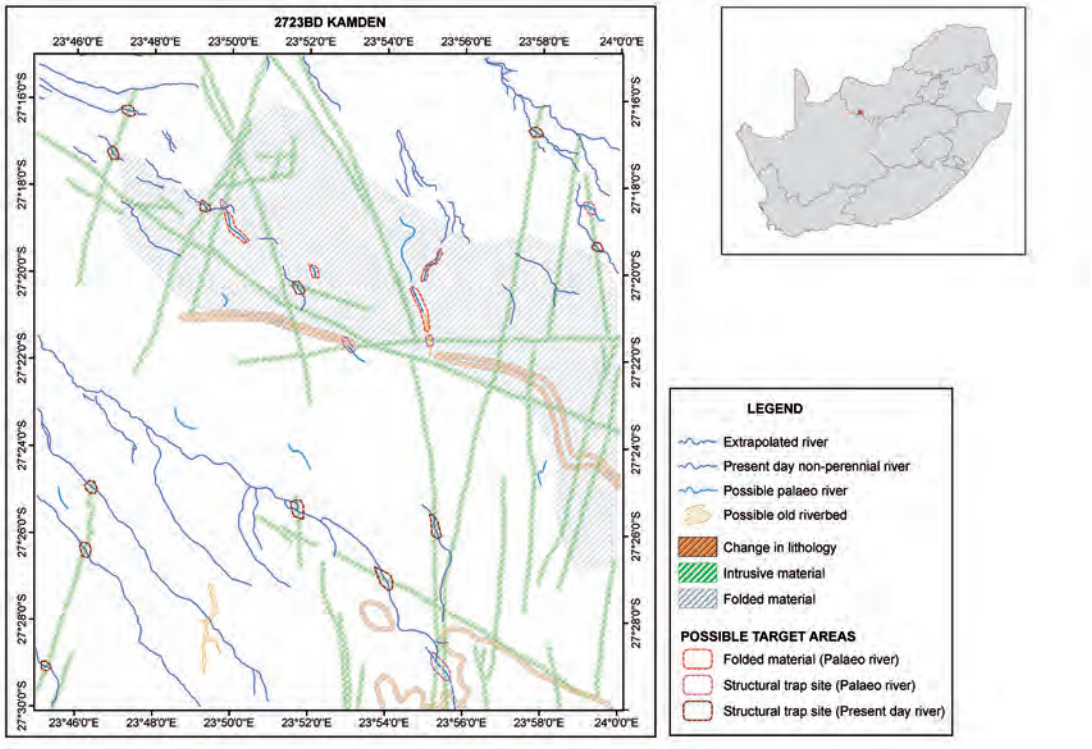
identify areas of interest for possible alluvial-diamond deposits, aimed at creating small-scale mining opportunities.

Progress

Marshall and Baxter-Brown (1995) described the basic principles of alluvial-diamond exploration. They stipulate that the requirements for the development of economic fluvial deposits in plateau gravel deposits are available sources of diamonds, structural trap sites, hardness of bedrock, gradient of the river system and regional warping. With these criteria in mind, existing regional aeromagnetic data, landsat TM data, geology, aerial photographs and a digital terrain model were studied and a few possible targets were identified. A number of prominent dykes were delineated from the aeromagnetic and landsat data, as well as the aerial photographs. Where these dykes cut through river or palaeoriver channels, they may act as structural trap sites for alluvial diamonds. Almost the entire area is underlain by dolomite and limestone of the Ghaap Plateau Group. The deposition of alluvial diamonds in dolomitic areas is mainly controlled by karstification. Dissolution of dolomite along zones of weakness (e.g. faults, fractures and dykes) leads to the formation of cave systems. These systems collapsed to form sinkholes and gorges which subsequently filled with gravel, sand and clay. The bedrock can therefore be considered favourable for the deposition of alluvial diamonds, provided there is a source. According to Ward et al. (2004), the Mahura Muthla diamonds exploited a few kilometres to the east had a kimberlite source probably situated towards the south.

Conclusions

A few possible palaeoriverbeds that were identified on the landsat data and aerial photographs appear to be oriented almost north–south. Some target areas were identified by extrapolation of these palaeorivers. The intersections of modern rivers and geological structures have also been indicated as areas of interest. It must be emphasised that the project was only aimed at identifying possible areas of interest. Much more detailed ground geological and geophysical work is required to understand the morphotectonics of the region and explore properly for potential deposits.



Future activities

The study of this area has been completed. However, a related statutory project (ST-2003-0783) will be conducted in the new financial year, entitled "Targeting of diamondiferous alluvial gravels in the North West Province".

0830 KAAPVAAL CRATON MAGNETOTELLURIC PROJECT

Project leader: C.J.S. Fourie, M.Sc.

Project team: R.H. Stettler, B.Tech., C.J. de W. Raath, B.Sc.Hons., J. Cole, M.Sc., E.H. Stettler, Ph.D., J.G. Barkhuizen, B.Sc. Hons., B.Com., D. Kruger, T. Suntken (student).

Installation of a long-period three-component magnetometer.

Objectives: to create an image of the deep crust and upper mantle based on the electric properties of rocks, defining the deeper compositional rock types and structures of the crust and upper mantle.

Duration: 2004/2005.

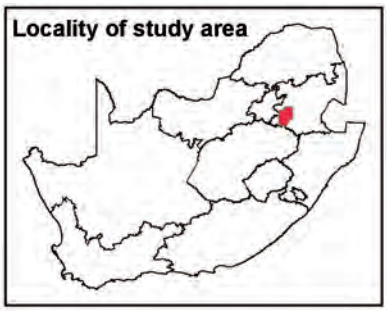
Budget: R266 755.

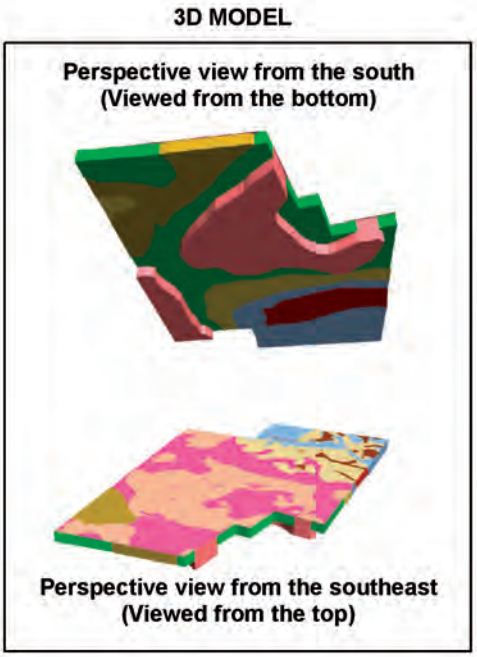
Motivation

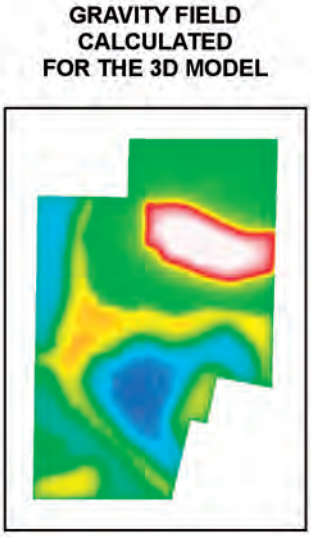
The aim of the project is to study the lithospheric structure underneath the Kaapvaal Craton and adjacent terranes. The image will provide a better understanding of rock compositions and structure at great depths, as well as the processes involved in the formation of diamonds.

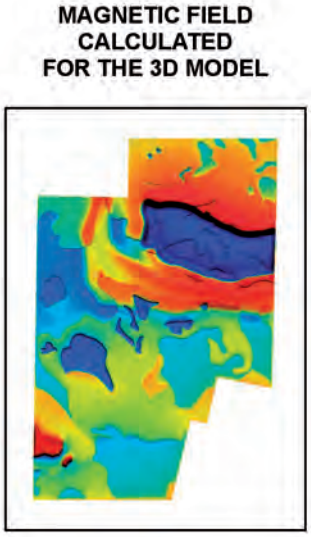
Progress

Project members based at the Dublin Institute for Advanced Studies in Ireland created preliminary models for the results obtained along the first profile between Sutherland and Mussina. They found these to be consistent with a thick









lithosphere beneath the Craton, and thinner lithosphere beneath the mobile belts.

The second phase of the project was completed. During the field season, data were collected along two sets of profiles forming crosses. The profiles of the southern pair ran between Bethlehem and Barberton, and between Kranskop in Natal and Wolwehoek in the Free State. The northern pair consisted of a profile from Vredefort through Mafikeng and ending at Kang in Botswana, and the second profile, in Botswana, ran along the South Africa–Botswana border from Kanye in the south to Serowe in the north. Data were collected at a total of 28 long-period and 38 broadband stations. The photograph illustrates the installation of a long-period three-component magnetometer.

Conclusions

The fieldwork has been performed successfully. The processing of the data is not yet completed, as the project schedules do not coincide exactly with the CGS's reporting year. The project is attracting enough interest to attract new companies to the consortium and to contribute (Rio Tinto).

Future activities

The project will continue into the following year, the last of the initial three years agreed on. The CGS has agreed to assist with the next field season and will contribute two staff members and two vehicles for the duration of the new surveys. In addition, the data will be interpreted and processed in Dublin, Ireland, in the new year.

0247 SEMI-AUTOMATIC 2D AND 3D INTERPRETATION: INTEGRATION OF MODELLING TECHNIQUES, INCLUDING NEURAL NETWORKS, FUZZY LOGIC AND WAVELETS; REFINEMENT OF MODELLING TECHNIQUES AND VISUALISATION

Project leader: P. Cole, M.Sc.

Project team: J. Cole, M.Sc., E.H. Stettler, Ph.D., D. Eberle, Ph.D. (Bundesanstalt für Geowissenschaften).

Objectives: to produce software and a manual.

Duration: 2004/2005.

Budget: R1 750.

Motivation

The interpretation of geophysical data is a time-consuming process. This project was aimed at finding ways to speed up the process, which will make interpretations more economically viable.

Progress

The project consists of two parts, namely the creation of semi-automatic 2D interpretation software (developed by the Bundesanstalt für Geowissenschaften in Germany) and development of 3D modelling software by the CGS. During the past year, a number of improvements were made to the 3D modelling software to improve the ease and speed of creating an initial model. This was achieved by creating a library of simple bodies that represent simple geological features, and to use polygons and polylines from other software packages used during the interpretation process as starting points for the model.

As a final stage of the project, two-dimensional surface interpretations of geophysical data obtained using statistical software developed by the BGR were used as a starting point in the creation of a three-dimensional model. Two different classification algorithms provided two different models, one representing the shallow material, and the other related to deeper-seated bodies. The best results were obtained using the deeper-seated bodies to calculate the gravity field. In this case the calculated values correlated well with the observed gravity data.

Conclusions

It appears that the magnetic data do not contribute much to the classes obtained using either the K-means clustering algorithm or the W-means algorithm. This is possibly owing to the dipolar nature of the magnetic anomalies. The results of W-means classification were dominated by the gravity data, while the results of K-means classification were associated mostly with the radiometric data. In the case of the W-means classification, the results provided a good starter model for the three-dimensional modelling process, albeit only for the gravity data.

Future activities

The project has been completed.

0481 NEAR INFRA-RED (NIR) SENSOR — UNMIXING OF THE NIR SPECTRUM

Project leader: E.H. Stettler, Ph.D.
Project team: P. Cole, M.Sc., K.R. Beare H.Nat.Cert.(UK).
Objectives: Progress report.
Duration: 2004/2005.

Motivation

The Geophysics Unit built an airborne near-infra-red (NIR) spectrometer three years ago to map rock composition from an aircraft. The spectrometer records the total reflected sunlight from the Earth's surface between 200 and 1 800 nm over 1 024 channels. The challenge is to extract the individual spectra of mineral species from this data, which will allow a first-order geological map to be constructed by airborne surveys which a geologist can update, and which will ease geological mapping considerably.

Progress

Various methods were investigated, but the one showing the most promise applies Singular Value Decomposition (SVD) to master spectra of mineral species in order to separate the NIR spectrum into a lower- and a higher-order contribution. Convolving the higher-order contribution with a spike function sharpens the smaller variations considerably and leads to obtaining a unique signature. These signatures are stored in a database for use as a reference.

Processing real recorded spectra is performed in the same way by again using SVD to remove the lower-order contribution and sharpening up the remainder. By comparing the sharpened-up remainder with the remainders of the mineral species master spectra in the database, the contribution of individual mineral species to the total NIR spectrum can be identified and rock types identified. The comparison is done by cross-correlation and removal of the identified signatures from the remainders spectrum so that the spectrum becomes simpler to unmix as the process continues.

Conclusions

Individual mineral species can be identified in this way, although it is computationally very intensive. As the technique could only be tested on three areas, a granitic terrain in the Limpopo Province, the Tswaing Crater near Pretoria and an area in the Karoo, employing the technique on data flown over many other geological environments will probably show its drawbacks, and adjustments will have to be made.

Future activities

SVD and cross-correlation are relatively slow processes and there may be faster mathematical techniques which give the same result; these will have to be investigated.

0840 TO TEST NEW EQUIPMENT AND SOFTWARE FOR COLLECTION AND INTERPRETATION OF AIRBORNE EM DATA

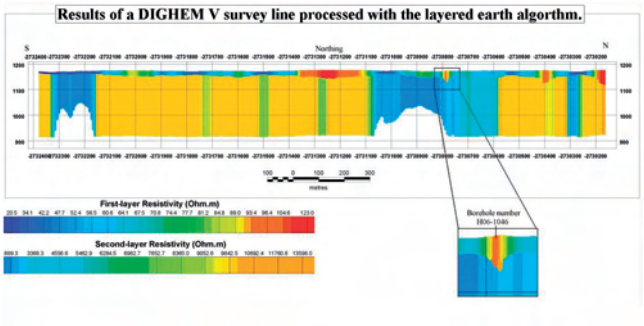
Project leader: J.P. Smit, B.Sc.Hons.
Project team: E.H. Stettler, Ph.D.
Objectives: to test new equipment and software for collection and interpretation of airborne EM data.
Duration: 2004/2005.
Budget: R1 000.

Motivation

An airborne electromagnetic system can be applied to mineral exploration, alluvial-diamond exploration, groundwater investigations, and geological mapping. The Geophysics Unit is in the process of acquiring an airborne electromagnetic platform. To this extent a Cessna Grand Caravan 208B aircraft has been purchased. Although good software comes as an add-on to most electromagnetic systems, a good up-to-date theoretical knowledge is essential if software is to be used correctly.

Progress

Good progress has been made on a layered-earth inversion algorithm for the interpretation of airborne electromagnetic data (see figure). While awaiting the arrival of the airborne platform theoretical work will continue on



software that will be utilised once a system is operational.

Time on this project will also be allocated for familiarisation with commercial software (EMFlow) that will be used in the interpretation of electromagnetic data.

Conclusions

The project is awaiting the purchase of electromagnetic equipment. Once this is done, the equipment and algorithms can be tested.

Future activities

Electromagnetic exploration methods are a vast field, with advances being made continuously by international researchers. Once the geophysics unit has acquired the necessary hardware it will be crucial to keep up to date with the latest theoretical advances.

0887 HYSTERESIS MEASUREMENTS — INSTRUMENT DEVELOPMENT

Project leader: L.P. Maré, M.Sc.

Project team: K.R. Beare, H.Nat.Cert.(UK), C.J.S. Fourie, M.Sc., L.R. Tabane.

Objectives: to assess the feasibility of designing an instrument for hysteresis measurement.

Duration: 2004/2005.

Budget: R28 500.

Motivation

The Physical Properties Laboratory needs to expand its capabilities to perform rock magnetic analysis, considered to be a routine procedure in similar laboratories around the world. As the equipment is expensive, the design and construction of new equipment has become an option worth exploring.

Progress

Identification of ferromagnetic minerals in a rock can help guide the design of partial demagnetisation experiments and the interpretation of results. The challenge is to associate a particular component of NRM (identified from partial demagnetisation) with a particular ferromagnetic mineral. This information can often determine whether a characteristic NRM is primary or secondary. Measurements in applied fields provide information on the nature and quantity of the magnetic minerals in rocks and the presence of dia-, para-, ferro- and superparamagnetism, their coercivity spectra and domain structure. Isothermal remanence (IRM) and coercivity of remanence measurements are the simplest applied-field measurements, for which only the applied field, obtained from a coil or electromagnet, and a magnetometer are required.

A desktop study on the different methods used for measuring magnetic hysteresis has been completed and three design options for this type of equipment have been identified:

1. The Free-air coil system is relatively simple to make, but its low magnetic flux density limits the fields that can be generated to ~100 mT. In order to obtain higher fields the coil would have to be huge and the copper wire used for the coil > 3 mm, increasing the possibility of overheating the system.
2. The Ferro-centred electromagnet system has a higher magnetic flux density and can produce fields up to 2,5 T. This is a more stable system than the free-air coil system, and several systems are available commercially.
3. The Vibrating Sample Magnetometer (VSM) is in principle similar to that of the spinner magnetometer, but the flux change in the pick-up coil system is produced by vibrating the sample rather that by rotation, and both induced and remanent magnetisation can be measured. Several such systems are available on the market. This is a complex and expensive system to build and we will not attempt to produce our own.

It was decided to attempt the development of an electromagnet system, but during the design phase it soon became clear that the budget for this project was insufficient.

Conclusions

It was decided that the design of an instrument for measuring magnetic hysteresis was not cost effective.

0868 DEVELOP AND TEST SEISMO-ELECTROKINETIC METHOD EQUIPMENT

Project leader: V. Hallbauer-Zadorozhnaya, Ph.D.

Project team: E.H. Stettler, Ph.D., J.P. Smit, B.Sc.Hons., K.R. Beare, H.Nat.Cert.(UK).

Objectives: to develop and test seismo-electrokinetic equipment.

Duration: 2004/2005.

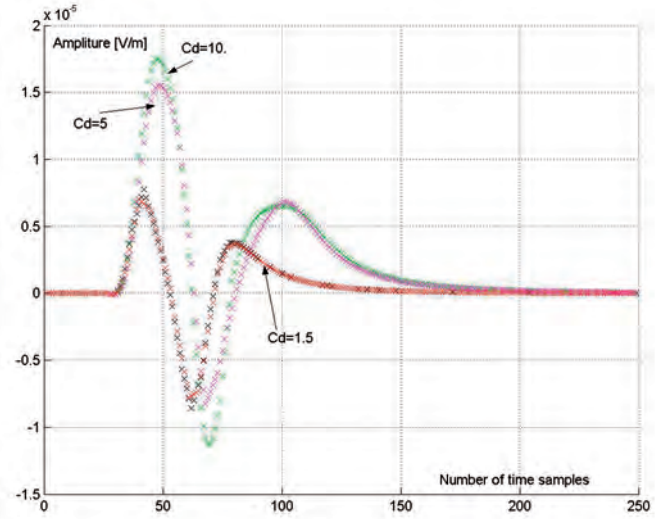
Budget: R65 088.

Motivation

The seismo-electrokinetic method is a new, mobile and inexpensive geophysical method, which can be used for the detection of groundwater located at a shallow depth. The method not only determines the porosity of a water-saturated layer, but also its permeability. A special instrument was built to record electro-kinetic effect (EKE) signals. New mathematical equations of the EKE phenomenon in water-saturated layers have been determined and software was developed, using Fortran, which can use the presented model for the interpretation of field data. This project is directed to develop and test the seismo-electrokinetic method equipment and to develop software for interpretation of field data.

Progress

The dynamic diapason on the instrument (Tsikl-5) was not suitable for registering EKE signals in the field, so the instrument was sent back to Novosibirsk in Russia for further development. The working instrument has been tested in the field and in laboratory conditions, and strong and stable signals were recorded which are caused by the water-saturated layer. An increase in amplitude in the EKE signal was observed along the profiles which was related to an increase in the thickness of the water-saturated layer. The repeatability of the signals was very good.



EKE signals generated by refracted wave in sediments with imperfect relation between the components.

Software1: Initially the software was not adapted to record field signals, but the supplier has sent a newer version which now works.

Software2: The results of mathematical modelling and interpretation of field data using an older version of software2 proved that this software worked. New software was then developed in MATLAB® in order to accelerate calculations, and improve the visualisation of results of the mathematical modelling.

Conclusions

As the instrument was tested at different sites and has the ability to record EKE signals in water-saturated layers, it can be used in the seismo-electrokinetic method. The software has been suitably modified to increase calculation time and for the modern visualisation of mathematical modelling data. The software can also be used for the manual interpretation of EKE data.

Future activities

At present the instrument can be used for the seismo-electrokinetic method, but it is very important to continue testing this instrument using another source of impact (for example

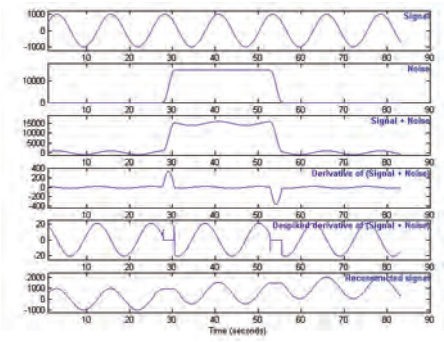
the Betsy-gun) or a new device for the excitation of seismic waves which could be built. This will allow us to reach impact signals with equal amplitude and form. Software development will continue to include the calculation of the EKE generated by the reflected waves and surface waves, as well as the development of an automatic inversion for the interpretation of EKE data in a dialogue regime. It is recommended that the vertical component of the electrical field occurring in the vicinity of the shot point, and recorded by vertical located electrodes, be included in the calculation.

0855 NEW PROCESSING TECHNIQUES FOR MAGNETOTELLURIC DATA — A DESK STUDY

Project leader: J. Cole, M.Sc.
Project team: P. Cole, M.Sc., E.H. Stettler, Ph.D.
Objectives: to study new processing techniques.
Duration: 2004/2005.
Budget: R1 500.

Motivation

The CGS is involved in the Southern African Magnetotelluric Experiment (SAMTEX), an international project that is aimed at studying the lithosphere and crust underneath the Kaapvaal Craton. Unfortunately, many of the measuring stations are located in the vicinity of DC railway power lines and mines. Electromagnetic fields generated by railway lines and mining activity severely affect the quality of the data. Existing processing techniques are mainly based on the Fourier Transform, but this method is suitable for processing continuous harmonic signals and cannot deal with the noisy data.



Progress

A software application was developed in MATLAB® to view and extract sections of raw magnetotelluric data. A number of different approaches were tried, but did not provide good results. The first approach was to apply wavelet denoising algorithms to the data. In this technique the data are transformed into "approximation" and "detail" coefficients, with the noise constrained to the "detail" coefficients. The detail coefficients are then suppressed and the signal is reconstructed using the remaining coefficients. It was found that this approach damaged the data, and the reconstructed signal could not be correlated with the original signal at all. Another approach was to carry out simple thresholding of the data. This was done by calculating the derivative of the electrical signal, removing the noise which now appears as localised anomalies, and integrating to get the electrical field again. Tests on synthetic data showed that this process once again damaged the data. The figure shows an example of this technique using synthetic data.

Conclusions

Signal processing techniques alone will not provide satisfactory results. It is essential that the characteristics of the electromagnetic fields of natural and man-made sources be studied and taken into account during any denoising process.

Future activities

The project team will embark on a detailed study of the electromagnetic characteristics of manmade and natural sources, and find ways to distinguish between these.

0841 IN-SITU DENSITY MEASUREMENTS

Project leader: C.J.S. Fourie, M.Sc.
Project team: P. Cole, M.Sc.
Objectives: to carry out in-situ regolith-density measurements using seismics.
Duration: 2004/2005.
Budget: R16 900.

Motivation

The project addresses shortcomings in traditional geophysical techniques with respect to problems in soil mechanics. Traditional techniques tend to be expensive, and are not necessarily accurate enough. In-situ density measurements using seismics is a promising technique which can provide solutions to these problems.

Progress

Equipment for the project, including a Geometrics Strataview seismograph, was purchased where possible. The weights and base plate with geophone connectors required for the project were constructed in the CGS's workshop.

The software was tested in MATLAB®, and then written in Visual Basic. This software was extensively tested, and enables the user to have many flexible options for the processing and interpretation of the data.

Field tests were performed successfully, and a report was completed, detailing all the results.

Conclusions

This project has received considerable interest from the scientific community. Results were presented at Geoscience Africa 2004 in Johannesburg. The results of the project are at this stage promising, and this technique may be able to answer more questions related to soil mechanics than previously envisioned, for example the Small Movement Elasticity Modulus, which is the main parameter that civil engineers use for structural design.

Future activities

The project will continue during the 2005/2006 technical programme.

18 SEISMOLOGY UNIT

0184 SEISMOLOGICAL MONITORING ANALYSES AND BULLETIN, COMPILATION OF CATALOGUE AND DATABASE OF SOUTH AFRICAN AND SADC SEISMICITY, AND ENHANCEMENT OF SEISMIC MONITORING CAPABILITIES

Project leader: I. Saunders, N.Dip. (Geotechnology).

Project team: L. Buso, N.Dip., B.E. Sutherland, T.T. Molea, L. Brink, E. Hattingh, M.Sc., M.R.G. Smith, B.Sc. Hons., M.B.C. Brandt, M.Sc. and M. Bejaichund, B.Sc.Hons.

Objectives: 1) The continued operation of the SANSN is essential for providing daily reports on the seismic activity of the earth's crust in South Africa. The information obtained is distributed in the form of quarterly bulletins and catalogues. The seismological activity monitored by SANSN provides the valuable data that are required for Seismic Hazard Analysis and insurance claims. Seismological data from the SANSN are preserved for prosperity through a National Earthquake Database and are presented in earthquake catalogues of Southern African Seismicity and SADC bulletins.

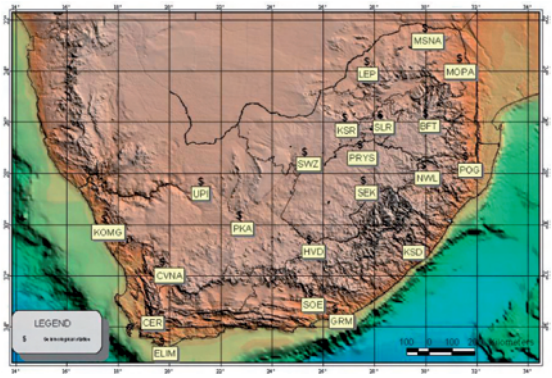
2) The development of a local magnitude scale and moment magnitude scale for South Africa.

Duration: 2004/2005.

Budget: R 1 278 895.

Motivation

The South African National Seismograph Network (SANSN) provides essential information regarding the seismicity and its distribution within the borders of South Africa. The information obtained through the analysis is shared nationally and internationally with interested parties through quarterly seismological bulletins and seismic catalogues. The information gathered through the SANSN is archived in the South African National Seismological Database (SANSB). The SANSB is required as input for Seismic Hazard Analysis, is used by the insurance industry and can be used for research to better understand the seismicity of South Africa. It is also required as input for the SADC bulletin.



A map of the South African National Seismograph Network.

The South African National Seismograph Network (SANSN) was recently upgraded to extended short-period and broadband seismographs to improve the monitoring capabilities of the network.

Local Richter magnitude is calculated with the formula $M_L=\log_{10}(A)+1.11\cdot\log_{10}(D)+0.00189\cdot D-2.09$, where A is the true ground motion in Nm on a simulated Wood-Anderson standard seismograph, and D is the epicentre distance in km. The development of Local and moment magnitude scales for South Africa will enhance the accuracy of the magnitudes recorded by the improved SANSN.

The SANSN serves as a training ground to equip analysts with the necessary skills to undertake more advanced projects. The analysis of the data gathered through SANSN and the published results contribute towards the Thrust of Geoscience Mapping and Physical Geohazards.

Progress

The SANSN provided information on earthquake activity in South Africa by releasing quarterly seismological bulletins for 2004. The seismological data obtained from the SANSN are used for Seismic Hazard Analysis studies, the insurance and engineering industries, and are published in the 2004 SADC bulletin. Four local students and two from Mozambique received seismological training during the financial year.

The development of local magnitude and moment magnitude scales for South Africa is essential, but is currently delayed until sufficient data are available.

Future activities

Stricter quality-assurance principles will be implemented during the 2005/2006 year. A method of automatic phase identification is under investigation to aid analysts and expedite the location of earthquakes. More advanced training of analysts in earthquake seismology will be introduced in order to add value to the project.

The upgrade of the SANSN to extended short-period and broadband seismographs has recently been completed. Once the upgraded SANSN has recorded a sufficient number of small, medium and large earthquakes, a new attempt will be made to develop local magnitude and moment magnitude scales with this improved data set. The new magnitude scales must also be tied in with the body wave magnitude mb as reported by the National Earthquake Information Centre (NEIC) of the USGS.

Table 1: List of natural earthquakes larger than ML=3 for the period April 2004 to March 2005.

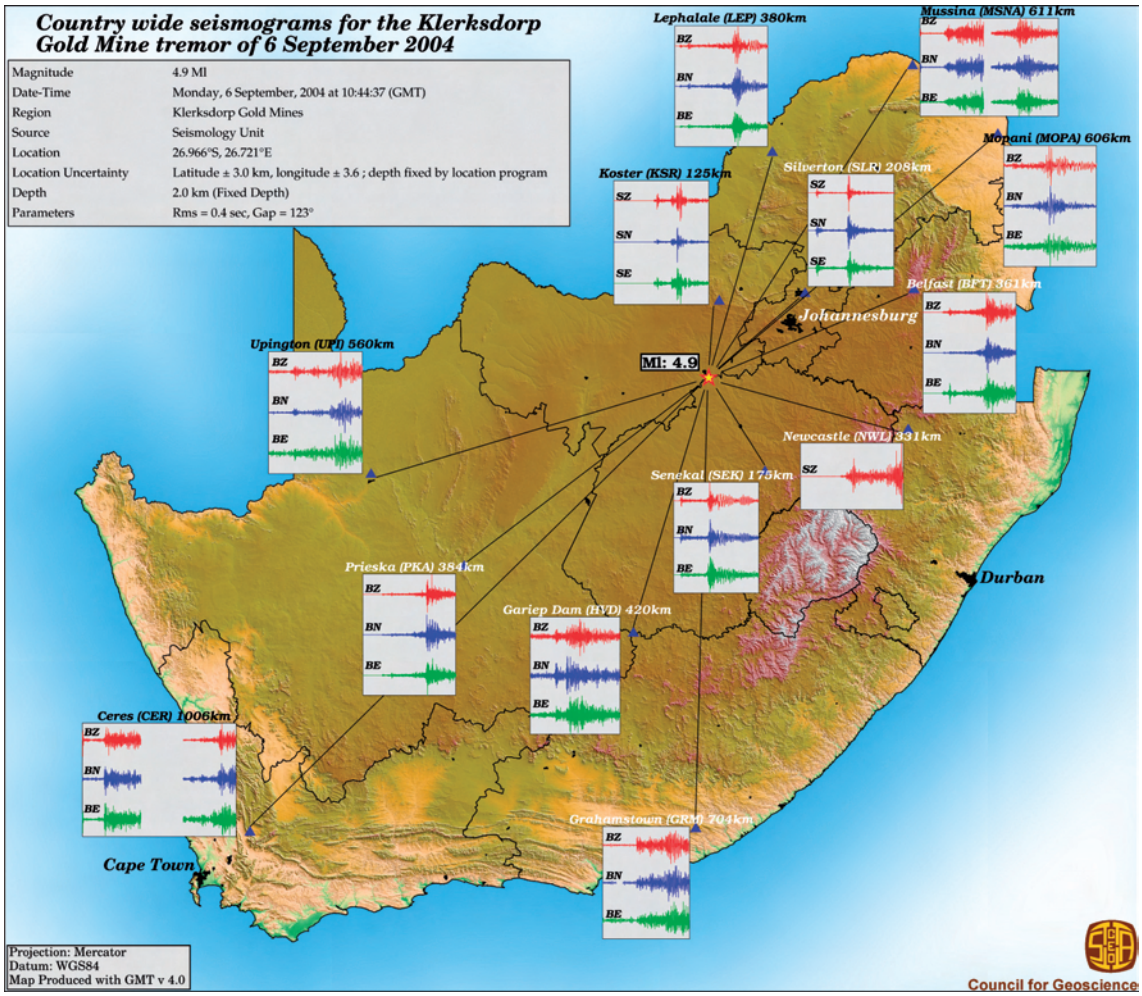
Date	Time	Region	Magnitude (ML)
2004/04/12	13:34:46	Koffiefontein	3.1
2004/04/17	04:34:16	Thabazimbi	3.2
2004/04/24	01:17:41	Witsand, W. Cape	3
2004/05/07	20:32:35	Indian ocean	3.7
2004/05/24	11:16:50	Bloemhof	3.1
2004/06/13	13:52:13	Swaziland border	3
2004/06/14	15:06:21	Central Botswana	3.1
2004/06/19	18:32:26	Lesotho	3.2
2004/06/20	12:53:49	W. of Burgersdorp	3.4
2004/06/27	15:08:19	Koffiefontein	3.6
2004/07/14	02:00:41	Phalaborwa, Limpopo	3.4
2004/07/15	06:46:43	GaRamela, Limpopo	3.6
2004/08/04	06:02:51	Gariep Dam	3.2
2004/08/09	09:39:03	Hantam, N. Cape	3.2
2004/09/01	11:55:29	Bokkeveldberge, N. Cape	3
2004/09/02	12:06:35	Gordonia, N. Cape	3
2004/09/03	15:14:03	Griekwastad, N. Cape	3
2004/09/05	15:58:15	Mafikeng, North West Province	3.2
2004/09/10	20:42:05	Thabazimbi, North West Province	3.8
2004/09/10	22:42:02	Kgatleng, Botswana	3.3
2004/09/15	12:56:05	Griekwastad, N. Cape	3
2004/09/16	12:45:04	Swartkop, N. Cape	3.2
2004/09/17	20:29:08	Amandelboom, N. Cape	3.1
2004/10/08	02:00:56	Bushmanland, N. Cape	3.3
2004/10/10	07:30:43	St Helena Bay, W. Cape	3.6
2004/10/12	10:11:17	Olifantshoek, N. Cape	3
2004/10/13	12:43:37	Rustden, W. Cape	3.2
2004/10/13	14:46:40	Gariep Dam	2
2004/10/15	02:00:35	Soutpansberge, Limpopo	3.2
2004/10/16	12:34:51	Soutpansberg, Limpopo	3
2004/10/18	11:35:47	Great Karoo, N. Cape	3
2004/10/22	06:29:02	Mahwelereng, Limpopo	3
2004/10/22	23:24:23	Klein-Karoo, W. Cape	3.7
2004/10/27	12:21:12	Tulbagh, W. Cape	3.7
2004/10/29	02:00:34	Kareedouw, E. Cape	3.1
2004/10/30	10:35:30	Indian ocean	3.4
2004/10/31	14:12:35	Offshore East London	3.1
2004/10/15	02:00:35	Soutpansberge, Limpopo	3.2
2004/10/16	12:34:51	Soutpansberg, Limpopo	3
2004/10/18	11:35:47	Great Karoo, N. Cape	3
2004/10/22	06:29:02	Mahwelereng, Limpopo	3
2004/10/22	23:24:23	Klein-Karoo, W. Cape	3.7
2004/10/27	12:21:12	Tulbagh, W. Cape	3.7
2004/10/29	02:00:34	Kareedouw, E. Cape	3.1
2004/10/30	10:35:30	Indian ocean	3.4
2004/10/31	14:12:35	Offshore East London	3.1
2004/11/06	05:51:37	Kliprand, W. Cape	3
2004/11/08	14:33:34	Grootvloer, N. Cape	3
2004/11/12	02:00:52	Makhuya, Limpopo	3.1
2004/11/18	08:07:48	Waterberge, Limpopo	4.1
2004/11/18	14:34:45	Indian ocean	3.2

2004/11/22	02:00:36	Roggeveld Mountain, W. Cape	3.4
2004/11/25	18:03:52	Pearston, E. Cape	3.6
2004/11/28	03:25:41	Indian ocean	4.2
2004/11/30	07:57:53	Koffiefontein	4.7
2004/11/30	08:19:14	The Overberg, W. Cape	3
2004/12/03	18:04:59	Rustenburg	3.1
2004/12/07	02:00:50	Touwsrivier	3
2005/01/07	18:25:10	Lesotho border	4.2
2005/01/09	23:16:25	Koffiefontein	3.9
2005/01/11	08:09:52	Namibia	4.2
2005/01/13	03:40:17	Magaliesburg	3.8
2005/01/15	03:19:42	Heidelberg	3.2
2005/01/16	18:51:37	Memel	3.5
2005/01/17	13:52:35	Williston	3.1
2005/01/24	09:27:28	Atlantic ocean	3.6
2005/02/18	23:10:57	Bushmanland	3.4
2005/02/20	04:48:52	Ceres	3.4
2005/02/26	13:48:38	Amandelboom	3.5
2005/02/27	02:54:38	Prince Alfred Hamlet	3.3
2005/03/04	04:49:51	Mokgalwaneng	3.5
2005/03/17	16:18:59	Rustenburg	3.2

Table 2: List of mining-related earthquakes larger than ML=4 for the period September 2003 to March 2005.

Date	Time	Region	Magnitude (ML)
2003/10/11	13:32:47	Free State	4.2
2003/11/27	12:21:11	Klerksdorp	4.0
2004/01/13	04:09:37	Klerksdorp	4.0
2004/03/23	22:54:59	Klerksdorp	4.1
2004/04/30	21:47:38	Free State	4.1
2004/09/06	10:44:37	Klerksdorp	4.9
2005/01/08	06:01	Free State	4.2
2005/01/25	20:10	Klerksdorp	4.2
2005/02/18	01:08	Klerksdorp	4.2
2005/03/09	12:15	Klerksdorp	5.3
2005/03/09	18:47	Klerksdorp	4.5

Map showing the sensitivity of the stations within the South African National Seismograph Network to an earthquake that occurred in the gold-mining region on 6 September 2004.



0475 THE COLLECTION OF SEISMOLOGICAL DATA AND MAINTENANCE OF THE NATIONAL SEISMOGRAPH NETWORK

Project leader: J. v L. Pretorius, Nat. H.Dip.Elec.Eng.

Project team: D. Ngcobo, Nat.Dip.Elec. Eng., M. Ndyamba, Nat.Dip. Elec.Eng., J. van Rhyn.

Objectives: to maintain and upgrade the National Seismograph Network.

Duration: Ongoing.

Budget: R924 000.

Motivation

The South African National Seismograph Network must be maintained continuously to produce high-quality data at a high station availability. The data is published regularly in bulletins and as seismic-hazard maps.

Progress

The project will be ongoing. The South African National Seismograph Network has expanded to twenty-one stations. The SANSN detection capabilities will now cover the whole of South Africa.

Future activities

As communications and data transfers are still very cumbersome and expensive, new technology will have to be introduced to collect data from the seismograph stations. The internet or satellite communications will be utilised to enable the central data centre to receive near real-time continuous data that could be used in a system for early warning for disaster-management projects.

5414 OPERATION AND MAINTENANCE OF THE PRIMARY AND AUXILIARY SEISMIC STATIONS AT BOSHOF, SUTHERLAND AND IN THE ANTARCTIC

Project leader: J. Steyn, M.Dip.Tech. (Elec.Eng.).

Researchers: J.J. du Plessis, B.Com., A. Graham, Nat.Cert.(IT), D.L. Ngcobo, N.Dip.(Elec. Eng.), D.L. Roblin, B.Sc.Hons, M.R.G. Smith, B.Sc.Hons.

Objectives: to maintain the International Monitoring System (IMS) stations at Boshof, Sutherland and the SANAE base in the Antarctic, and ensure a continuous flow of seismic data from the remote sites to the International Data Centre (IDC) based in Vienna, Austria. The objective of the National Data Centre's (NDC) operations is to apply computer software packages, developed by the IDC, to meet the requirements of the Protocol of the Treaty and of the Operational Manual for the IDC.

Duration: ongoing.

Reporting Year: First.

Budget: R220 000 (funded by the CTBTO).

Motivation

As part of South Africa's commitment to the Treaty, the CGS is designated to act as a tech-

Satellite dish at the Boshof station.

nical point of contact with respect to seismological and infrasound matters and also to operate a National Data Centre which functions within the framework as required by the Comprehensive Nuclear-Test-Ban Treaty Organisation (CTBTO). The CGS's obligation furthermore is to manage the various components within the project and ensure continuous data flow and availability from the seismograph facilities. Apart from the CGS's active participation in CTBT matters, the operation of an NDC and analysis of seismic data, obtained from the local and neighbouring National Data Centres which all form part of the IMS, contributes towards international cooperation and enhances the corporate image of the CGS.

Progress

The seismic station at Boshof was upgraded during July 2004. The software at the central site in Pretoria was also upgraded to accommodate the CD1.1 data format. After the CGS has obtained licenses to transmit the seismic data by satellite to the United States NDC and the IDC in Vienna, the station was tested at the IDC. Seismic data from the Boshof station were received at the IDC on 22 September 2004, and officials of the IMS visited South Africa early in October 2004 to inspect the station and facilities for certification. The Boshof seismograph station was certified on 21 December 2004, indicating that the station and operations comply with the CTBTO requirements. The contract for the Testing and Evaluation and Post-Certification Activities for PS39 between the Preparatory Commission for the CTBTO and the CGS was signed on 24 December 2004.

Conclusions

The Boshof seismograph station was certified because of the reliability of the data communications infrastructure that was established during 2004, as well as the quality of seismic data that are being reproduced from the borehole seismometers at the remote station.

Future activities

As the terms of reference are well defined under the contract, staff from the CGS working on this project, will perform their tasks with dedication as prescribed in the procedures. Certain technical additions, for example remotely monitoring system performances and data flow to the IDC, will be proposed to IMS Operations. Improving the operational environmental conditions at the remote site is also planned for 2005.

0774 RELATIVE LOCATION OF SEISMIC EVENTS: THEORY AND ITS APPLICATION FOR SOUTH AFRICAN SEISMICITY

Project leader: E. Kgaswane, M.Sc.

Researchers: E. Kgaswane, M.Sc., M. Bejaichund, B.Sc.Hons.

Objectives: to modify and test the relative location procedure (RLP) developed as part of the Seismology Unit's Statutory Project for 2003/2004.

Duration: 2004/2005.

Budget: R10 495.

Motivation

The relative location software is an earthquake-location tool designed for significant improvement (to better than 1 km) for the location of local mining-induced events. This method is based on the relative-location technique (Spence, 1980; Gibowicz and Kijko, 1994). Its advantage over any other location tool is that systematic biases (velocity modelling errors) which are the principal cause of source-location errors are implicitly isolated. Moreover, an increase in accuracy will not require an extension of the existing National seismic network.

In line with the proposed CTBTO technical programme, a number of objectives have further been identified to test the suitability of crustal models in the relative location technique. Some of these objectives are largely a continuation of earlier work (Kgaswane, 2002).

Progress

The locations based on relative-location procedure (RLP) show an average of 59 per cent improvement in location with respect to the standard locations (SEISAN) for the mining events from the Far West Rand mining region, while there is a 48 per cent improvement for the Klerksdorp mining area. A combined average shows a 53,5 per cent improvement.

The relative-location technique in its current form would be sufficient to be used as an al-

ternative to "standard" locations (SEISAN). However, its application at this stage would be restricted to local seismicity that is clustered or swarms of earthquakes with known master events. In addition, the routine application of RLP will require further built-in features that will rapidly enable the choice of a suitable master event for each slave event. This built-in facility should also be able to automatically allocate weights and remove stations/phases with large outliers or residual anomalies without necessarily compromising suitable azimuthal station geometry around the source area. A corresponding up-to-date catalogue will also be required from the mines as a means of calibrating the master event.

Future activities

At this stage there is no formal proposal to continue this project to the next technical year; however, there will be efforts in the background aimed at enhancing the capacity of the relative-location algorithm. In light of the significantly improved locations obtained, it is possible that the algorithm will be used for all future routine analyses.

References

GIBOWICZ, S.J. and KIJKO, A. 1994. Introduction to Mining Seismology. Academic Press, San Diego.

KGASWANE, E.M., 2002. Quality checks of P and S travel times - implications for reliable location estimates. Internal Report, 2002-0260.

SPENCE, W., 1980. Relative epicenter determination using P-wave arrival-time differences. Bulletin, Seismological Society of America, 70, pp. 171–183.

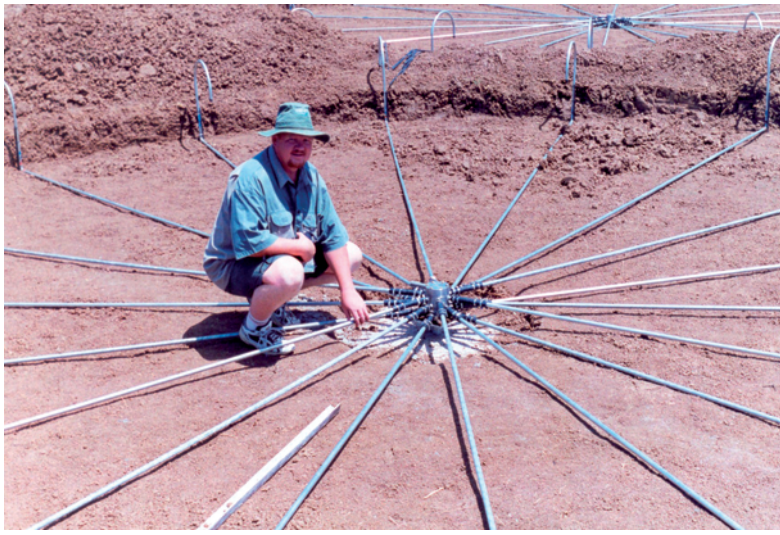
5415 INFRASOUND STATION IS47

Project leader: C.R. Randall, M.Sc., H.E.D., Dip.Data.

Researchers: J. Pretorius, Nat.H.Dip. (Elec Eng.), E. Kgaswane, M.Sc, D. Roblin, B.Sc.Hons., J. Steyn, Nat. H.Dip. (Elec Eng.), D. Ngcobo. Nat.Dip. (Elec Eng.).

Objectives: to install and operate the infrasound station IS47 in Boshof.

Duration: 2004/2005.



A closer view of the piping at a rosette, with the 18-to-1 manifold at the centre. Pressure from the eighteen open ends is averaged at this manifold.

Budget: 3 500 000 (funded by the CTBTO).

Motivation

Infrasound station IS47 is one of the 60 infrasound stations of the IMS (International Monitoring System) of the CTBTO (Comprehensive Nuclear-Test-Ban Treaty Organisation). The technology of infrasound (very low-frequency sound waves) is important in the detection of atmospheric nuclear explosions and complements the other technologies chosen by the CTBTO — seismic, hydroacoustic and radionuclide — for monitoring adherence to the Comprehensive Nuclear- Test-Ban Treaty of 1996.

Progress

The project is almost complete.

Conclusions

This project is part of an increasing cooperation of the CGS with the CTBTO, and entails a gain in knowledge, skills, contacts and money for the organisation.

Future activities

The CGS expects to sign a maintenance contract for IS47 in 2005 (in addition to the present one for the seismic station PS39 at Magdalenas-Rust), and this responsibility should continue for

many years. The amount for the first year will probably be in the order of R300 000.

0784 RE-EVALUATION OF EPICENTRES OF HISTORICAL EARTHQUAKES

Project leader: M.B.C. Brandt, M.Sc.

Project team: M. Bejaichund, B.Sc. Hons., E.M. Kgaswane, M.Sc., E. Hattingh, M.Sc., D.L. Roblin, B.Sc.Hons.

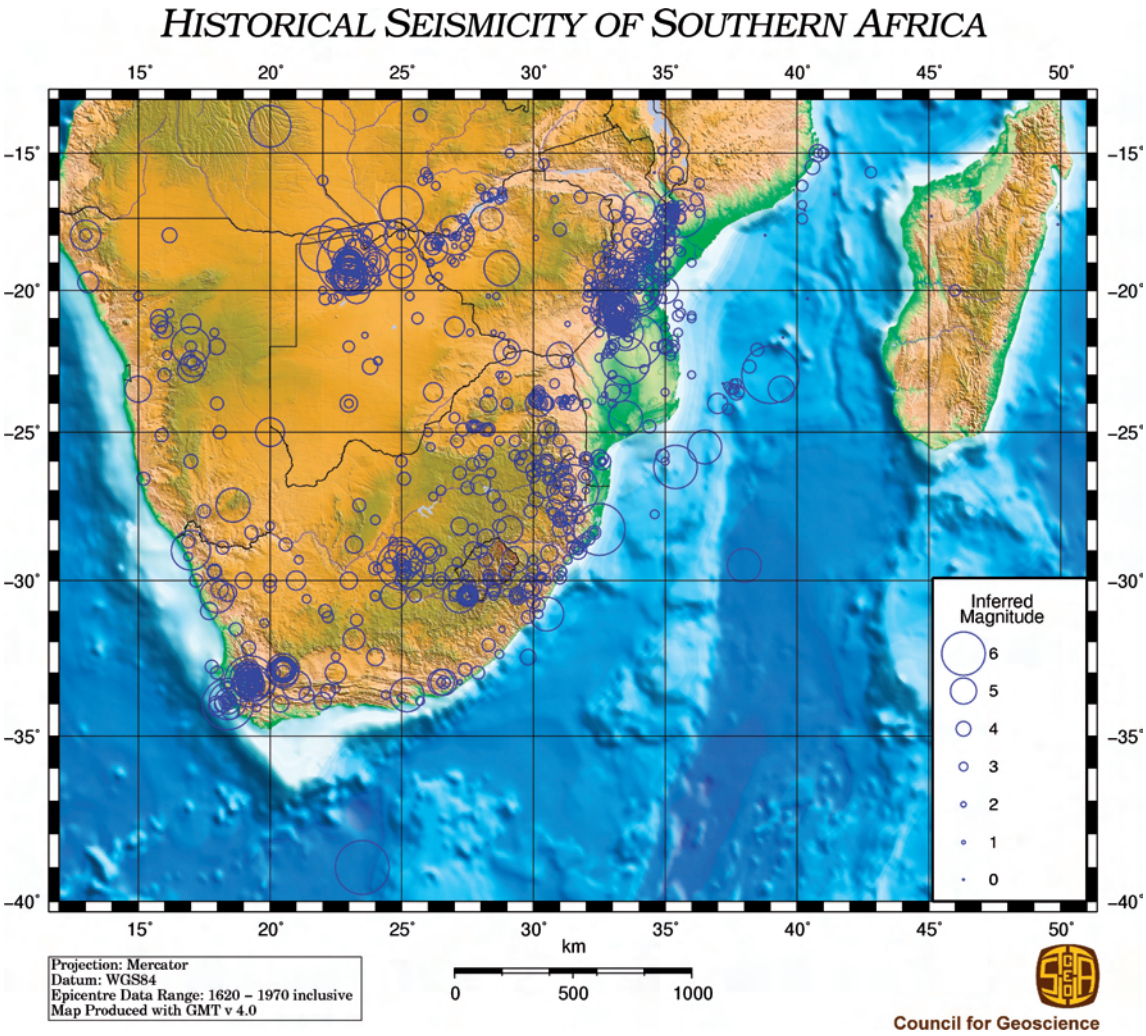
Objectives: to update Seismologic Series No. 9, Seismic History of Southern Africa, with new and re-evaluated information on historical earthquakes for the period 1620 to 1971. This, updated historical earthquake catalogue will be used to gain a better insight into the seismicity and tectonic processes in southern Africa. It will be used for seismic-hazard assessments for future advanced infrastructure such as dams and nuclear-power plants.

Duration: 2003/2004–2004/2005.

Budget: R12 369.

Motivation

According to Fernandez and Guzman (1979), Seismologic Series No. 9, Seismic History of Southern Africa, the inhabitants of the city of Cape Town experienced moderate to large earthquakes during the period 1620 to 1902.



An earthquake in 1809 caused damage to the city. The nearby Ceres–Tulbagh region, in turn, experienced moderate to large earthquakes during the second part of the 20th Century. A re-evaluation of historical seismicity to re-evaluate the epicentres for the historical earthquakes is thus crucial for an accurate seismic-hazard analysis for the southwestern Cape region. The motivation for this project is to find new sources of historical earthquakes and re-evaluate the existing sources to ensure that any bias brought about by unclear historical reporting is removed. An updated historical earthquake catalogue will be compiled to provide an accurate reflection of historical accounts of earthquakes for the whole of southern Africa.

Progress

For the period 1620 to 1902 the seismological information contained in Theron (1974) was re-evaluated and the epicentres and intensities listed in Finsen (1950) were improved. This was achieved by re-evaluating the original sources described below. Publications only recently discovered by De Klerk and Read (1988) were used to re-evaluate one event and update the catalogue with 19 previously unknown earthquakes, six of which were from the Cape Town region. Additionally, one previously unknown event was discovered in Russel (1971). All the major earthquakes for the period 1900 to 1930 were updated with re-appraised information published by Ambraseys and Adams (1992): four events were updated and three previously unknown events were included. Epicentres and intensities listed in Finsen (1950) were improved for the 20th Century. Small earthquakes for the period 1903 to 1930 and all the events from 1931 to 1970 have been taken from the former catalogue, Seismologic Series 9, without modification except for changes to place names and to improve readability. For the 20th Century, 27 previously-unknown events were discovered, 26 in De Klerk and Read (1988) and one in Frankel (1936). The catalogue was updated with one event from De Klerk and Read (1988) and with events only recently published by the International Seismological Centre for the period 1964 to 1970, which also involved previously excluded events reported by the Goetz Observatory.

The updated Seismic History of Southern Africa was submitted for publication on 18 January 2005.

Conclusions

The updated historic earthquake catalogue will improve the seismic-hazard assessment for future advanced infrastructure, such as large dams and nuclear-power plants.

Future activities

The updated Seismic History of Southern Africa (new Seismologic Series) will be published in 2005/2006.

0849 ACQUISITION AND TESTING OF SEISMIC ARRAY PROCESSING SOFTWARE

Project leader: M.B.C. Brandt, M.Sc.

Objectives: to acquire and test array processing software for use in analysis of data from a seismic array.

Duration: 2004/2005.

Budget: R7 000.

Motivation

Data from seismic arrays can be processed as multichannel records. Processing algorithms include, for example, F-K analysis, stacking and signal (arrival) enhancement, regional and teleseismic travel-time estimation and group filtering. Array processing software might be applied to a future small-aperture array which could be used in addition to the South African National Seismograph Network to enhance the seismic-monitoring capabilities for southern Africa.

Progress

A free trial version of the Seismic Network Data Analysis Software for Linux was obtained from the SYNAPSE Science Centre, Russia. However, owing to the high cost of purchase, the use of this software was abandoned.

The Geotool software was obtained from the Comprehensive Nuclear-Test-Ban Treaty Organisation (CTBTO). The F-K analysis module (array processing software) of the Geotool software was tested on an array consisting of nine elements (vertical, short-period seismographs) which was set up inside the electronics laboratory. The software performed well, but some

timing problems have been identified in the equipment setup.

Conclusions

The F-K analysis module (array processing software) of the Geotool software was found to be capable of analysing data from a seismic array.

Future activities

A possible, future, dedicated nine-element array could be set up near the International Monitoring System (IMS) station of Boshof.

0862 DEVELOPMENT OF A PROCEDURE AND SOFTWARE FOR THE GENERATION OF SYNTHETIC (MONTE-CARLO) SEISMIC-EVENT CATALOGUES

Project leader: A. Kijko, Ph.D.

Researchers: M. Bejaichund, B.Sc.Hons.

Objectives: to develop a procedure and a user-friendly computer program (written in MATLAB®) for the generation of synthetic (Monte-Carlo) seismic-event catalogues. These catalogues would be able, for a specific seismically active area, to model its spatial, temporal and earthquake-size distribution.

Duration: 2004/2005.

Budget: R5 300.

Motivation

Monte-Carlo-simulated catalogues are essentially computer-generated seismic-event catalogues. The procedure is governed by certain criteria and seismicity parameters entered by the user, such as the seismicity of the area, maximum regional magnitude m_{max}, mean activity rate, b value of the frequency magnitude Gutenberg Richter distribution, completeness of the data and the location of mining areas.

The current South African seismic-event catalogue dates back almost 400 years. Often reinsurance companies and engineers would like an idea of the seismic hazard expected in, for example, 10 000 years, which can be assessed by statistical analysis. With a Monte-Carlo catalogue one can test results obtained from a seismic hazard assessment. It would also allow for the testing and verifying of seismic hazard and seismic risk maps.

Progress

The project is complete and a report has been published.

Conclusions

The developed technique makes it possible to take into account incompleteness of the existing seismic-event catalogues and uncertainty of mathematical models describing spatial, temporal and size distribution of seismic events. The developed code can generate two types of synthetic data; data used by program HAZARD AREA (HA) and data used by program HAZARD SITE (HS). The programs HA and HS are routine software used by the CGS for seismic-hazard assessment.

Future activities

The developed technique will make it possible to estimate the seismic hazard expected in 10 000 years, for example as a service to reinsurance companies and engineers.

0863: USER MANUAL FOR "SYSTEM FOR SEISMIC-HAZARD ASSESSMENT"

Project leader: M. Bejaichund, B.Sc.Hons.

Researchers: A. Kijko, Ph.D., J. Ramperthrap, B.Sc.

Objectives: to create a user manual for the commercially available in-house-developed seismic hazard assessment software.

Duration: 2004/2005.

Motivation

This user-friendly unique software for seismic-hazard assessment was developed in-house and is now at a stage where it can be made commercially available. A user manual was thus required to accompany the software.

Progress

The project is complete, and the report "Seismic-hazard assessment and risk program: software package for seismic hazard and risk assessment" (2004-0285) has been completed.

The package has the following components:
Hazard for the Area (HA)
Procedure for the Generation of Synthetic Catalogues (MC)
Estimation of m_{max} (MMAX)

where HA is a MATLAB®-based computer program for seismic-hazard assessment at the area of interest, MMAX is a MATLAB®-based computer code for assessment of maximum regional earthquake magnitude, m_{max}, and MC (Monte-Carlo) simulated catalogues are essentially computer-generated catalogues, covering, for example, a duration of 10 000 years.

Future activities

The software is readily available to the public for seismic-hazard assessment of any area of concern.

19 SPATIAL DATA MANAGEMENT UNIT

DEVELOPMENT AND IMPLEMENTATION

0794 GEOPORTAL DEVELOPMENT

Project leader: K. Wilkinson, H.Nat. Dip. (Cartography).

Project team: L.G. Wolmarans, B.Sc.Hons., H.J. Brynard, Ph.D., A.J. Voors, Nat.Dip.(Cartography), C.W. Ries, B.Sc.Hons. GIS and Geology, R. van Rooyen, B.Sc. Hons., S. Tucker, Dip.S.B.M. (Damelin).

Objectives: to develop and implement a portal for the dissemination of earth-science and related data.

Duration: 2004/2005.

Budget: R168 433.

Motivation

During 2004 the Spatial Data Management (SDM) Unit initiated a project to establish a Geoportal that will enable users within the CGS to access different applications and data provided by the SDM Unit. The first phase of this project entailed the compilation of a comprehensive user-requirements document that would serve as a basis upon which the management of the CGS could make a decision whether to progress with the project or not. In view of the apparent preparedness of management to advance with the project, it was decided as a next step to design a preliminary rudimentary portal that would provide access to existing applications. These include the Geohydrological Data Access System (GDAS) that was developed under the completed NORAD Programme, and the Geohazards Enquiry System that was recently initiated in collaboration with the KwaZulu-Natal regional office. This system, when completed, will provide access to a geohazards map service and will enable users to make enquiries as to the geotechnical properties of their residential location.

Future activities

The internet portal should be completed during 2005/2006.

0276 METADATA SERVER TECHNOLOGY

Project leader: H.J. Brynard, Ph.D.

Project team: L.G. Wolmarans, B.Sc.Hons., A.J. Voors, Nat.Dip.Cartography.

Objectives: to develop web map services.
Duration: ongoing.
Budget: R79 800.

Motivation

For users of spatial data it is important to obtain information on the nature and content of data before looking at or purchasing such data. For this reason metadata is of extreme importance. Metadata merely contains information on the structure, content and lineage of spatial data. The CGS has for some time been at the forefront of supplying metadata to users. Modern technology has made metadata even more accessible by means of the MetadataExplorer that forms part of the ArcIMS map server software. This technology enables the user to view metadata via an Internet browser where metadata can be selected using either text-driven dropdown menus or by selecting an area on an overview map.

Metadata of most of the spatial data sets in the CGS's spatial data have been compiled to date. MetadataExplorer is presently available to users within the CGS head office through the Intranet, and will be made available to the general public on the Geoportal when this is completed.

0664 DEVELOPMENT OF A MINERAL-LEASE MANAGEMENT SYSTEM

Project leader: H.J. Brynard, Ph.D.

Project team: Contractors.

Objectives: to develop a Mineral Lease System for the Department of Minerals and Energy (DME).

Duration: 2003/2004–2004/2005.

Budget: R82 416.

Motivation

During 2002 the CGS initiated the development of the National Mineral Lease Management System required to administer applications for mining and exploration permits and rights, and to support the requirements of the new Act. A contractor was requested by the CGS to write the software and application development, and a prototype of the system has been completed and implemented at the Department.

The system developed meets several client needs and allows total integration of spatial and non-spatial data and provides for easy data maintenance. The system will allow the DME to spatially visualise and present the critical information relating to the measure of empowerment of disadvantaged communities, and will also identify areas already occupied by prospecting and mining rights.

Progress

The project is now complete, and the system is fully operational at DME.

GEOHAZARDS ENQUIRY SYSTEM

Geohazards are defined as geological or geomorphological processes that usually occur comparatively suddenly, that threaten lives, property and strategic infrastructure. In view of the strategic importance of the geohazards data in the custody of the CGS it was decided that such data should be made available to the general public. With this in mind it was decided to develop a simple prototype Geohazard Enquiry System that comprises an interactive Internet-based map viewer. This system will allow the user to home in on his property using guiding maps and to select an area of interest underlying his property. The user will then be shown what the cost of the enquiry will be and, if satisfied, he will be presented with payment options for the transaction, upon which he will be able to obtain a report on the relevant geotechnical properties of the selected site. The latter part, dealing with the commercial aspect, has not yet been developed and will be done through a private commercial enterprise.

This system will be made available on the CGS Geoportal when completed, and will be used as a basis to develop a proposal for a longer-term investigation to develop a methodology to provide a range of geohazard products on a national basis using the current CGS data corpus.

1:250 000-SCALE GEOLOGICAL MAPPING — STATUS OF PRODUCTS.

Project number	Map title	Project leader and team	Progress
0014	2622 Morokweng	C.W. Ries, B.Sc.Hons., P. Msiza, C.S. Kgari, M.H. Sello, M. Letsoalo.	50%
0025	3226 King William's Town	C.W. Ries, B.Sc.Hons., C. Thomas, Nat.Dip. Cartography, P. Msiza, C.S. Kgari, M.H. Sello, M. Letsoalo.	100%
0034	2918 Pofadder	C.W. Ries, B.Sc.Hons., P. Msiza, C.S. Kgari, M.H. Sello, M. Letsoalo.	100%
0036	3018 Loeriesfontein	C.W. Ries, B.Sc.Hons., P. Msiza, C.S. Kgari, M.H. Sello, M. Letsoalo.	50%
0102	2426 Thabazimbi	C.W. Ries, B.Sc.Hons., P. Msiza, C.S. Kgari, M.H. Sello, M. Letsoalo.	50%
0268	3022 Beaufort West	D.M. van der Walt, B.Sc.Hons, P. Msiza, C.S. Kgari, M.H. Sello, M. Letsoalo.	100%
0720	2926 Bloemfontein	C.W. Ries, B.Sc.Hons., P. Msiza, C.S. Kgari, M.H. Sello, M. Letsoalo.	100%

1:50 000-SCALE GEOLOGICAL MAPPING — STATUS OF PRODUCTS.

Project number	Map title	Project leader and team	Progress
0769	3322CD George	C.W. Ries, B.Sc.Hons., P. Msiza, C.S. Kgari, M.H. Sello, M. Letsoalo.	50%

1:1 000 000-SCALE GEOCHEMICAL MAPS — STATUS OF PRODUCTS.

Project number	Map title	Project leader and team	Progress
0430	2916 Springbok	C.W. Ries, B.Sc.Hons., C. Thomas, Nat. Dip. Cartography, P. Msiza, C.S. Kgari, M.H. Sello, M. Letsoalo, M. Roos, B.Sc.Hons.	100%
0299	2528 Pretoria	C.W. Ries, B.Sc.Hons., C. Thomas, Nat. Dip. Cartography, P. Msiza, C.S. Kgari, M.H. Sello, M. Letsoalo, M. Roos, B.Sc.Hons.	100%
0714	2816 Alexander Bay	C.W. Ries, B.Sc.Hons., C. Thomas, Nat. Dip. Cartography, P. Msiza, C.S. Kgari, M.H. Sello, M. Letsoalo, M. Roos, B.Sc.Hons.	100%

1:50 000-SCALE GEOTECHNICAL MAPPING — STATUS OF PRODUCTS.

Project number	Map title	Project leader and team	Progress
0823	2429BA Ga-Maja	D.M. van der Walt, B.Sc.Hons., M. Roos, B.Sc.Hons., E. Dixon, Nat. Dip. Cartography, P. Msiza, C.S. Kgari, M.H. Sello, M. Letsoalo.	75%
0755	2429AB Nuwe Smitsdorp	D.M. van der Walt, B.Sc.Hons., M. Roos, B.Sc.Hons., E. Dixon, Nat. Dip. Cartography, P. Msiza, C.S. Kgari, M.H. Sello, M. Letsoalo.	75%
0758	2627BA Randfontein	C.W. Ries, B.Sc.Hons., P. Msiza, C.S. Kgari, M.H. Sello, M. Letsoalo.	100%
0620	2930CB Pietersburg	C.W. Ries, B.Sc.Hons., M. Roos, B.Sc.Hons., E. Dixon, Nat. Dip. Cartography, P. Msiza, C.S. Kgari, M.H. Sello, M. Letsoalo.	75%
0066	3318CB Melkbosstrand	C.W. Ries, B.Sc.Hons., M. Roos, B.Sc.Hons., E. Dixon, Nat. Dip. Cartography, P. Msiza, C.S. Kgari, M.H. Sello, M. Letsoalo.	100%
0565	3318DA Philadelphia	C.W. Ries, B.Sc.Hons., M. Roos, B.Sc.Hons., E. Dixon, Nat. Dip. Cartography, P. Msiza, C.S. Kgari, M.H. Sello, M. Letsoalo.	100%
0712	3118CD Cape Town	C.W. Ries, B.Sc.Hons., M. Roos, B.Sc.Hons., E. Dixon, Nat. Dip. Cartography, P. Msiza, C.S. Kgari, M.H. Sello, M. Letsoalo.	100%
0726	2926BA Sannaspos	C.W. Ries, B.Sc.Hons., M. Roos, B.Sc.Hons., E. Dixon, Nat. Dip. Cartography, P. Msiza, C.S. Kgari, M.H. Sello, M. Letsoalo.	100%
0685	2628AA Johannesburg	C.W. Ries, B.Sc.Hons., M. Roos, B.Sc.Hons., E. Dixon, Nat. Dip. Cartography, P. Msiza, C.S. Kgari, M.H. Sello, M. Letsoalo.	100%
0825	2926AB Maselspoort	C.W. Ries, B.Sc.Hons., P. Msiza, C.S. Kgari, M.H. Sello, M. Letsoalo.	50%
0782	2628CA Meyerton	C.W. Ries, B.Sc.Hons., P. Msiza, C.S. Kgari, M.H. Sello, M. Letsoalo.	50%
0802	2431CC Bosbokrand	C.W. Ries, B.Sc.Hons., P. Msiza, C.S. Kgari, M.H. Sello, M. Letsoalo, E. Dixon, Nat. Dip. Cartography, M. Roos, B.Sc.Hons.	50%

1:250 000-SCALE METALLOGENIC MAPS - STATUS OF PRODUCTS.

Project number	Map title	Project leader and team	Progress
0589	2726 Kroonstad	M. Roos, B.Sc.Hons., A. Voors, Nat.Dip.Cartography	65%

20 INFORMATION AND COLLECTIONS MANAGEMENT UNIT

GEOSCIENCE MUSEUM

Curators: A. Raath, Nat.Dip.,
M.M. Lekotoko, B.Sc.

The Geoscience Museum houses a collection of more than 29 000 gemstone, meteorite, mineral and rock specimens, of which approximately 9 000 specimens are currently on display. The meteorite and mineral collections, in particular, are among the most comprehensive in Africa and are internationally renowned, and the new "World of Minerals" display provides an exciting introduction to minerals and mineralogy.

During the past year the Geoscience Museum conducted a particularly active education programme, which included the following presentations:

- Laudium Heights Primary School Science Expo;
- Atteridgeville Outreach for International Museum Day;
- Career Awareness project in Mamelodi;
- Lehlabile Circuit Teachers and Brits Circuit Principals programmes;
- Museum Park Tourism Expo;
- Transvaal Museum Bugs Week;
- Pretoria Zoo fossils exhibition.

In addition, bonds were forged with the following Gauteng-based educational organisations:

- FEST Science Museum, Pretoria;
- Inkwe Ridge Observatory, Pretoria East;
- Johannesburg Planetarium;
- Museum Africa, and the Palaeontology 21 and Geology Museums, University of the Witwatersrand, Johannesburg
- University of Pretoria: Geology Museum and Discovery Centre.

PROMOTION

Unit Manager: D.J. Barnardo, M.Sc.,

Staff: R.R.M. Price, B.Sc.Hons.,
D. Motloi, B.A. (Pub. Admin.),
A.P. Oberholzer, B.A.

During the year the Unit provided input into or manned stands at a number of national and international expositions, conferences and workshops, including:

- 10–15 May 2004 — National Science Week 2004 (SET Week 2004) organised by the Department of Science and Technology. The events in Gauteng, Mpumalanga, Northern Cape and Western Cape were supported with CGS exhibitions.
- 6–9 July 2004 — A CGS exhibition stand at the West Africa Industrial Week, Accra, Ghana.
- 12–16 July 2004 — A CGS exhibition stand at the Geoscience Africa Expo, Wits University campus, Johannesburg during the annual conference of the Geological Society of South Africa.
- 20–28 August 2004 — A CGS stand at the 2004 GEOEXPO, Florence, Italy during the 32nd International Geological Congress (IGC32).
- 25 August–3 September 2004 — The Geoscience Museum of the CGS participated in the Museum Park stand at the annual Pretoria Show.
- 6–10 September 2004 — A CGS stand at the Mining Week of the Department of Minerals and Energy, during the Electra Mining Africa 2004 Trade Expo, held at the Expo Centre, NASREC, Johannesburg.
- 13–17 September 2004 — A CGS stand to promote geoscience as career was presented during the Geography Week at the Faculty of Education of the Pretoria University Groenkloof Campus.
- 21–22 September 2004 — A CGS stand to promote geoscience as career was presented during the Soweto Career Day and Expo 2004, at the Johannesburg University Soweto Campus.
- 27–29 September 2004 — A CGS stand to promote geoscience as career was presented during the 1st Gauteng Mathematics, Science and Technology Education Conference Cum Exhibition, Sci-Bono Science Centre, Newtown Cultural Precinct.
- 1–3 November 2004 — A CGS stand at the 1st International Innovation, Science and

Technology (INSITE) Fair, Department of Science and Technology (DST), Gallagher Estate. The CGS was also represented on the DST stand.
- 24–27 November 2004 — A CGS stand at the 7th International Mining and Machinery Exhibition (IMME 2004), Calcutta, India.
- 8–10 February 2005 — A CGS stand at the Investing in African Mining (INDABA 2005) Conference, Cape Town.
- 28 February–6 March 2005 — A CGS stand and geoscience career-awareness talks at the SCITECH 2005 event, Tshwane Events Centre, Pretoria.
- 6–9 March 2005 — A CGS stand as part of the National SA Pavilion at the PDAC 2005 International Trade Show, Toronto, Canada.
- 16–22 March 2005 — A CGS career-education stand at the National Festival of Science, Engineering and Technology (SASOL SCIFEST 2005), Grahamstown.

LIBRARY SERVICES

Manager: Lorraine Niebuhr, B.Inf.(Hons).

Staff: E.E. Viljoen, B.Inf.,
L. Breytenbach, Nat.Dip.,
S. Makhafola, B.Tech.,
A.P. Oberholzer, B.A. (Website).

The Library and Information Centre is responsible for the collection and maintenance of information, for the dissemination of information to employees and external clients, and for the maintenance of the CGS's collections of reports, plans, unpublished geological maps and borehole logs.

The Publication Shop is responsible for the sale of publications and reports of the CGS and publications of the Geological Society of South Africa. Staff maintain both the CGS's and the Geological Society of South Africa's (GSSA) lists of exchange publications, and provide copy services and base materials such as orthophoto maps, topographic maps and aerial photographs. The following statistics are indicative of the activities of the Publication Shop and Unpublished Reports Sections:

Visitors	3 653
Enquiries received	3 442
Unpublished reports received	939
Publications sold	1 743
Maps sold	2 287
Map sets sold	263
CD-ROMS sold	86
Publications donated	410
GSSA publications sold	152
Aerial photographs issued	1 119
Orthophotos issued	36

The Library currently houses 16 000 book titles and 3 846 journal titles of which 337 are current subscriptions and 908 are received on exchange. The Library holds 2 601 journal titles that have been discontinued and has a collection of 12 000 other documents. Membership of Sabinet was continued during the year and the library remains an active member of the Interlending Scheme.

The extensive catalogue can be accessed using a sophisticated search facility on the Library's web page. Catalogues of unpublished CGS, STK, Lebowa Minerals Bureau and Goldfields of S.A. Ltd reports, extracted from SAGEOLIT, are available on the CGS's website. Access to full-text electronic journals, or e-journals, has also been made possible through the library's subscription agent, a facility for the exclusive use of staff of the CGS.

To expand the Library's electronic catalogue and automated loan system, the staff have embarked on an extensive retrospective serials cataloguing project. This applies to items such as the CGS's bulletins and memoirs.

A CD-ROM collection is also catalogued and housed in the library. The production of information on CDs is a growing trend and the library currently has 220 CDs.

BIBLIOGRAPHIC DATABASES

0374 SAGEOLIT

Database Manager: R.R.M. Price, B.Sc.Hons.

Staff: M. Janse van Rensburg,
1 contract worker.

SAGEOLIT (South African Geological Literature Database) now contains 230 628 records, in-

cluding published and unpublished material. SAGEOLIT increases the amount of information available to SADC member states by supplying CD-based SADC Bibliographic and Map databases to SADC member countries. SAGEOLIT also includes a registration system for the Council's internal reports, an innovation implemented during the current year. Searches by farm name are made possible by 19 000 links from a table of farm information to SAGEOLIT records.

The Map Library database, part of SAGEOLIT, contains references to 52 476 georeferenced records — published maps and unpublished maps and plans — which can be accessed by Geode/GIS. There are a further 4 781 maps and 25 650 plans which are not georeferenced.

Additions to the database structure now allow for the linking of individual records to stratigraphic units listed in the SACS database, making more accurate searches possible. The number of links is still small, but will be increased during the coming years.

An index to the publications of the Geological Society of South Africa was published on CD-Rom.

A database of photographic and other material stored in the Archives of the CGS lists approximately 2 200 items. This database is under reconstruction in order to integrate it with SAGEOLIT.

NATIONAL CORE LIBRARY

Manager:	D. Motloi, B.A. (Public Administration).
Staff:	L.R. Lekalakala, J. Mosaka, R.R.M. Price, B.Sc.Hons., (Database), 6 contract workers.

The National Core Library is a repository of borehole core collected from exploration and mining activities of the past few decades. It is a national resource of considerable value to geological research, as it preserves material that has been obtained at great expense, sometimes from kilometres beneath the surface of the earth.

The third phase of the storage facility at Donkerhoek has been completed and the process of moving rock samples is in progress. The Core Library has now accessioned borehole core from more than 2 000 boreholes, representing over 580 km of drilling.

Notable new acquisitions include core from 16 boreholes from the Pering Base-Metal Mine near Reivilo. These holes add considerably to the material available on the Griqualand West Sequence. Other new acquisitions include core from Philippolis, Bethal, Griquatown and, most recently, from Reivilo. The core samples obtained from Reivilo are from two boreholes drilled for research by the Agouron Institute for their Proterozoic drilling project. The core has been vertically cut in half, the other half having been sent to the Smithsonian Institution in Washington, D.C.

Core is accessed by means of a stand-alone database system which is in the process of being updated to include lithostratigraphic units, as well as geographic references. In order to do this, a file listing units on the SACS database has to be kept up-to-date, and comparisons have to be made with boreholes listed on COREDATA. The possibility of integrating this database into GEODE is being considered.

The core library remains a valuable archive for geological information and continues to attract scientists and tourists from abroad, including students from international and South African universities.

PUBLICATIONS

Editors:	S.J. van Eck, B.A., Z.E. Nel, M.A., J.A. van Heerden, B.A.
Graphic Designer:	A. Becker, H.Nat.Dip.
Cartographer:	A.J. Cloete, Nat.Dip.

The following publications were released during the year:

Memoir 94: Piroklastiese afsettings van Perm-Ouderdom in die Hoof-Karookom met spesiale verwysing na die Collingham Formasie, Ecca Groep by J.H.A. Viljoen.

Memoir 96: Evolution of the ore-forming fluids in the Rooiberg tin-field by L.S. Labuschagne.

Bulletin 135: Late Permian Actinopterygian (Palaeoniscid) fishes from the Beaufort

Group, South Africa: biostratigraphic and biogeographic implications by P.A. Bender.

Bulletin 137: Stratigraphic and sedimentological investigation of the contact between the Lystrosaurus and Cynognathus Assemblage Zones (Beaufort Group: Karoo Supergroup) by J. Neveling.

Explanation: Explanation of sheet 3124 (1:250 000). The geology of the Middelburg area by D.I. Cole, J. Neveling, J. Hattingh, J.S.V. Reddering, L.P. Chevallier and P.A. Bender.

Explanation: Explanation of metallogenic sheets 2830 and 2732 (1:250 000): Richards Bay metallogenic map explanation by H.G. Hira, H.L. King and D.L. Ehlers).

Explanation: Explanation of the engineering and geotechnical conditions for the White River 2531AC 1:50 000-scale map sheet by T.L. Swanepoel.

SACS: Catalogue of South Africa lithostratigraphic units: Volume 7: South African Committee for Stratigraphy, by M.R. Johnson.

Explanation: Explanation of the engineering and geotechnical conditions for the Springs 2628AD 1:50 000-scale map sheet, by P.K. Zawada, B. Carr, S. Johnson, S. Kupe, J.H. Strydom and T. Swanepoel.

Explanation: Explanation of the engineering and geotechnical conditions for the Vereeniging 2627DB 1:50 000-scale map sheet, by R. Joubert.

Explanation: Explanation of the engineering and geotechnical conditions for the Centurion 2528CC 1:50 000-scale map sheet, by S.B. Johnson and R. Joubert.

Report: Annual Report of the Council for Geoscience 2003/2004.

Report: Annual Technical Report of the Council for Geoscience 2002/2003.

Report: Annual Technical Report of the Council for Geoscience 2003/2004.

Seismological Series 32: Catalogue of earthquakes in southern African and surrounding oceans for 1997 by G. Graham, L. Brink, M. Smith and B. Sutherland.

Seismological Series 33: Catalogue of earthquakes in southern African and surrounding oceans for 1998 by G. Graham, L. Brink, B. Sutherland, D.L. Roblin and M. Smith.

Seismological Series 34: Catalogue of earthquakes in southern African and surrounding oceans for 1999 by G. Graham, B.E. Sutherland, L. Brink, D.L. Roblin and M.R.G. Smith.

Seismological Series 35: Catalogue of earthquakes in southern African and surrounding oceans for 2000 by E. Hattingh, B.E. Sutherland, L. Brink, D.L. Roblin and M.R.G. Smith.

Seismological Series 36: Catalogue of earthquakes in southern African and surrounding oceans for 2001 by E. Hattingh, B.E. Sutherland, L. Brink, D.L. Roblin and M.R.G. Smith.

Seismological Series 37: Seismic history of southern Africa by M.B.C. Brandt, M. Bejaichund, E.M. Kgaswane, E. Hattingh and D.L. Roblin.

The geology and mineral resources of Mozambique by S. Lächelt.

Boletim Geológico no. 43: The impact of sea-level change — past, present, future. Proceedings of the INQUA Commission on the Holocene Workshop in Inhaca, Mozambique, November 4B8, 2002 by F. Momade, M. Achimo and S. Haldorsen.

Geoclips. Volume 7, March 2004

Geoclips. Volume 8, June 2004

Geoclips. Volume 9, September 2004

Geoclips. Volume 10, December 2004.

21 SPECIAL PROJECTS

VISIT BY THE MINISTER OF THE DEPARTMENT OF MINERALS AND ENERGY TO MALI

Project leader: M.W. Kota, M.Sc.

Objectives: to explore strategic partnerships and future cooperation on collaborative projects with other science councils and mining organisations based in Mali, with a particular focus on projects intended to stimulate the development of small-scale mining initiatives in both countries.

Duration: Three days (4–6 November 2004).

Motivation

The CGS was requested to form part of a scientific delegation accompanying the Minister of Minerals and Energy, Ms Phumzile Mlambo-Ngcuka, on a diplomatic mission to Mali. As part of the CGS's efforts to forge strategic collaborative partnerships with other geoscience organisations on the African continent, this opportunity was used to discuss potential areas of cooperation with both the local geological survey in Mali, the Ministère des Mines de l'Energie et de l'Eau, Direction Nationale de la Géologie et des Mines and UNOMIN, a formalised grouping representing some of the various small-scale mining operators in Mali.

Progress

Discussions held during this visit culminated in an agreement and the signing of a letter of intent between the CGS, CSIR and UNOMIN.

Conclusions

Compilation of the project proposal is still in progress and, once completed, this will be used to motivate for funds to finance the project which is aimed at assisting the UNOMIN group of small-scale miners by investigating ways of improving the efficiency of their mining methods, such as panning.

SOUTH AFRICA–ANGOLA BILATERAL MEETINGS

Project Leader: M.W. Kota, M.Sc.

Objectives: to extend an invitation to the representatives of the Instituto Geologico de Angola to participate in the EEZ workshop organised by the CGS and held in Cape Town on 14 to 16 March 2005, as well as to discuss possible collaboration on geoscience projects focussing on minerals development and small-scale mining initiatives.

Duration: Two days (16 to 17 February 2005).

Motivation

Part of a scientific delegation accompanying the Minister of the Department of Minerals and Energy, Ms Phumzile Mlambo-Ngcuka, during the South Africa–Angola bilateral meetings held in Cape Town. The aim of this visit was to further the objectives of the Exclusive Economic Zone (EEZ) project implemented by the CGS under the auspices of the African Mining Partnership. An invitation was extended to representatives of the Instituto Geologico de Angola to participate in the workshop which was organised by the CGS and held in Cape Town from 14 to 16 March 2005 to discuss technical aspects of applications to be made by African coastal states when lodging their claims for extensions of their Exclusive Economic Zones. Possible co-operation on minerals development and small-scale mining projects was also an item on the agenda for possible discussions with Angolan delegates.

Progress

Although there was considerable interest during informal discussions with some of the members of the Angolan delegation, no formal discussions or significant conclusions emanated from these meetings as the geosciences in the Angolan delegation were only represented at

ministerial level, and the ministers were having other bilateral discussions which were running parallel to the technical sessions.

Conclusions

It was concluded that invitations would be sent to the Instituto Geologico de Angola by mail and that any further discussions between the two organisations would have to be pursued at a later date.

MINERAL RESOURCES ASSESSMENT FOR GOLD, PLATINUM AND DIAMONDS

Project Leader:	C.J. Vorster, M.Sc.
Project team:	G. Henry, Ph.D., M.G.C. Wilson, M.Sc., R.N. Hansen, B.Sc. Hons., E. Muthego, B.Sc.Hons.
Objective:	to obtain a semiquantitative assessment of the remaining resources of gold, diamond, and platinum resources of South Africa in order to assist the DME in managing the mineral resources of South Africa.
Duration:	Five months.
Budget:	R775 000.

Motivation

This project was initiated in response to an urgent request by the Minister of Minerals and Energy requesting the CGS to undertake a semiquantitative assessment of the remaining mineral resources of South Africa in order to assist the DME in managing the mineral resources of South Africa. The initial phase of the project focussed on assessments for gold, diamond and platinum resources of South Africa and should be concluded by the end of June 2005; the results will be formally communicated to the Department of Minerals and Energy soon thereafter.

Progress

Although the project was initiated very late in the programme year, much work has been achieved to date, and the project is well on track for completion by the end of June 2005.

Conclusions

It is expected that the current phase of the project will be completed by the end of June 2005, after which another set of commodities will be assessed. These will be decided upon after consultation with the DME.

22 ADMINISTRATION

ADMINISTRATION: HUMAN RESOURCES

1 Qualifications of staff

Qualification	Percentage 2002/3	2003/4	2004/5
Doctorate	9,27	9,45	9,30
Masters	11,59	12,70	12,96
Honours	22,19	19,87	20,93
Bachelors	7,95	10,75	8,97
Diploma	10,26	9,77	16,28
Matric	20,20	19,87	14,62
Sub	18,54	17,59	16,94

2 Racial composition of staff

	2002/3	2003/4	2004/5
Black	95	104	105
Indian	5	5	8
White	191	187	183
Coloured	11	11	5
Total	302	307	301

3 Gender of staff

	2002/3	2003/4	2004/5
Male	189	193	188
Female	113	114	113
Total	302	307	301

4 Staff movements

Year	Total number of staff
1996	340
1997	358
1998	390
1999	417
2000	307
2001	302
2002	302
2003	307
2004	301

STAFF

CEO: T. RAMONTJA, M.Sc.
PA TO CEO: J.S. NKOE, Nat.Dip.

EXECUTIVE MANAGER (SECONDED TO DST)	M.S. MZIMBA, Ph.D.
EXECUTIVE MANAGER SCIENTIFIC SERVICES	G. GRAHAM, Ph.D.
EXECUTIVE MANAGER REGIONAL GEOLOGY AND MAPPING	P.K. ZAWADA, Ph.D.
COMPANY SECRETARY	N.R. RADEBE, B.A.
SECRETARY TO EXECUTIVE MANAGERS:	M.L. DE KLERK

CENTRAL REGIONS

MANAGER

HADDON IG

SCIENTIFIC OFFICERS

BOSCH PJA

CRONWRIGHT MS

DE KOCK GS

GRANTHAM GH

INGRAM BA

JOHNSON MR

NEVELING J

NOLTE JC

OPPERMAN R

TECHNICAL OFFICERS

BRITZ M

NKWINIKA RD

NORTH WEST UNIT

SCIENTIFIC OFFICER

GABBRIELLI F

GENERAL CLERK

CHOLO ZB

TECHNICAL OFFICER

MOLEFE SM

EASTERN CAPE UNIT

ADMINISTRATIVE OFFICER

WENTLEY CR

GENERAL CLERK

MXATULE BJ

SCIENTIFIC OFFICERS

GOEDHART ML

REDDERING JSV

ROBERTS MP

ROHWER MH

TECHNICAL OFFICER

MAJOKWENI LB

WESTERN CAPE UNIT

MANAGER WESTERN AND NORTHERN CAPE UNITS

CHEVALLIER LP

ADMINISTRATIVE OFFICERS

MALHERBE JE

PETERSEN C

GENERAL CLERKS

DE BRUIN E

MOSES D

SCIENTIFIC OFFICERS

COLE DI

DE BEER CH

DONDO C

GIBSON LA

HARTZER FJ

MACEY PH

NGCOFE LDS

NHLEKO OLC

ROBERTS DL

SIEGFRIED HP

STAPELBERG FDJ

VILJOEN JHA

TECHNICAL OFFICER

OOSTHUIZEN BC

NORTHERN CAPE UNIT

ADMINISTRATIVE OFFICER

MANS A

SCIENTIFIC OFFICERS

AGENBACHT ALDP

BOTHA PMW

MINNAAR H

MOEN HFG

TECHNICAL OFFICER

SKEFFERS CJ

LIMPOPO BUSINESS UNIT

MANAGER

BAGLOW N

ADMINISTRATIVE OFFICER

MAKHUBELE GS

GENERAL CLERK

MANGANYE TM

MASHAO TP

SCIENTIFIC OFFICERS

DIPPENAAR M

NDINDANI HA

KWAZULU-NATAL UNIT

MANAGER KWAZULU-NATAL and EASTERN CAPE

BOTHA GA

ADMINISTRATIVE OFFICER

DLAMINI P

GENERAL CLERK

MPOFANA B

NGCOBO LE

SCIENTIFIC OFFICERS

CLARKE BM

GROW RG

NGCOBO FN

RICHARDS NP

WILLARD CA

ENGINEERING GEOSCIENCES

MANAGER

DAVIS GN

ADMINISTRATIVE OFFICER

PRETORIUS MJ

DATABANK ADMINISTRATOR

GROBLER JD

ENGINEERING GEOLOGIST

MOGADIME ME

SCIENTIFIC OFFICERS

CROUKAMP L

FORBES C

HEATH GJ

MPATENI NT

TROLLIP NYG

TECHNICAL OFFICERS

ENGELBRECHT HP

MOTJALE MI

NTSHABELE NL

PEER V

ENVIRONMENTAL GEOSCIENCES

SCIENTIFIC OFFICERS

COETZEE H

NTSUME GM

VENTER JS

GEOCHEMISTRY

SCIENTIFIC OFFICERS

BENSID ML

ELSENBROEK JH

PETSO TO

STRAUSS SW

VAN ROOYEN RC

TECHNICAL OFFICERS

MAHLANGU MM

MOKOATEDI JK

MOLEFE MG

RADEBE JS

GEOPHYSICS

MANAGER

COLE P

ADMINISTRATIVE OFFICER

GRAHAM A

SCIENTIFIC OFFICERS

COLE J

FOURIE CJS

HALLBAUER-ZADOROZHNAYA VY

MARE LP

RAATH CJDW

SMIT JP

STETTLER EH

TECHNICAL OFFICERS

ADLEM M

KOTZ M

MAHANYELE PJ

STETTLER RH

TABANE LR

INFORMATION MANAGEMENT

MANAGER INFORMATION and COLLECTIONS MANAGEMENT

BARNARDO DJ

ADMINISTRATIVE OFFICERS

NEL ZE

TROSKIE SMJ

VAN ECK SJ

VAN HEERDEN JA

GENERAL CLERKS

CHAUKE PR

MOKONE MM

SCIENTIFIC OFFICER

PRICE RRM

TECHNICAL OFFICER

CLOETE AJ

JANSE VAN RENSBURG MG

OBERHOLZER AP

SCHOEMAN A

LIBRARY

CHIEF LIBRARIAN

NIEBUHR L

ADMINISTRATIVE OFFICERS

BREYTENBACH L

MAKHAFOLA RS

MSIZA A

SWART TN

VAN WYK J

VILJOEN EE

GENERAL CLERKS

DIKOBE MM

COLLECTIONS MANAGEMENT

ADMINISTRATIVE OFFICER

KGARI MJ

LEKOTOKO MM

MAHWAYI S

TECHNICAL OFFICER

LEKALAKALA LR

MOHUBA MK

MOSAKA J

MOTLOI LLD

RAATH A

INFORMATION TECHNOLOGY

MANAGER

MOTAUNG PD

BUSINESS TECHNOLOGY CONSULTANT

SMITH P

HELPDESK OFFICER

MAYEKI N

SYSTEMS ENGINEER

MODIAKGOTLA SSR

TECHNICAL OFFICER

DOMINGO EE

JANSE VAN RENSBURG SJ

MTSWENI SA

LABORATORY

MANAGER

CLOETE M

SCIENTIFIC OFFICERS

ATANASOVA MTG

CLOETE HCC

DE BRUIN D

FRIEDLAND J

HORSTMANN UE

JORDAAN LJ

JOUBERT C

MARITZ H

REDDY K
ROELOFSE T
ROELOFSE F
VAN TONDER DM
SECRETARY
INAMA JN
TECHNICAL OFFICERS
BURGER KIG
DELPORT FA
DIKGOMO SA
KGADITSE SD
LEHAHA MT
MABE E
MABENA ST
MATJI JM
MONYAYI ST
NKOSI ME
PAPO RM
RADEMEYER MC
SEJAKE MJ
SELLO RH
STRYDOM MJ
TSAAGANE ME
VON WIELLIGH MHM
VUMA SM
WALLISER JE
WILLIAMS QD

MARINE GEOSCIENCE

MANAGER
COLES SKP
SCIENTIFIC OFFICERS
BOSMAN C
FAULL AS
LEUCI R
MADOTYENI ZM
RICHARDSON AG
VAN DEN BOSSCHE P
YOUNG PM
TECHNICAL OFFICERS
BOTHA CA
KIDWELL W
KUPIDO W

MINERAL RESOURCES DEVELOPMENT

MANAGER
KOTA MW
ADMINISTRATIVE OFFICER
PUTTER GV
SCIENTIFIC OFFICERS
DE KLERK S
EHLERS DL
FROST-KILLIAN S
HANSEN RN
HENRY G
HORN GFJ
KGWAKGWE KP
OOSTERHUIS WR
VAN NIEKERK D
VORSTER CJ
WILSON MGC
WIPPLINGER PE
TECHNICAL OFFICERS
BUITENDAG WL
ENDRES PA
GUZEK KM
MALAN NP
McILRAE NM
SALAMON M
SCHALEKAMP MM
SOLOMON M

SEISMOLOGY

MANAGER
KIJKO A
ADMINISTRATIVE OFFICER
DUARTE D
SCIENTIFIC OFFICERS
BEJAICHUND M
BRANDT MBC
HATTINGH E
KGASWANE EM
RANDALL CR

ROBLIN DL

TECHNICAL OFFICERS

BRINK L

BUSO L

MOLEA TT

NGCOBO DL

PRETORIUS JVL

SAUNDERS I

SMITH MRG

STEYN J

SUTHERLAND BE

SPATIAL DATA MANAGEMENT UNIT

MANAGER

WILKINSON KJ

ADMINISTRATIVE OFFICER

LOMBAARD FJM

SCIENTIFIC OFFICER S

BRYNARD HJ

RIES CW

VAN DER WALT DM

VAN ROOYEN PJ

WOLMARANS LG

TECHNICAL OFFICERS

DIXON ER

GROBBELAAR DA

KGARI CS

LETSOALO M

MAGAGANE MEM

MSIZA P

NKOSI MP

ROOS HM

SELLO MH

SMITH R

THOMAS C

VAN DER WESTHUIZEN CBA

VOORS WA

STRATEGIC PLANNING UNIT

ADMINISTRATIVE OFFICER

DU PLESSIS JJ

BUSINESS DEVELOPMENT SPECIALIST

BARKHUIZEN JG

SCIENTIFIC OFFICER

KEYSER N

WATER GEOSCIENCES

MANAGER

TITUS RA

GOUVERNEUR M

SCIENTIFIC OFFICER

GROENEWALD J

HOHNE S

MAJOLA KA

RUST UA

SHONGWE JT

STRACHAN LKC

TECHNICAL OFFICER

LEWIN TGA

MINNAAR FH

FINANCIAL SERVICES

MANAGER

MATSEPE LD

ADMINISTRATIVE OFFICER

BREYTENBACH AF

DIRKER E

MOSTERT JCN

NKADIMENG G

PAWESKA MD

PEENS WJF

POWER S

QAYISO NA

REDDY N

ROBINSON JJ

SNYMAN SE

HUMAN RESOURCES

MANAGER

KOLA MEM

ADMINISTRATIVE OFFICER

LESHOMO JD

MAEMA JJ

RECRUITMENT SPECIALIST

MKHIZE ZJL

TRAINING AND DEVELOPMENT SPECIALIST

SCHEPPERS N

INTERNAL AUDIT

INTERNAL AUDITOR

MOTLOUNG SM

LOGISTICAL SERVICES

MANAGER

BOTHA JD

ADMINISTRATIVE OFFICERS

HUGO JLM

JIJANA CK

MANDA M

NKWASHU SM

PHUSHELA PSH

RAMOTHWALA BMH

RAMOTHWALA NJ

SNYMAN J

ZWANE JJ

GENERAL CLERK

DIKETANE MW

MASOGA ME

MOTALAUTE TS

TJIANE LC

TECHNICAL SERVICES

MANAGER

OTTO MA

ADMINISTRATIVE OFFICER

MAHLANGU E

MAKITLA PS

SMYTHE MM

TECHNICAL OFFICERS

ADAMOS P

MADZHIE M

MAHLANGU JZ

MNISI JV

RANTJIE JM

STEVENS R

23 APPENDIX

23.1 REPRESENTATION ON COUNCILS, COMMITTEES AND WORKING AND STUDY GROUPS

Museum Park Board of Directors (D.J. Barnardo)

Council of the Geological Society of South Africa (GSSA) (Vice-president and Member of the Management Committee: M.G.C. Wilson)
- Board of Trustees (Member: M.G.C. Wilson)
- Managing Committee of the Geological Society of South Africa (GSSA) (Member: M.G.C. Wilson)
- Committee of the Groundwater Division (R. Titus)
- Committee of the Mineralogical Association of South Africa (MINSA) (M. Cloete)
- Committee of the Limpopo Branch (N. Baglow, M. Dippenaar)
- Committee of the Pretoria Branch
- Committee of the Western Province Branch (C.H. de Beer)
- Conservation Committee (D.J. Barnardo)
- Conservation Committee of the Western Province Branch (Secretary: C.H. de Beer)
- Co-editor of GSSA–CGS Geology Text Book (Geology of South Africa) (M.R. Johnson)
- Editorial Board of the South African Journal of Geology (SAJG) (M. Cloete)
- Environmental and Conservation Committee (D. van Tonder)

Council of the South African Institute for Engineering and Environmental Geologists (SAIEG) (G.N. Davis)

Council of the Southern African Society for Quaternary Research (SASQUA) (Treasurer: G.A. Botha)

South African Council for Natural Scientific Professions (SACNASP). Professional Affairs Committee (PAC) for Earth Science (Chairperson: E.H. Stettler)

Committee for Heads of Research and Technology (COHORT) (formerly Committee of Heads of Science Councils (CHSC) (T. Ramontja)

Committee for Site Investigation of the Department of Water Affairs and Forestry (DWAF) (G.N. Davis)

Advisory Committee on the West Coast Biosphere Project (D.L. Roberts)

Executive Committee of the Palaeontological Society of Southern Africa (PSSA) (J. Neveling)

Executive Committee of the South African National Committee on Tunnelling (SANCOT) a committee of South African Institute of Mining and Metallurgy (SAMM) (G.N. Davis)

Management Committee of the Far West Rand Dolomitic Water Association of the Chamber of Mines (N.Y.G. Trollip)

Quaternary Research Committee of the Southwestern Cape (QUARC) (Board member: D.L. Roberts)

South African Committee for Stratigraphy (SACS) (Secretary: M.R. Johnson; N. Keyser, P.K. Zawada)
- Task Group for Alkaline and Basic Intrusives (Secretary: L.P. Chevallier)
- Task Group for Biostratigraphy (Secretary: J. Neveling)
- Task Group for the Bushveld Complex and Associated Basic Intrusives (Secretary: Vacant)
- Task Group for Cape Granite Suite (Secretary: H.P. Siegfried)
- Task Group for the Cenozoic (Secretary: G.A. Botha)
- Task Group for Chronostratigraphy (Secretary: G.S. de Kock)
- Task Group for Gariep - Cape Rocks (Secretary: C.H. de Beer)
- Task Group for Jurassic and Cretaceous Rocks (Secretary: J.S.V. Reddering)
- Task Group for the Karoo Igneous Province (Secretary: Vacant)
- Task Group for the Karoo Supergroup (Secretary: D.I. Cole; J.H.A. Viljoen)
- Task Group for pre-Bushveld Intrusive and Swazian Rocks (Secretary: N. Baglow)
- Task Group for pre-Gariep Rocks in the Northern and Western Cape (Secretary: P.H. Macey; C.H. de Beer, H.F.G. Moen, A.L.D. Agenbacht)
- Task Group for pre-Karoo Rocks in KwaZulu-Natal and southern Mpumalanga (Secretary: Vacant)
- Task Group for the Transvaal Supergroup East of 25°E (Secretary: P.J.A. Bosch; F.J. Hartzer)
- Task Group for the Transvaal Supergroup West of 25°E and Olifantshoek Supergroup (Secretary: H.P. Siegfried)
- Task Group for the Ventersdorp Supergroup (Secretary: N. Keyser)
- Task Group for the Waterberg and Soutpansberg Groups (Chairman: G. Brandl)
- Task Group for the Witwatersrand Supergroup (Secretary: Vacant)

South African Mineral Resource Committee (SAMREC) and the Working Group on the compilation of the main South African code for the reporting of mineral resources and mineral reserves (P.E. Wipplinger)

Mining and Minerals Policy Implimenting Structure of the SPC (D.J. Barnardo, R.R.M. Price)

National Steering Committee of Service Providers to the Small-Scale Mining Sector (NSC) (P.E. Wipplinger)

Organising Committee for the Biennial Groundwater Conference 2005, organised by the Groundwater Division of the Geological Society of South Africa, 7 to 9 March 2005. (L. Strachan, R. Titus).

Programme Steering Committee of the Department of Water Affairs and Forestry for the Norwegian-associated Programme on Sustainable Groundwater Development for the Community Water and Sanitation Programme in South Africa (R. Titus).

Steering Committee of the Geoinformation Consortium (GIC) (H.J. Brynard)

Steering Committee of the Library and Information Services of the Science Councils (LISSCO) (L. Niebuhr)

Steering Committee of the Interest Group for the Applied Studies on Dolomite (N.Y.G. Trollip)

Steering Committee of the Water Research Commission (WRC)
- Deep Artesian Groundwater Exploration for Oudtshoorn (J.H.A. Viljoen)
- Deep Groundwater Flow Dynamics (C.H. de Beer)
- Geohydrology of Western Namaqualand (C.H. de Beer)
- Research on the Correlation of High Uranium, Arsenic and other Chemical Element Values in Ground Water in the Northwestern Cape (P. Bosch)
- Statistic-based regionalised flood frequency estimation study for South Africa using systematic, historical and palaeoflood data (P.K. Zawada)

Steering Committee for the South African Environmental Observatory Network (SAEON) (Member: P.K. Zawada)

Technical Committee for the Development on Controls under the proposed Mineral and Petroleum Resources Development Act, 2002 (H.J. Brynard and P.E. Wipplinger)

Action Group of the Western Cape Wetland (L. Gibson)

Research Group on Mining activities for the Succulent Karoo Ecosystem Plan for Conservation International (D.I. Cole, L. Chevallier)

Small-Scale Mining Standards Generating Group (SGG)

Working Group for Luminescence Dating of the South African Coastal Dunes (Western Cape leader: D.L. Roberts)

Working Group of Water Research Commission Strategic Planning for Groundwater studies in the Eastern Cape (L.P. Chevallier)

Cartographic Association of South Africa (CASA) (H.M. Roos)

Makana Council Housing and Industrial Development Working Group, Grahamstown (Member: M.L. Goedhart)

Mining Qualifications Authority (MQA)
Mining and Exploration Geology. Technical Review Group (SGG), South African Qualifications Authority and Department of Minerals and Energy (Member: C. Forbes)

National Research Foundation Open Research Programme. Advisory Panel for Bushveld Complex Research (Member: M. Cloete)

Reader for J.S.E. Securities Exchange S.A. for assessment of Resource/Reserve statements on coal and base metals on the basis of guidelines as set out by the South African Mineral Resource Committee (SAMREC) (P.E. Wipplinger)

South African Bureau of Standards (SABS)
- Solid mineral fuels (P.E. Wipplinger)
- South African Qualification and Certification Committee (SAQCC) (Boreholes) (J.G. Barkhuizen)
- South African code of practice for the systematic evaluation of coal resources and coal reserves (P.E. Wipplinger)
- Subcommittee on National Standards for Groundwater Extraction (J.G. Barkhuizen)
- The use of galvanised piping in the building industry (P.E. Wipplinger)

Technology Demonstration Centre (TDC) - Zenzele (Board Member: P.E. Wipplinger)

23.2 INTERNATIONAL COOPERATION

Council of the International Seismological Centre (ISC) (G. Graham)

Editorial Advisory Board Africa Geoscience Review (G.S. de Kock, M.R. Johnson, D.I. Cole)

Editorial Board of Geochemistry: Exploration Environment Analysis (D. de Bruin)

Editorial Board of Gondwana Research (G.H. Grantham)

Geochronology of Mozambique and on Geochemistry of Matchless Amphibole Belt, Namibia (G.H. Grantham)

Geology Subcommittee of the Mining Sector Coordinating Unit of the South African Development Community (SADC)
- Engineering Geology Working Group (P.K. Zawada)
- Hydrogeology Working Group (L.P. Chevallier)
- Regional/National Geological, Mineral and Bibliographic Databases Working Group (D.J. Barnardo)
- Stratigraphy Working Group (Chairman: F.J. Hartzer)

International Association on the Genesis of Ore Deposits (IAGOD)
- Southern African representative of the Industrial Mining Working Group (G.F.J. Horn)

Commission for the Geological Map of the World (CGMW)
- Subcommission for the Metallogenic Map of the World (President: E.C.I. Hammerbeck)
- Working Group on Common Standards for Digital Geological Data and Data Structures, Digital Data Dissemination (DIMAS) (Member: H.J. Brynard)

International Commission on Stratigraphy (ICS)
- Subcommission on Precambrian Stratigraphy (Corresponding member: F.J. Hartzer)
- International Subcommission on Stratigraphic Classification (ISSC) (SACS representative: M.R. Johnson)

International Geological Correlation Programme (IGCP)(S. Frost-Killian).

International Geological Map of the World (IGMW)
- Coordinator for the Tectonic Map of Africa (Subequatorial chief compiler: G. de Kock)

International Union for Quaternary Research (INQUA)
- Commission on Coastal and Marine Processes (G.A. Botha)
- Commission on Palaeopedology and the International Union for Soil Science (ISSS) (G.A. Botha)
- South African National Committee, National representative to the INQUA Congress, Reno, USA 2003. (Chairman: G.A. Botha)

IUGS/UNESCO International Geological Correlation Programme
IGCP 478 - The Vendian-Cambrian of West Gondwana (C.H. de Beer)

National Committee for the International Union of Geodesy and Geophysics (IUGG) (J. Cole)

National Committee of the International Union of Geological Sciences (IUGS) and the International Geological Correlation Programme (IGCP) (S. Frost-Killian)

National Consultative Workshop on NEPAD in Science and Technology (G. Graham)

Pan African START Secretariat (PASS) (R. Titus)

Steering Committee of the Geoscience Information Consortium (previously known as the International Consortium of Geological Surveys for Earth Computer Sciences (H.J. Brynard)

Collaborative research project funded by the National Science Foundation (United States) investigating changing palaeofloras and insect predation in the Late Permian to Triassic (J. Neveling)

23.3 COURSES AND LECTURES PRESENTED BY COUNCIL EMPLOYEES

BOSCH, P.J.A. 2004. The geology of South Africa with special attention to the Tshwane Metropolitan area. Half-day lecture at the Transvaal Museum for Technikon lecturers and student teachers.

BOSCH, P.J.A. The geology of the Pilanesberg Complex. Lecture for pupils of the German School, Pretoria.

STRACHAN, L. Short course on "The Chemistry of Water — Why is it Important — How do we Characterise it" DWAF Grip Limpopo Programme, 26 to 27 January 2005.

TITUS, R. Short course for the Groundwater Division of the Geological Society South Africa (GWDSA) titled "Introduction to Groundwater". 14–16 February 2005 at the Council for Geoscience, Pretoria.

23.4 COURSES ATTENDED

ArcGIS 9 (M. Rohwer).

ACRU Agrohydrological modeling system course; SAIAE Continuing Professional Development (CPD) Event, School of Bioresources Engineering and Environmental Hydrology, University of KwaZulu-Natal, 21–23 September 2004 (C.A. Willard).

Design, construction and rehabilitation of small dams; SAIAE Continuing Professional Development (CPD) Event, School of Bioresources Engineering and Environmental Hydrology, University of KwaZulu-Natal, 21–23 September 2004 (N.P. Richards).

Introduction to Arc GIS I (Arc View 8.2), GIMS, Knysna, 30 March–1 April 2004 (M.L. Goedhart).

Mine Environmental Planning Workshop, KwaZulu-Natal Unit, Council for Geoscience, 11–15 October 2004, Pietermaritzburg (G.A. Botha, convener, N.P. Richards, B.M. Clarke, R.G. Grow, C.A. Willard, J.S.V. Reddering).

Magnetotelluric Data Analysis Workshop, De Beers, Johannesburg, 17 July 2004 (J. Cole).

Soil Classification course, Department of Agriculture and Environmental Affairs, Cedara, 18–20 May 2004 (C.A. Willard).

Visual SCS-SA; SCS design flood estimation in small catchments; SAIAE Continuing Professional Development (CPD) Event, School of Bioresources Engineering and Environmental Hydrology, University of KwaZulu-Natal, 21–23 September 2004 (N.P. Richards).

23.5 PUBLICATIONS IN ACADEMIC JOURNALS AND BOOKS

ABDALA, F., HANCOX, P.J. and NEVELING, J. In Press. The cynodonts from the uppermost Burgersdorp Formation (Karoo Supergroup), South Africa, and its bearing on the biostratigraphic subdivision and correlation of the Triassic Cynognathus Assemblage Zone. *Journal of Vertebrate Palaeontology.*

BOSCH, P.J.A. 2004. The geological, pedological and climatical influence on variety generation in Haworthia koelmaniorium var. koelmaniorum and H. koelmaniorum var. mcmurtryi. *Aloe*, 41 (2 and 3).

COLE, D.I. 2004. Impact of mining on the Knersvlakte flora — past, present and future. *Aloe*, 41 (2 and 3), pp. 40–44.

DE BRUIN, D. 2005. Multiple compositional megacryst groups from the Uintjiesberg and Witberg kimberlites, South Africa. *South African Journal of Geology*, 108, pp. 229–242.

GERYA, T.V., UKEN, R., WATKEYS, M.K., MARESCH, W.V. and CLARKE, B.M. 2004. "Cold" diapirs triggered by intrusion of the Bushveld Complex: Insight from two-dimensional numerical modelling. In, Whitney, D.L., Teyssier, C. and Siddoway, C.S., Gneiss domes in orogeny: *Special Paper*, Geological Society of America, 380, pp. 117–127.

GRANTHAM, G.H, MACEY, P., INGRAM, B.A. and CRONWRIGHT M. 2004. Karoo-age andesitic Volcanism along the northern Mozambique Coast. *Gondwana Research*, 7(4), supplementary issue, pp. 1303–1304.

GRANTHAM, G.H., ARMSTRONG. R.A. and MOYES, A.B. (in press) The age, chemistry and structure of mafic dykes at Roerkulten, H.U. Sverdrupfjella, western Dronning Maud Land, Antarctica. *Proceedings of the Fourth International Dyke Conference (IDC4)*, 2001, Itala, South Africa. Balkema Press.

KOSTROVITSKY, S.I. and DE BRUIN, D. 2004. Chromium assemblage of minerals in micaceous kimberlites of Yakutian Province. *Russian Geology and Geophysics*, 45, pp. 565–576.

MÄNTYNIEMI, P., TSAPANOS, T.M. and KIJKO, A. 2004. An estimate of probabalistic seismic hazard for five cities in Greece by using the parametric-historic procedure. *Engineering Geology*, 72, pp. 217–231.

NEVELING, J. 2004. Stratigraphic and sedimentological investigation of the contact between the Lystrosaurus and the Cynognathus Assemblage Zones (Beaufort Group: Karoo Supergroup). Bulletin, Council for Geoscience, 137, 164 pp.

TUCHSCHERER, M.G., REIMOLD, W.U., KOEBERL, C., GIBSON, R.L and DE BRUIN, D. 2004. First petrographic results on impactites from the Yaxcopoil-1 borehole, Chicxulub structure, Mexico. *Meteoritics and Planetary Science,* 39, pp. 899–930.

23.6 CONFERENCES, SCIENTIFIC AND TECHNICAL MEETINGS

32nd International Geological Congress, Florence, Italy, 20–28 August 2004 (G.A. Botha, G. Grantham, I.G. Haddon, G.S. de Kock, S. Frost-Killian, P.K. Zawada, H.M. Roos, D. Barnardo).

Biennial Groundwater Conference of the Groundwater Division of the Geological Society of South Africa, 9–11 March 2005 (R.A. Titus, L.K.C. Strachan, S. Hohne, K.A. Majola).

Geoscience Africa, University of the Witwatersrand, Johannesburg, 12–16 July 2004 (J. Cole, L.P. Maré, C.J.S. Fourie, M.G.C. Wilson, R.N. Hansen, S. Frost-Killian).

17th Electromagnetic Induction Workshop, National Geophysical Research Institute, Hyderabad, India, 13–16 October 2004 (E.H. Stettler, V. Hallbauer-Zadorozhnaya, J.P. Smit).

Student conference of Natural Sciences, University of Stellenbosch, 1 November 2004 (R.N. Hansen).

Workshop: Mining Opportunities in the Free State Region, DME Free State, Welkom Club, Welkom, 28 July 2004 (D.L. Ehlers).

Mining Summit: Mineral Potential of the Mpumalanga Province, Mpumalanga Department of Economic Development and Planning, Pienaar Dam Resort, Middelburg, 27 January 2005 (D.L. Ehlers).

2nd Biennial Conference of the Association of African Women Geoscientists, Ridar Hotel, Mukono, Kampala, Uganda, 25–27 October, 2004 (A.S. Faull).

Fractured aquifers, 22–24 November 2004, by Dr A. Shapiro (USGS), University of Western Cape (N. Baglow).

Milestones in Mafic Magmatic Ore Deposits, 23–24 June 2004, by Prof. A.J. Naldrett, Rustenburg. (M. Dippenaar).

Compliance, Competency and Accountability, 5 November 2004, by GSSA/SAIMM, Johannesburg (M. Dippenaar).

23.7 CONFERENCE ABSTRACTS and POSTERS

ADAMS, S., Xu, Y. and TITUS, R. Groundwater Recharge Assessment of the Crystalline Basement and Alluvial Aquifers of Central Namaqualand. Proceedings of the Biennial Groundwater Conference of the Groundwater Division of the Geological Society of South Africa, 9–11 March 2005.

BOTHA, G.A., PORAT, N., DULLER, G.A.T. and TAYLOR, R. 2004. Beach ridge sets reflecting the Late Holocene evolution of the Lake St Lucia coastal lagoon, Maputaland, South Africa. Poster 72-17, Abstracts, 32nd International Geological Congress, Florence, Italy, 20–28 August 2004.

CRONWRIGHT, M.S., COETZEE, H., COLE, J., COLE, P., INGRAM, B.A. and GRANTHAM, G.H. 2004. The application of supervised image classification to reconnaissance geological mapping in areas of poor exposure and access. A practical example from northern Mozambique. Abstracts, 20th Colloquium on Africa Geology, BRGM, Orleans, 2–7 June 2004, 436 pp.

CRONWRIGHT, M.S., COETZEE, H., COLE, J., COLE, P., INGRAM, B.A., GRANTHAM, G. H. and MANHICA, V. 2004. The application of supervised image classification to reconnaissance geological mapping in areas of poor exposure and access — a practical example from northern Mozambique. Geoscience Africa 2004, Johannesburg.

DE KOCK, G.S., SAMI, K. and NEUMANN, I. 2004. Breakup of Gondwana: joint analysis adjacent to the Agulhas Fracture Zone. Abstract, 32nd International Geological Congress, International Union of Geological Sciences, Florence, Italy, August 20–28, 2004.

DE KOCK, G.S., THOMAS, R.J., GRESSE, P.G., EGLINGTON, B.M., SAMSON, S., INGRAM, B., MACEY, P., and DE BEER, C.H. 2004. Pre-Ouarzazate Group geology in the Sirwa-Taghdout region, Morocco. Abstract, 32nd International Geological Congress, International Union of Geological Sciences, Florence, Italy, August 20–28, 2004.

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ELSENBROEK, J.H., MEYER J. and MYBURGH, J. 2004. Haemorrhagic diarrhoea and reproductive failure in Bonsmara cattle resulting from anomalous heavy metal concentrations in soils, forages and drinking water associated with geochemical anomalies of toxic elements on the farm Puntlyf, South Africa. Geoscience Africa 2004, University of the Witwatersrand, Johannesburg, South Africa, 193–194.

FAULL, A.S., 2004. Beyond 200 Nautical Miles: A once-off chance to expand the Exclusive Economic Zone. 2nd Biennial Conference of the Association of African Women Geoscientists, Ridar Hotel, Mukono, Kampala, Uganda, 25–27 October 2004.

GASTALDO, R.A., ADENDORFF, R., BAMFORD, M., LABANDEIRA, C., NEVELING, J. and SIMS, H. 2004. Taphonomic trends of macrofloral assemblages across the Permian-Triassic boundary in the Karoo Basin, South Africa. Abstracts with Programs, Geological Society of America, 2004 Denver Annual Meeting (November 7–10, 2004), 36(5).

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GROW, R.G., RICHARDS, N.P. and BOTHA, G.A. 2004. Mass movement deposits and slope instability mapping of KwaZulu-Natal, South Africa. Abstracts, Geoscience Africa 2004, University of the Witwatersrand, 1, p. 232.

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HANCOX, P.J., DAMIANI, R.J., NEVELING, J. and RUBIDGE, B.S. 2004. Palaeoenvironments of the Early Triassic Burgersdorp Formation (Cynognathus assemblage zone, subzone A) in the north-eastern Free State, South Africa. Geoscience Africa 2004, University of the Witwatersrand.

HEATH, G., CROUKAMP, L., HORSTMANN, U. COETZEE, H. and DU PLESSIS, J. 2004. The prevention of water ingress into operational and abandoned gold mines on the central and East Rand. Geoscience Africa 2004, University of the Witwatersrand.

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Namaqua-Natal Belt of southern Africa and the Maud Belt of Antarctica: two stages of intrusions as suggested by SHRIMP zircon U-Pb chronology. 32nd International Geological Congress, International Union of Geological Sciences, Florence, Italy, August 20–28, 2004.

HORSTMANN, U.E., COETZEE, H., NTSUME, G., HEATH, G. and CROUKAMP, L. 2004. Isotopic fingerprinting of water entering abandoned and working mines on the Witwatersrand. Geoscience Africa 2004, University of the Witwatersrand.

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MARITZ, H. 2004. Analysis of trace elements in regional geochemistry samples by inductively coupled plasma mass spectrometry (ICP-MS). Geoscience Africa 2004, University of the Witwatersrand, Johannesburg, South Africa, 419–420.

NEVELING, J. and ABDALA, F. 2004. New record of Trirachodon (Synapsida, Cynodontia) in the northwestern Karoo: Implications for the *Cynognathus* Assemblage Zone subdivision. Geoscience Africa 2004, University of the Witwatersrand.

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SIMS, H.J., ADENDORFF, R., GASTALDO, R.A. and NEVELING, J. 2004. Assessing changes in community diversity: portrait of a Permian Gondwanan floodplain ecosystem. Abstracts with Programs, Geological Society of America, 2004 Denver Annual Meeting (November 7–10, 2004), 36(5).

STRACHAN, L.K.C., and SMIT, A.F. 2005. A new software assessment tool for auditing water. Proceedings of the Biennial Groundwater Conference of the Groundwater Division of the Geological Society of South Africa, 9–11 March 2005.

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VAN ROOYEN, R.C., JORDAAN, L.J., MARITZ, H. and STRAUSS, S.W. 2004. Review Paper on the Regional Geochemical Mapping Program of South Africa. Technical Training Course on

Geochemical Exploration/Mapping (For Countries in Africa), 10 October–8 November 2004, Beijing, China.

VAN TONDER, D.M., CLOETE, M. and ATANASOVA, M. 2004. Mineralogical approach to solving customer complaints on various types of contamination in industrial glass by using SEM and EDS. Proceedings of 8th International Congress on Applied Mineralogy, Aguas de Lindoia, Brazil.

VAN TONDER, D.M., CLOETE, M., ATANASOVA, M. and ROBERTS, M.P. 2004. Imaging and micro-analysis solve customer complaints on defects in glass. Abstract of the 43rd Annual Conference of the Microscopy Society of Southern Africa. University of Pretoria, Pretoria, South Africa.

VAN ROOYEN, R.C. 2004. Interpretation of anomalous soil and stream sediment data. Technical Training Course on Geochemical Exploration/Mapping (For Countries in Africa), 10 October–8 November 2004, Beijing, China.

23.8 VISITS TO FOREIGN COUNTRIES

On Site Inspection Workshop of the CTBTO.	Austria	C.J.S. Fourie
Working Group B of the CTBTO.	Austria	G. Graham
Workshop for South Africa-India bilateral project no 3. 4–17 March, 2004, Brugge, Belgium.	Belgium	S. Frost-Killian, G.S. de Kock, L. Wolmarans
17–24 April 2004. CGMW workshop on the progress on the compilation and publication of the International Tectonic Map of Africa.	Belgium	G.S. de Kock, L. Wolmarans
6th–7th December. Karoo Tri-Nations correlation project planning meeting.	Botswana	J. Neveling, I. Haddon
PDAC 2005 International Convention, Prospectors and Developers Association of Canada, Metro Toronto Convention Centre. Toronto, 6–9 March.	Canada	M.W. Kota
Technical Training Course on Geochemical Exploration/ Mapping (for countries in Africa), 10 October–8 November.	China	D. de Bruin, L.J. Jordaan, H. Maritz, G.M. Ntsume, R.C. van Rooyen
Collaborative project.	France	P. Cole
3–8 March, presented paper "Can an earthquake in the Indian Ocean create a tsunami along the South African coast?" at the International Coordination Meeting for the Development of a Tsunami Warning and Mitigation system for the Indian Ocean.	France	A. Kijko
17th Electromagnetic Induction Workshop.	India	E.H. Stettler, V. Hallbauer-Zadorozhnaya, J.P. Smit
Indian Geological Survey, with a field excursion to the Satpura Basin.	India	D. Cole
24–27 November, 7th International Mining and Machinery Exhibition, Confederation of Indian Industry in association with Ministry of Mines and Minerals of India, Kolkata.	India	S-L. de Klerk
International Geological Congress, Florence, Italy. August 2004.	Italy	G.A. Botha, G. Grantham, I.G. Haddon, G.S. de Kock, S. Frost-Killian, P.K. Zawada, H.M. Roos, D. Barnardo
Presented paper on CGS initiatives in Seismology in Eastern and Southern Africa at AfricaArray Workshop in Polmonova.	Italy	G. Graham
International Association of Gondwana Research Conference in Kochi, Japan 12–15th November.	Japan	G. Grantham

Represented CGS in DME delegation accompanying Minister of Minerals and Energy on visit.	Mali	M. Kota
Workshop on the Geology of Mozambique held in Trondheim, January, 2005.	Norway	G. Grantham, P. Macey, B. Ingram, M. Roberts
Research and Capacity Building.	Russia	E.H. Stettler, V. Hallbauer-Zadorozhnaya
2nd Biennial Conference of the Association of African Women Geoscientists, Ridar Hotel, Mukono, Kampala, Uganda, 25–27 October.	Uganda	A.S. Faull
20 to 23 February presented paper "Real-time assessment of seismic hazard" at the "Gulf seismic forum" conference.	United Arab Emirates	A. Kijko
ESRI User Conference in the USA. 9–13 August 2004.	U.S.A.	H.M. Roos
The University of Texas at Dallas.	U.S.A.	H. Coetzee
Between 14 and 27 August presented papers "New trends in Seismic Hazard analysis" at the Solid Earth Physics Seminar at Harvard University, "Estimation of the maximum earthquake magnitude Mmax" the "Geoscience Seminar" at St Louis University and "Estimation of the maximum earthquake magnitude and return periods for New Madrid Zone" at "Earthscope Science 2004" workshop in Memphis.	U.S.A.	A. Kijko
5th International meeting of the National Geoscience Data Repositories in Washington, D.C. 21–23 September 2004.	U.S.A.	K.J. Wilkinson

ACRONYMS

AHP ..... Analytical Hierarchy Process
ANN ..... Analytical Neural Networks
AMP ..... African Mining Partnership
BGS ..... British Geological Survey
CFBR ..... Cape Fynbos Biodiversity Region
CGS ..... Council for Geoscience
CGMW ..... Commission for the Geological Map of the World
CSIR ..... CSIR (no longer an acronym for "Council for Scientific and Industrial Research")
CTBTO ..... Comprehensive Test Ban Treaty Organisation
DEM ..... Digital Elevation Model
DME ..... Department of Minerals and Energy
DSAN ..... Deep Space Array-based Network
DST ..... Department of Science and Technology
EKE ..... Electro-Kinetic Effect
GMRAP ..... Global Mineral Resource Assessment Project
GSI ..... Geological Survey of India
IDC ..... Industrial Development Corporation
IMS ..... International Monitoring System
ISCW ..... Institute for Soil, Climate and Water
ISSC ..... International Subcommission for Stratigraphic Classification
LANDSAT ..... LAND resource assessment SATellite system
LGM ..... Last Glacial Maximum
LISCO ..... Library and Information Services of the Science Councils
MCM ..... Marine and Coastal Management — formerly Sea Fisheries Research Institute
MGU ..... Marine Geoscience Unit
NDC ..... National Data Centre
NEPAD ..... New Partnership for African Development
NIR ..... Near Infra-red
NPA ..... National Ports Authority
NSC ..... National Steering Committee of Service Providers to the Small-Scale Mining Sector
UNOMIN ..... Union Nationale des Opérateurs Miniers du Mali
OSL ..... Optically Stimulated Luminescence
REE ..... Rare Earth Elements
RLP ..... Relative Location Procedure
RIM ..... Robben Island museum
SADC ..... Southern African Development Community
SAGEOLIT ..... South African Geological Literature Database
SAHRA ..... South African Heritage Resources Agency
SAMTEX ..... Southern African Magnetotelluric Experiment
SANAE ..... South African National Antarctic Expedition
SANSN ..... South African National Seismograph Network
SDM ..... Spatial Data Management
SHRIMP ..... Sensitive High Resolution Ion MicroProbe
SVD ..... Singular Value Decomposition
SKEP ..... Succulent Karoo Ecosystem Plan
SXRF ..... Simultaneous X-ray Fluorescence Spectrometer
UNCLOS ..... United Nations Convention on Law of the Sea
UNESCO ..... United Nations Educational, Scientific, and Cultural Organisation
USGS ..... United States Geological Survey
WMA ..... Water Management Area