



Institute



Dr Ingrid Dennis

Institute for Groundwater Studies

Review

The Institute for Groundwater Studies (IGS) has seen many changes over the past year. The most significant of these has been the retirement of the former Head of Department, Prof. Frank Hodgson, after more than 30 years of service in this position.

Prof. Hodgson founded the IGS in 1974 and became its first Director. In 1988, the Groundwater Division of the Geological Society of South Africa rewarded him with the Ground Water medal for his significant contributions to the advancement of groundwater in South Africa. Prof. Hodgson negotiated a 6-year contract [1995 – 2000] with the German Government to sponsor 12 students per year from Africa to obtain their honours degrees from the IGS. In 2004, the UFS rewarded him with a centenary medal for his entrepreneurial management of the IGS. The nine indigenous trees that Prof. Hodgson planted in front of the IGS building will always bear witness to the fact that he was not only a brilliant scientist, but also deeply involved in environmental concerns.

After Prof. Hodgson's retirement, two members of the Institute, Prof. Gerrit van Tonder and Dr Danie Vermeulen took over the director's duties until 1 August 2007, when the final decision was taken to appoint Dr Ingrid Dennis as the Director of the IGS on a permanent basis.

Dr Dennis has an impressive academic and professional record and has received numerous awards for excellence in both her studies and her professional career. She is a member of the International Hydrogeological Association and the South African Council for Natural Scientific Professions.

During 2007, 17 honours, 20 M.Sc. and 13 Ph.D. students were registered at the Institute.

Five affiliated researchers at the IGS, namely Ms Adrie van Wyk, Messrs Danie Vermeulen, Rainier Dennis, and Robel Gebrekristos, obtained their Ph.D. degrees during 2007. Ms Van Wyk and Mr Gebrekristos have since left the IGS to pursue careers with private firms. The remaining three were appointed as full-time researchers at the Institute.

The institute was privileged to have visits and collaboration from two international experts, namely Dr Allen Shapiro, a research hydrologist from the United States Geological Survey

(USGS), and Prof. Dave Kremer from the University of Nevada, Las Vegas (UNLV), United States of America (USA).

About 254 delegates from across South Africa and the world registered for the three-day South African Groundwater Conference from 8-10 October 2007 in Bloemfontein. This was the biannual conference of the Groundwater Division of the Geological Society of South Africa and drew groundwater practitioners, researchers, regulators and other interested parties from across South Africa, Africa, Europe, Asia and North America. A wide variety of papers were delivered on topics including groundwater regulation and governance, aquifer characterisation, surface/ groundwater interaction and groundwater pollution and quality. The IGS presented 16 papers at the conference and received the "Best Poster" award. Staff members of the IGS served on the organising committee of the conference.

The opening address was made by the Minister of Water Affairs and Forestry, Ms Lindiwe Hendriks. Discussions were held between the Minister and Dr Dennis on how the IGS, as part of the UFS cluster for "Water management in water-scarce areas", can promote the integration of water resources and build capacity within the government and private sectors by means of research projects and the training of students.

A pre-conference course was held by Dr Allen Shapiro (USGS) and Prof. Van Tonder at the IGS. Dr Shapiro is a research hydrologist with the U.S. Geological Survey in Reston, Virginia, USA. His research has focused on characterising groundwater flow and chemical transport in fractured rock. He is a collaborating researcher on the Water Research Commission's (WRC) "Bulk Flow" project.

At the conference dinner, the Ground Water Division bestowed an Honorary Membership on, and awarded the Ground Water medal to, Prof. Jopie Botha, a retired professor from the IGS. He was nominated by Dr K Pietersen, and the decision of the Executive Committee was unanimous. The award is given to members of the groundwater community of South Africa who have made a significant contribution to the advancement of groundwater. This award aims at recognising the scientific contribution to the field of groundwater studies in South Africa, especially in developing the theoretical understanding of ground-



Attending the South African Groundwater Conference held in Bloemfontein are, from the left: Mr Trevor Balzer, Department of Water Affairs and Forestry, Minister's office, Dr Jennifer Pretorius, IGS, Mr Guy Preston, Department of Water Affairs and Forestry, Working for Water; front: Mr Chris Moseki, Department of Water Affairs and Forestry, Water Resource Planning Systems, Ms Lindiwe Hendriks, Minister of Water Affairs and Forestry, Dr Ingrid Dennis, Director: IGS.

water flow in fractured rock aquifers. Prof. Botha has played a significant role in mentoring a number of groundwater professionals.

During the GWD conference, the IGS arranged (and partly financed) the visit of Dr H.A. Dharmagunawardhane, Senior Lecturer in Hydrogeology and Applied Geophysics, Department of Geology, University of Peradeniya, Sri Lanka, to attend the conference. Dr Dharmagunawardhane was instrumental in arranging the workshops presented by Prof. Van Tonder, Drs Vermeulen and Dennis in Sri Lanka in 2006 and 2007.

A Memorandum of Understanding (MOU) between the University of D'Abomey-Calavi, Benin and the UFS was signed. The MOU will provide a platform for the IGS to assist in the development of the curriculum and training for both staff and students at the University of D'Abomey-Calavi.

A three-year project on the impacts of irrigation of mine water on groundwater resources was completed in 2007. This research, co-sponsored by the WRC and Coaltech 2020, provided a quantification of the impacts from four different irrigation sites, with suggested guidelines for the implementation of this practice.

During 2007, a two-year WRC contract was also awarded to the IGS, with

the title, *Scoping level assessment of how water quality and quantity will be affected by mining method and mining of the Waterberg coal reserves.*

The three-year WRC project on *Field investigations to study the fate and transport of dense non-aqueous phase liquids (DNAPLs) in groundwater* was completed early in 2007. For this project, the IGS collaborated with the University of Johannesburg and the Council for Geoscience. Six research products in the form of research reports and guidelines were produced as a result. A follow-up four-year research project on *Light Non-Aqueous Phase Liquids* was initiated in 2007. Collaborating organisations are: the Universities of KwaZulu-Natal and Pretoria, and Golder and Associates Consultants.

Another four-year project from the WRC, *Measurement of the bulk flow and transport characteristics of selected fractured rock aquifer systems in South Africa*, was awarded to the IGS. Collaborating organisations are USGS and the Universities of Venda, Fort Hare, and the Western Cape.

In 2007 the IGS, together with the Department of Water Affairs and Forestry (DWAF) and Fetwater, presented short courses in Groundwater Resource Directed Measures Port Elizabeth and Cape Town. These courses focused on training groundwater professionals in assessment, as dictated by the Water Act of 1998.

These training courses will continue into 2008.

The IGS was awarded with Phase 2 of the project Geohydrological Software Development for Decision Support, and two Reserve Determinations by the DWAF.

A number of contracts have been obtained from SASOL Mining, SASOL Synfuels and ESKOM. These are used as projects for M.Sc. and honours students.

In addition, numerous contracts for geohydrological investigations at mining and industrial sites were awarded to the IGS.

Staff members attended and presented papers at four international conferences in the USA, Canada and Ghana.

On 30-31 October 2007, Prof. Marc Kpodekon (Dean of Natural Sciences) and Dr Codo Francois de Paule from the University of D'Abomey-Calavi in Benin paid a visit the Institute for Groundwater Studies. They were accompanied by Mr Wouter van den Wall Bake, the Programme Officer for international projects from Vanhall-Larenstein in the Netherlands. The aim of the visit was to sign an MOU between the University of D'Abomey-Calavi and the UFS. The MOU will provide a platform enabling the IGS to assist in the development of the curriculum and training for both staff and

Staff

Director: Dr Ingrid Dennis

Professors: Prof. Gerrit van Tonder

Senior Lecturer: Dr Brent Usher

Researchers: Drs Rainier Dennis, Jennifer Pretorius, Danie Vermeulen, Mr Sakhile Mndaweni

Affiliated Researchers: Profs Jopie Botha, Frank Hodgson, Dr Francois Fourie, Messrs Michael du Preez, Robel Gebrekristos, Sechaba Lenong, Mehari Menghistu, Richard Akoachere, Michael Bester, Modreck Gomo, Ms Michelle Pienaar

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Prof. Frank Hodgson, former head of the IGS, retired after more than 30 years of service in this position. The photo was taken during his farewell function.

and another formed the basis of a presentation by Prof. Kreamer at the GSA conference in Denver.

In 2007 the contract with the DWAF entitled: *Geohydrological Software Development For Decision Support: Phase 1* ended. However, the IGS was also awarded with Phase 2 of the above-mentioned contract. The focus of the contract will be training in the following software packages: South African Groundwater Decision Tool, Groundwater Dictionary and Groundwater Resource Directed Measures. The Department of Water Affairs and Forestry also awarded the IGS with two Reserve Determinations for the Thukela and Mhlatuze Water Management Areas. These projects include both research and training components.

Two researchers, Drs Jennifer Pretorius and Brent Usher, visited the USA for a fortnight in October 2007. Two papers were presented at a special session on "Groundwater in the Developing World" at the Annual Geological Society of America Meeting in Denver, Colorado. As part of this session, interested researchers, academics and Non-Governmental Organisations (NGOs) held a specially convened meeting to establish a multi-organisational, university-driven consortium to further groundwater research and development in the developing world under the leadership of Prof. Kreamer of UNLV and Dr Michael

Campana. The Geosciences School at the University of Nevada was also paid a visit to explore collaboration possibilities, and a meeting was held with the Dean of the College of Sciences at UNLV to establish a formal collaboration agreement. As a final leg, the National Ground Water Association's Conference on Light Non-Aqueous Phase Liquids was attended in Houston, Texas, in support of the Institute's research activities in this field.

During July 2007, Dr Vermeulen attended a conference in Accra, Ghana and delivered a paper entitled *Quantification of the impact of irrigating with coalmine waters on the underlying aquifers*. This paper was subsequently selected to be published in a book by Springer, entitled *Appropriate Technologies for Environmental Protection in the Developing World*. Dr Vermeulen also chaired a number of the sessions at the conference.

As member of the International Mine Water Association, Dr Vermeulen also attended the 14th Annual BC/MEND (Mine Environment Neutral Drainage) Metal Leaching / Acid Rock Drainage Workshop on Challenges in Collection and Treatment of Mine Drainage (28-30 November 2007), at the Simon Fraser University Harbour Centre, Vancouver, BC. This is an annual workshop attended by researchers and professionals from the mining industry from all over the world.

students at the University of D'Abomey-Calavi. Vanhall-Larenstein will assist with finances for this exchange.

Prof. David Kreamer of the University of Nevada (UNLV) in Las Vegas, USA visited the IGS on two occasions as part of his extended sabbatical, which included three other African countries. During his first visit, in May 2007, Prof. Kreamer reviewed some of the research projects underway at the IGS. He also lectured the postgraduate students on the practical application of geophysics for groundwater contamination problems. He returned to the IGS in June 2007. In this period, the possibility of collaboration was discussed, and the basis of several joint papers on groundwater issues was outlined. One paper has subsequently been submitted to a special edition of the journal *Groundwater* for consideration,

Research outputs

Research articles

Dennis, I. & Wentzel, J. 2007. Groundwater resource-directed measures software. *Water SA* 33(1): 79-86.

Fourie, F. 2006. Aspects of the lateral and vertical resolution of surface electroseismic data with implications for groundwater exploration in fractured Karoo rocks. *South African Journal of Geology* 109(4): 571-584.

Van Tonder, G.J., Usher, B.H., Dennis, I. & Vermeulen, P.D. 2007. Predicting rebound in a deep colliery in South Africa. *Mine Water and the Environment* 26(2): 79-87.

Conferences contributions

Akoachere, R. & Van Tonder, G.J. 2007. *Three methods for the determination of mechanical and hydraulic fracture apertures in fractured rock aquifers.* Paper presented at the Biennial South African Groundwater Conference, University of the Free State, Bloemfontein, South Africa. 8-10 October.

Akoachere, R.A., Itie, T.M., Yaya, O.O. & Oteze, G.E. 2007. *Using morphometric analysis to evaluate groundwater hydraulic characteristics in the piedmont regions of Mount Cameroon, West Africa.* Paper presented at the 19th Annual Conference of the Nigerian Association of Hydrogeologists (NAH), Port Harcourt, Nigeria. 18-23 November.

Akoachere, R.A., Van Tonder, G.J., Yaya, O.O. & Menghistu, M.M. 2007. *The partial hydraulic conductivity theory of bulk flow in aquifers: (Isotropy to anisotropy).* Paper presented at the 19th Annual Conference of the Nigerian Association of Hydrogeologists (NAH), Port Harcourt, Nigeria. 18-23 November.

De Sousa, E.R., Usher, B.H. & Bernardes, C. 2007. *Evaluation of the hydraulic effectiveness of a Phytoremediation System from South-eastern Brazil.* Paper presented at the XXXV International Association of Hydrogeologists (IAH) Congress: Groundwater and Ecosystems, Lisbon, Portugal. 17-21 September.

De Sousa, E.R., Usher, B.H. & Bernardes, C.J. 2007. *Evaluation of the hydraulic effectiveness of a phytoremediation system from south-eastern Brazil.* Paper presented at the Biennial South African Groundwater Conference, University of the Free State, Bloemfontein, South Africa. 8-10 October.

Demmer, T., Barnes, J., Van Rensburg, H.J., Hubert, G.L.H., Meyer, M. & Vermeulen, P.D. 2007. *Development of a conceptual aquifer model for the Tenke-Fungurume area, southern DRC.* Paper presented at the Biennial South African Groundwater Conference, University of the Free State, Bloemfontein, South Africa. 8-10 October.



The Ground Water Division (GWD) bestowed an Honorary Membership on, and awarded the Ground Water medal to, Prof. Jopie Botha at the conference dinner of the GWD's biannual conference.

Dennis, I. & Moseki, M.C. 2007. *Investigation of the applicability of various groundwater / surface water interaction methodologies in South African fractured rock environment.* Paper presented at the XXIV General Assembly of the International Union of Geodesy and Geophysics (IUGG), Perugia, Italy. 2-13 July.

Dennis, I., Veltman, S., Dennis, S.R. & Watson, M. 2007. *Geohydrological software for decision support.* Paper presented at the Biennial South African Groundwater Conference, University of the Free State, Bloemfontein, South Africa. 8-10 October.

Fourie, F. 2007. *Geotechnical application of a 2-D resistivity survey: Mapping bedrock elevation for bridge construction.* Paper presented to the 10th SAGA Biennial Technical Meeting and Exhibition, Wild Coast Sun, South Africa. 15-18 October.

Fourie, F. 2007. *Limitations of the Helmholtz-Smoluchowski Equation in Electroseismics.*

Paper presented to the 10th SAGA Biennial Technical Meeting and Exhibition, Wild Coast Sun, South Africa. 15-18 October.

Fourie, P.J. & Usher, B.H. 2007. *Geochemical numerical modelling of acid mine drainage from an open-cast coal mine.* Paper presented at the Biennial South African Groundwater Conference, University of the Free State, Bloemfontein, South Africa. 8-10 October.

Gebrekrstos, R.A. & Usher, B.H. 2007. *A column experiment to characterise DNAPL Saturation using Partitioning Interwell Tracer Test (PITT).* Paper presented at the Biennial South African Groundwater Conference, University of the Free State, Bloemfontein, South Africa. 8-10 October.

Gebrekrstos, R.A., Shapiro, A.M. & Usher, B.H. 2007. *In situ estimation of the effective chemical diffusion coefficient of the rock matrix in a fractured aquifer.* Paper presented at the Biennial South African Groundwater

Conference, University of the Free State, Bloemfontein, South Africa. 8-10 October.

Gebrekrstos, R.A., Usher, B.H., Lenong, S.E. & Pretorius, J.A. 2007. *Innovative methods to characterize fractured rock aquifers and comparison to established methods*. Poster presented at the Biennial South African Groundwater Conference, University of the Free State, Bloemfontein, South Africa. 8-10 October.

Hodgson, F.D.I. 2007. *Water management in South African collieries*. Paper presented at the Biennial South African Groundwater Conference, University of the Free State, Bloemfontein, South Africa. 8-10 October.

Jovanovic, N., Saayman, I., Beekman, H., Adams, S., Campbell, R., Conrad, J., Fey, M. & Usher, B.H. 2007. *Improved tools and protocols for aquifer vulnerability assessment in South Africa*. Paper presented at the Biennial South African Groundwater Conference, University of the Free State, Bloemfontein, South Africa. 8-10 October.

Le Roux, P.A.L., Hensley, M., Van Huyssteen, C.W.J., Van Tol, J., Vermeulen, P.D. & Lorentz, S.A. 2007. *Hydrosequences of wetland soils in selected catchments*. Paper presented to the National Wetlands Indaba: Wetlands for tomorrow, Gauteng Department of Agriculture, Conservation and Environment (GDACE), Kempton Park, South Africa. 22-26 October.

Pretorius, J.A., Usher, B.H. & Gebrekrstos, R.A. 2007. *Characterising DNAPL fracture flow in the field using a surrogate DNAPL*. Paper presented to the Geological Society of America Annual Meeting, Denver, Colorado, USA. 28-31 October.

Pretorius, J.A., Usher, B.H. & Gebrekrstos, R.A. 2007. *Fate and transport of dense non-aqueous phase liquids (DNAPLs) in South African aquifer systems*. Paper presented at the Biennial South African Groundwater Conference, University of the Free State, Bloemfontein, South Africa. 8-10 October.

Reynolds, K., Nel, J., Pretorius, C., Petrik, L., Buckley, C., Usher, B.H., Gericke, G. & Roux, D.T. 2007. *Sustainability of inland ash disposal facilities as salt sinks*. Poster presented at the 11th International Conference on Diffuse Pollution and the 1st Joint Meeting of the IWA Diffuse Pollution and Urban Drainage Specialist Groups, Sao Paulo, Brazil. 26-31 August.

Reynolds, K., Pretorius, C., Petrik, L., Buckley, C., Usher, B.H., Gericke, G. & Roux, D.T. 2007. *Sustainability of inland ash disposal facilities as salt sinks*. Poster presented at the World of Coal Ash (WOCA) 2007 Science, Application and Sustainability Conference, Lexington, Kentucky, USA. 7-10 May.

Usher, B.H. 2007. *Appraisal of multi-country groundwater assessment and protection projects in Africa*. Paper presented to the Geological Society of America Annual Meeting, Denver, Colorado, USA. 28-31 October.

Van Tonder, G.J., Usher, B.H. & Hughes, D. 2007. *Groundwater / surface water interaction: A new perspective*. Paper presented at the Biennial South African Groundwater Conference, University of the Free State, Bloemfontein, South Africa. 8-10 October.

Van Wyk, A. & Usher, B.H. 2007. *Field scale application of biobarriers for hydraulic control in fractured aquifers*. Paper presented at the Biennial South African Groundwater

Conference, University of the Free State, Bloemfontein, South Africa. 8-10 October.

Veltman, S. & Dennis, S.R. 2007. *Using neural networks for simulating groundwater / surface water interaction in hydrological yield modelling*. Poster presented at the XXIV General Assembly of the International Union of Geodesy and Geophysics (IUGG), Perugia, Italy. 2-13 July.

Veltman, S. & Dennis, S.R. 2007. *Using neural networks for simulating groundwater / surface water interaction in hydrological yield modelling*. Paper presented at the Biennial South African Groundwater Conference, University of the Free State, Bloemfontein, South Africa. 8-10 October.

Vermeulen, P.D. & Usher, B.H. 2007. *Determination of the impact of mine water irrigation on groundwater resources*. Paper presented at the ERTEP 2007 - First International Conference on Environmental Research, Technology and Policy: Building Tools and Capacity for Sustainable Production, La Palm Royal Beach Hotel, Accra, Ghana. 17-19 July.

Vermeulen, P.D., Van Tonder, G.J. & Usher, B.H. 2007. *Detailed quantification of coalmine water irrigation impacts on the underlying aquifers*. Paper presented at the Biennial South African Groundwater Conference, University of the Free State, Bloemfontein, South Africa. 8-10 October.

Xu, Y. & Usher, B.H. 2007. *Groundwater quality issues in Africa and some suggested solutions*. Paper presented at the Biennial South African Groundwater Conference, University of the Free State, Bloemfontein, South Africa. 8-10 October.