



GEOSTATISTICAL ASSOCIATION OF AUSTRALASIA

Newsletter 12 November 2000

Contact Addresses: PO Box 1719, West Perth WA, 6872.

Http://: www.gaa.org.au.

From The Editor

Welcome to the new-look GAA Newsletter. The GAA committee resolved since the last issue (admittedly some time ago now) to generate all future newsletters in electronic format for ease of distribution and posting on the GAA website. However, those of you who would prefer to receive the letter as hard copy can do so by contacting the GAA at <http://www.gaa.org.au/>. This may seem a somewhat circular argument as this letter has been mailed to you, but I feel this is in keeping with inherent uncertainty and risk that you always encounter in the geostatistical world. As adapted from a quote by past GAA president John Henstridge –

“ The best thing about being a geostatistician is that you are always uncertain”

In this issue:

- Committee Activities - what the GAA have been up to over the last few months
- GAA Talks - Geostats 2000 GIS and Logic
- Introducing the GAA Committee - some background on your committee
- Learning Geostatistics - Where to go for geostatistics education in Australia
- GAA Symposium - Quantifying Risk - Call for papers
- In memory of two great geostatisticians - Georges Matheron and Michel David

GAA Activities

The year has started fairly quietly for the GAA but now your committee is working hard to get things moving on four main fronts: the newsletter, the website, regular meetings and a conference. Here's a little update on progress:

The Newsletter. Mark Murphy has worked valiantly to put this together but he faces the usual problem of all newsletter editors – lack of contributions. If you have any suggestions, hot tips, bits of news, open questions, etc, please email Mark at mmurphy@anaconda.com.au. The current plan is to issue the next newsletter in February 2001 so please send or email your contributions before then.

The Website. The GAA website <http://www.gaa.org.au/> has the potential to be a very useful resource for members, particularly those not based in Perth. Your committee hopes to build a series of pages covering topics of interest, tips etc. These could include:

Change of support

Block size selection for resource models

Kriging variance – uses and abuses

Unfolding

Flavours of indicator kriging

Anything else that you care to suggest!

If you have something that you would like to contribute or if there is a particular topic that you would like covered, let us know. Other ideas for the site are a list of members (perhaps just name, organisation and email address?), a library of useful bits of software (eg, Datamine macros, Vulcan scripts, VB code etc) and a list of training and higher education courses. It's your website so let us know what you would like to see (sorry, no pictures of Claudia Schiffer are available). The website content is being coordinated by Ian Lipton itl@mrtconsulting.com.au and kindly maintained by Anna at Confed-Computer Services anna@confed.com.au

Technical Talks. More irregular than regular, at present! The small number of people that were able to attend the August

meeting enjoyed an interesting and well-presented talk by Warrick Brown on the use of neural networks for mineral prospectivity mapping. Earlier in the year Lyn Bloom and Ute Mueller presented a summary of the more interesting papers from the 6th International Geostatistical conference in South Africa.

The CD of papers from this conference is rumoured be available later this year – search out the Geostats2000 Website for details.

Ian Lipton's proposed talk on Modelling Bulk Density had to be postponed due to a trip to China. It is now on scheduled for the 5th of December. See details and an abstract at the end of this newsletter.

We are always in need of speakers, so if you have an interesting case history to present,

some radical ideas to debate or have a distinguished visitor from overseas, please contact anyone on the committee and we will slot you in, even at short notice.

Your committee has also being trying to locate an ideal venue for the meetings in Perth. If you want to see the meetings changed in any way (topic, format, venue volume of free drinks afterwards, etc) let us know!

Membership. Membership Fees for the 2000/2001 financial year (July-June) are now overdue! Please forward your fees to your GAA secretary at PO Box 1719, West Perth WA.

GAA Conference 2001 –Quantifying Risk – Call For Papers

Conference Theme -

'The quantification of risk in mining and environmental sciences through spatial statistics.'

Conference date: April 2001

- **Venue - somewhere comfortable in Perth, Western Australia**
- **Deadline for receipt of abstracts: 15th December 2000**
- **Deadline for receipt of full draft: 31st January**

(to give you the full advantage of the Xmas break to prepare your presentation!)

A variety of formats (such as pdf documents, Powerpoint presentations etc) will be considered for publication, on CD-ROM.

We are hoping to receive contributions from a wide range of disciplines, not just mining, and perhaps provide some new cross-disciplinary perspectives on how we assess risk. The papers can be as mathematical or as non-mathematical as you wish and case histories are most welcome.

Neural Networks and GIS

Warrick Brown's excellent presentation was given at UWA in August. An abstract of the talk is given below. If you missed the talk you will find the abstract on the site via the Calendar of Events link. You can also read Warwick's paper in Volume 47, Number 4 of the Australian Journal of Earth Sciences. A multi-layer feed-forward neural network, trained with a gradient descent, back-propagation algorithm, is used to estimate the favourability for gold deposits using a raster GIS database for the Tenterfield 1:100,000 sheet area, NSW. The database consists of solid geology, regional faults, and airborne magnetic and gamma ray survey data (U, Th, K, and total count channels), and 63 deposit and occurrence locations. Input to the neural

network consists of feature vectors formed by combining the values from co-registered grid cells in each GIS thematic layer. The network was trained using binary target values to indicate the presence or absence of deposits. Although the neural network was trained as a binary classifier, output values for the trained network are in the range [0.1,0.9] and are interpreted to indicate the degree of similarity of each input vector to a composite of all the deposit vectors used in training. These values are re-scaled to produce a multiclass prospectivity map.

To validate and assess the effectiveness of the neural network method, mineral

prospectivity maps are also prepared using the empirical weights of evidence and the conceptual fuzzy logic methods. The neural network method produces a geologically plausible mineral prospectivity map similar, but superior, to the fuzzy logic and weights of evidence maps. The results of this study indicate that the use of neural networks for the integration of large multisource data sets used in regional mineral exploration, and for prediction of mineral prospectivity, offers several advantages over existing methods. These include the ability of neural networks to; 1) respond to critical combinations of

parameters rather than increase the estimated prospectivity in response to each individual favourable parameter, 2) combine data sets without the loss of information inherent in existing methods, and 3) produce results that are relatively unaffected by redundant data, spurious data and data containing multiple populations. Statistical measures of map quality indicate that the neural network method performs as well, or better, than existing methods while using approximately a third less data than the weights of evidence method.

Your GAA Committee

Who are these people to whom you send GAA dues each year? – The brief resumes below give you an idea

Ian Glacken - President. Ian is a mine and ore reserve geologist who gained his extensive experience working at Kambalda, Olympic Dam, and in Perth, working and consulting on resource projects worldwide. Ian developed an interest in geostatistics while working for WMC Resources, and was lucky enough to be able to carry out post-graduate studies at Stanford University where he studied under André Journel and carried out research on conditional simulation for grade control. Ian joined Snowden Mining Industry Consultants in 1998 and now holds the position of General Manager Geology and Resources. Ian's work interests include resource estimation, mine and orebody audits, conditional simulation for risk analysis, sampling theory and applications, and reconciliation studies.



Ian Lipton - Vice President. Ian is a graduate from the University of Birmingham who moved to Ora Banda in Western Australia (population 11, at that time) in the 1980's to start his career in exploration with BHP Minerals. After several years he moved to mine geology at Ora Banda and Brown's Creek in New South Wales.

Over the next few years Ian was involved in a wide range of resource estimation projects in gold, iron ore and base metals in Australia and overseas. In 1997 Ian joined Mining & Resource Technology mining consultants in Perth and his recent project work includes feasibility studies for nickel laterite

projects, recoverable resource estimation for gold deposits, and technical audits for gold, iron ore, copper, lead and nickel mines. Ian is currently acting as co-Webmaster for the GAA website and will be GAA president in the next term of office.

Sjoerd Duim – Treasurer. Sjoerd is a Mining Engineer originally from The Netherlands, who after a brief stint in a German coal mine started his graduate mining career with De Beers Consolidated Mine Ltd in Kimberley, South Africa, in June 1983. His practical mining experience was gained at the various underground diamond mines in Kimberley and at the Finsch open pit diamond mine. Sjoerd also worked for a short while at the Western Deep Levels gold mine, the worlds deepest mine. In November 1988 Sjoerd transferred to Johannesburg to join the Anglo American Corporation of South Africa Ltd (AAC). During the early years in Johannesburg Sjoerd obtained an MSc(Eng) degree (Mineral Economics option) from the University of the Witwatersrand (December 1991), where he studied under Prof. D. Krige and Dr. I Clark. Sjoerd performed mineral resource evaluation and mine planning work for AAC, including projects in Bulgaria, Ireland, the Philippines, Zambia and Zimbabwe. Sjoerd moved to Australia in March 1998 and joined the Mining and Geology division of GRD MINPROC Limited, where he has been involved in mine planning work for a variety of local and worldwide projects. Sjoerd has been treasurer of the GAA since April 1999.



Mark Murphy - Committee. Graduated from the NSWIT in Sydney in 1985. He completed a Dip.Ed in 1986 and spent several years as a high school teacher before driving his Volkswagen across the Nullabor to Kalgoorlie to work as an exploration geologist. He spent the next 10 or so years living near and working as a mining geologist in various exotic locations near Meekatharra, Laverton and Leonora in Western Australia. For the last few years he has been working as a resource geologist with Anaconda Nickel and is spending his spare time working on a MSc project at ECU investigating application of geostatistics to Ni-laterite deposits. Mark is currently newsletter editor and you are likely to hear from him directly in his search for new content for the GAA newsletter.



Dr Lyn Bloom - Committee. Lyn is a Associate Professor of Mathematics at the School of Engineering and Mathematics at Edith Cowan University Western Australia. Lyn's interests include geostatistics, resources and environmental modelling technology and mathematics education. Lyn has co-authored several research papers on fractal simulation and application of the method to a variety of geostatistical problems. Lyn provides useful connections for the GAA to the tertiary education and statistical community.

Dr John Henstridge – Committee. John is a past president of the GAA and the founder and Managing Director of Data Analysis Australia. John has many years experience as a consultant in industry and in academia. His work as a consultant covers all areas of applied statistics, with particular expertise in time series, forecasting and statistical software. John has worked and taught in a number of countries including England, Thailand and the Philippines.

John is a Fellow and Chartered Statistician of the Royal Statistical Society and a member of the Statistical Society of Australia, the International Association for Statistical Computing, the Australian Mathematical Society and the Market Research Society of Australia.

Paul Hodkiewicz -Committee Paul completed a BSc in Geology at the State University of New York at Oneonta in 1986 and a MSc degree in Geology at Bowling Green State University, Ohio in 1989. From the late 80's to the mid 90's, he worked as a mine geologist on Carlin-type gold deposits in the Jerritt Canyon district of northeastern Nevada. In the late 90's Paul moved into exploration searching for epithermal and Carlin-type gold systems in North Sulawesi, Indonesia. In 1998, he moved to Perth with his wife and two children and started a PhD at UWA. His PhD project is a GIS study of genetic constraints on the formation and distribution of world-class lode gold deposits, focussing on the Eastern Goldfields province of the Archean Yilgarn craton of Western Australia.



Roger Cooper – Committee. Roger is Senior Geologist, WA with BFP Consultants in Perth. Roger has fourteen years experience in exploration and resource evaluation. His main areas of expertise are orebody modelling, data manipulation and geostatistics, and he is currently completing an MSc in geostatistics. Roger has previously worked on open pit and underground resource projects in Zambia, Fiji, Indonesia, New Zealand and Australia

Mark Flemming – Committee. Mark graduated from Macquarie University in Sydney in 1977 and has worked throughout Australia in a number of mine based and regional exploration roles. He has been involved in wide range of deposits ranging from the Jabiluka Uranium deposit in the Northern Territory, tin mines in Tasmania and N.S.W., and the development of the Hellyer Mine (also Tas.). Mark moved into regional exploration when he joining RGC in the late 80's. He then moved back to the Northern Territory in 1993 to work at the Woodcutters Mine and joined Normandy Mining following PosGold's takeover of Aztec in 1994. Since joining Normandy he has been Chief Geologist at Golden Grove in W.A. and managed the feasibility study for developing the Gossan Hill deposits at Golden Grove. He currently holds the position of Chief Geologist – Technical for the Group.



Brian Davis is our final committee member but he missed the deadline to become famous in print – perhaps the next newsletter.

Learning Geostatistics ? - Education in Australia

One of the stated aims on the GAA web page is to assist in development and training, so I thought I'd do a small investigation into the opportunities for geostatistical training within Australia. The results are a little biased to personal experience, however, anyone who would like to suggest other avenues is welcome to contribute in future issues of the newsletter.

From the University sector, I found that Edith Cowan University in WA and the University of Queensland have or are planning to have, coursework or postgraduate courses directly designed to give formal training in geostatistics.

At ECU, Maths undergraduates are offered a one semester elective unit (Introduction to Geostatistics) that involves a lot of hands on assignments using GSLIB datasets and software, with projects ranging from simple kriging through to simulation. At a postgraduate level ECU offers a Postgraduate Certificate in Geostatistics that involves three units of study equivalent to one semester of full time study. Core units include 'Introduction to Geostatistics' and 'Geostatistical Methods' which covers a wide range of geostatistical methods. Both these courses are available on-line. Three electives are offered including 'Modelling and Simulation', 'Time Series Analysis' and 'Spatial Modelling and GIS'. There is also the possibility of study for an MSc (Mathematics and Planning) or a PhD with a research topic in the area of geostatistics. More details can be found on <http://www-chs.ecu.edu.au/courses/postgraduate2000.html> under the School of Engineering and Mathematics section. Thanks to **Lyn Bloom** for the details and background of the courses at ECU.

At the **University Of Queensland**, the WH Bryan Mining Geology Research Centre (BRC) is offering postgraduate degrees (MSc & PhD) in geostatistics. Postgraduate studies are conducted through the Department of Mining Minerals and Materials Engineering.

The Master of Science or Engineering course is a research-based Master's (MSc, MEngSc) and is usually taken full time over two years. Candidates for research-based Master's degrees are awarded the degree on the basis of a submitted thesis of original research that demonstrates the candidate's application of methodological and

conceptual skills in a research field. Depending on the background and needs of the student, some course work may be required. This is to ensure that the course produces graduates that are competitive when considering international standards in the field. Anticipated to commence in 2002, BRC is also offering a one-year, full-time program for Master in Mineral Resources (Geostatistics) based solely on course work.

The BRC Doctor of Philosophy (PhD) degree is awarded as a result of sustained research publications and thesis in an area of interest over an average time of 3.5 years. Depending on the background and needs of the student, some course work may be required. The PhD program is intended largely for candidates who wish to pursue research careers. More details can be found on the BRC web site <http://www.uq.edu.au/departments/index.phtml?menu=2&ID=123>. BRC is offering scholarships for postgraduate course (see the advertisement on the following page).

BRC also runs yearly programs of short courses run by internationally recognised experts. The courses are geared towards mining industry professionals and extend beyond geostatistics into related technical areas ranging from sampling and optimisation through to mine design and project evaluation. Again details can be found on the BRC web page.

Details from other Universities are less well researched however, the University of Adelaide, the University of Wollongong and the West Australian School of Mines offer undergraduate subjects in geostatistics for geologists and/or mining engineers with the possibility of postgraduate research in the subject of geostatistics.

Thanks to **Roussos Dimitrakopoulos** for assistance on the background the details and background on BRC courses and what is happening at other universities.

Several Australian consultant firms offer short industry-oriented courses in Geostatistics. Two of these are detailed as follows.

John Vann (a past president of the GAA) from **SRK** runs a 3-day short course 'Introduction to Geostatistics' which has a strong geological focus. Topics range from basic statistical concepts, through variography and issues of structural modelling to the background and outputs of kriging. This practical course aims to help practitioners get

better value and understanding out of software tools that they may be using, and helps them to understand the limitation of estimation methods. The next course is in December - see the SRK website <http://www.srk.com.au/> for more details.

Snowden Mining Industry Consultants run several short courses each year including 'Applied Mining Geostatistics' (4 days), 'Ore Optimisation Using Conditional Simulation' (2 days) and 'Grade Control and Reconciliation' (4 days). Full details are given on the Snowden site

<http://www.snowden.com.au/>. The course formats are practical, conceptual, non-mathematical, relevant, and example and case study-driven. A variety of typical industry software packages are demonstrated. In-house courses are formatted and facilitated on request. Contact: Viv Snowden (tel) 61-8-9481 6690.

Companies and institutions that have an interest in this area are welcome to submit details for the next newsletter. Perhaps even advertise?

WH BRYAN MINING GEOLOGY RESEARCH CENTRE

THE UNIVERSITY OF QUEENSLAND, BRISBANE, AUSTRALIA

POSTGRADUATE SCHOLARSHIPS

The WH Bryan Mining Geology Research Centre (BRC), is offering Postgraduate Scholarships (MSc & PhD) in:

- **Mining geostatistics**
- **Resource modelling and analysis**
- **Mine optimisation and planning**

Eligibility: Postgraduate scholarships are offered for research on projects of significant importance to the minerals industry. High standards are desirable in mathematical / statistical and computing abilities.

The BRC is a member of the Sir James Foots Institute of Mineral Resources at The University of Queensland. The University of Queensland is one of the largest mining and mineral research centres in the world. The BRC provides state of the art facilities in a stimulating, high tech and professional environment. The Centre conducts advanced research in geostatistics, resource modelling, mine optimisation and planning. BRC staff includes experts in their fields. The Centre has links to and conducts collaborative research with major mining companies.



Applications should include curriculum vitae, academic transcripts and the names of at least two referees and be sent to:

Prof. R. Dimitrakopoulos

**WH Bryan Mining Geology Research Centre
The University of Queensland**

Brisbane, Qld 4072. Australia.

Applications close: Open

Further information can be obtained from the WH Bryan Mining Geology Research Centre, University of Queensland, Brisbane, Qld. 4072. Phone 61 (0)7 3365 3473; Fax: 61 (0) 7 3365 7028; Web: <http://www.minmet.uq.edu.au/~bryan>

Prof. Matheron, whose entire adult life was devoted to research, published over 250 papers, mostly internal to the CGMM and the CG, and five books. In his works, there is a prodigious amount of ideas, proposals, models where researchers and engineers will find material to develop for years to come. A good example of this is Conditional Simulation: the original turning bands method was presented by Matheron in an internal CGMM Note in 1972 and since then, the field of Simulation has grown exponentially, with new techniques appearing in recent years, making it one of the most important current research topics.

Behind this enormous and varied output, lies a recurring theme: the use of probabilistic models. Georges Matheron showed an exceptional capability for reducing what might seem intractable practical problems to simpler questions, which could be solved through the use of appropriate models. This is why the methods and concepts he elaborated have endured: they respond to real world problems.

A good testimony to this and a source of much pride for Prof. Matheron is the explosion in the fields of application of Geostatistics: initially confined to mining, it is now used in Petroleum, Forestry (where, independently of Matheron, B. Matern developed a very similar theory), Agronomy, Oceanography, Meteorology, Fishery, Environmental Sciences, etc...

This lifetime experience in modelling *unique* natural phenomena through a *probabilistic* approach, led Prof. Matheron to write "Estimating and Choosing, An Essay on Probability in Practice" (1978), which is required reading for any professional geostatistician. As the translator of this book into English, A.M Hasofer, says in his preface:

"Reading Matheron's work was an illumination. Here was a coherent, well thought-out framework for the use of probabilistic models to describe unique phenomena in a purely objective way. In one sweep, Matheron was able to rid the practice of probability of all the confusing philosophical overtones that has clouded it for decades, and to provide a clear guide for the determination of the suitability and range of applicability of probabilistic modelling."

Beyond his exceptional scientific ability, Prof. Matheron was in the deepest sense of the word, a master: how many students or professionals have had their whole career initiated or changed through his teachings and publications or by meeting him?

The disappearance of Georges Matheron ends an era; he leaves behind him two flourishing disciplines: Geostatistics and Mathematical Morphology. His ideas and his example will live on.

To his wife, Françoise, his four daughters and their families, we convey our deepest sympathies.

"Vale, George Matheron"

Daniel Guibal compiled this obituary that is reproduced with permission from the SRK Geostatistics Newsletter, Issue 24, October 2000. Daniel is a life member of the GAA and has worked for many years directly with Georges Matheron



Michel David, Professor of Geostatistics at École Polytechnique, Montréal and Fellow of the Academy of Science of the Royal Society of Canada, died on May 10, 2000 in Laval, Québec. He left behind his wife Ellen and their two children Kaitlin and Justin, as well as his remarkable legacy.

A world renowned expert in geostatistics and ore reserve estimation, Michel is credited for putting geostatistics on the scientific world map and establishing geostatistics as the tool for ore reserve estimation and orebody modelling world-wide. Due to Michel's influence, geostatistics is now taught in all mining schools and many geology departments, and has spread to other scientific and engineering fields.

Although the role of the individual and their contribution to civilisation is perhaps a topic for philosophers to debate, it is universally recognised that non-ordinary

individuals change the way people do things. Michel was a non-ordinary person. He was beyond the conventionalities of life; an individual with great intellect and curiosity, passion and tenacity, pragmatism and the focus to somehow lead people to change the way they did things.

A graduate in Ingenieur civil des mines from the École des Mines of Nancy, France, in 1967; Michel was trained by the founder of geostatistics Georges Matheron and his collaborator Philippe Formery. He was the first amongst a generation of geostatisticians responsible for the dissemination of geostatistics throughout the world. Michel came to École Polytechnique in Montreal to establish the first regular courses in geostatistics for future mining engineers and geologists in the Americas. He went on to receive his MSc (1969) and PhD (1973) degrees in operations research from the University of Montreal, became an assistant professor before completing his PhD and a full professor at the Department of Mineral Engineering in his 30's.

Early in his career, it was evident that Michel felt that "to be is to do" and that his theoretical approach to geostatistics should be tested in "real world" situations, thus his romance with consulting began in 1971. Having a flair for bringing experts together, Michel became director of the Mineral Exploration Research Institute in Montreal in 1978. In 1980, he used his leadership skills to establish Geostat Systems International. Starting with orebody models and reserve estimation, Michel applied his work and ideas to numerous mining projects and operating mines world-wide, consulted to over 60 mining companies from Canada and the US to Chile, South Africa, Thailand, to Papua New Guinea, Australia. If humans were capable of carrying out activities on other planets, Michel would have been there to see more and learn more!

In 1993, the international community of one hundred leading researchers and practitioners in geostatistics from every continent came to the International Forum on Geostatistics for the Next Century in Montréal to honour Michel's remarkable contribution to the development and implementation of geostatistics. The event reflected not only his recognition by and respect from the international community and his peers, but in addition, Michel's "intellectual inheritance" and quest for new, enhanced, integrated and technically broader, geostatistical frameworks for mining and resource modelling. Overwhelmed by his accomplishments, we asked him during that meeting: "What describes you the best, Michel?" "Teacher," he said. A teacher and a mentor he was to so many of us who owe him the start of our careers and the way we look at the world around us.

There are a remarkable number of people, some of them exceptionally accomplished that were influenced by Michel David, the Teacher. Amongst his students were Canadians who have made their own contribution to the field, including Raymond Sabourin, Noël Billette, Jean-Marc Belisle, Georges Verly, Kateri Guertin, Alexandre Desbarats, Denis Marcotte, Robert de l'Étoile, Alain Cazavant, Alain Moreau, and Mark Jutras. Several foreign postgraduate students and research fellows came to École Polytechnique to work under Michel; several of them including Peter Dowd, Michael Davis, Dominique François-Bongarçon,

Jean-Michel Rendu, Roussos Dimitrakopoulos and Michel Dagbert went on to leave their own mark with international careers. Michel's visiting professorship at the Colorado School of Mines attracted American students who also became known for their work, including Randall Barnes, Jeff Myers and Kadri Dagdelen, amongst others. His numerous short courses to geologists and mining engineers throughout the world led to additional converts to geostatistics, such as Robert Sandefur, Harry Parker, Bruce Stanley, David Armstrong, Alan Noble, Viv Snowden, Art De Carle, Bruce Davis, and R. Mohan Srivastava.

Books can change the world. Michel's books had a significant impact on his success as a teacher. Of most significance in his earlier years was his first breakthrough and beloved book in 1977: *Geostatistical Ore Reserve Estimation*, the first English language book on geostatistics. It was followed by the *Handbook of Applied Advanced Geostatistical Ore Reserve Estimation* in 1988. Three more books were achieved in collaboration from the NATO ASI international geostatistics workshops at Frascati, Italy in 1975, the Tahoe, California workshop in 1983, and the 1986 CIM conference on reserve estimation in Montreal. "My books are my first children" Michel proclaimed proudly to the world and it was no surprise that his favourite book was next to him at the very end.

Yet, despite his endless written work, unlike many teachers, he taught his pupils to learn for themselves, look at other viewpoints, read other people's papers and books, investigate other methods and ideas, to see more, learn more, think better, and observe that the world has many colours and myriads of shades. This is perhaps one of the attributes of the non-ordinary person who does change the way people do things.

In recognition of his contribution, Michel received several major awards. The International Association for Mathematical Geology honoured him in 1988 with its highest award, the W. C. Krumbein medal. The same year, he became a Fellow of the Royal Society of Canada. The Canadian Institute of Mining recognized his worldwide achievements in 1989 with the award of the Selwyn G. Blaylock medal.

In the last decade, Michel diverted his zeal and commitment to his private life and was fortunate to reunite with Ellen. He was also fortunate to accomplish what he called "the best thing I ever did", to create his two wonderful children, Kaitlin 8 and Justin 3; his pride for them could never be hidden. Kaitlin's magical violin playing of the French national anthem moved Michel to tears. Justin zipped around Michel's bed with his dump trucks, demonstrating perhaps his early inclinations into mechanics. As a family, they struggled daily with the effects of Michel's advancing multiple sclerosis. And as a family, they encountered and conquered difficult obstacles with humour, compassion and a zest for life.

Michel will be remembered as the brilliant, passionate, enthusiastic and pragmatic teacher and mentor he was to so many of us. Michel will be remembered as the curious, intuitive, adventurous, thinker beyond boundaries and the trivialities of everyday life. Michel will be remembered as the unique individual who accomplished in a short period of time more than most people do in an entire lifetime. Michel will be remembered as one of those who lead people to change the way they do things.

Michel will be remembered with his smile and bright sharp eyes which he kept to the very end. We will continue your quest for excellence, innovation and education.

"See you later Michel!"

This obituary was written by Roussos Dimitrakopoulos (Professor and Director W H Bryan Mining Geology Research Centre The University of Queensland, Brisbane, Australia) and Michel Dagbert (President Geostat Systems International Inc, Montreal, Canada)

Roussos was the last PhD student of Michel David in the late 80's, a co-worker at Geostat Systems in the early 90's, a colleague and a personal friend. Michel was research associate of Michel David at the Mineral Exploration Research Institute in the late 70's, co-founder of Geostat Systems, a colleague and a personal friend

GAA Membership

GAA membership is strong with nearly 150 members on the books - mainly from Western Australia but with substantial representations from the Eastern states and overseas. The membership role comprised 124 ordinary, 7 associate, 4 student members and 7 honorary members as at the last AGM. A handful of new members were accepted during the current year.

Membership dues for the 2000/2001 financial year are now well overdue! The bulk of the dues for the current year will be used to organise the GAA conference so please forward your fees to your GAA secretary at PO Box 1719, West Perth WA. Please indicate if you require a receipt, which can be sent to you via e-mail.

There are five types of membership with annual dues as listed below:

Ordinary Member: \$35 AUD pa

Associate Member: \$15 AUD pa

Student Member: \$5 AUD pa

Corporate and honorary life memberships are awarded by invitation of the Executive committee. Only Ordinary Members have voting rights. An application for membership can be found on the GAA website.

Now that you have heard all about us be prepared to become famous yourself. We will be contacting some of you to find out who you are and what your interests are in the GAA and what you would like your committee to do for you over the coming year.

Geostatistics On the Web

For the curious try these links..

<http://www.nwer.sandia.gov/fernauld/techniq.html>

.... Nice examples of sequential gaussian simulation - animation of 100 simulations quite nice

<http://www.elsevier.nl/inca/publications/store/3/9/8/>

Computer and Geosciences - get in quick on this one as after Dec 2000 free access to online articles will be limited - some interesting software can be downloaded from various authors.

<http://www-sst.unil.ch/research/variowin/index.html>

The Variowin software site - only works in 2D but can be easily manipulated so you can model 3D outputs from other software.

<http://www.ai-geostats.org/>

A new revamped site has just come on line this month - join up and watch for the interesting questions and varied uses of geostatistics that appear in your mail - lots of useful links and searchable archives

<http://www.avignon.inra.fr/biometrie/geoenv2000/>

Read all about the geoEnv2000 conference in France that for which your boss turned down your application for training funds

<http://www.ibrae.ac.ru/~mkanev/eng/Software.html>

Geostat office software site - 3Plot is worth a download and a play

<http://www.stokos.demon.co.uk/practica.htm>

Get an online copy of Practical Geostatistics - published in 1979 but still a useful starting point for any budding geostatistician

You can get the year 2000 version of the book at

<http://uk.briefcase.yahoo.com/drisobelclark>

but only the first chapter !

<http://www.geovariances.fr/publications/articles.php3>

Some interesting articles - well worth a browse and quite handy for explaining concepts to those less than technical managers

If you find a good site with some useful or interesting information please mail the link to mmurphy@anaconda.com.au and I'll include it in the next issue.

Code Corner

When dealing with lists of numeric data - it is often useful to colour code them in an XL spreadsheet. The following bit of VB code does this with the ability to set colour ranges to percentile bins of each list. The should run through as many adjacent columns in a spreadsheet as you like - I've tried it out with up to 11 but not yet on XL2000.

'Run this macro from the first 'value' cell e.g. "D2" 'it will colour code according to percentile 'bin all cells below to the first empty cell and across columns to the first empty cell. If you have gaps in the data you may want to fill them with a dummy value but -999 will upset your percentiles along with below detection negatives and non-numeric entries!

'To add more colours add more lines to the select case statement - see the XL help files under colour index for more colours

```
Sub ColVal()  
Dim Counter As Integer  
Dim Perc20, Perc40, Perc60, Perc80, Perc95 As Single  
Dim PercRange As Range  
Application.DisplayStatusBar = True  
Application.StatusBar = "Counting rows"  
Application.ScreenUpdating = False  
Do While Not IsEmpty(ActiveCell)  
    Counter = 0  
    'Count the rows in the sheet  
    Do While Not IsEmpty(ActiveCell)  
        ActiveCell.Offset(1, 0).Range("A1").Select  
        Counter = Counter + 1  
    Loop  
    Application.StatusBar = "Rows Counted - Allocating colours"  
    'Move back to start cell  
    ActiveCell.Offset(-Counter, 0).Range("A1").Select  
    Set PercRange = ActiveCell.Range("A1:A" & Counter)  
    'Colour the column by percentile bins - see help for colours  
    Do While Not IsEmpty(ActiveCell)  
        Select Case (ActiveCell)  
            Case Is >= Application.Percentile(PercRange, 0.95)  
                Selection.Font.ColorIndex = 7  
            Case Is >= Application.Percentile(PercRange, 0.75)  
                Selection.Font.ColorIndex = 3  
            Case Is >= Application.Percentile(PercRange, 0.5)  
                Selection.Font.ColorIndex = 5  
            Case Is >= Application.Percentile(PercRange, 0.25)  
                Selection.Font.ColorIndex = 4  
            'add more Case Is statements here for more bins  
            Case Else  
                Selection.Font.ColorIndex = 1  
        End Select  
    Loop  
Loop
```

```

End Select
ActiveCell.Offset(1, 0).Range("A1").Select
Loop
ActiveCell.Offset(-Counter, 0).Range("A1").Select
'move one column to the right
ActiveCell.Offset(0, 1).Range("A1").Select
Application.StatusBar = "Finished column .. doing next"
Application.ScreenUpdating = True
Application.ScreenUpdating = False
Loop
Application.ScreenUpdating = True
Application.DisplayStatusBar = False
MsgBox "Done"
End Sub

```

Your Output should look something like ...

0.434	0.035	2.46	5	18.7
0.687	0.025	11.66	2.9	9.8
1.040	0.032	11.82	1.7	15.1
0.960	0.023	13.85	1.3	12.2
1.070	0.039	9.19	2	18.5
0.791	0.026	11.88	1.3	11.8
0.739	0.022	14.39	1.4	12.7
0.674	0.02	16.08	1.4	10.8
0.671	0.019	15.66	1.4	9.4
0.533	0.019	14.41	1.3	10.5
0.515	0.018	17.01	1.3	9.2
0.492	0.02	14.85	1.2	11.6
0.737	0.032	0.82	2.5	16.9
0.921	0.028	1.13	2.7	15.2
0.679	0.027	1.05	2.5	14.3

Other bits and pieces are on offer in future newsletters including - ternary plots and log probability (that's natural logs) in Excel as well as modelling semivariograms (spherical and exponential models only so far). Please feel free to contribute any useful ideas for any software package.

With a bit of luck you can download an Excel 5 spreadsheet with this code from the GAA website within the next few weeks.

Modelling Bulk Density - the importance of getting it right

Ian Lipton will present his ideas on this very import topic to mineral industry practitioners on the Tuesday the 5th of December.

Abstract

Tonnage and grade are the principal reported components of mineral resource estimates but tonnage is a derivative of two more fundamental estimates; volume and bulk density. Typically, most of the effort in a resource estimation study is directed towards grade and volume, yet poor application of bulk density data to resource models can result in significant biases. The impact on tonnage estimates is easily recognised but poor density estimates may also introduce subtle biases into the grade estimates.

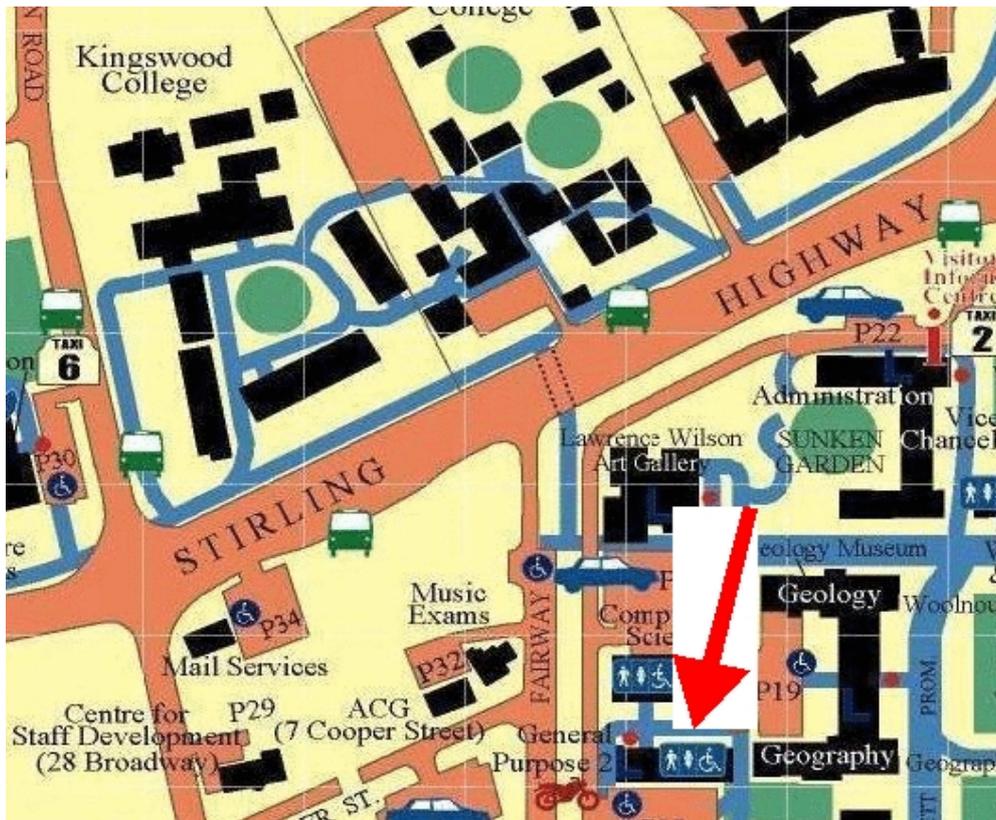
Methods for measuring bulk density have been discussed previously. This paper focuses on the manipulation of bulk density data and the extension of bulk density from essentially point measurements to block estimates within resource models. Bulk density is a continuous, geologically controlled, spatial variable and should be treated as such. Issues such as combining data from multiple sources, sample support and the interdependence of bulk density and grade estimates must be resolved. The statistical and geostatistical techniques

used for grade estimation are, under the right circumstances, equally applicable to bulk density. The importance of bulk density needs to be recognised. With robust raw data and correct estimation procedures, better estimates of bulk density can be obtained and both local and global tonnage and grade estimates can be improved.

. The talk location and time are as follows.

University of Western Australia
General Purpose Building II - Ground Floor Lecture Theatre
(Centre for Global Metallogeny, formerly the Key Centre)

5:00 pm to 7:30 pm



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