



# GEOSTATISTICAL ASSOCIATION OF AUSTRALASIA

Newsletter 22

October-2004

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Http:// www.gaa.org.au

## OVERVIEW FROM THE PRESIDENT

Dear Colleagues,



Greetings,

This is just a short letter to invite you, if you have not already organised it, to join us in Perth at the International Symposium 22-24 November 2004, Hyatt Regency, Perth, WA on "Orebody Modelling and Strategic Mine Planning - Uncertainty and Risk Management". Also on 21<sup>st</sup> November at 4pm at the Hyatt Regency there will be a special GAA meeting where André Journel will be presenting his new book entitled "Evaluation of Mineral Reserves: A Simulation Approach" and there will be a discussion on "The Future of Geostatistics".

To register go to [http://www.ausimm.com/ommp2004/registration\\_brochure.pdf](http://www.ausimm.com/ommp2004/registration_brochure.pdf)

I will be in attendance as will a number of the officers of the GAA. We look forward to meeting you then.

Roussos Dimitrakopoulos  
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## MINING GEOLOGY WORKSHOP, BRISBANE, OCTOBER 21, 2004

The Geoscience Task Force, the Australian Institute of Geoscientists (AIG), and the Geostatistical Society of Australasia (GAA) are running a one day workshop entitled 'Mining Geology 2004- Innovation in coal and metalliferous mining geology' in Brisbane on October 2, 2004. The workshop is a forum for presentation of new case studies and will promote technical discussion, learning, information exchange and networking opportunities for mine staff, contractors, consultants and the research community. There will also be two consecutive workshops held the following day (Friday October 22, 2004), which can be taken separately or together. The registration brochure is available on the AusIMM's website at: <http://www.ausimm.com/societies/minegeology2004.pdf>

# GAA PRESENTS

*ANDRÉ G. JOURNEL*

Presenting his new book

**”EVALUATION OF MINERAL RESERVES:  
A SIMULATION APPROACH”**

AND

A GAA DISCUSSION ON

**“ THE FUTURE OF GEOSTATISTICS”**

***TIME:***            ***4 PM***

***DATE:***            ***SUNDAY 21 NOVEMBER 2004***

***VENUE:***           ***HYATT REGENCY PERTH***

PLAZA BALLROOM 3  
99 ADELAIDE TERRACE  
PERTH WA 6000

## PUTTING MORE GEOLOGY INTO NUMERICAL MODELS OF DEPOSITS

Andre G. Journel  
Geological and Environmental Earth Sciences Dpt  
Stanford University, Stanford, California

Most reserves evaluation and mine planning start with a numerical model of the spatial distribution of the deposit mineral zones, within which grades interpolation is performed. Yet no model is better than the interpolation algorithm that relates the data to the unknowns. Should the interpolation process itself be independent of the data, based on the data only, or include explicitly additional information indicated but not included in the data specific to that deposit? We suggest that it is that additional information, beyond the actual data, which determines the quality of a mine model hence of its reserves forecasts. Local data, particularly when sparse in an early development stage, are less consequential than the structural/geological information used to tie them to the unknowns.

Research in mineral deposit modeling should focus on developing numerical algorithms able to put more geology into the models. Ignoring prior geological interpretation on vague grounds that it is uncertain or too subjective is not only counterproductive, it is conceptually wrong. Better an inaccurate geology than an automatic interpolation algorithm, whether geostatistical or not, that replaces all geology by its own that is by none. Accordingly, the major source of uncertainty is the geological interpretation.

Recent developments on multiple-point geostatistics have adopted that route, replacing the 2-point variogram by pattern statistics lifted directly from prior training images proposed by geologists to represent their prior concept about facies or rock types morphology and spatial distribution.

These conceptual geometrical patterns are morphed and anchored to the actual local data. Only once the architecture of the deposit has been built on sound geological considerations, can grades interpolation be performed using then traditional variogram-based algorithms.

An eye opener example:

Figure 1 gives images of three different binary facies distributions, say the black facies represent the high grade mineralization. The three images are conditioned to the same 30 sample data shown at the left of the figure. Although the three facies distributions are clearly different leading possibly to different mining dilution hence recovery, their exhaustive (indicator) variograms in both EW and NS directions are about the same. Had those variograms been calculated from the 30 sample data they would be all identical! The point made is that a variogram, and more generally a 2 point statistics, does not suffice to characterize complex spatial patterns.

These 3 images are now used as training images for conditional simulation with an algorithm based on multiple-point (mp) statistics; conditioning is to the same 30 samples. The results are shown at the top of Figure 2: mp simulation has succeeded to distinguish the 3 types of spatial patterns; as for variogram reproduction (bottom of Figure 2) it is as good or better than what would be provided by any traditional variogram-based simulation algorithm. In mp geostatistics, the variogram structural function is replaced by multiple-point spatial patterns lifted from a training image and anchored to the hard conditioning data. The challenge for the geologist is to provide such training images corresponding to his geological interpretation of the data available; alternative geological scenarios could be considered. This challenge is no different from that of inferring a variogram model.

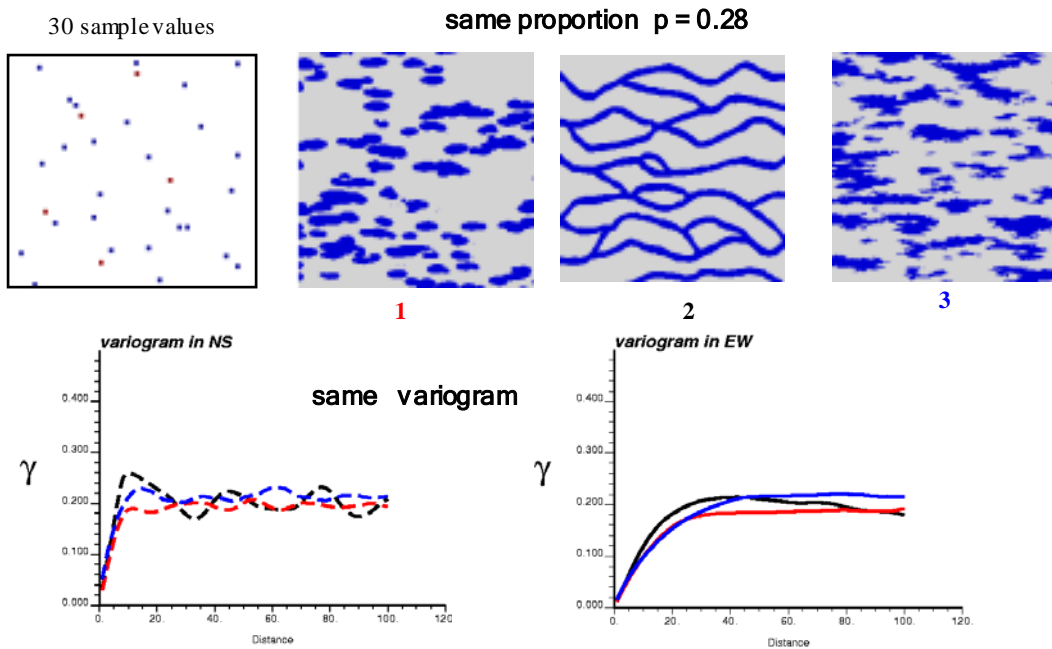


Figure 1 : Widely different patterns, same statistics up to order 2

Three different simulations conditioned to the same 30 samples

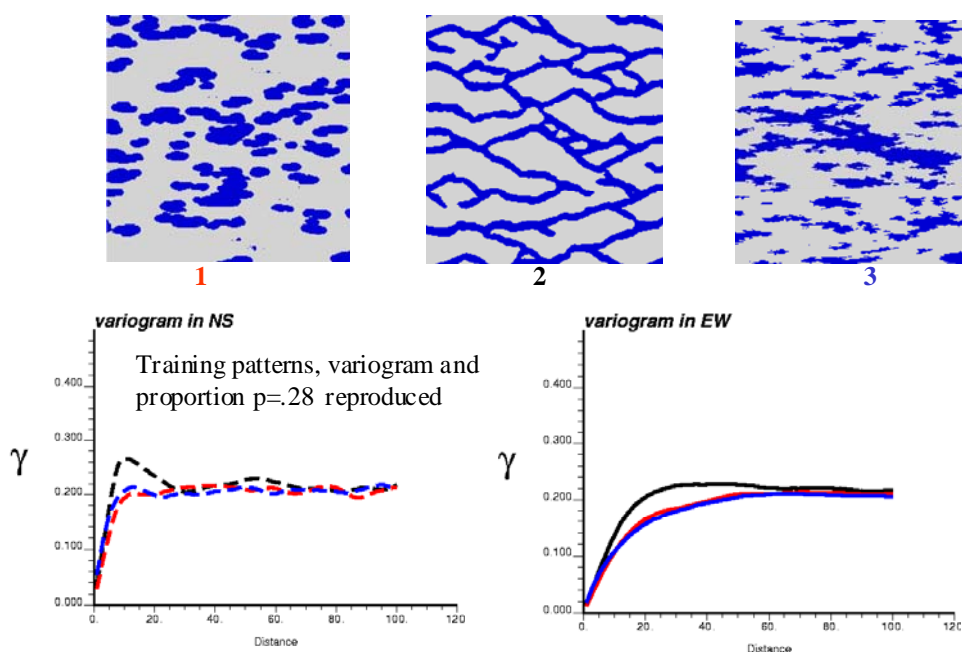


Figure 2 : Simulated realizations using for training images the patterns of Figure 1



## International Symposium

22-24 November 2004, Hyatt Regency, Perth, WA

# Orebody Modelling and Strategic Mine Planning

Uncertainty and Risk Management

Extended to **3 days**  
due to  
overwhelming interest!

[www.ausimm.com/ommp2004/](http://www.ausimm.com/ommp2004/)

Email: [conference@ausimm.com.au](mailto:conference@ausimm.com.au) Telephone: (07) 3295 9565 Facsimile: (07) 3295 9566



## LIST OF PAPERS FOR CONFERENCE

- |  |  |
|--|--|
| <p>Putting More Geology into Numerical Models of Deposits<br/><i>A Journal</i></p>   | <p>Strategic Mine Planning at Murrin-Murrin – Implementation of NetVal – The Final Step<br/><i>R O Jaine and M Laing</i></p>   |
| <p>New Techniques in Mining Grade Control – Optimal Ore Block Design<br/><i>B Shaw, S Khosrowshahi and R Gaze</i></p>  | <p>Development and Application of Whittle Multi-Mine at Geita Gold Mine, Tanzania<br/><i>T Joukoff</i></p>   |
| <p>Application of Conditional Simulations to Capital Decisions for Ni-Sulfide and Ni-Laterite Deposits<br/><i>O Tavchandjian</i></p>   | <p>The Value of Additional Drilling to Open Pit Mining Projects<br/><i>G Froyland, M Menabde, P Stone and D Hodson</i></p>   |
| <p>Quantification of Risk Using Simulation of the Chain of Mining – A Case Study on Escondida Copper<br/><i>S Khosrowshahi, B Shaw and G Yeates</i></p>                      | <p>Using Real Options to Incorporate Price Risk into the Valuation of a Multi-Mineral Mine<br/><i>V Blais, R Poulin and M Samis</i></p>  |
| <p>Conditional Simulation of Multiple Variables Using Minimum/Maximum Autocorrelation Factors for an Iron Ore and a Nickel Deposit<br/><i>S Khosrowshahi and M Godoy</i></p> | <p>The Use of Blending Optimisation for Improved Profitability<br/><i>C Wharton</i></p>  |
| <p>Accounting for Ore Reserve Risk in Planning and Scheduling of Open Pit Mines<br/><i>K Dagdelen</i></p>  | <p>Pit Optimisation Using Recoverable Resource Models<br/><i>D Kentwell</i></p>  |
| <p>Hybrid Pits – Linking Conditional Simulation and Lerchs-Grossmann Through Set Theory<br/><i>D Whittle and A Bozorgebrahimi</i></p>  | <p>The Use of Conditional Simulation to Assess Process Risk Associated With Grade Variability at the Corridor Sands Detrital Ilmenite Deposit<br/><i>M Abzalov and P Mazzoni</i></p> |
| <p>Global Asset Optimisation<br/><i>G Whittle</i></p>  | <p>Integrated Strategy Optimisation for Complex Operations<br/><i>B King</i></p>   |
| <p>Mining Schedule Optimisation for Conditionally Simulated Orebodies<br/><i>M Menabde, G Froyland, P Stone and G Yeates</i></p>   | <p>Pseudoflow, New Life for Lerchs-Grossman Pit Optimisation<br/><i>D C WMuir</i></p>  |
| <p>Modelling the Geometry of Geological Units and its Uncertainty in 3D From Structural Data – The Potential-Field Method<br/><i>J Chilès and C Aug</i></p>                  | <p>Optimising Multiple Operating Policies for Exploiting Complex Resources – An Overview of the Comet Scheduler<br/><i>R Wooller</i></p>   |
| <p>Orebody Modelling, Mine Planning, Reserve Evaluation and the Regulatory Environment<br/><i>J Rendu</i></p>  | <p>Network Linear Programming Optimisation of an Integrated Mining and Metallurgical Complex<br/><i>E K Chanda</i></p>   |
| <p>Blasor-Blended Iron Ore Mine Planning Optimisation at Yandi<br/><i>P Stone, G Froyland, M Menabde, B Law, R Pasyar and P Monkhouse</i></p>                                | <p>Optimisation in the Design of Underground Mines<br/><i>M Brazil, D Lee, J H Rubinstein, D A Thomas, J F Weng and N C Wormald</i></p>  |
| <p>Mine Design in Western Australia – From a Regulator's Perspective<br/><i>I Misich and P Burke</i></p>   | <p>Some Thoughts on Strategic Development Planning for 'No-Surprises-Mining'<br/><i>C Musingwini and R C A Minnitt</i></p>   |

Applying Numerical Optimisation Methods for the Selection of an Underground Mining Method

*P G Carter, D H Lee and H Baarsma*

Optimising the Strategic Mine Plan – Methodologies, Findings, Successes and Failures

*B Hall and C Stewart*

Risk Management Through the Use of 2D Conditional Co-simulation at Argo Underground, St Ives Gold Mine, Gold Fields, Kambalda

*M Dusci, D Guibal, J Donaldson and A Voortman*

Assessing Underground Mining Potential at Ernest Henry Mine Using Conditional Simulation and Stope Optimisation

*C Standing, P Myers, P Collier and M Noppé*

Incorporating Geological Uncertainty in the Decision to Expand the Main Pit at the Navachab Gold Mine Through the Use of Stochastic Simulation

*M Kent, R Peattie, V Chamberlain and R Sanhueza*

Koniambo Lateritic Ni-Co Deposits From Geological Modelling to Mineral Resource Classification – A Case Study

*M Audet and A F Ross*

Risk Assessment in Strategic and Tactical Geomechanical Underground Mine Design

*W F Bawden*

Multi-Mine Better Than Multiple Mines

*G Hall*

Integrating Multiple Simulations and Mining Dilution in Open Pit Optimisation Algorithms

*A Richmond*

Planning, Designing and Optimising Production Using Geostatistical Simulation

*P A Dowd and P C Dare-Bryan*

Diamond Resources and Reserves – Technical Uncertainties Affecting Their Classification, Reporting and Valuation

*W J Kleingeld and G D Nicholas*

New Method for Metal Price Risk Using Copulas

*L Martinez and R Wolff*

A Practical Process for Simulation, with Emphasis on Gaussian Simulation

*M Nowak and G Verly*

A Multistage Approach to Profitable Risk Management for Strategic Open Pit Mine Planning

*M Godoy*

Optimising Open Pit Design with Simulated Orebodies and Whittle Four-X: A Max Upside/Min Downside Approach

*R Dimitrakopoulos, L Martinez and S Ramazan*

Stochastic Optimisation of Long-Term Production Scheduling For Open Pit Mines with A New Ineger Programming Formulation

*S Ramazan*

New Efficient Methods For Conditional Simulations of Large Orebodies

*J Benndorf*

Conditional Simulation by Successive Residuals: Updating Existing Orebody Realisations

*A Jewbali*

Application

*A Boucher*

Grade Uncertainty in Stope Design: Integrated Optimisation for risk Quantification

*N Grieco*

Multi-Fractal Fault Simulation Using Geological Analogues And Risk Quantification For Underground Mine Development At Wyong NSW Australia

*J Scott, R Dimitrakopoulos, S Li and K Bartlett*

Quantification of Geological Risk Using Stochastic Simulations and Applications in the Coal Mining Industry

*S Li, R Dimitrakopoulos, J Scott and D Dunn*



**ASB MARKETING**  
**ARTWORK APPROVAL**  
Ph 08 9474 3067 Fax 08 9474 3080

Polo shirt - Light Grey Marle  
Embroidered on left chest in red, black & white



Actual embroidery size below



Geostatistical Association  
of Australasia

**ARTWORK APPROVAL**

- Artwork approved
- Changes required

Signature: \_\_\_\_\_

Date: \_\_\_\_\_

## CALENDAR OF EVENTS

### 2004 OCTOBER 21

**MINE GEOLOGY WORKSHOP**, Brisbane. For Details: <http://www.ausimm.com/societies/minegeology2004.pdf>

### 2004 NOVEMBER 8-10

**GEOLOGICAL SOCIETY OF AMERICA ANNUAL MEETING**. Denver Colorado USA For Details: <http://www.geosociety.org/meetings/2004/>

### 2004 NOVEMBER 22-23

**OREBODY MODELLING AND STRATEGIC MINE PLANNING - UNCERTAINTY AND RISK MANAGEMENT**. Perth WA For Details: [www.ausimm.com.au](http://www.ausimm.com.au)

### 2004 DECEMBER 6-7

**PNG MINING AND INVESTMENT CONFERENCE**: Sydney. For Details [www.ausimm.com.au](http://www.ausimm.com.au)

### 2005 FEBRUARY 28 - MARCH 2

**SME ANNUAL MEETING AND EXHIBIT**, Denver, Colorado. For Details: [www.smenet.org](http://www.smenet.org)

### 2005 MAY 10-12

**SECOND WORLD CONFERENCE ON SAMPLING AND BLENDING**, Novotel Twin Waters Resort, Sunshine Coast, QLD For Details: [www.ausimm.com](http://www.ausimm.com)

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## FROM THE EDITOR

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