QG Newsletter

Quantitative Group
Our Skills On *Your* Team

December 2006

Introducing the New QG: Quantitative Group

QG are very pleased to announce that Scott Dunham joined QG in September 2006. Scott is a geologist who has spent much of the last decade in management positions on large mining operations, most recently as Technical Services Manager at Cadia Valley (Newcrest) and prior to that in the same role at Mount Keith (WMC, now BHP Billiton). Scott brings a new suite of technical and managerial skills to our company, and the focus of the company will broaden accordingly. To reflect this widening of our scope Quantitative Geoscience has been renamed to Quantitative Group – 'the new QG'.

QG will continue to assist mining operations in extracting the full potential of their biggest assets - the ore body and their people - by focusing on fundamental practices. We will add to our geostatistical and mine geological expertise an integrated set of strategic consulting skills that aim to bridge the resource-reserve gap, especially in the following fundamental areas:

- Reconciliation
- Strategic Mine Planning
- Geometallurgical Modelling

QG's approach, based on the motto "Our Skills on Your Team", will not change. We believe that a core part of our service is to work closely with clients and ensure they have a sound understanding and ownership of the relevant issues. This partnership approach is designed to deliver on-going and sustainable benefits.

More details of QG's services can be found at: **www.qgroup.net.au/aboutus_qgstory.asp**. For Scott's full CV go to: **www.qgroup.net.au/ourpeople_sd.asp**.

Scott Dunham (centre) joins Scott Jackson (left) and John Vann (right) at Quantitative Group as a Director and Principal

'QG's approach, based on the motto "Our Skills On Your Team", will not change'

What's inside this issue:

Quantitative Geoscience Pty Ltd (ABN 30 095 494 947) and Quantitative Group Pty Ltd (ABN 61 120 267 192), trading as QG
address : Suite 12, 18 Parry St Fremantle WA, Australia 6160 (PO Box 1304 Fremantle WA, Australia 6959)
phone : +61 (0) 8 9433 3511 | fax : +61 (0) 8 9433 3611 | email : info@qgroup.net.au | web : www.qgroup.net.au

Quantitative Group
Our Skills On *Your* Team

Newsletter

December 2006

How's Your Reconciliation?

Scott Dunham is convinced that reconciliation is not approached in many cases with a 'holistic' view. Reconciliation is the fundamental performance measurement tool in the mining industry. Six Sigma, Lean, Statistical Process Control and McKinsey are all based on measuring performance and taking appropriate action to improve on the basis of factual data.

Knowing the delivered head grade is not straightforward – this is a sampling tower at a copper-gold mine

QG believes that thorough and complete reconciliation is an essential tool for every well managed mining operation. Scott adds: "Reconciliation is more than simply accounting for material movements or tracking individual business unit performance. The true value of reconciliation is derived by accepting that there will always be differences between various estimates and measurements. The important thing is to understand these differences, monitor and compare performance trends and when necessary take action to evaluate the opportunities that a detailed reconciliation system can identify. Reconciliation has the potential to make or break your business. You ignore the differences between the performances of different aspects of the mining value chain at your peril."

QG have first hand knowledge of the issues that can be created by poor performance monitoring or poor interpretation of the results. Our co-piloting approach is ideally designed to increase the skills of your people in understanding the implications of their reconciliation results and the best way to communicate these results where they matter.

QG can develop reconciliation systems to monitor the performance of the resource, reserve, mining operation, processing system, marketing system or any combination of the above. More importantly, QG can help you develop the skills to interpret the results of your reconciliation, identify opportunities and take appropriate action.

'Reconciliation has the potential to make or break your business. You ignore the differences between the performances of different aspects of the mining value chain at your peril'

Quantitative Geoscience Pty Ltd (ABN 30 095 494 947) and Quantitative Group Pty Ltd (ABN 61 120 267 192), trading as QG
address : Suite 12, 18 Parry St Fremantle WA, Australia 6160 (PO Box 1304 Fremantle WA, Australia 6959)
phone : +61 (0) 8 9433 3511 | fax : +61 (0) 8 9433 3611 | email : info@qgroup.net.au | web : www.qgroup.net.au

Quantitative Group
Our Skills On *Your* Team

Newsletter

December 2006

Geometallurgical Modelling

Our recently revised website includes some materials on geometallurgical modelling found at: **www.qgroup.net.au/technical_geomodelling.asp**. QG have been helping several clients in this area and we briefly present some discussion of this important, emergent area.

What is Geometallurgy?

Geometallurgy is a cross-discipline approach to ore-body characterisation, which has the objective to determine the true economic value of a resource. By integrating geology, mining operations, mineral processing and metallurgy, geometallurgy aims to improve the fundamental understanding of resource economics.

Geometallurgy is relevant at both feasibility study and operational phases. A geometallurgical approach to mine planning and plant design is based on identifying the various attributes that contribute to the realised value of a resource. This includes traditional attributes such as the grade of the economic elements as well as less traditional factors including:

- Concentration of deleterious elements;
- Hardness;
- Grindability;
- Mineral species and 'mineral grade';
- Mineral liberation;
- Metallurgical recovery;
- Mining recovery;
- Drillability;
- Fragmentation;
- Reagent consumption; and
- Smelter enabling characteristics.

Risk reduction

Applying geometallurgical modelling techniques can directly reduce the risks associated with meeting production targets. Geometallurgy has the potential to act on both the consequences and likelihood axes to decrease risk.

As knowledge of material types, their spatial associations and likely performance parameters increases, operations can improve scheduling and planning outcomes. Production plans can be developed to reduce variability, take advantage of blending to better achieve down stream product specification and deliver a more reliable result. More knowledge equals less production uncertainty and less need to change the plan to deal with unexpected outcomes. This approach reduces the likelihood of an adverse outcome at both the development (project) and operating phases.

Spatial modelling

For geometallurgical characterisation to have a real impact on the business, it must result in improved mine planning. This requires generation of maps of the physical characteristics that have been identified as value drivers.

Creating a spatial model of the geometallurgical properties of a deposit is similar to creating a resource model. The fundamental difference is that the resultant 3D model contains additional variables related to the realised value of each block. Application of appropriate spatial modelling tools is essential, because unlike the grade variables most operations are familiar with, many of these geometallurgical parameters behave quite differently when considered in a spatial context. Note that many of these variables are not additive. In some other cases it may be preferential to simulate rather than estimate. Each deposit will be different and understanding the required business outcome is essential to adopting the correct geostatistical tool.

It's not all about grade!

'A geometallurgical approach is based on identifying the various attributes that contribute to the realised value of a resource'

Quantitative Geoscience Pty Ltd (ABN 30 095 494 947) and Quantitative Group Pty Ltd (ABN 61 120 267 192), trading as QG
address : Suite 12, 18 Parry St Fremantle WA, Australia 6160 (PO Box 1304 Fremantle WA, Australia 6959)
phone : +61 (0) 8 9433 3511 | fax : +61 (0) 8 9433 3611 | email : info@qgroup.net.au | web : www.qgroup.net.au

Quantitative Group
Our Skills On *Your* Team

Newsletter

December 2006

Geometallurgical Modelling cont...

Geometallurgy in mine planning

Instead of working directly with grade, the planning team (in conjunction with the geologists and metallurgists) will work with the concept of realised value per shift/day. The production capability of the operation is maximised around this value proposition.

How can QG help?

1. Value chain development

Geometallurgical modelling is a high-leverage management tool that has the potential to materially improve bottom-line operational performance. QG's Directors and Principal Consultants bring a wealth of experience to help with the implementation of a geometallurgical approach. Our mentoring and coaching skills are well suited to facilitating workshops to identify business value drivers. With our broad commodity expertise we can help fast-track development of a geometallurgical value chain and ensure that your operation avoids common pitfalls and recognises the full spectrum of opportunities.

2. Multivariate statistics

QG's expertise in analysing and modelling multivariate spatial variables is ideally suited to resolving the most appropriate approaches for each unique geometallurgical application. Using statistical tools (for example, principal component analysis, cluster analysis, discriminant analysis, etc.) QG can help identify those physical parameters most related to key value drivers. Our expertise in managing large and complex databases, data-mining and pattern recognition allow the critical variables to be grouped for further analysis and modelling.

3. Sampling and representativity

Sample quality is equally (if not more) important to sample quantity. Poor sample quality can lead to incorrect conclusions and poor decisions. QG can help set up sampling protocols and quality assurance programs to monitor and improve sample quality for geological and metallurgical sampling programs.

4. Spatial modelling

In order to extract the full value from implementing a geometallurgical approach, the key parameters must be spatially modelled. This involves creating an appropriate block model that can be used as an input for downstream mine planning and scheduling. Depending on the properties of each variable QG can assist in identifying the most appropriate modelling approach and parameters, noting that some geometallurgical variables may necessitate different approaches to grade modelling if valid results are to be achieved. QG can build your geometallurgical model whilst at the same time training your staff using our 'co-pilot' mentoring techniques. This ensures not only a robust spatial model but also enables your people to own and maintain the model and underlying modelling processes.

5. Mine planning

Implementing a geometallurgical approach requires the integration of geological and metallurgical variables with the mine planning system. Instead of dealing with one or two key variables, your planning system needs to incorporate the full range of value drivers. The basic planning approach is to maximise the value per unit produced in any given time period. QG has experience in developing systematic planning and management information systems that complement geometallurgy. Measuring, planning and reporting on the performance of geometallurgical drivers is essential to the success of a value-based approach.

'To extract the full value from implementing a geometallurgical approach, the key parameters must be spatially modelled'

Quantitative Geoscience Pty Ltd (ABN 30 095 494 947) and Quantitative Group Pty Ltd (ABN 61 120 267 192), trading as QG
address : Suite 12, 18 Parry St Fremantle WA, Australia 6160 (PO Box 1304 Fremantle WA, Australia 6959)
phone : +61 (0) 8 9433 3511 | fax : +61 (0) 8 9433 3611 | email : info@qgroup.net.au | web : www.qgroup.net.au

Quantitative Group
Our Skills On *Your* Team

Newsletter

December 2006

Chris De-Vitry and Mike Job Join QG

QG continue to boost our team, and we welcome Mike Job and Chris De-Vitry, who both join as Principal Consultants. We welcome them and introduce them here to our readers.

Chris De-Vitry joined QG in January 2006. Chris developed a passion for geology very early in life: his father is a prospector and small-scale miner. However after 12 months underground at the business end of a shovel Chris was convinced study would be a good option. In 1992 Chris completed a BSc in Geology at ANU and was subsequently employed by WMC at Leinster W.A. In 1994 Chris returned to study and completed his honours in geology at the University of Western Australia and in 1995 Chris returned to WMC Resources as an underground mine geologist at Rocky's Reward underground nickel mine. Chris then worked from 1997 to 2000 as a resource geologist for WMC in Melbourne, Canada, Cuba and Perth. From 2000 to 2001 Chris was senior mine geologist at the Three Springs open pit Talc Mine.

Chris worked with BHP Billiton at Newman until 2004 as a resource geologist then senior resource geologist, developing a deep knowledge of the iron business. Chris then worked with MPI Mines at the historic Stawell gold mine in Victoria as Senior Resource Geologist. In January 2006 Chris joined Quantitative Geoscience as a Principal Consultant.

Chris has experience in porphyry copper, nickel laterite, stratiform copper-lead-zinc, numerous styles of gold mineralisation, massive and disseminated nickel, talc and iron-ore. He has strong skills in data-validation, geological modelling and in integrating geology and geostatistics into the mining process. He also has advanced skills in numerous mining software packages especially Isatis, of which he is a long time user.
Chris has an M.Sc. (Ore deposit Geology and Evaluation) from UWA and is undertaking an M.Sc. (Geostatistics by research) at the University of Adelaide, Department of Engineering, Computer and Mathematical Studies, supervised by Prof. Peter Dowd. Chris's research focuses on non-linear estimation and simulation of correlated variables. For Chris's full CV go to: **www.qgroup.net.au/ourpeople_cdv.asp**.

Mike Job is a geologist with a background in mining, exploration and resource geology, but actually began his career in the petroleum industry in 1985 after graduating with a B.Sc from Macquarie University in 1984. In 1987, Mike began work in the Kalgoorlie Goldfields and has since gained over 15 years experience in Archaean gold and nickel exploration and mining in Western Australia with Newcrest Mining, Consolidated Gold, New Hampton Goldfields and WMC. Mike also has two year's experience working on porphyry gold-copper deposits in central NSW for Newcrest Mining.

Mike has held positions as Senior Mine Geologist and Resource Geologist for both large and small mining companies, and was the Geology Manager at BHP Billiton's Leinster Nickel Operation before joining QG in June 2006. Mike's professional interests include geological data gathering and interpretation and is passionate about geological resource estimates that are practical, robust and auditable.

Mike has been working on nickel, iron, gold and copper projects since joining QG. In 2007 Mike will be seconded to the University of Alberta to complete a Masters degree in Geostatistics with Prof. Clayton Deutsch. For Mike's full CV go to:
www.qgroup.net.au/ourpeople_mj.asp.

Chris De-Vitry (top) and Mike Job (bottom)

'Mike and Chris will complete Masters Degrees in geostatistics at the Universities of Alberta and Adelaide respectively'

Quantitative Geoscience Pty Ltd (ABN 30 095 494 947) and Quantitative Group Pty Ltd (ABN 61 120 267 192), trading as QG
address : Suite 12, 18 Parry St Fremantle WA, Australia 6160 (PO Box 1304 Fremantle WA, Australia 6959)
phone : +61 (0) 8 9433 3511 | fax : +61 (0) 8 9433 3611 | email : info@qgroup.net.au | web : www.qgroup.net.au

Quantitative Group
Our Skills On *Your* Team

Newsletter

December 2006

QG Training

Clayton Deutsch 'Master Classes' in Geostatistics

QG are very pleased to announce that, in May 2007, Clayton Deutsch of the University of Alberta Centre for Computational Geostatistics will be running a series of 'Master Classes' in geostatistics in conjunction with QG. The program will be run in Fremantle, Western Australia.

Professor Clayton Deutsch

Dr. Deutsch is a Professor in the School of Mining and Petroleum Engineering, Department of Civil & Environmental Engineering at the University of Alberta. Prior to joining the University of Alberta, Dr. Deutsch was an Associate Professor (Research) in the Department of Petroleum Engineering at Stanford University and he is co-author of the GSLIB book.

The classes will commence with a day of linear and non-linear revision and then cover a range of topics including simulation, non-linear estimation and multivariate applications. Places will be very limited.

QG offer a range of specialised in-house programs

QG provide specialised technical in-house training in geostatistics, resource estimation, risk analysis and management, grade control and sampling.

In addition QG can design and deliver multidisciplinary programs aimed at technical managers, focussed on business improvement and strategy in the area of resources and reserves, for example, reconciliation, strategic mine planning, geometallurgical modelling and quality management.

QG's training is designed to transfer skills and concepts to participants, to be interesting and topical, to connect with professionals by being relevant and to be scientifically sound.

Our programs have been run by most of the world's leading mining companies. In the past year or so we have run programs for

- Barrick (Cowal Mine)
- BHP Billiton Iron Ore (Newman)
- BMA Coal
- Bryan Centre University of Queensland
- Goldfields (St Ives)
- Lihir Gold Mine (PNG)
- Newcrest Mining (Cadia Valley Operations)
- Olympic Dam Mine
- Oxiana (Laos)
- Rio Tinto (Australia, USA, South Africa)

Our training receives excellent customer satisfaction ratings and can build skills, confidence and enthusiasm for your team.

'Clayton's Master Classes will cover simulation, non-linear estimation and multivariate applications ... places will be very limited'

Quantitative Geoscience Pty Ltd (ABN 30 095 494 947) and Quantitative Group Pty Ltd (ABN 61 120 267 192), trading as QG
address : Suite 12, 18 Parry St Fremantle WA, Australia 6160 (PO Box 1304 Fremantle WA, Australia 6959)
phone : +61 (0) 8 9433 3511 | fax : +61 (0) 8 9433 3611 | email : info@qgroup.net.au | web : www.qgroup.net.au

QG Newsletter

Quantitative Group
Our Skills On *Your* Team

December 2006

QG Nuggets

What else is happening?

QG bike team

QG entered a team in the 'City of Perth Great Bike Ride' which took place on Sunday 26th of November. The ride, a fundraiser for the Heart Foundation, comprised a 53km loop from Perth to Freo and back around the river. Scott Jackson, Mike Job and Mike Stewart were all part of Team QG and there were a few other 'ring ins' to make up the numbers like Mike's brother Greg Job. Chris De-Vitry is skating on thin ice after defecting and riding for the BHPB Iron Ore Team. The good news is we all finished safely and no one was in need of the Heart Foundation's research efforts.

The intrepid QG cycling team: Mike Job (QG); Steve Norregaard (Tectonic Resources); Greg Job (Harmony); Peter van Luyt (PVL Consulting); Mike Stewart (QG); Phil Storey (Highline); Scott Jackson (QG). Not pictured is Glenn Kelly (Harmony) who didn't turn up until after the photos were done…Inset – QG's Chris De-Vitry having an identity crisis

Population Growth

In line with Peter Costello's admonition to 'have one for Mum, one for Dad and one of the country' Chris De-Vitry and his wife Claudia have been hard at work. Well, mostly Claudia, if truth be known: their third child, Amelia Anna was born 3rd April 2006, weighing 6 pounds 13 ounces at Stawell Hospital in Victoria. Amelia joins older brothers Nicolas 7 and Anton 5 years old. Chris adds that Claudia is "...always 21, fit and fantastic and perfect in every way" a statement that proves that Chris is, indeed, smart

What have QG been up to?

A selection of recent work:

- A large scale audit of the Newman Joint Venture resources for BHP Billiton Iron Ore;
- Assistance with resources for both Copper and Lead-Zinc streams at Mt Isa (Xstrata);
- Resource estimation for nickel deposits in Australia and Finland;
- Co-pilot training of several geologists from Olympic Dam;
- Simulation work for resource risk analysis at Copper-Gold and Nickel operations;
- Resource estimation for Oxiana at Sepon, Laos;
- Consulting work at Waihi in New Zealand, for Newmont;
- In-house training courses, both technical and managerial in Australia, the USA and South Africa.

CCG

Quantitative Group have recently joined the Centre for Computational Geostatistics (CCG). The CCG is based at the University of Alberta in Edmonton, Canada and is engaged in a wide variety of research, teaching and citizenship activities related to geostatistical modelling. The centre is headed up by Prof. Clayton Deutsch (see separate article in this newsletter). For more information, see **www.uofaweb.ualberta.ca/ccg/**. QG remain committed to research and to being leaders in industrial geostatistics.

'The good news is that we all finished safely and no one was in need of the Heart Foundation's research efforts...'

Quantitative Geoscience Pty Ltd (ABN 30 095 494 947) and Quantitative Group Pty Ltd (ABN 61 120 267 192), trading as QG
address : Suite 12, 18 Parry St Fremantle WA, Australia 6160 (PO Box 1304 Fremantle WA, Australia 6959)
phone : +61 (0) 8 9433 3511 | fax : +61 (0) 8 9433 3611 | email : info@qgroup.net.au | web : www.qgroup.net.au