SRK Structural Interpretation Assists Glencar's Gold Discovery in Mali

In March 2005, Glencar Mining plc engaged Toby Davis (SRK Perth) to develop structural models for mineralisation for a number of gold prospects they had identified in their Komana Project in southwest Mali.

This project included interpretation of regional geophysical datasets and mapping prospects in 1000 sq km of tenements. Glencar wanted to design their future drilling programs around field evidence based structural models for mineralisation.

One of these prospects, Komana West, is hosted in structurally complex Birimian sedimentary rocks. A structural model for mineralisation and the deformation history of the project area was developed by mapping exposures around the deposit. One small exposure of veining illustrated the sequence of deformation that led to mineralisation. Here it was discovered that because of the nature of the deformation preceding mineralisation, as well as that which accompanied it, a significant number of veins in the deposits would be oriented nearly perpendicular to the fabric that defined the host high strain zone. This realisation highlighted the need to change the drillhole orientation from that used by previous explorers, which may not have sampled the veins adequately.

With SRK's input, Glencar developed a drilling strategy based on the improved understanding of the structural controls on gold mineralisation with subsequent drilling intersecting 20 m containing 55g/t Au. The Komana West deposit appears to be quite large; mineralisation has been defined over a strike length of more than 1.5 km. Glencar's success has also benefited the local community: Glencar has provided funds for two new nurses and two high school teachers in nearby villages – a huge boon – which will nearly double the health and education resources of the area.

Toby Davis: tdavis@srk.com.au

1

Owen Herod

Owen is a mine geologist with 5 years practical experience in exploration and open pit environments. He has a strong numerical background and has developed skills in deposit and regional geology, 3D ore body modeling, data management and pit optimisation. Since joining SRK, Owen has worked on exploration, mine and resource geology projects principally in Western Australia.

Owen Herod

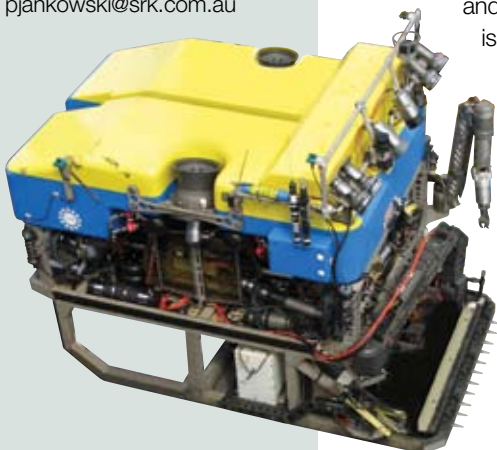Owen Herod: oherod@srk.com.au

Phil Jankowski

At the outset of his career, Phil worked for 9 years on Archaean gold deposits, gaining experience in both open pit and underground mine geology and grade control, as well as in exploration and resource development.

Phil Jankowski

Subsequently, he spent nine years as a resource geologist with a major Australian mining company before joining SRK in 2004. He specialises in mine geology, orebody interpretation and wireframing, resource estimation using linear and non-linear geostatistics, the integration of geological and grade information, technical audits of resource estimates and grade control systems and reconciliation.
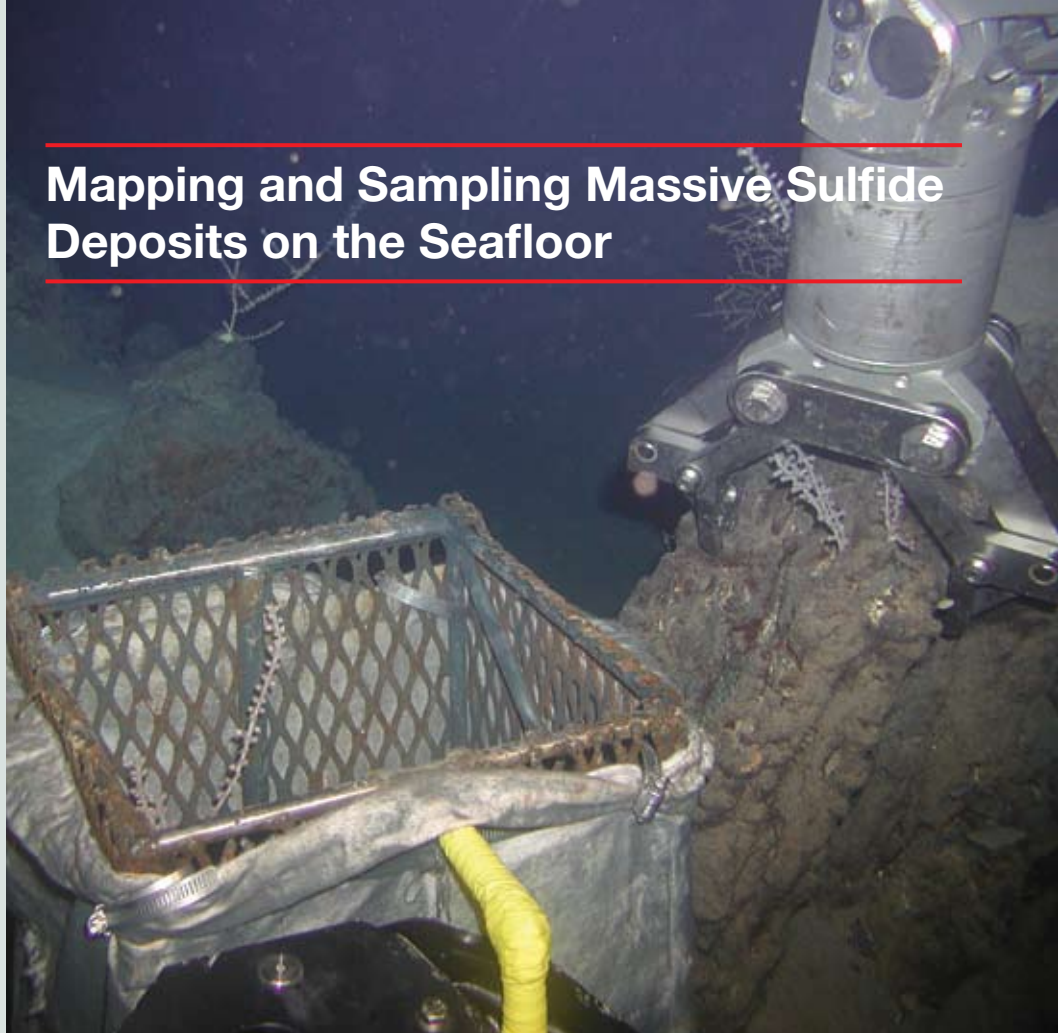
Phil Jankowski: pjankowski@srk.com.au

Mapping and Sampling Massive Sulfide Deposits on the Seafloor

Remote Operated Vehicle (ROV) grab sampling at a water depth of more than 1600m

Paul Hodkiewicz and Phil Jankowski from SRK in Perth are working with Nautilus Minerals Inc. (NUS: TSX-V) as they explore the seafloor for massive sulfide gold-copper-zinc-silver deposits in the Southwestern Pacific. Nautilus now has applications and tenements in the territorial waters of Papua New Guinea, Tonga, and Fiji that collectively cover an area the size of the United Kingdom.

Seafloor massive sulphide deposits (SMS) are formed where hot hydrothermal fluids rise and mix with cold sea water on the seafloor. They are the modern analog of volcanic hosted massive sulfides (VHMS) deposits such as the Iberian Pyrite Belt, Kidd Creek and Noranda in Canada, and Kuroko in Japan. Nautilus is exploring for inactive hydrothermal fields where SMS mineralisation has formed in the recent past.

The remotely operated vehicle (ROV) "Jason" was used to map and sample Nautilus' SMS deposits

SRK consultants joined three research cruises, where remote operated vehicles (ROV) and dredges were used to sample SMS deposits at the Solwara 1 and Solwara 4 projects in the Bismarck Sea of Papua New Guinea. This was a unique opportunity to observe massive sulfide deposits, intact and undeformed, on the seafloor in the original tectonic settings that are associated with volcanic rifts in backarc basins. These observations have enhanced our understanding of SMS deposit types and are directly applicable to terrestrial base-metal exploration and evaluation.

The Solwara 1 project comprises two outcrops of high grade sulfide mineralisation, 900m and 400m long with widths varying from 80m to 200m. Production is planned to commence in 2009.

Paul and Phil completed the NI43-101 and AIM Technical Reports describing the geology, sampling, assaying, and exploration programs.

Phil Jankowski: pjankowski@srk.com.au
Paul Hodkiewicz phodkiewicz@srk.com.au

Probabilistic Targeting for Mesothermal Gold Mineralisation

Over the last 12 months, Monarch Gold Mining Company has developed a large tenement portfolio in the Eastern Goldfields of Western Australia through mergers and acquisitions. For Monarch, SRK took on a geological review of the area and generated a series of ranked exploration targets.

Monarch's tenement package covers the approximately 100km strike length of the Ida Fault, which separates the Eastern Goldfields and Southern Cross provinces of the Yilgarn Craton. Historically, the area has abundant workings, now under care and maintenance. The Archaean Greenstones of the Yilgarn host significant mesothermal gold mineralisation in the region.

Initially, the project focused on improved regional scale interpretation. New magnetic data were processed and used to review the regional geological interpretation. SRK partners, ioGlobal, validated and analysed the geochemical data and through site work, reviewed the local, deposit scale controls on known mineralisation.
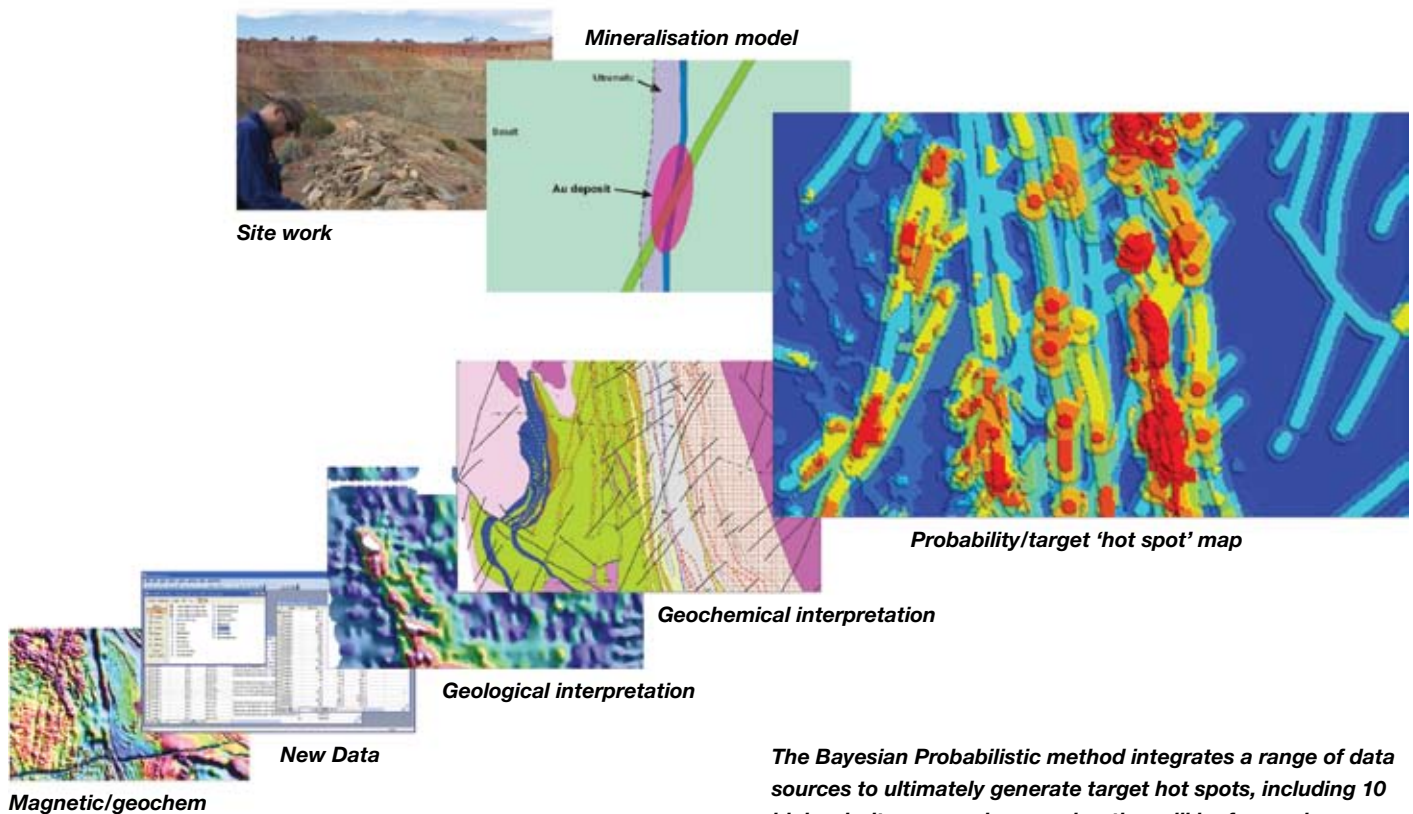
SRK employed a Bayesian Probabilistic method to rank targets for exploration. This method identifies key features of the mineralisation model and mathematically codes exploration information to integrate a range of data sources, following this general process:

- Key features are identified, such as fault jogs or lithological contacts, and a probability matrix is developed, based on proximity to features, and their cumulative effects

- These features are then automatically picked from the regional GIS using a simple search algorithm and classified as either fluid sources, pathways or traps

- Individual maps for fluid source, pathway and trap are constructed using the probability matrix

- The probability maps are combined to produce an exploration 'hotspot map' for each model, with targets and rank generated by contouring the map

The method successfully identified areas of known mineralisation. Subsequently, SRK generated 160 targets using three models, including ten high priority zones or trends, where Monarch will now focus its exploration.

Owen Herod: oherod@srk.com.au

Mineralisation model

Site work

Probability/target 'hot spot' map

Geochemical interpretation

Geological interpretation

New Data

Magnetic/geochem

The Bayesian Probabilistic method integrates a range of data sources to ultimately generate target hot spots, including 10 high priority zones where exploration will be focused

Toby Davis

Toby is a Structural Geologist with over 11 years experience in mining, exploration and research. He specialises in solving problems dealing with scale integrated studies that link deformation and mineralisation (including remobilization) for the mining and exploration industries.
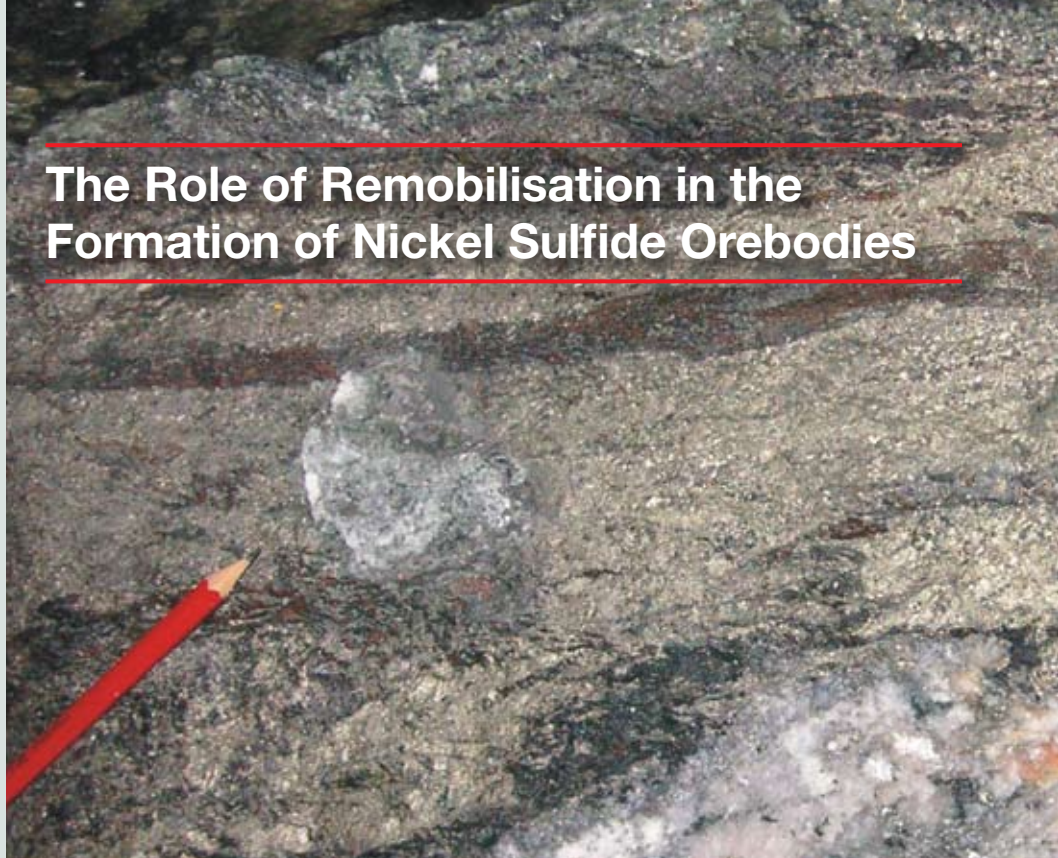
He is especially adept at utilising a wide variety of data types, including structural, geochemical, ore textural, grade control, geophysical and geological mapping data, over a range of scales to determine the structural evolution of mineralising systems.

Toby has international experience in a wide range of deposit types including lode and intrusion-related gold, sedimentary hosted Zn-Pb-Ag and copper, IOCG, Fe-Ni sulphide, layered intrusion PGE systems and VHMS deposits. Toby provides customised training courses and workshops in all aspects of the structural geology of ore deposits.

Toby Davis: tdavid@srk.com.au

Toby Davis

Andrew Ham

Andrew is a Senior Consultant with over 10 years postgraduate research and consulting project experience in orogenic belts in Australia, China, Venezuela, Ghana, El Salvador, Mexico, Canada and the USA. He holds a PhD (structural geology) from James Cook University in Australia and he has consulted on the application of structural controls on mineralisation in a number of base and precious metal deposits, from grass roots exploration to producing operations.

Andrew has successfully applied structural geology to optimise resource modeling and domaining (identifying factors that influence continuity and grade), exploration targets (near mine, district, and regional), and to constrain geotechnical domains.

His project experience includes orogenic Au, epithermal Au-Ag, Carlin-like Au systems; disseminated and massive Ni (Komatiite hosted); massive sulfide (Cu, Ni), shear zone hosted and porphyry Cu-Au systems.

Andrew Ham: aham@srk.com

Andrew Ham

The Role of Remobilisation in the Formation of Nickel Sulfide Orebodies

Massive sulphides overprinting foliated basalt

The current historically high price of nickel has generated much interest in nickel deposits throughout the world. Consequently, SRK geologists in Australia and Canada have received many requests for work from clients, such as BHP Billiton, Consolidated Minerals, Goldstream Mining, Jubilee Mines and LionOre.

The established genetic models for nickel sulfide orebodies are based on exsolution of iron and nickel sulfides from ultramafic magma with the role of structures confined to controlling channels that localised lava flows. This model is based largely on the sulfides located at the contact of ultramafic rocks with various underlying rock types. But there is more to the story.

We have found that remobilisation was a significant, if not the dominant, process in the formation of many nickel sulfide orebodies, and has typically imparted a strong structural signature to mineralisation. The importance of understanding remobilisation becomes clear when we consider that potential effects can range from in-situ recrystalization, to comprehensive external transfer to form new sulfide deposit at sites distal from the initial accumulation.

Remobilisation may affect:

• Beneficiation, by changing the mineralogy and smelting characteristics of ores

• Mining, by dislocating ores and changing the ground conditions

• Exploration, by relocating deposits

We have identified features that indicate remobilisation at nearly all scales and found that nickel sulfide deposits commonly display a spatial relationship to folds and other ductile structures. Additionally, a pervasive feature of these deposits is tectonic foliations overprinted by sulfides. Many of the deposits we have studied are essentially breccias – rock that has been fractured and later had sulphides deposited along the fractures.

Ore components can travel from centimetres to hundreds of metres or more during remobilisation. Remobilisation over short distances will have very little effect on mining and exploration activities, but movement over hundreds of metres will certainly influence exploration and will require models with a strong structural component. Commonly observed features of many nickel sulfide deposits show that they are not simply magmatic deposits.

By gaining a better understanding of the remobilisation processes involved, we can develop more effective exploration programs.

Toby Davis: tdavis@srk.com.au

3D Structural Mapping of Gold Continuity, Venezuela

Gold Fields Venezuela commissioned SRK Consulting to undertake a study to determine the structural controls of gold mineralisation at the Choco 10 deposit in Venezuela. Gold Fields acquired the project when they completed the takeover of Bolivar Gold Corp in early 2006. In February 2006, SRK determined that the VBK mineralisation was strongly controlled by distinct foliation domains. Specifically, mineralisation appeared to be localised in areas of low strain, defined by folds and spaced crenulation cleavages which lay immediately adjacent to zones of high strain, where very planar or closely spaced crenulated foliations dominated. SRK recommended that Gold Fields compile and collect structural data from mapping and oriented core, and apply the data in 3D to improve structural interpretations of the relationship between mineralised domains and structural domains.

In July 2006, the Gold Fields Technical Manager commissioned SRK to provide a detailed structural study of the VBK mineralisation on the Choco 10 exploration lease. An intensive drilling program, begun in early 2006, was ongoing during the site visit in July. SRK provided a more detailed understanding of the controls on VBK mineralisation and updated the structural models using data from the recent drilling program. Our role was primarily to assist in planning resource and grade control drilling, 3D modeling and domain definition for resource estimation, and generating targets for exploration. The structural study was also designed to develop a deformation history for the Choco 10 deposits, and to link it to the regional-scale structural framework.

SRK representatives visited the site to map out the ore domains using the newly acquired structural database. To use the structural data effectively, we captured horizontal slices of the structural data every 25 to 50 metres and processed the data in a stereonet program where form planes of the data were generated and exported. 3D discs, created from this dataset, were imported into the Leapfrog computer program to compare the geometry of the foliation data set with Leapfrog wireframes of gold grade. Form lines based on the continuity of the foliation on sections parallel to the drill fences showed a clear relationship between the continuity of grade with the geometry of the foliation.

These form lines were imported into Datamine and Gold Fields staff used these lines in modeling the ore domains, increasing their confidence in the continuity of gold mineralisation. Together with the Gold Fields geologists, SRK was able to reach an improved understanding of the deformation framework and the structures that have most influence on gold mineralisation.

An abstract co-authored by Gold Fields and SRK Consulting was submitted to the SGA on the structural controls of mineralisation at the Choco 10 deposits; the paper is to be presented at the conference in 2007.

Andrew Ham: aham@srk.com

Thickly sliced image illustrating the relationship between foliation geometry (projected on the sliced plane) of LeapfrogTM modeled wireframes of Au (0.5, 1 & 2g/T)
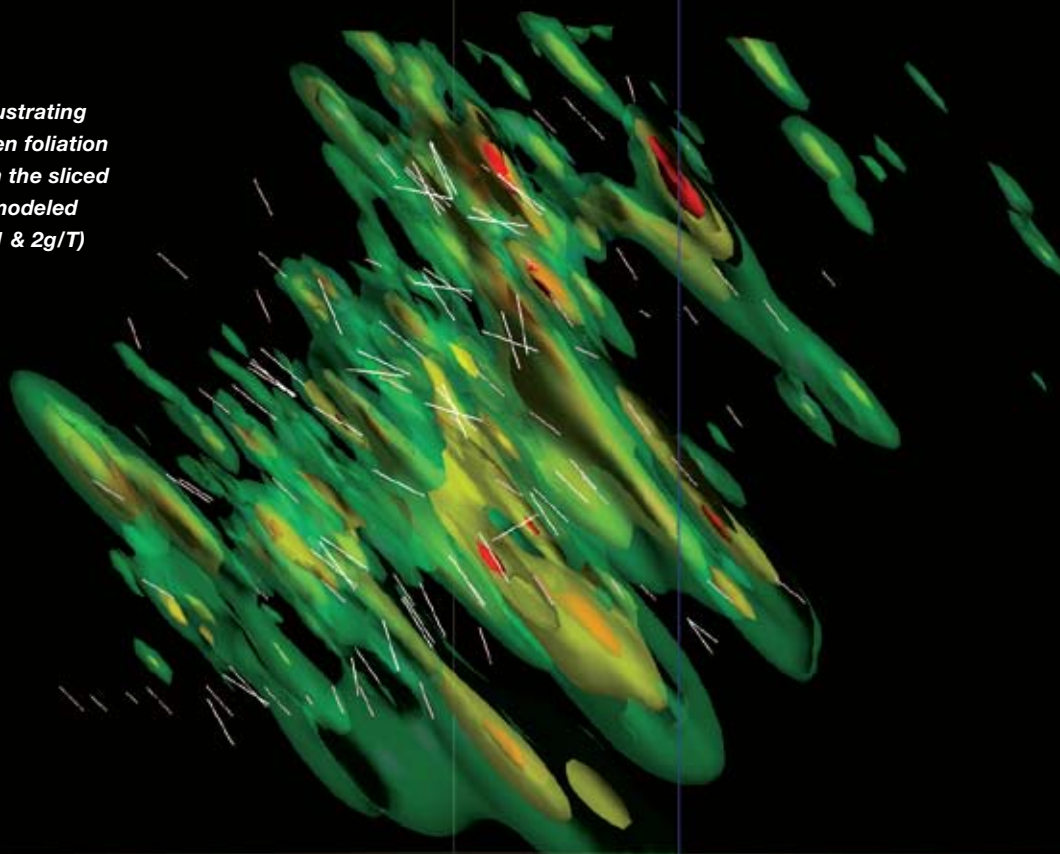
Andre Vorster

Andre Vorster (MSc, MBA) PrSciNat, has been working with De Beers Africa Exploration from 1990 to 2004, first as a student and later full time. He joined SRK in late 2005. He has been active in the diamond and copper industries (along with other commodities) and worked in countries such as Gabon, DRC, Central African Republic, Guinea, Sierra Leone, Angola and Botswana.

Andre Vorster

Andre Vorster: avorster@srk.co.za

Neil Marshall

Neil Marshall is a Chartered Principal Consultant with 25 years of experience in mining, tailings and civil geotechnical engineering. He holds a BSc (Hons) in Engineering Geology and Geotechnics and an MSc in Engineering Rock Mechanics. Neil gained most of his early experience in underground and open pit mining environments in Ghana and Zambia.

Neil Marshall

He specialises in the geotechnical characterisation of rock masses, open pit slope design, the design and evaluation of underground mining methods, underground support and excavation design and numerical modeling. He has managed a number of major geotechnical investigations for open pit feasibility and design. Since joining SRK in 1998, Neil has undertaken geotechnical projects throughout the UK and Europe, as well as in West and Southern Africa, South America, Central Asia, India and the Far East.

Neil Marshall: nmarshall@srk.co.uk

SRK's Involvement in the DRC

SRK is at work on one of the richest copper and cobalt producing areas in the world, the province of Katanga in the southeastern Democratic Republic of Congo (DRC). A significant share of the copper and cobalt is mined informally and exported illicitly from the African nation.

SRK has been extensively involved in the task of delineating and evaluating the drilling of numerous copper and copper-cobalt deposits in the Katanga province. Full project management, including geological, mining, infrastructure, maintenance and logistics control, should be ongoing for at least another 18 months.

World production of copper is expected to increase in 2007/8, with areas on the border between the DRC and Zambia playing a major role. SRK plans to be on the forefront of developments.

With the DRC's new mining code in effect in early 2004, the rush was on by majors and juniors alike to secure tenements for diamond prospecting and mining on the rich Congolese portion of the Kasai Craton. Once again SRK conducted audits and advised on exploration and evaluation of both primary diamond and placer deposits. In conjunction with clients, SRK has been studying in varying degrees the prospectivity of the different regions, reviewing historical results, developing geological models, analysing mining methods and deriving resource classifications.

Andre Vorster: avorster@srk.co.za

SRK is actively working in DRC's Katanga province, one of the world's richest copper and cobalt belts
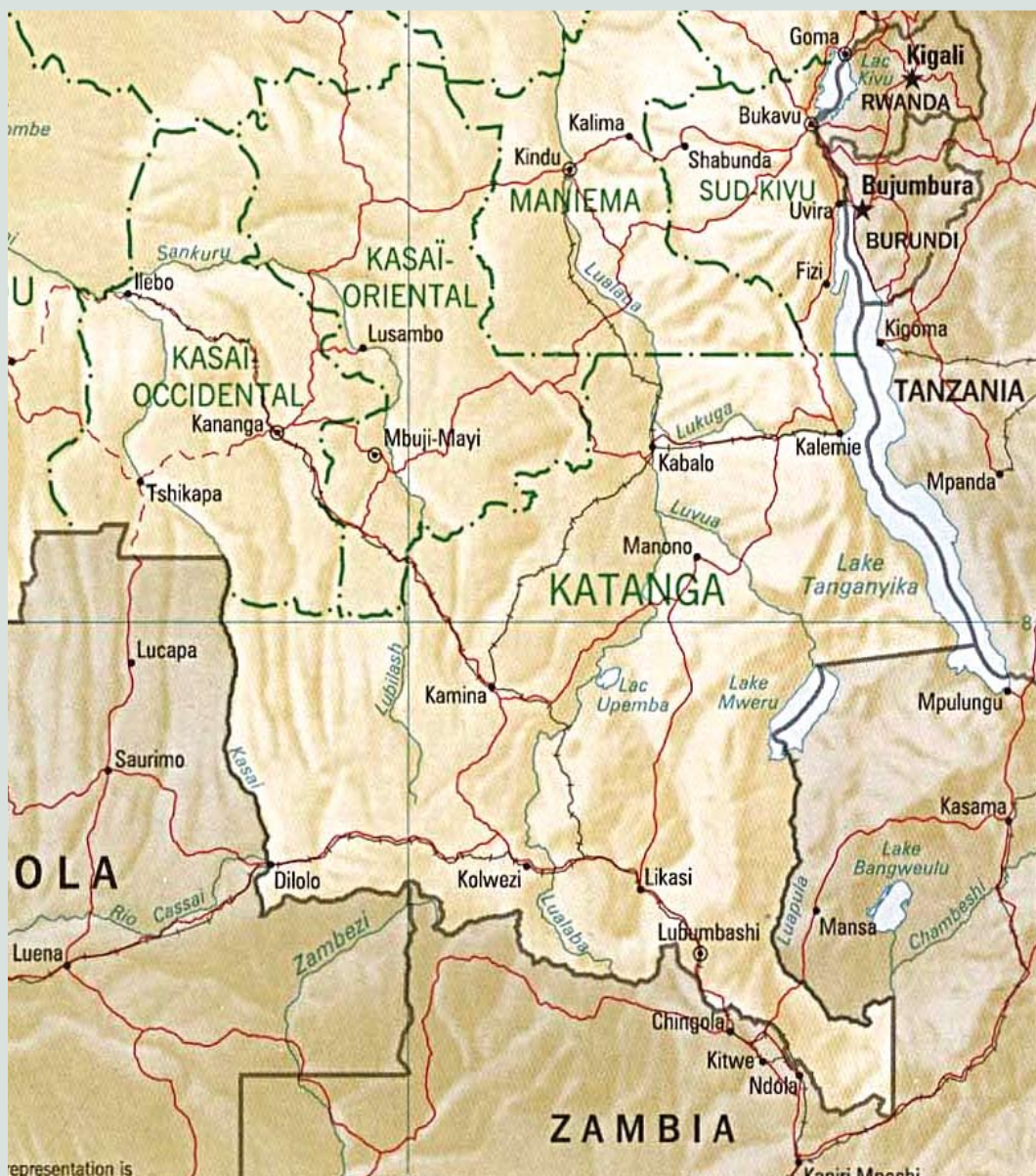
SRK Structural Modeling of the Kumtor Gold Deposit

The Kumtor Pit is located 4000m in the Tien Shan Mountains of Kyrgyzstan

SRK has been developing and regularly updating a structural geological model for the Kumtor gold deposit in Kyrgyzstan, primarily to resolve geotechnical issues and aid pit design. The project, overseen by Principal Geotechnical Engineer, Neil Marshall, is being led by Dr Rob Seago, a structural geologist with 20 years experience in the oil, gas and mining industry. Rob has worked extensively in Indonesia, Pakistan, Middle East, Europe and the Far East.

The Kumtor Gold deposit is located in the southern Tien Shan Metallogenic Belt, a major suture that traverses Central Asia, from Uzbekistan in the west through Tajikistan and the Kyrgyz Republic into northwestern China, a distance of more than 1,500 kilometres. Important gold deposits occur along this belt, including Muruntau, Zarmitan, Jilau and Kumtor.

Centerra Gold Inc, based in Toronto, Canada, owns 100% of the Kumtor gold mine through its subsidiary Kumtor Gold Company. Kumtor is located in the Kyrgyz Republic, north of the border with the Peoples Republic of China. It is the largest gold mine operated in Central Asia by a Western-based company, having

produced more than 5.5 million ounces of gold between 1997 and 2005. Proven and probable reserves exceeded 5 million ounces, as reported in January 2006.

The structure of Kumtor is complex, having undergone four phases of deformation. Early plate collision caused a regional schistosity and subjected the rocks to lower greenschist metamorphism. A D2 (Caledonian) thrust event produced regional scale folds and thrust faults. Mineralisation occurred during D3 (late Hercynian), with north directed thrusting and localised transpressional strike-slip tectonics. During the Himalayan event (D4), the whole region experienced NW directed thrusting, which overprinted and re-activated the pre-existing fabrics, all of which play a role in the slope stability of the pit.

In late 2004, SRK conducted a review of the geological work of the Kumtor mining department. Using Kumtor's extensive geological database and examining drill core, SRK carried out comprehensive pit mapping with the construction of structural cross sections. These were digitised and developed into a 3D model using GEMCOM software. Gold grade from blast holes and drilling was used to determine

the distribution of mineralisation associated with major fault structures. This was an important tool, as was core logging, in pinpointing incohesive faults as potential slip surfaces, as many of the faults at Kumtor are re-activated structures.

The resulting structural geological model was presented to Kumtor's geotechnical consultants, who then produced viable pit designs to control potential slope stability in the pit. The geological structure of the area affects the stability of pit slopes and this work integrated the structural model into the geotechnical analyses.

Over the past two years SRK has been involved in developing and applying the structural geological model for the present open pit and for other adjacent prospects to significantly increase understanding of the Kumtor Gold deposit. Potential failure sites have been identified and pit walls have been modified and planned to account for these problems, leading to a safer and more cost-effective pit. The work was carried out in a professional manner with a high degree of technical ability and SRK has built a close working relationship with Kumtor staff.

Neil Marshall: nmarshall@srk.co.uk

Paul Hodkiewicz

Paul has over 18 years of experience in the mining industry, including 10 years as an exploration and mine geologist before joining SRK. He has experience with a variety of commodities and deposit styles, including gold (epithermal, Carlin-type, lode), porphyry copper, sulfide nickel, PGEs, manganese and iron. Paul's expertise is helping clients to improve their understanding of regional - to deposit-scale controls on mineralisation, in order to optimise exploration targeting, resource estimation, and mine production.

Paul Hodkiewicz: phodkiewicz@srk.com.au

Paul Hodkiewicz

Chris Woodfull

Chris Woodfull

Chris has 20 years experience in exploration, mining geology and environmental management, in industry or as a consultant. This experience has given him a broad technical background and strong project management skills.

With SRK he has been mainly involved in structural geology-focused studies assisting geological model development, target delineation and/or grade control for shear zone/vein-hosted gold, regional prospectivity studies for gold, copper and coal, geological contributions to independent technical review studies and structural risk assessment for advanced exploration to operating coal projects.

Recently, he has also been managing the development of two multi-client, basin-scale structural framework and risk studies to assist companies operating and exploring in the Sydney-Gunnedah Basin in NSW and the Bowen-Surat Basins in Queensland.

Chris Woodfull: cwoodfull@srk.com.au

3D Modeling of Structural Domains in Western Africa for Gold Fields

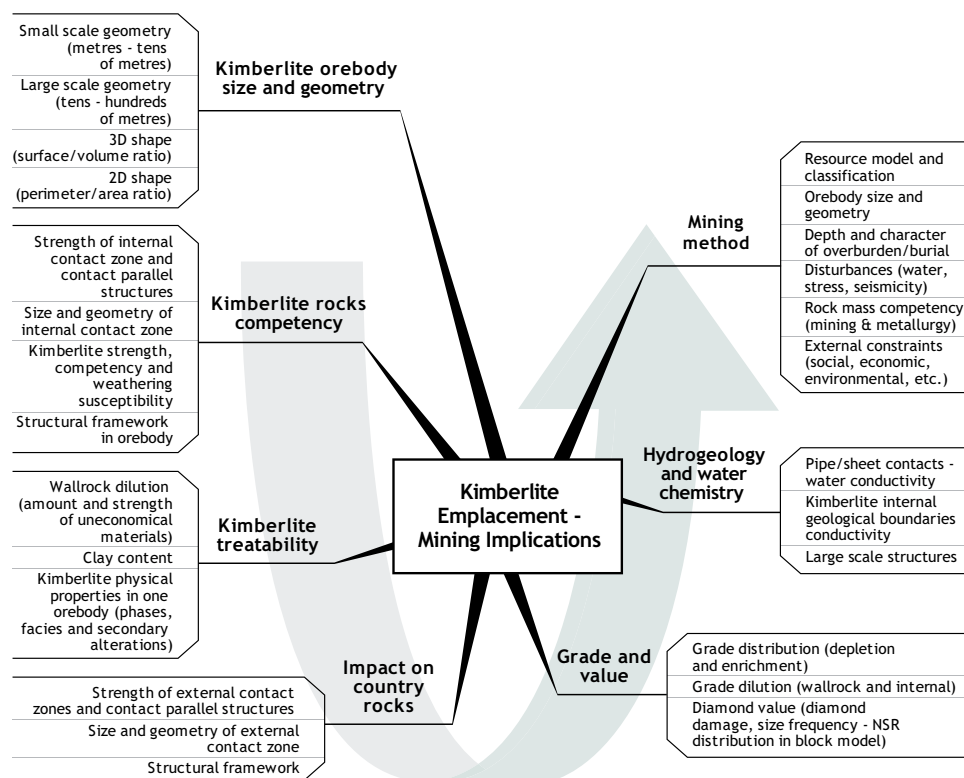*Structural mapping course at the Essakane gold deposit, Burkina Faso*

SRK provided consulting services in structural geology for the Essakane gold deposit in Burkina Faso and for the Damang open pit cutback feasibility study in Ghana. Both projects involved reviews of drill core and mapping of surface exposures, as well as extensive 3D modeling with Leapfrog software.

Essakane is a structurally complex gold deposit hosted in folded Paleoproterozoic sedimentary rocks in eastern Burkina Faso. Gold grades are variable and there is a high nugget effect. SRK Australia reviewed oriented drill core and field exposures to improve interpretations of structural controls on gold mineralisation. We combined surface mapping and drilling data in a 3D model and used Leapfrog software to interpret structures and to provide wireframe domains for resource estimation. In addition, SRK provided training in structural mapping for site-based geologists.

As part of the feasibility study for the Damang open pit cutback, SRK consultants from Perth and Cardiff reviewed geology and resource models to improve structural interpretations, and to guide near-mine exploration. A key finding was that higher grade mineralisation is associated with gently dipping vein arrays within the steeply-dipping conglomerate host unit. Leapfrog software was used to model the high-grade and low-grade domains and to provide wireframe models for resource estimation. The models were also used to successfully target extensions of higher-grade mineralisation below the existing open pit.

Paul Hodkiewicz: phodkiewicz@srk.com.au

Importance of Kimberlite Pipe Geometry and Kimberlite Emplacement Model

Mind Map: Kimberlite Emplacement – Mining Implications

Kimberlite orebody size and geometry
- Small scale geometry (metres - tens of metres)
- Large scale geometry (tens - hundreds of metres)
- 3D shape (surface/volume ratio)
- 2D shape (perimeter/area ratio)

Kimberlite rocks competency
- Strength of internal contact zone and contact parallel structures
- Size and geometry of internal contact zone
- Kimberlite strength, competency and weathering susceptibility
- Structural framework in orebody

Kimberlite treatability
- Wallrock dilution (amount and strength of uneconomical materials)
- Clay content
- Kimberlite physical properties in one orebody (phases, facies and secondary alterations)

Impact on country rocks
- Strength of external contact zones and contact parallel structures
- Size and geometry of external contact zone
- Structural framework

Mining method
- Resource model and classification
- Orebody size and geometry
- Depth and character of overburden/burial
- Disturbances (water, stress, seismicity)
- Rock mass competency (mining & metallurgy)
- External constraints (social, economic, environmental, etc.)

Hydrogeology and water chemistry
- Pipe/sheet contacts - water conductivity
- Kimberlite internal geological boundaries conductivity
- Large scale structures

Grade and value
- Grade distribution (depletion and enrichment)
- Grade dilution (wallrock and internal)
- Diamond value (diamond damage, size frequency - NSR distribution in block model)

Critical issues are illustrated in this mind map

Various kimberlite emplacement processes have a major impact on the nature of the kimberlite orebody and host rocks and must be considered in mine design and mining approach. Failure to understand these processes can adversely affect the economic outcome of a mine. It is therefore important to investigate those processes in order to better characterise the mining constraints and more accurately predict the mine's economic viability.

SRK is keeping abreast of research into the advances in kimberlite emplacement and, in particular, Jarek Jakubec was invited to participate in a workshop on kimberlite emplacement held in Saskatoon.

The significance of the emplacement model of the kimberlite pipes or sheets is commonly recognised in resource geology. However, its importance is not always appreciated in the mine design process. The geometry of the orebody, the character of the contact zones, internal structures and distribution of inclusions can directly influence pit wall stability, dilution, treatability and dewatering strategy and should be taken into account when evaluating various mining methods. The problems are exacerbated in smaller pipes and narrower sheets, and in orebodies with more irregular shapes. They are more apparent in underground mining than open pit mining.

SRK is implementing the results of international research in field data collection programs to ensure that critical data are identified and addressed. The individual aspects of mine design are illustrated in the mind map above.

Jarek Jakubec: jjakubec@srk.com

Jarek Jakubec

Jarek Jakubec, Corporate Consultant and manager of the Mining and Geology group with SRK Canada, is based in the Vancouver office. Jarek graduated from the Mining Technical University in Ostrava in the Czech Republic

Jarek Jakubec

in 1984. He has more than 23 years of operational and consulting experience in geology, rock mechanics and mining; his focus is on diamond mining and mass mining methods. After spending eight years in geology and mining in Europe and Canada, Jarek joined De Beers Consolidated Mines in South Africa as Head of the Geotechnical Section for the large open-pit diamond mines in Botswana. Besides geotechnical engineering, he was involved in the development of geological models of diamond pipes and participated on several research studies, such as kimberlite weathering effects on mine design.

Jarek joined the SRK office in Vancouver in 1997 and started actively promoting our consulting services to the diamond industry. His wide experience with the diamond industry ranges from feasibility project management and project audits to mining method selection and participation in diamond resource evaluation. Over his professional career, Jarek has had the opportunity to work on many exciting projects at diamond producing mines around the world, including those in Siberia, southern Africa, South America, Australia, and Canada. He has published several papers on various aspects of diamond mining. Jarek is qualified as a competent person in terms of National Instrument 43-101.

Jarek Jakubec: jjakubec@srk.com

Louis Bucci

Louis is an Economic Geologist with over 10 years of international commercial and academic work experience with an emphasis on the investigation of mineralised hydrothermal systems. In particular, Louis

Louis Bucci

has worked on gold, base metal, nickel, PGM/E and tin-tungsten commodities, across deposit models ranging from structurally-controlled/orogenic, to porphyry and intrusion-related, to classic base metal systems (eg. VMS, MVT and skarn).

Louis' strengths revolve around the integration and interpretation of technical datasets with detailed field observations, as a means of assisting clients to focus their exploration resources and efforts. His recent experience has been primarily in the areas of geological due diligence and project analysis, advising clients and their investors of the prospectivity potential of their current ground holdings and adjacent areas, as well as targeting at the regional, terrane and continental scale.

Louis Bucci: lbucci@srk.com.au

JORC and the Chinese Resource Classification System – An SRK View

SRK has been involved with exploration and mining projects in China since the 1990s, with a strong focus on providing Competent Person's Reports for stock exchange listings in Hong Kong and London. In addition, much Due Diligence and Fatal Flaw analysis work on Chinese resource projects has been completed, for both western and Chinese companies. Through this work, SRK has found that there are fundamental philosophical and practical differences between the Joint Ore Reserves Committee (JORC) and Chinese resource classification systems.

The system for categorizing mineral resources and ore reserves in China has recently changed. The traditional system (Old), which is derived from the former Soviet system, has been slowly phased out since 1999, and uses categories A through F for resources, based on decreasing levels of geological confidence. The current system (New) uses a three-dimensional matrix based on degrees of confidence in Economic, Feasibility, and Geological evaluations. The resulting classification is categorized by a three number code, and is also allocated either to "Resource" or "Reserve" status. This new system meets the standards of the United Nations Framework Classification, which was proposed for international use in 2004.

All new projects in China must comply with the New system. However, resource estimates and feasibility studies carried out on projects before 1999 used the Old system. As a result, projects with an extended exploration and development history often contain resource and reserve estimates reported under both the Old and the New codes. These codes can be difficult to reconcile and evaluate, particularly in the absence of any other supporting data on which the resource estimate was based. Given our obligations under JORC and Valmin as members of the AusIMM and/or AIG, the Competent Person must provide a comparison of how JORC non-compliant resource estimates broadly fit the JORC classification categories. Table 1 provides a *rule of thumb* comparing the Chinese Classifications with JORC (2004), which project evaluation teams can use.

Initially, this *rule of thumb* comparison can be used during project evaluation, to understand the level of detail that should have been incorporated into the resource estimate. However, any detailed analysis of the resource requires a thorough review of these data before assigning a definitive classification under JORC. If the relevant Chinese Government Authority has signed off on the resource being evaluated, these data should be readily available for review by the evaluation team.

Louis Bucci: lbucci@srk.com.au

Table 1: *Rule of Thumb* categories of the New Chinese Classification System compared with the Old System and JORC

Old Classification		A & B		C			D	E & F
New Classification								
"E" Economic Evaluation (100)	Designed mining loss accounted	Recoverable Reserve (111)	Probable Recoverable Reserve (121)		Probable Recoverable Reserve (122)			
	Designed mining loss not accounted (b)	Basic Reserve (111 b)	Basic Reserve (121 b)		Basic Reserve (122 b)			
Marginal Economic (2M00)		Basic Reserve (2M11)	Basic Reserve (2M21)		Resource (2M22)			
Sub-Economic (2S00)		Resource (2S11)	Resource (2S11)		Resource (2S22)			
Intrinsically Economic (300)		-	-	Resource (331)		Resource (332)	Resource (333)	Resource (334)
"F" Feasibility Evaluation		Feasibility (101)	Pre-Feasibility (020)	Scoping (030)	Pre-Feasibility (020)	Scoping (030)	Scoping (030)	Scoping (030)
"G" Geological Evaluation		Measured (001)			Indicated (002)		Inferred (003)	Predicted (004)
JORC							Unclassified or Exploration Potential	
					Inferred			
			Probable Reserve OR Indicated Resource					
		Proved/Probable Reserve OR Measured Resource						

Optimising Risk Assessment in Coal and Energy-rich Sedimentary Basins

Over the past few years SRK has developed 4D structural/basin models that enable explorers and operators in four of the major coal-bearing sedimentary basins of eastern Australia to manage their key geological risks more effectively.

Initially releasing its structural framework study of the Sydney Basin and part of the Gunnedah Basin in January 2004, the team has continued to refine the Sydney Basin Study data in two updates, a major update in November 2005 and a minor update in September 2006.

SRK's second study, the Bowen and Surat Basins Study, commenced in October 2005. Upon completion around September 2007, structural/basin models covering four economically significant sedimentary basins, extending for approximately 2,000 kilometres along Australia's eastern seaboard, will have been developed.

These studies comprise a 4D structural/ basin model developed at a regional scale (1:500,000 to 1:100,000) supported by an integrated database that includes public information contributed by supporting companies and organisations. The datasets in this GIS-based work platform include:

- Published geological map data (digital ±scanned plans), mine-based geological mapping (such as faults, igneous bodies), selected bore hole data, stress measurements
- A range of potential field data compiled from geophysical survey-based image data, including seismic, magnetics, gravity and radiometrics
- Digital elevation models and satellite imagery (Landsat/ASTER) data

Developing a detailed geological model is considered fundamental to cost-effective, risk-based mineral or hydrocarbon exploration and mining strategies, particularly beneath cover. Sponsors of the studies agree that both these basin interpretations are adding value to their existing projects and broader exploration initiatives. The data apply not only to areas prospective for coal, coal seam gas, oil and gas, but the interpretations also allow for the selective examination, compilation and interpretation of data for mineral exploration, including gold and base metals.

Chris Woodfull: cwoodfull@srk.com.au

Digital elevation image for the project region showing northern and southern module areas, Bowen and Surat Basins, and some of the coal and petroleum drill hole locations (yellow diamonds) incorporated into the GIS

Bowen Basin

Gareth O'Donovan

Gareth O'Donovan is a Principal Exploration Geologist with over 20 years experience in mining and exploration projects in Africa and Asia. He specialises in the design, implementation and management of exploration projects

Gareth O'Donovan

from grassroots to pre-feasibility in all terrains and environments, mobilising multi-disciplinary field teams, and more recently reviews, competent person's reports, audits and valuations of exploration and mining properties world-wide and in a variety of commodities. For the past three years he has been Managing Director of SRK Exploration services Ltd.

Drew Craig

Drew is an Associate Exploration Geologist, based in London and working through the SRK Exploration Services office in Cardiff. With over five years in exploration and mining he has worked on projects in Russia, Kazakhstan, Mali, Sierra

Drew Craig

Leone, Liberia, DRC, Rwanda, Madagascar and the Falkland Islands. This experience has covered a variety of commodities: gold, diamonds, bauxite, iron ore, uranium, zinc oxide, magnesite, and tantalum.

Drew completed his MinEx MSc in 1999 at the Royal School of Mines, London, having previously spent time in Aberdeen with the UK oil industry.

Strong communication skills and a wide range of practical field skills, in-part gained during military service (mountain expedition leader, survival instructor), allow him to specialise in remote exploration and project set-ups as well as project management, GIS, core logging, QA/QC, GPS survey, logistical support and security.

Drew Craig: drewcraig@srkexploration.com

SRK Exploration Services – Optimistic Begi

Familiarisation with local customs is

SRK **Exploration Services** (SRKES) has experienced dynamic growth in business over the past 36 months. Since its inception in 2003 the SRKES team, led by Gareth O'Donovan, has grown to over 10 geologists and GIS specialists and a number of associates offering specialised services.

The scope of deliverable services provided ranges from competent person's reporting and auditing through to direct project management, drill program design and sampling protocol implementation. Our clients include both juniors and majors and our geographic footprint reaches over 30 countries across Africa, Asia, the Middle East, Europe, and South America. SRKES works on a variety of commodities, including: iron ore, diamonds, gold, uranium, copper, tin, tantalum, bauxite, molybdenum, magnesite, chromite, lead and zinc.

With additional funding from the Welsh Development Agency SRKES established a state-of-the-art GIS suite in our Cardiff offices. This new capability allowed the expansion of our existing services and the use of a powerful tool for project data management, remote imagery interpretation and target generation.

In the year ahead, in conjunction with SRK offices around the world, SRKES aims to expand its team and scope of services. Our webpages can be found at: http://www.srkexploration.com.

Regional Focus - FSU

From the outset, SRK Exploration Services have been very keen to develop the provision of western exploration mining services and practices in the former states of the Soviet Union (FSU). Along with UK staff, SRKES has developed a core team of Russian exploration specialists and field personnel for management and field roles, supporting projects in Kazakhstan, Kyrgyzstan, Uzbekistan, Russia and the Ukraine, and covering a wide range of commodities. Specific services include: data management and review, field management and drilling supervision, project auditing, QA/QC assessments and laboratory audits. Over the coming year SRK Exploration expects to support the recently established SRK office in Moscow. This is an essential step toward defining our presence in these countries.

innings

often critical to the success of a project

Logistics, Security and Medical Training: Modern exploration often places field personnel in remote areas and the deterioration of global security requires that both managers and field staff need to be aware of the risks involved. Exploration therefore needs to be managed in a way that minimises the risks to personnel and equipment.

Drilling Supervision and Program Design: SRKES geologists specialise in providing a confidential and efficient drilling management service to both large and small mining companies. Having employed the fundamentals of target generation, it is important to apply sound principles and field expertise to the design of a drilling program.

Sampling and QA/QC: The collection of reliable samples from a mineral prospect or mine is an essential basis for the production of an accurate resource inventory. SRKES has the expertise to design, manage and audit sample collection and preparation procedures on behalf of clients in both the exploration and mining industries.

Commodity Focus - Uranium

SRK Exploration has been commissioned to work on a series of uranium projects over the past 12 months. These projects involve a variety of requirements in uraniferous regions in Burundi, Colombia, Guinea, Kazakhstan, Kyrgyzstan, Madagascar, Mali, Niger and Zambia.

In Mali and Niger, SRKES conducted a preliminary assessment of known uraniferous areas leading to a shortlist of prospective areas that were followed up by arranging reconnaissance permitting. During a month-long expedition to the permitted areas, SRK Exploration's team made geological observations supported by radiometric ground survey data. The client used the final report to develop their future strategy in the region.

In June 2006, SRKES undertook a similar project in Madagascar. After a data review and field visit, we submitted a technical report assessing the potential of a large historically producing region. On the basis of this report, SRKES drew up plans for a three-month reconnaissance program to assess the prospectivity of adjacent areas. Once initiated, this program will include geochemical and geophysical prospecting supported by GIS data processing and target generation. Detailed follow-up exploration is planned if results meet expectations.

Projects in other countries combine data reviews, target generation and permitting advice. Over the coming year, SRKES aims to develop additional exploration capabilities and increase our knowledge in this commodity.

Drew Craig: drewcraig@srkexploration.com
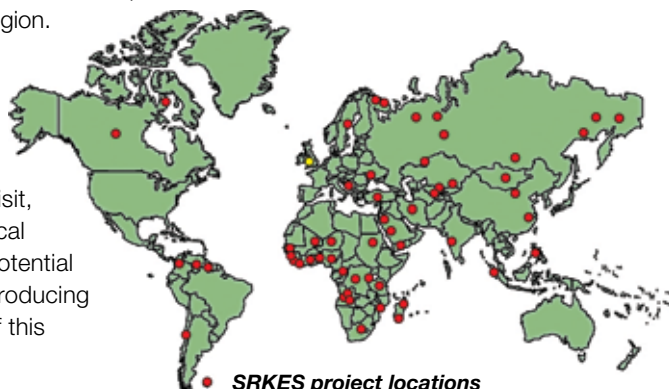
SRKES project locations

13

Brent Barber

Brent has nearly 30 years of applied economic geological experience. During his working career he has been involved in the exploration and evaluation of gold and base metal, alluvial (gold and diamonds), heavy mineral sand, coal, hydrocarbons, industrial rock and mineral, pegmatite and dimension stone prospects and mines.

Specialisation:

• Mineral exploration project and environmental impact assessment design and management.

• Ore reserve and mineral resource evaluation: coal, alluvial (diamond and gold), heavy mineral sands, industrial rock and mineral, pegmatite and dimension stone deposits.

• Regional mineral potential assessment: base and precious metals, coal, hydrocarbon, industrial rocks and minerals and gemstones.

Brent Barber: bbarber@cats-net.com

Brent Barber
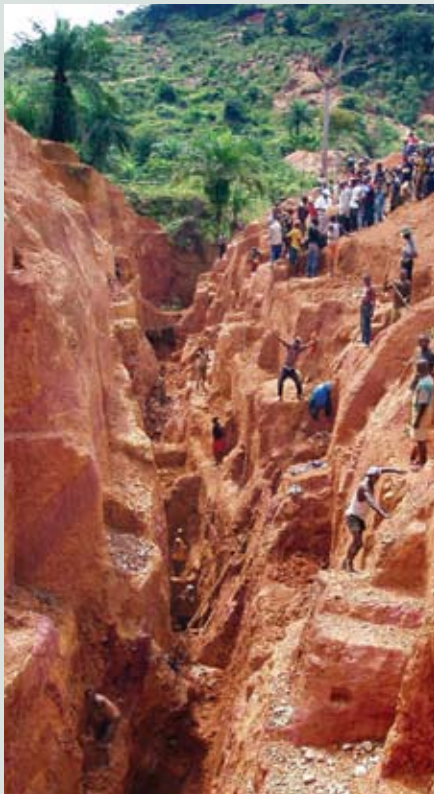
Dar es Salaam Office

Bulk diamond sampling - exploration project near Williamson Diamond Mine, northern Tanzania

Reflecting the upsurge in mining and mineral exploration in eastern Africa, with Tanzania now being the third largest producer of gold on the continent, SRK opened an office in Dar es Salaam in April 2006. The Executive Director of SRK – Eastern Africa, Brent Barber, emphasizes that the goal is to develop an office, predominantly staffed by professionals from Eastern Africa, capable of meeting the demands for international experience in engineering and the scientific disciplines in the region.

Initially the office will focus on providing professional services in the fields of mineral potential assessment, exploration program design and implementation, and environmental impact assessment and management planning. In addition, SRK - Eastern Africa will develop relational databases, similar to the ones developed for gold in Zimbabwe, Zambia and north-western Mozambique.

The first of these to be completed will be a database of the Lupa Gold Field in south-western Tanzania, the

Artisanal wolframite working in the eastern DRC - the resumption of formal mining will improve the livelihood of impoverished communities

second most important gold producing region in the country, from which over 22 tonnes of gold were produced prior to Independence in 1961. The Lupa is underlain by a series of banded gneisses associated with greenstone-type remnants of metabasite and quartz-magnetite and talc schists that have been intruded by a series of predominantly granitic rocks. The metamorphic facies of these rocks, which have been assigned to the Palaeoproterozoic age Ubendian Supergroup, is predominantly upper greenschist to lower amphibolite.

However, most previous exploration and mining activities in the Lupa Gold Field have been directed at relatively narrow, high-grade gold quartz vein and shear zone deposits. This bias has prematurely resulted in the Lupa being characterised as an area possessing high grade but limited tonnage gold potential. The presence of metabasites associated with extensive shear zones, auriferous quartz-magnetite schists and disseminated sulphides in felsitic rocks, all of which could form a gold deposit with bulk mining potential, suggest that this reputation may be undeserved.

Brent Barber: bbarber@cats-net.com

Significance of Structural Architecture in Controlling Mineralisation

An example from a 'Carlin-like' Gold Deposit, Jianchaling Mine, China

In October 2004, Sino Gold commissioned SRK to undertake a structural geology study of the Jianchaling Gold Mine in Central China. This study was intended to improve the understanding of the structural controls and continuity on the Carlin-like gold mineralisation within the operating mine, as well as to develop targets for the near mine exploration program.

Previous geology studies classified the deposit as a hybrid between an epizonal Lisvenite deposit and a Carlin-like gold deposit, as the petrographic and geological associations exhibited characteristics of each style. Gold mineralisation was primarily located within fractures and veins of a host ultramafic unit at the contact of the F145 fault, which separated the hanging wall dolomites. Early studies were comprehensive on the geology and petrology of the deposit, but they did not adequately define the structural controls of mineralisation or ways to optimise future mining or exploration. Once mining moved to deeper levels of the deposit, it was quickly discovered that gold mineralisation was not continuous along the fault from the upper to lower levels, resulting in a significant write-down of mining reserves.

SRK undertook a mapping study of the drill core, focused on the structure of the underground and surface exposures. A new deformation framework was established that was integrated with the paragenesis of metamorphism, alteration and mineralisation. The study indicated that the bulk of the gold mineralisation at the deposit lays on a shallow north dipping portion of the steeply dipping F145 fault. Up to 80 metres of horizontal rotational displacement of the fault pre-dated mineralisation and this displacement was crucial in providing the necessary heterogeneity for brecciation and dilation along the fault during mineralisation.

The Jianchaling deposit is an excellent example where deformation that pre-dated mineralisation was critical in developing heterogeneities within a host fault/structure that subsequently localised mineralisation. By mapping the cleavage-bedding relationships, foliation asymmetry, shear zone and fault kinematics in the units in the hanging wall and footwall to the deposit, we arrived at a clearer picture of the deformation framework, as well as identifying a mechanism for gold mineralisation within the F145 fault. The shallow dipping portions of the fault were the result of early recumbent folding that provided favorable traps where mineralising fluids could accumulate during a later transpressional deformation along the orogen.

This study highlighted the need for quality geology studies that identify structures that control mineralisation and/or affect the continuity at early stages of feasibility studies. Once this information is incorporated into the geological and resource model, it can be continually improved and updated during future development in order to optimise production and exploration.

The results of this work were presented at the 2005 SGA conference hosted in Beijing.

Andrew Ham: aham@srk.com

Example of a well developed crenulation cleavage part of the early deformation architecture that controlled gold mineralisation

André van der Merwe

In 1988, André van der Merwe began his geological career with Johannesburg Consolidated Investments Co Ltd (JCI) as a Geophysicist/Senior Geologist in field exploration for gold, platinum, base

André van der Merwe

metals and coal in South Africa. As a Senior Geologist for Randfontein Estates Gold Mining, he was responsible for the geological control of a mine section. He undertook fundamental research into mining-induced seismology in the platinum mines at the CSIR Division of Mining Technology in the Witwatersrand Basin; then as Consulting Seismologist, he worked with clients in South America, Canada, Australia and Africa.

Rejoining JCI as Senior Geophysicist, he worked in geologically diverse terrains across West and East Africa, Australia and Indonesia on gold, platinum, base metals and diamonds projects.

At RSG Global he became Regional Manager - Southern Africa, responsible for business development and consulting assignments, including exploration, technical audits, feasibility studies and new project development opportunities. He gained hands-on experience beyond sub-Saharan Africa in Europe, South America and Australia.

As a Partner and Principal Geologist with SRK Consulting, André is responsible for geological consulting on exploration, technical reviews and audits, as well as valuations and technofinancial studies of predevelopment projects, and for reporting for bourses in Australia, RSA, the UK and Canada.

André van der Merwe:
avandermerwe@srk.co.za

Valuation of Exploration Properties

The May 2007 deadline is looming on the South African mining calendar. That is the date by which anybody who feels aggrieved by the loss of a mineral right under the "old order" must file a legal writ against the Government to retain it. This date has caused a flurry of requests for valuation of disputed mineral rights. Valuing an early stage mineral property is fraught with difficulty, since the desirability (and hence value) of the site is very much in the eye of the beholder.

There are accepted technical approaches to valuing early stage mineral properties, such as multiples of exploration expenditure, comparable transactions (which are very seldom comparable), in-situ mineralisation and the Kilburn method. All of these require careful consideration and professional experience to apply objectively. SRK has been in the vanguard of making such valuations, and has been involved in several high profile merger/acquisition cases. André van der Merwe recently presented a paper on valuing the properties of Platinum Group Minerals at the 2nd International Platinum Conference held by The South African Institute of Mining and Metallurgy (see figures for some of the findings). He is also presenting a night class to legal practitioners at the Pretoria Bar on the valuation of mineral properties.
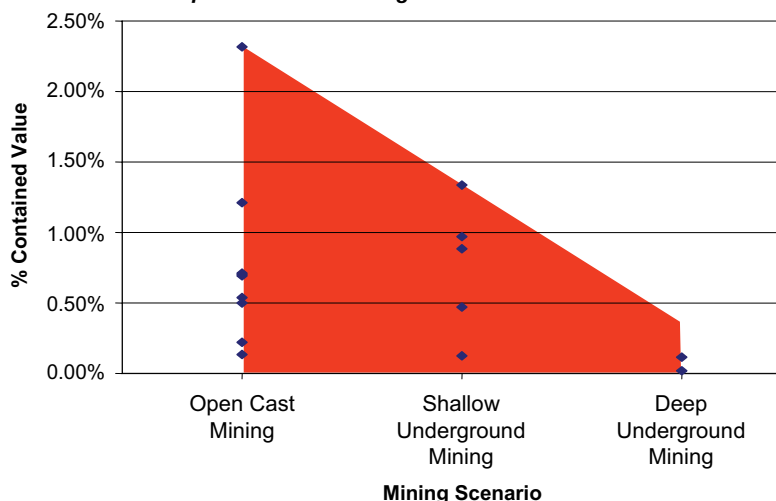
André van der Merwe:
avandermerwe@srk.co.za

Histogram of Yardstick values

Frequency distribution of Price Paid for in-situ PGE ounces, expressed as a percentage of the full value of the contained metal
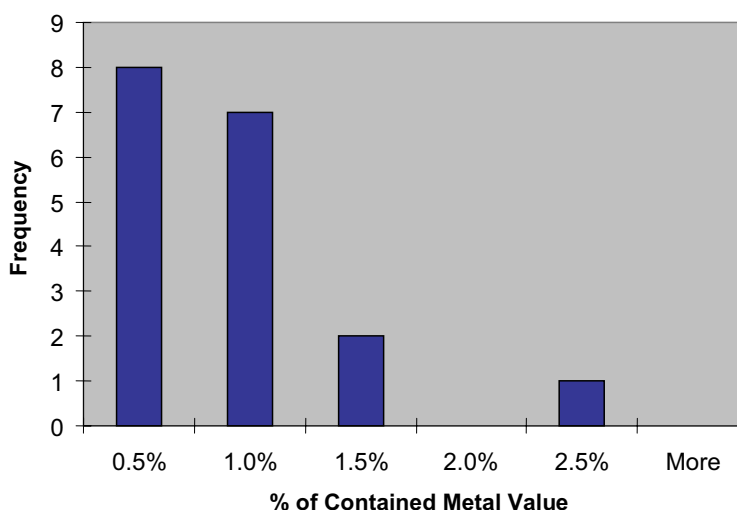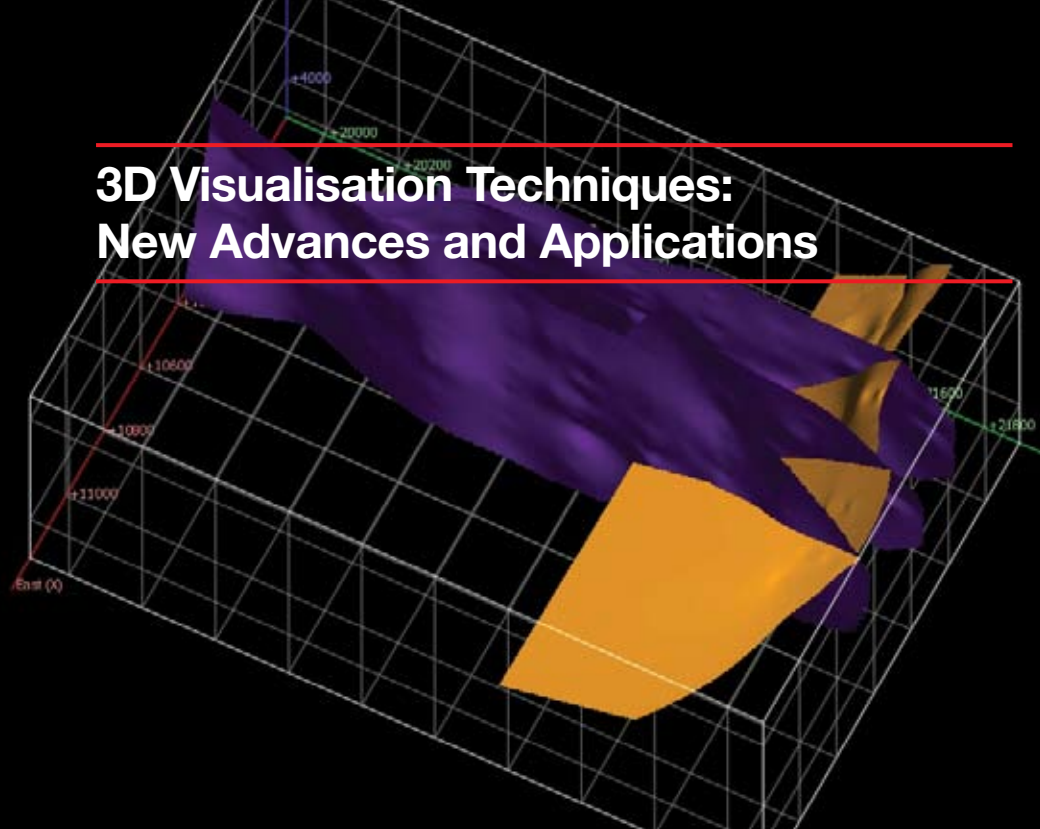

Yardstick vs Mining Scenario

Comparison of % value attributed to in-situ PGE mineralisation with expected/actual mining scenario

3D Visualisation Techniques: New Advances and Applications

Dyke (orange) offset by a series of Valley Parallel faults (magenta), Antamina, Peru

Recent advances in computational power have driven innovations in graphic design and three-dimensional modeling in mining and exploration. No longer is a geologist or engineer tied to two-dimensional sections and plans previously used to interpret the geology or mine plan for a deposit.

However, where there are innovations, a competent geologist or engineer must be aware of the pitfalls. SRK's geological modeling approach ensures a three-dimensional model is built on the thorough understanding of the deposit's geology using traditional geological tools, such as structure contours and 3-point solutions, to aid interpretation. Care must be taken to construct interpretations in 2D and 3D that are strongly linked to 'geo-reality' and not 'geo-fantasy'.

At the outset, SRK constructs a plan on how the geological model will be put to use: for resource, exploration, rock mechanics, mine planning, hydrogeological investigations – and on the scale required for each. A hierarchy and geological framework for the deposit is required, outlining which geological entities should be modeled first, using which data sources.

Several new advances in geological software enable the construction and validation of 3D geological models. SRK uses a combination of Leapfrog, FracSIS, and Gemcom software to aid geological modeling.

Using Leapfrog, we can model the first order distribution of numerical datasets rapidly, including grade, magnetic susceptibility, geotech parametres, and deleterious elements. This often highlights unforeseen geological trends which, previously, were poorly represented in traditional geological models.

Using FracSIS, we can integrate multiple 2D and 3D datasets, for example, allowing the interrogation of drillhole versus geological mapping data, geophysical data, satellite imagery, and existing 3D geological models.

Recent advances in Gemcom have expanded its 3D graphics and geological modeling capability. It can drive geological modeling by interrogating drillhole data, but when required to integrate with other data sources, including geological mapping and satellite imagery, it falls short.

Currently no one software package stands alone as the complete solution for geological modeling. However, by integrating Leapfrog, FracSIS, and Gemcom software, we can produce significantly advanced geological models in reduced timeframes, and often highlight unforeseen exploration potential around existing deposits.

James Siddorn: jsiddorn@srk.com

James Siddorn

James Siddorn

James Siddorn is a Senior Consultant for SRK, based in Toronto, with over 11 years experience in Ni-Cu-PGE Au, Ag, tantalum, and diamonds, with 8 years experience in applied 3D geological modeling. He is an expert in the construction of four dimensional near mine to district scale models for the structural controls on ore distribution. He is a skilled structural geologist, with extensive underground and surface mapping experience, focused on the structural controls on Archaean gold deposits. He has a broad mining experience focused on conventional and mechanised mining, including cut and fill, shrinkage, VRM and longhole mining.

James specialises in combining the structural analysis of the controls on ore distribution with 3D geological modeling and 2D GIS. James is highly proficient in computer based 3D geological modeling and its application to applied structural-economic geology, hydrogeology and geotechnical analysis. He is also skilled in the use of 2D and 3D GIS, including MapInfo, ArcView, ErMapper, gOcad, Leapfrog, AutoCAD, FracSIS and Gemcom. He has built comprehensive 3D geological models of over 10 different deposits, for both resource and country rock definition.

Recently, James was awarded the 2006 Barlow Memorial Medal by the Canadian Institute of Mining and Metallurgy. This medal is awarded for the best paper on economic geology published by the Institute in any year.

James Siddorn: jsiddorn@srk.com

George Even

George Even

George is a Principal Geologist and Partner in the Chile office. His 35 years of experience range from work on grassroots exploration programs to open pit stability design. After spending 10 years in both exploration and mining in North America, he has worked for the last 25 years based from Santiago. His project experience includes design of exploration programs, development of structural and geotechnical models and geotechnical slope stability studies. He has conducted numerous technical and due diligence reviews throughout South and Central America.

In the last few years, under his leadership, the geology team in the Santiago SRK office has diversified and greatly expanded its client and project base by adding key staff. SRK's Santiago geologists are able to run exploration programs and mine-based resource-reserve estimations, as well as integrate their services to the mining and geotechnical departments.

George Even: geven@srk.cl

Chris Bonson

Chris Bonson

Chris Bonson is a Senior Consultant in structural geology working from SRK's Vancouver office. His principal area of expertise is in the structural analysis and 3D modeling of mineralised terrains, from the deposit- to regional-scales – skills which he applies to exploration targeting, resource delineation and characterisation, and to the evaluation of geotechnical risks in mining.

Chris has worked on a variety of industry-related problems using a broad range of geological and geophysical data. His experience encompasses the structural analysis and modeling of various commodities, including base and precious metal deposits of the Americas and Europe, diamondiferous kimberlites of northern Canada, coal deposits of the UK and Canada, and hydrocarbon systems of the Mediterranean region.

Chris Bonson: cbonson@srk.com

Structural Controls on Kimberlite Geometry and Emplacement

Linkage between two kimberlite dyke segments

SRK was enlisted by De Beers (Canada) to conduct a structural investigation of its Snap Lake Diamond Project, located in the Canadian Arctic, 220 kilometres northeast of Yellowknife. The ore body at Snap Lake is a diamondiferous kimberlite dyke, which dips gently towards the east, under Snap Lake.

The broadly tabular geometry of the ore deposit of the Snap Lake dyke represents a marked departure from the pipe-like diamond deposits that De Beers is accustomed to mine elsewhere. However, like other dykes, the Snap Lake kimberlite dyke is not perfectly tabular, but in fact is segmented across a range of scales (centimetres-decametres). Certain scales of segmentation could potentially be a challenge for mining; dilution due to drift-scale changes in elevation between the adjacent dyke segments represents the most likely problem. Additionally, the dyke has been emplaced into Archaean granitic host-rocks, which are cut by a regional scale fault system, the Snap-Crackle fault.

In partnership with De Beers Snap Lake geologists and technical staff of their Mineral Resource Management group,

SRK is refining the structural interpretation of the Snap Lake deposit by mapping the structures in the underground development and ore horizons. The principal objectives of the investigation are to augment the current understanding of the geometry of the kimberlite dyke using quantitative structural analysis and to provide a rationale for the formation of these structures in an emplacement model. In time, this information will be used in mine planning and day-to-day interpretation of faces.

SRK is well-equipped to assist with this analysis due to our combined expertise in analysing faults and fluid-driven fractures (dykes), in kimberlite geology and in diamond mining. To date, we have formulated a dyke growth model consistent with the geometry; identified the scaling relationships and preferred orientations of dyke segment linkage; and established the relation of areas of complex dyke geometry to different fault sets. These findings are helping to finalise mine development plans and to streamline day-to-day geological data collection and interpretation.

Chris Bonson: cbonson@srk.com
Jarek Jakubec: jjakubec@srk.com

Building Geological Expertise for Clients in Chile

The ability to integrate different services has been the key to SRK Consulting's successful and ongoing relationship with one of our key clients in Chile, a major underground copper mine operator. Over the last four years, SRK has worked alongside the client's own staff, helping them maximise the usefulness of geological data, while providing a combination of exploration program assessment, deposit modeling, structural geology, and open pit geotechnical design.

The first step was aiding the client in designing the collection and interpretation of geotechnical data from their own drill hole campaigns, exploring the geological surface. The aim was to identify mineralisation amenable to open pit excavation that could not be mined from the existing underground operations. This preliminary database served as the mine design parameters for the client's engineering staff. Two mineralised areas were studied, one to the north of the existing underground mine and one to the south. Concurrent with the drilling program, SRK specialists in hydrogeology and environmental engineering conducted parallel studies of the site and integrated this information into the overall project database.

As part of the process in collecting the geological, geotechnical and structural information from the drill core, SRK trained client personnel in the procedures we employ for logging the drill core and techniques for orienting the structures present. SRK's staff remained continuously in the field to aid in the collection of data and to supervise these activities.

Because the client's obvious focus was on the existing underground operations, there was a lack of data regarding key geological structures and structure sets in the future open pit areas. The data SRK collected from the drilling campaigns greatly increased the information available and, with the help of alpinists, SRK geologists were able to aid the client in surface structural mapping. In addition, SRK mapped geotechnical structural windows in the underground workings bordering the north pit area. As a result, from the drilling campaigns, as well as surface and underground mapping, it was possible to prepare an integrated structural model for this area. Armed with this information, SRK specialists were able to study and model the effects of the possible interaction between the open pit and underground operations.

SRK's close contact with the client revealed the need to study controls on the mineralisation in the area of the proposed northern pit, where the high grade mineralisation is more erratic and appears to occur at a greater depth than in the adjacent underground operations immediately to the south. Using Leapfrog 3D visualisation software, SRK modeled varying copper grades for the entire mine and exploration drill hole database. The results showed a clear correspondence between the location of structures oriented west-northwest and the northward continuity of the >1% copper envelope. SRK and the client's geologists mapped these north-northwest structures on the surface. Future studies should clarify if these structures do, in fact, play the determining role in the distribution of the high grade mineralisation.

George Even: geven@srk.cl

Field investigation next to subsidence crater

Peter Gleeson

Peter Gleeson joined the Perth office as Principal Consultant (Geology) at the end of November 2006. Peter has over twenty years of experience both in consulting and production roles. This experience includes 10 years as open pit and underground mine geologist and five years as an exploration geologist. He has worked on resource estimation projects, project evaluations and 3D modeling studies in a variety of different geological environments and with commodities, ranging from precious and base metals to iron ore.

Peter Gleeson

He is also experienced in performing mine feasibility, mine planning and expansion studies, as well as audits. His work experience encompasses mines and projects in Australia, Southern Africa, West Africa, North America, South America, Europe and Indonesia and he has had extensive exposure to diverse world-class ore deposits and mineral systems.

Peter has implemented several innovative geological modeling technologies, which have helped to improve the way in which companies produce 3D geological models and interpretations to facilitate exploration and the evaluation of mineral deposits. He is an expert user of several modeling software packages in mining and geology, such as Vulcan, GOCAD, Geomodeller, FracSIS, Leapfrog and Datamine.

Peter Gleeson: pgleeson@srk.com.au

# Generating 4D Geological Maps from Regional

Examples: Lumwana and the Eastern Goldfields

Geological interpretation is still the basic skill underlying the mining and exploration industries. Historically, exploration activities have tended to be dominated by geochemical prospecting methods. But it is becoming more common to interpret results by applying a much broader geological understanding of the mineralisation processes than geochemistry alone allows.

The key driver for the exploration industry at present is the discovery of mineral deposits under cover, meaning hidden beneath surficial deposits or in the subsurface of other geological formations. The range and scale of datasets available to explorers and the way they are used is changing. A wide range of datasets from global remote sensing to local and regional geophysical surveys are now being tested in studies at local scale. Regardless of the type of data or the area it covers, all data interpretation requires sound geological reasoning.

Geological input is critical during drill targeting and resource estimation, where the primary risk factor is the effective utilisation of the underlying geological model. A resource model is a numerical expression of a geological entity; however the relationship between it and the underlying geology is rarely evaluated or communicated critically. Similarly, a geophysical or geochemical target requires evaluation in its geological context to ensure the drilling budget is allocated effectively.

Our understanding and visualisation of geological settings is greatly impacted by technology. Using advanced computer graphics and processing improves our ability to picture the geological model and, more importantly, to check the validity of our interpretations. Unravelling the complex geological history of an area to understand the interaction between mineralising events and structures that pre- and post-date them, is fundamental to exploration and resource geology.
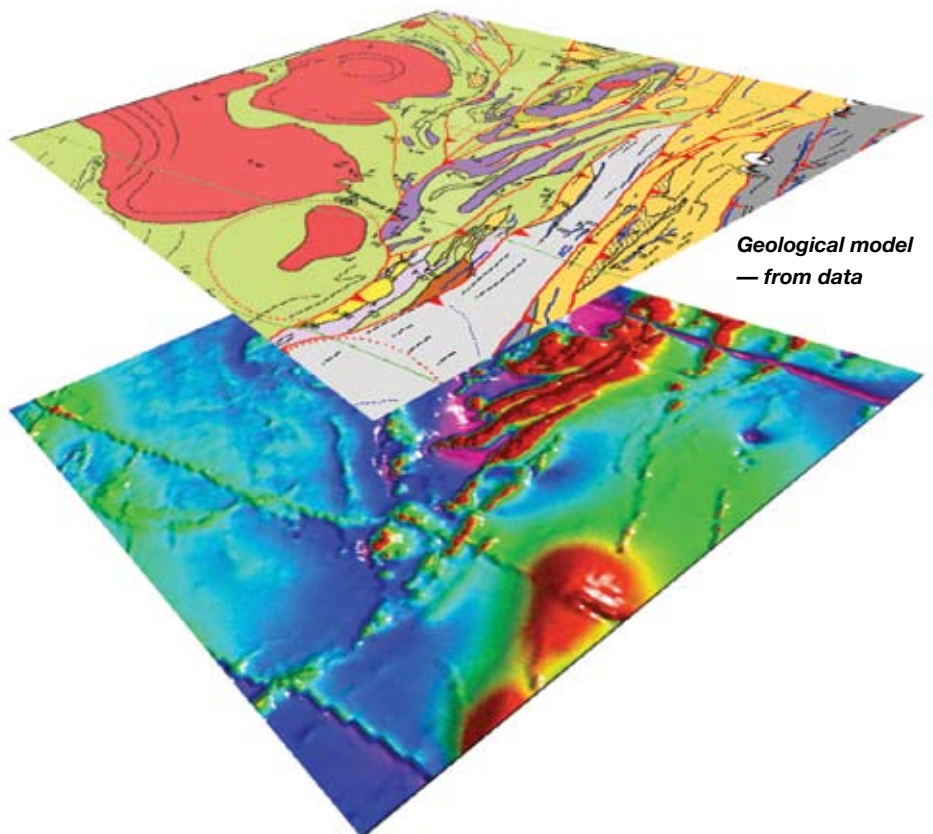
Geological model — from data

Geophysics

SRK's approach to targeting and resource geology has always been to apply the top geological skills to the best data using the most appropriate technology. In the early 1990s SRK partnered with Fugro to generate regional geological interpretations of Western Australia using high-quality aeromagnetic data. Serial cross-sections were used to control 3D continuity, and time factors were worked into interpretations of structures by analysing the timing and origins of the major structures in the Archaean Cratons. This work led to an understanding of the extensional nature of the sedimentary basins, and the recognition of structures associated with it. It was recognised that extensional shear zones are located at major granite margins and are associated with gold deposits.

Using geophysical inversion methods to construct three-dimensional geometry has further enhanced interpretation, and allowed us to expand regional potential field datasets to 3D with added confidence.

Leapfrog has greatly advanced SRK's ability to relate detailed structural analysis to resource geology. Leapfrog can model both geochemical and geological information directly in three dimensions, which provides an immediate visualisation of the geometrical links between particular structures and alteration systems, and the grade of mineralisation.
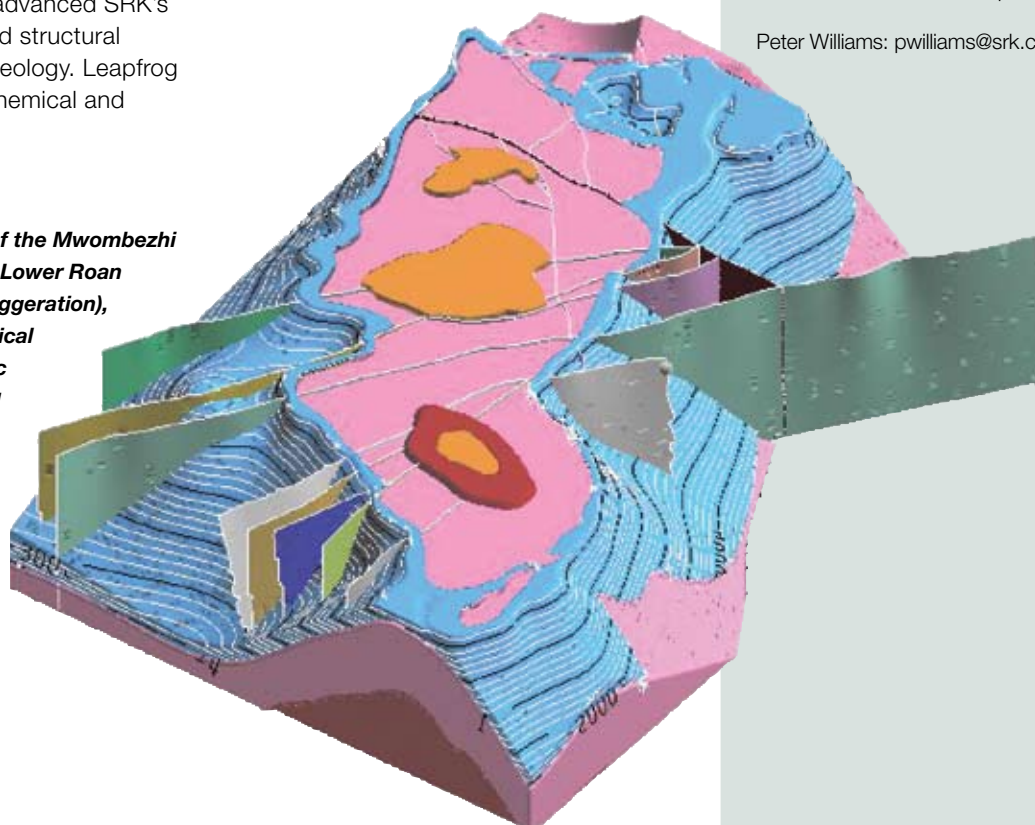
Despite the expansion of tools, and the increased range of problems that can now be tackled realistically using computer models, the difficulty of generating high-quality geological interpretation remains the main limitation to applying modeling to the wide variety of geological problems at a range of scales. Geological interpretation is still the fundamental skill needed in exploration and mining. Fostering this vital skill within industry requires on-going training both at the institutional level and within the workplace for continued development of professional geologists.

Peter Williams: pwilliams@srk.com.au
Peter Gleeson: pgleeson@srk.com.au

Peter Williams

As well as managing SRK Australia, Peter still has a very hands-on approach to consulting. Peter has over 30 years experience in the minerals industry with more than 13 of those years as a consultant.

Peter Williams

His specialisation includes the areas of mineral exploration, structural geology and geology, geophysics-GIS integration with particular expertise in major deposit syntheses, major research projects (SRK Global Archaean Synthesis, 30 1:100k geophysical interpretation sheets in the Eastern Goldfields). His special interests include the relationship of structures to mineral systems, particularly shear-hosted Au, stratiform base metal, nickel sulphides, epithermal Au, breccia-hosted Cu-Au skarn, porphyry-Cu, and alkali granite Sn-W environments.

He has conducted major interpretation projects from aeromagnetic data for exploration targeting, and has worked in a range of geological terranes in Australia (specialising in the Yilgarn Craton and Mount Isa), West Africa, East Africa, Zimbabwe, Zambia, DRC, Indonesia, PNG, Vanuatu, Solomon Islands and Europe.

Peter Williams: pwilliams@srk.com.au

3D exploration model of the Mwombezhi Dome and prospective Lower Roan horizon (2x vertical exaggeration), generated from geological mapping, aeromagnetic interpretation data and geophysical inversion

With permission of Equinox Minerals

Jean-François Couture

Dr. Jean-François Couture, P. Geo., is a Principal Geologist for SRK, based in Toronto, with over 25 years of experience in mineral exploration and mineral deposit evaluation. He is an accomplished ore

Jean-François Couture

deposit geologist with expertise in structural geology, lithogeochemistry, mineralogy and petrology, and the integration of GIS data at regional and local sites for defining exploration targets.

As a Qualified Person under the meaning of NI43-101, Jean-François has authored and co-authored over 20 recent independent technical reports for various gold, base metals and uranium exploration and mining projects in Canada, Argentina, Burkina Faso, Chile, China, Finland, Ghana, Kazakhstan, Niger, Sweden, South Africa and the United States. He is skilled in geological modeling, ore deposit modeling, digital data integration, exploration project management, due diligence and resource estimation.

Jean-François Couture: jfcouture@srk.com

Allan Moran

Allan Moran is a Principal Geologist with SRK's Geology/Mining Department in the Tucson office. He is an Oregon-registered Geologist, and a Certified Professional Geologist through AIPG. Allan has 36 years of diversified experience in mineral exploration,

Allan Moran

exploration management, mine geology, and in conducting geologic/economic evaluations of property specific sites for major and junior mining companies.

He has worked as a consultant to the mining industry for six years. His expertise in specific commodities includes 22 years evaluating gold deposit models, six years with porphyry copper and molybdenum deposits, and six years of experience with uranium. He has been responsible for authoring technical reports as a Qualified Person, in compliance with Canadian National Instrument form 43-101.

Allan Moran: amoran@srk.com

Independent Technical Reports: Adding Value

Securities regulators worldwide have set in place formal guidelines regulating public companies and the technical information relating to mineral projects they must disclose for market-related reporting and financial investment. The mineral industry has developed guidelines to increase the relevance, accuracy and transparency of technical information that public companies disclose. Although the guidelines were developed for local markets, "CRIRSCO" has made recent progress in formulating an international reporting template. CRIRSCO is the Committee for Mineral Reserves International Reporting Standards), a committee of the National Mineral Reserve Reporting Organizations of Australia, Canada, Chile, South Africa, USA, United Kingdom and Ireland and Western Europe. The international reporting template encapsulates the content of the various reporting standards, but it does not supersede existing reporting standards at national levels.

As the number and type of regulatory requirements grows, it is increasingly difficult for mineral companies to be sure that the technical information they disclose complies under one or more of the securities regulatory frameworks.

SRK professionals are recognised "Qualified Persons" or "Competent Persons" under many jurisdictions. This status allows SRK to prepare independent technical reports on any mineral project because we are cognizant of the national regulatory requirements specific to each jurisdiction. SRK adds value to its clients when our professionals author independent technical reports, prepared according to the relevant standards, and file them under a format that allows efficient regulatory review.

Jean-Francois Couture: jfcouture@srk.com
Allan Moran: amoran@srk.com

SRK's New Office in Kolkata

Subrato Ghosh is managing SRK's office in Kolkata, India. The new office, SRK's first in India, is involved with a major study of Hindustan Copper's existing mines and operations and with detailed exploration for POSCO prospects. The primary focus of the new office is developing a core team of geologists and mining engineers with the aim of providing services for the exploration industry in India and neighbouring countries, including Indonesia.

Subrato Ghosh

Subrato is a Principal Resource Geologist with 16 years of experience in software applications and resource modeling. He graduated from the Indian School of Mines in 1990, then spent a couple of years working as an exploration geologist with Hindustan Copper Limited, a copper mining corporation.

Before joining SRK in August 2006, Subrato spent a major part of his time in mining IT consulting, including the promotion of mine planning software, software implementation and consulting on projects that ranged from database management to geological report preparation and tactical mine planning.

He participated in country-wide capacity building projects, assisting the Bhutan geological survey in computerizing data and project management including mine planning and GIS integration. He gained GIS experience with another IT company after leaving HCL.

Subrato has worked with multiple commodities: copper, iron, chromite, coal and lignite, gypsum and limestone. He is presently working on his PhD topic, which revolves around using geospatial systems in sustainable mine management.

Subrato Ghosh: sghosh@srk.com

Optimising Field Investigations

SRK's Structural Geology Workshop

Most ore deposits are formed within tectonically active areas, such as ancient basins and orogenic belts. It is no wonder then that the vast majority of mineral deposits are affected or controlled by structural features. From the perspective of mineral exploration and mining, the potential influence of both large and small scale structures on projects cannot be understated, with structures impacting most technical issues, including: grade control, resource estimation, targeting, rock mass engineering and hydrogeology.

In SRK's experience, many projects suffer from a lack of recognition or understanding of important geological structures or structural relationships, which at an advanced stage of development may come back to haunt the project owner. Through workshops aimed at the practical applications of structural geology in the mining industry, SRK offers the opportunity for mine and exploration geologists to improve their understanding of and confidence in the practical analysis of structures, thereby helping to circumvent costly headaches and to improve exploration success.

Workshops, usually run over several days, consist of a series of tailored lectures and exercises that allows participants to grasp the different facets of structural geology whilst emphasising the practical value of robust structural analysis using real life case studies drawn from SRK's global experience. A major emphasis is placed on honing skills used in day-to-day exploration and mining. In this respect, on-site mapping and core-logging exercises form a key aspect of training. At the end of the course, participants are better equipped to understand the structures that control mineral deposits, to map, visualise and interpret these structures and to solve complex structural problems.

Course presenters are highly-trained specialists, experienced in integrating structural geology with data such as drill program results, regional geophysics and geochemical surveys. Their extensive experience of practical problems and their solutions underpins the content of the workshops, which are designed to have a practical, site-specific focus.

SRK structural geologists have recently completed successful structural geology workshops for mines in North and South America, Africa, Australia and other parts of Asia Pacific.

For more information please contact your nearest SRK office.

3D Structural Geology Modeling, Peru
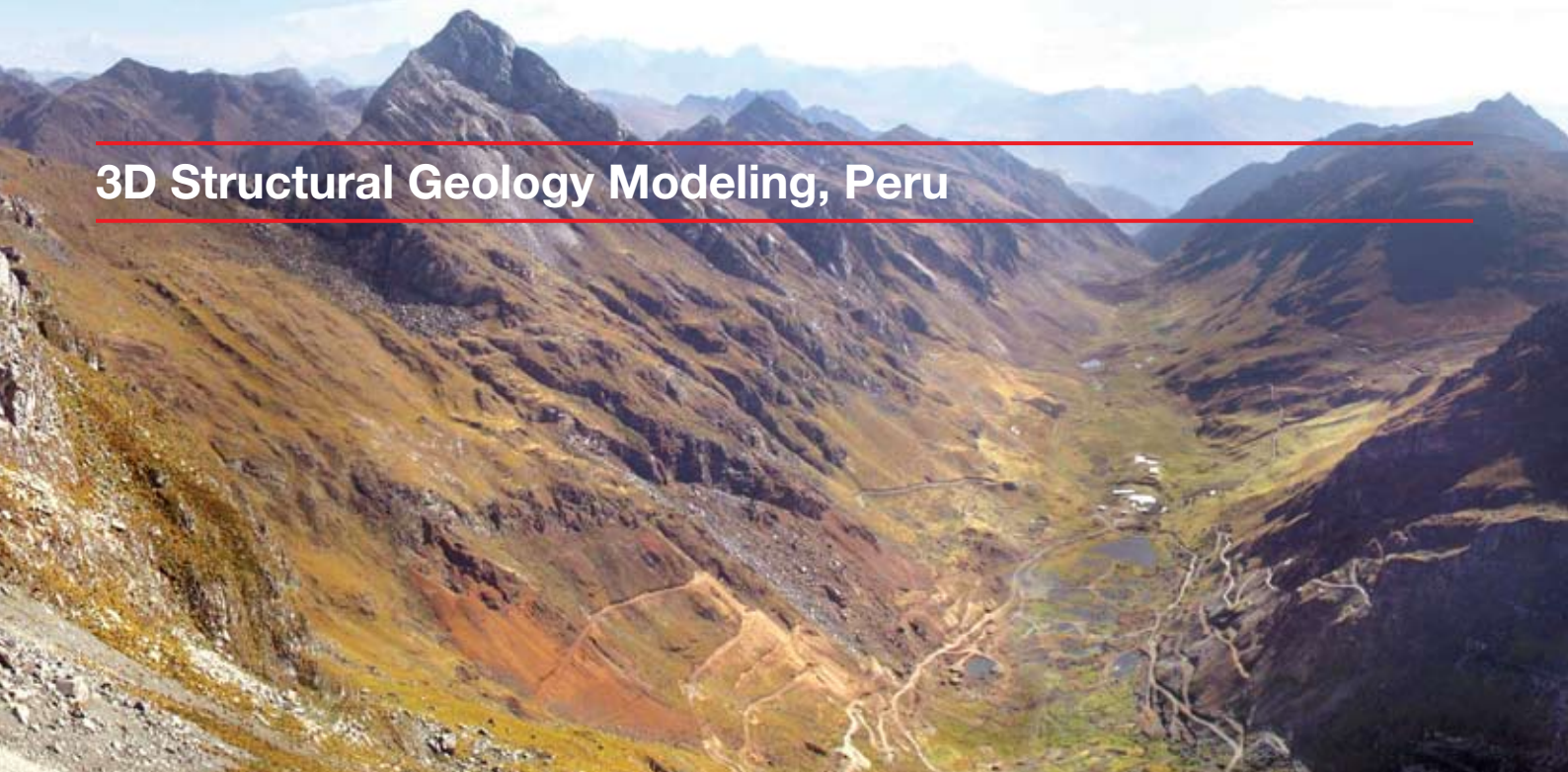
Magistral Valley

Sally Goodman

Sally is an Associate Consultant with SRK, based in Montreal and working through the Toronto office. Sally is an applied Structural Geologist, with over 15 years experience of structural analysis of complex areas, mainly in the

Sally Goodman

PreCambrian terrains of Europe and North America. Her key skill is the integration of the structural framework with diverse data sets (geophysical/geochemical survey data, satellite imagery, lithological mapping etc.) to reconstruct the spatial and temporal development of mineralising systems at a regional to deposit scale.

Since joining SRK, this skill has been applied to project/target generation and ranking, optimisation of drill-testing, resource estimation and grade control in a range of deposit/commodity types, including Archaean gold, orthomagmatic nickel, banded iron formation, oil and gas.

Sally has also recently taught mineral deposit geology, metamorphic petrology and environmental geology at McGill University and Concordia University, Montreal.

Sally Goodman: sgoodman@srk.com

Designing or excavating an open pit mine requires a detailed understanding of major structures that have the potential to create large failures in pit walls. Evaluating large scale structures geometrically and kinematically enables an operator to mitigate the associated structural risk in developing an open pit.

Using accurate three-dimensional modeling, SRK combines detailed mapping and kinematic analysis of large scale structures in real time, taking into account mining induced stress fields and neotectonic seismic activity.

Recently, SRK conducted structural geological investigations of the Antamina Mine for Compania Minera Antamina Inc. and the Magistral project for Inca Pacific Resources Inc. Both deposits are located high in the Peruvian Andes. As part of the broader geotechnical characterisation of the deposits, the studies were principally focused on the construction of 3D structural models by integrating all available data (drillholes, surface maps and structural studies of drillholes), with the aim of delineating the geometry of major structures (faults, dykes and stratigraphic contacts) that might present possible zones of pit slope failure.

For both deposits, the major structures were constructed in three dimensions using a combination of Gemcom, AutoCAD, and Leapfrog software. The structures modeled

included different generations of faulting and their kinematics, dykes, and lithological contacts. All model entities were ground-truthed and geotechnically characterised in the field, to provide a more robust correlation between surface geological observations and drillhole geological observations. The drillhole databases for both deposits contain a large number of fault intersections, which, in the absence of oriented data, is easy to misinterpret. As a result, the field mapping constraints proved extremely important in guiding the interpretation of the major faults. The fault intersections and offsets were also checked against field evidence to produce a realistic representation of the major structures within the pit area.

For the Magistral deposit, a total of ten structures were modeled and evaluated for their potential for pit slope failure. This resulted in the slight modification of the design of the planned open pit geometry. For the Antamina deposit, a total of sixty structures were modeled and evaluated for their potential for pit slope failure. No major geotechnical issues affecting current pit stability were identified at Antamina, though further investigations are warranted into possible intersections of structures with the ultimate pit.

James Siddorn: jsiddorn@srk.com
Sally Goodman: sgoodman@srk.com
Chris Bonson: cbonson@srk.com