PETER K. KAISER, Ph.D., P.Eng.

EDUCATION

1979	Ph.D.	Geotechnical Engineering, University of Alberta, Canada
1972	Dipl. Ing.	Civil Eng., Federal Technical University (ETH), Zürich, Switzerland

POSITIONS HELD

1998 – Present	President, MIRARCO – Mining Innovation, Rehabilitation and Applied Research Corporation
1987 – Present	Professor of Mining Engineering, Chair for Rock Engineering and Ground Control, and Director of Geomechanics Research Centre, Laurentian University, Sudbury, Ontario
1977 – 1987	Professor of Civil Engineering at University of Alberta, Edmonton, Alberta

EXPERIENCE SUMMARY

Technical and scientific contributions as an educator, researcher, advisor and consultant in many aspects of geomechanics related to underground excavations: time-dependent failure of tunnels, design of tunnels and underground caverns, borehole stability, rock support including shotcrete and spray-on linings, cable bolting and rock reinforcement, in situ stress determination, rock mass response monitoring and applications to mining and civil engineering. Research has also focused on rock avalanches, rock tunnelling including mechanized excavation, soft ground tunnelling, shaft behaviour, nuclear waste disposal, ground support in hard rock mining and support in rock-burst area. Specific project experience includes:

Campbell Red Lake Mine

Over the years, GRC has been involved in several projects at this mine, dating back to 1989. During a recent extensive study of ore dilution and rockburst hazards, practical procedures were developed to determine the combined effect of geological structures, stress and geometry on stope stability. This methodology allows users to rationally compare various mining methods or mining sequences. The results were presented in practical terms of feet of drift at risk and in terms of dilution potential ratings.

Kidd Creek Mine

In collaboration with Itasca Ltd. and Brummer Associates, the GRC contributed to the Kidd Creek Deep project that focused on the development of a cost-effective mining method for the next 1000'. Site characterization for mine design, modelling to evaluate potential geomechanics problems, rockburst control, and cable bolt support issues constitute the main components of our involvement in this investigation. In particular, we established a procedure to effectively determine the influence of faults on stope and pillar stability. Observations from higher levels were used to calibrate models and empirical design methods. We concentrated specifically on the optimal integration of data collected by the geology department into the mine design. In other words, a methodology was developed to properly consider the influence of major geological features on dilution and thus on stope sizing and ground support.

Brunswick Mine

Our involvement at BMS was through a technical review task force, the design of rockburst support testing procedures and an on-site study to utilize seismic data for daily operational decision making. As part of the review team, late stage mining issues and their impact on mining methods and ground control measures were assessed. This involved the development of a rationale for selecting appropriate ground support means and mining sequences.

Winston Lake Mine

At Winston Lake, we were involved in an extensive field instrumentation program to improve dilution control by cable bolting. This involved stress-change and deformation monitoring of a steeply dipping orebody hanging wall. The data interpretation led to two major improvements of our understanding of the detrimental effect of rockmass relaxation due to near-by mining: (a) relaxation leading to a reduction in cable bolt capacity, and (b) relaxation causing instability of otherwise stable rock formations. Both these factors, if ignored, have a major economic impact on the mining cost. Experience from this case study has since been used to develop improved empirical design methods for stope design and has been used to successfully interpret elastic numerical model results for mining scenarios where relaxation may lead to structurally controlled instabilities, caving or stope back unravelling.

El Teniente Mine

El Teninete Mine is a mine that has experienced very severe rockbursts, rockbursts that cause much more damage than we conventionally experience in Canadian mines. This project was primarily concerned with the use of rock support to control rockburst damage. The benefit of this experience is that we have extensive experience with various ground control measures (bolts, shotcrete, etc.) in moderate to very severe rockburst conditions. A methodology was also developed to establish a measure of risk by determining the damage potential (the feet of tunnels at risk) for tunnels supported with different support types (e.g., split set versus rebar support, etc.). This case history also provided valuable data and experience that eventually lead to the use of modified Hoek and Brown parameters for stability assessment in brittle rock. This method has since been further developed and is now used extensively at the GRC to assess the stability of excavations and pillars in brittle rock.

CONSULTING ACTIVITIES

Consultant to numerous consulting engineers, mines and public agencies on geotechnical engineering problems including ground control and rock support, shaft design, tunnelling and under-ground excavations in soils and rocks, rockbursts, slope stability, dam design, retaining walls, and pipeline failures. Examples:

1999	Member of Technical Review Team on Yucca Mountain Project,
1998	Member of Technical Review Team on Rockbursting at Creighton Mine, INCO Ltd.
1996	Member of Technical Review Committee responsible for reviewing ground support issues at Brunswick Mine.
1994-1995	Member of the Technical Advisory Committee responsible for establishing guide-lines and support practice for mining in burst prone ground at Macassa Mine, Lac Minerals Inc.
1982-1995	Advisor/peer-reviewer on Canadian nuclear waste disposal program for Atomic Energy of Canada Ltd.
1983 & 1987	United Nations Development Program to develop Research and Testing Facilities for Rock Mechanics, Tunnelling and Monitoring in India.

PROFESSIONAL ACTIVITIES

1991 – 1995	Vice-President (North America), International Society of Rock Mechanics (ISRM). Member of ISRM commissions on: Rock Failure Mechanisms in Underground Openings; Rockbursts; and Tunnelling in Squeezing Rock
1994 - 1998	Vice-President, Canadian Tunnelling Association; Correspondent to ITA Journal
1990 - Pres	Advisory Board Journal of Rock Mechanics and Rock Engineering

1983 - Pres Member, Advisory Board for the journal 'Rock Mechanics and Rock Engineering'

PROFESSIONAL AFFILIATIONS

Member Professional Engineers of Ontario;
Canadian Institute of Mining and Metallurgy;
International Society for Rock Mechanics;
Canadian Geotechnical Society,
Canadian Rock Mechanics Association,
Canadian Tunnelling Association;
American Society of Civil Engineers

PUBLICATIONS

Approximately 150 technical and scientific publications in the field of geomechanics, tunneling and mine design. Recent selected publications include:

Refereed Journals

1. Martin,C. D., P. K. Kaiser, and Dr. R. McCreath, 1999. Hoek-Brown parameters for predicting the depth of brittle failure around tunnels. *Canadian Geotechnical Journal,* **36**: 136-151.
2. Diederichs, M. S. and P. K. Kaiser, 1999. Stability of large excavations in laminated hard rock voussoir analogue revisited. *International Journal of Rock Mechanics and Mining Sciences,* **36**: 97-117.
3. Diederichs, M. S. and P. K. Kaiser, 1999. Tensile strength and abutment relaxation as failure mechanisms in underground excavations. *International Journal of Rock Mechanics and Mining Sciences,* **36**: 69-96.
4. Alcott, J.M., P.K. Kaiser, and B.P.Simser, 1998. Micro-seismic Rockburst Hazard Assessment at Noranda's Brunswick No.12 Mine. *Pure and Applied Geophysics Journal, PAGEOPH*, **153**: 41-65.
5. Kaiser, P.K., D.D. Tannant and D.R. McCreath, 1996. Drift support in burst-prone ground. *CIM Bulletin*, **89**(998): 131-138.
6. Diederichs, M.S. and P.K. Kaiser, 1996. Rock instability and risk analyses in open stope mine design. *Canadian Geotechnical Journal*, **33**(3): 431-439.
7. Kaiser, P.K. and D.R. McCreath, 1994. Rock mechanics considerations for drilled and bored excavations in hard rock. *Tunnelling and Underground Space Technology*, **9**(4): 425-437.
8. Wiles, T. and P.K. Kaiser, 1994. In situ stress determination using the Under-excavation Technique -- Part I: Theory. *International Journal of Rock Mechanics and Mining Sciences & Geomechanical Abstracts*, **31**(5):439-446.
9. Kaiser, P.K. and T. Wiles, 1994. In situ stress determination using the Under-excavation Technique -- Part II: Application. *International Journal of Rock Mechanics and Mining Sciences & Geomechanical Abstracts*, **31**(5):447-456.
10. Kaiser, P.K. and S. Yazici, 1992. Computerized data collection system for rockmass failures in underground openings. *International Journal of Rock Mechanics and Mining Sciences & Geomechanics Abstracts*, **29**(4): 431-446.

Books

1. Hoek, E., P.K. Kaiser and W.F. Bawden, 1995. Rock Support for Underground Excavations in Hard Rock. A.A. Balkema, Rotterdam, 215 p.
2. Hutchinson, D.J. and M.S. Diederichs, 1996; P.K. Kaiser, D.R. McCreath, A. Thompson and C. Windsor (contributors). Cablebolting in Underground Hard Rock Mines, Bitech Publishers Ltd., Richmond, BC, Canada, 406 p.
3. Kaiser, P.K., D.R.McCreath and D.D. Tannant, 1997. Canadian Rockburst Support Handbook, 324 p. (available from MIRARCO) or as part of *Canadian Rockburst Research Program 1990-95.* Vol.2, 324 p. (Published by CAMIRO, Sudbury).

Papers in Conference Proceedings

1. Espley, S.J., D.D. Tannant, G. Baiden, and P.K.Kaiser, 1999. Design Criteria for Thin Spray-on Membrane Support for Underground Hardrock Mining. *CIM-AGM* Calgary (on CD).
2. Kaiser, P.K. and D.D. Tannant, 1999. Lessons learned for deep tunneling from rockburst experiences in mining. *Proc. Vorerkundung und Prognose der basistunnels am Gotthard und am Lötschberg,* Balkema, 325-337.
3. Kaiser, P.K., and D.D.Tannant, 1997. Use of shotcrete to control rockmass failure. *International Symposium on Rock Support*, Lillehammer, Norway, 580-595.
4. Martin, C.D., P.K. Kaiser and J.A. Alcott, 1996. Predicting the depth of stress-induced failure around underground excavations in brittle rocks. *49th Canadian Geotechnical Conference*, St. John's, **1**:105-114.
5. Vasak, P. and P.K. Kaiser, 1995. Tunnel stability assessment during rockbursts. *CAMI '95 3rd Canadian Conference on Computer Applications in the Mineral Industry*, Montreal, Quebec, 238-247.