

**Education**

*D.I.C., University of
London, 1976*

*Ph.D. Rock Mechanics,
James Cook University,
North Queensland,
Australia, 1976*

*M.Eng.Sc. Geomechanics,
James Cook University,,
North Queensland,
Australia, 1972*

*B.E. Civil Engineering,
James Cook University,
North Queensland,
Australia, 1970*

Golder Associates Ltd. – Burnaby**Employment History*****Golder Associates Ltd. – Burnaby, BC***

*Senior Engineer, Specialist Engineer, Associate, and then Principal (from 1983)
(1975 to Present)*

Providing consulting services on mining, civil engineering, and petroleum engineering projects.



PROJECT RELATED EXPERIENCE – UNDERGROUND MINES

Perseverance Mine Western Australia	Conducted due diligence audit of the geotechnical aspects of the Feasibility Study of the deepening of the Perseverance Mine and continuing caving and long hole open stope mining for Western Mining Corporation Ltd. (2002)
Diavik Mine Northwest Territories, Canada	Reviewed assessments of proposed underground mining for Diavik Diamond Mines Inc. (2002 – 2006)
Musselwhite Mine Ontario, Canada	Conducted a review of geotechnical, stability and support, mining method, mine design, sequencing, and backfill aspects of the Musselwhite Mine for Placer Dome Inc. (2001 - 2002)
Britannia Mine British Columbia, Canada	Undertook detailed assessments of historical underground workings in preparation for the abandoned historical mine to become a balancing reservoir for water entering the mine prior to being treated for the removal of dissolved minerals by a water treatment plant. Also reviewed stability of portals and shafts on surface, and developed closure plans, as well as supervised construction of closure structures. (2001 – to date)
Agua de la Falda Mine Chile	Conducted a detailed assessment of pillar mining activities for Homestake Mining Company. (2001)
Golden Giant Mine Ontario, Canada	Participated in detailed review and assessment of planned extraction of shaft pillar at the Golden Giant Mine for Newmont Corporation. (2001)
Cigar Lake Mine Saskatchewan, Canada	Carried out detailed assessment of stability and hydrogeological aspects of inflow to the Cigar Lake Mine as part of an insurance claim for Micon International Ltd. (2001)
Ekati Mine Northwest Territories, Canada	Provided input on geotechnical, stability and support, mine design, mining method, backfill, and pit/underground interaction aspects of scoping study of BHP Diamonds Inc.'s Panda and Koala diamond pipes, conducted by MRDI. (2000 - 2001)
Pogo Mine Alaska, USA	Provided input on geotechnical, stability and support, mine design, mining method, and backfill aspects to the feasibility study of the Pogo Mine, undertaken by MRDI for Teck Corporation. (2000 - 2001)
Unicalce Lime Mine Italy	Conducted review of geotechnical, mining method, and blasting of Limestone Mine for Unicalce S.p.A. (2000 - 2002)
Cigar Lake Mine Saskatchewan, Canada	Carried out on-going assessments and reviews of the geotechnical, hydrogeological, stability and support, mining methods, and freezing aspects of the Cigar Lake Mine for the Cigar Lake Mining Corporation and then Cameco Corporation. (2000 - 2006)
Hudson Bay Mining and Smelting Mines Manitoba, Canada	Carried out assessments and on-going reviews of geotechnical, hydrogeological, and mining aspects of Callinan, Trout Lake, Chisel, Snow Lake, Ruttan, 777, and Konuto Mines for Hudson Bay Mining and Smelting Co. Ltd. (2000 – 2005)
Myra Falls Mines British Columbia, Canada	Carried out review of mining methods, current backfill practices, and alternative systems to optimize future backfill production and placement (including paste backfill), at the Myra Falls Mines for Outokompu. (2000)



Eskay Creek Mine British Columbia, Canada	Carried out assessments of geotechnical, hydrogeological, mining, and backfill aspects of the Eskay Creek Mine for Homestake Mining Company. (2000)
Williams and David Bell Mines Ontario, Canada	Carried out detailed review of geotechnical, mining, backfill, and rock burst aspects of Williams and David Bell Mines for Homestake Mining Company. (2000)
Snap Lake Project Northwest Territories, Canada	Carried out assessments of geotechnical, hydrogeological, stability and support, blasting, mining methods, backfill, and mining/environmental aspects of the proposed Snap Lake Mine, initially for Windspear Resources and subsequently for de Beers. (2000 - 2002)
Stillwater Mine Montana, USA	Carried out detailed review of geotechnical, hydrogeological, and mining aspects of Stillwater Mine for MRDI and then Stillwater Mining Company for the Nye and East Boulder operations. (2000 - 2001)
Cigar Lake Mine Saskatchewan, Canada	Conducted detailed review of geotechnical, hydrogeological, mining method, and freezing aspects of the feasibility study, undertaken by Cigar Lake Mining Corporation, of the proposed Cigar Lake Mine for Cameco Corporation. (1999)
Midwest Project Saskatchewan, Canada	Carried out assessments of geotechnical, hydrogeological, and mining aspects of the proposed Midwest project for Cogema Resources and Denison Mines Corporation. (1999 - 2002)
Aguas Tenidas Mine Spain	Carried out review of geotechnical and stability aspects of the Aguas Tenidas Mine for Golder Associated UK, who was providing design and review services to the owner of the mine. (1999)
Vipiteno Mine Italy	Carried out review of geotechnical, stability, mining method, and mine design of the Vipiteno Mine for Omya S.p.A. (1999 - 2002)
South Deep Mine South Africa	Carried out review of geotechnical, stability, mining method, mining sequence, and rock-burst control aspects of the South Deep Mine for Kilborn Consultants, who were working for the owners at the time of the merger with Placer Dome. (1999)
Lisheen Mine Ireland	Carried out review of the mine design, stability, mining method, and proposed mining sequence of the Lisheen Mine, for Anglo American plc. (1999 - 2000)
Bougrine Mine Tunisia	Carried out detailed review of geotechnical, stability, and mining aspects of the Bougrine Mine for Breakwater Resources. (1999 - 2000)
Deep Post Mine Nevada, USA	Conducted on-going reviews and assessments of geotechnical, hydrogeological, mining, and backfill aspects of the Deep Post Mine for Barrick Gold Corporation and then Newmont Corporation. (1999 to date)
Campbell Red Lake Mine Ontario, Canada	Carried out detailed review of geotechnical, stability, and mining aspects of the Campbell Red Lake Mine for Placer Dome. (1999 - 2000)
Rodeo and Meikle Mines Nevada, USA	Carried out on-going reviews and assessments of geotechnical, hydrogeological, mining, backfill, and blasting aspects of the Rodeo Mine, from initial project feasibility to current sustained production, for Barrick Gold Corporation. Subsequently provided similar review and assessments for Meikle Mine as well. (1999 to date)



Deep Post Mine Nevada, USA	Assessed potential interaction between proposed underground mining of Deep Post Mine and the stability of the Betze-Post Open Pit for Barrick Gold Corporation. (1998)
Getchell And Turquoise Ridge Mines Nevada, USA	Carried out on-going review and assessment of geotechnical, hydrogeological, and mining aspects of the expansion, and subsequent production mining of, Getchell and Turquoise Ridge Mines for Placer Dome. (1998 to date).
Bullion Project Nevada, USA	Carried out a review of geotechnical, hydrogeological, and mining aspects for proposed acquisition by Placer Dome. (1998).
Dome Mine Ontario, Canada	Carried out review of stability aspects of underground mining operations, including stability of hydraulic backfill and interaction of underground workings, and further open pit development, for Placer Dome. (1998).
McLean Lake and Midwest Projects Saskatchewan, Canada	Carried out assessments of geotechnical, hydrogeological, and mining aspects of the proposed McLean Lake and Midwest projects for Cogema Resources. (1998 - 1999)
Bissett Mine Manitoba, Canada	Conducted review of the Bissett Mine underground mining operations for Harmony Gold. (1998 - 2000)
Cigar Lake Mine Saskatchewan, Canada	Conducted review of proposed future mining of Cigar Lake Mine for Cogema Resources. (1998)
Deep Post Mine Nevada, USA	Assessed potential interaction between proposed underground mining of Deep Post Mine, and the stability of the Betze-Post Open Pit, for Barrick Gold Corporation. (1998)
Cobrizo Mine Peru	Conducted geotechnical, stability, mining, and backfilling assessments of underground mining operations at the Doe Run's Cobrizo Mine, Peru. (1998 to date)
Cresson Project Colorado, USA	Assessed the historical mining activities, and developed remediation plans to stabilize the material above the extensive old mine workings and provide for stable foundations for the valley leach facilities for Cripple Creek and Victor Gold Mining Company, Colorado, USA. (1998 - 1999)
El Indio Mine Chile	Provided assessments of the closure strategy for the underground and open pit workings and the hydrogeological (mine inflow) aspects of the El Indio and Tambo mining complexes as part of the development of a conceptual closure plan study for Barrick Gold's El Indio Mine in Chile. (1998)
Chelopech Mine Bulgaria	Developed mining methods and approaches for the proposed expansion of the Chelopech Mine in Bulgaria, and for Navan Resources of Ireland and Homestake Mining Co. of USA. (1997 - 1998)
Clover Hill Mine New Brunswick, Canada	Reviewed the factors leading to the development of the leak, assessed the cause of the leak, and reviewed the attempts made to remediate the major inflow to Potacan's Clover Hill potash mine for the Department of Natural Resources and Energy of the Government of New Brunswick, Canada. (1997 - 1999)



Greymouth Coal Project New Zealand	Reviewed mine design, ground control, excavation sequence, and hydrogeological aspects of feasibility study undertaken by Greymouth Coal Operating Ltd of hydraulic mining and room and pillar mining of coal property owned by Greymouth Coal Ltd., New Zealand. The assessment was undertaken as part of a broader review by MRDI, Calgary, Canada. (1997)
Battle Mountain Mining Complex Nevada, USA	Developed and assessed concepts for underground drainage tunnel system beneath open pits to enhance the quality of pit drainage water during operations and at closure for Battle Mountain Gold Company, Nevada, USA. (1997)
Tara Mine Ireland	Undertook a review of mining approaches for proposed pillar extraction activities at shallow depth with significant subsidence restraints for Outokumpu's Tara Mine, Ireland. (1997)
Clover Hill Mine New Brunswick, Canada	Conducted assessment of flooding problem and remediation activities of Potacan's Clover Hill potash mine, New Brunswick, Canada, and advised Alexander Holburn Beaudin & Lang, Vancouver, Canada, on technical aspects of insurance claim. (1997)
Cobriza Mine Peru	Conducted review of interaction of underground mining and major surface landslide, and general assessment of underground mining and backfilling operations at Centromin's Cobriza Mine, Peru. (1997)
Ulu Mine Northwest Territories, Canada	Carrying out ongoing rock mechanics, ground control, and excavation support assessments for Echo Bay Mines' Ulu Mine, Northwest Territories, Canada. (1996 to 1997)
San Juan Ridge Mine California, USA	Performed assessment of support requirements and ground control aspects of Siskon Gold's San Juan Ridge Mine, California, USA. (1996)
El Indio Mine Chile	Carrying out review of mining, ground control, blasting, excavation support, and backfilling aspects of Barrick Gold's El Indio Mine in Chile. (1996 to 1997)
Confidential Client Canada	Performed risk assessment of underground mining at very great depths. (1996)
Diavik Diamond Project Northwest Territories, Canada	Acting as technical Director for mining, geohydrology, waste rock, tailings, hydrology, and environmental coordination studies for diamond mining project in the Canadian Arctic for Diavik Diamond Mines Inc. in the Northwest Territories, Canada. (1996 to 1997)
Udon Thani Project Thailand	Provided input to various aspects of feasibility study for the development of the Udon Thani potash deposit in Thailand for Asia Pacific including development of mining and backfilling concepts. (1995 - 1999)
McArthur River Mine Saskatchewan, Canada	Conducted on-going reviews of geotechnical, hydrogeological, mining and backfill aspects of Cameco's McArthur River Mine. (1995 - 2005)
Asse Mine Germany	Conducted review of stability and potential inflow problems to salt mine. (1995)
Texas Mine Maryland, USA	Carried out review of stability and proposed backfilling of abandoned mine to provide for long-term stability of the overlying property at Genstar's site. (1995)
Cluff Mining Operations Saskatchewan, Canada	Performed review of proposed mining of high grade pods beneath lake at the extremity of DJ Extension to Cluff Mining's uranium operations. (1995)



Contact Lake Mine Saskatchewan, Canada	Performed assessment of hangingwall stability problems and associated impact on ore dilution at Cameco's Contact Lake Mine in Saskatchewan, Canada. (1995)
Lupin Mine Northwest Territories, Canada	Carried out detailed investigation of the possibility of placing paste backfill without cement or with minimum cement at Echo Bay's Lupin Mine in the Northwest Territories, Canada. (1995)
Solvay Mine Wyoming, USA	Reviewed major pillar collapse of room and pillar trona mine owned by Solvay Minerals Inc. for Commercial Union Insurance in Wyoming, USA. (1995)
Pea Ridge Mine Missouri, USA	Carried out detailed review of Pea Ridge iron ore mine prior to possible acquisition by Sheffield Steel in Missouri, USA. (1995)
Cresson Project Colorado, USA	Conducted assessment of potential impact of old mine workings beneath proposed heap leach pads and remediation requirements of the foundations prior to constructing pad lining in Colorado, USA. (1995 – 1996)
McArthur River Uranium Mine Project Saskatchewan, Canada	Responsible for development of mining method, and detailed assessment of ground control, groundwater, blasting, and backfill aspects of Cameco's McArthur River Project for feasibility study and permit application requirements in Saskatchewan, Canada. (1994 - 1995)
HW Mine British Columbia, Canada	Conducted assessment of proposed development excavation in cemented backfill for Westmin's HW Mine in British Columbia, Canada. (1994)
Akzo Salt Mine New York, USA	Continuing to review pillar collapse and mine flooding of Akzo Salt Mine for Commonwealth Insurance of Vancouver, Canada. (1994 to date)
ZCCM Copper Mines Zambia	Carried out general mining, ground control, rock mechanics, blasting, and backfill consulting for Konkola Mine, Chingola B Mine, Nchanga Mine, and Baluba Mine for ZCCM, Zambia. (1994 – 1997)
Mufulira Mine Zambia	Performed detailed review of mining plans, assessment and design of revised mining methods, and review of implementation plans for ZCCM's Mufulira Mine, Zambia. (1994 – 1996)
Chambishi Mine Zambia	Performed review of detailed feasibility study in preparation for privatization of ZCCM's Chambishi Mine, Zambia. (1994)
Cluff Mining Operations Saskatchewan, Canada	Carried out review of geotechnical and mining aspects of the proposed underground mining of the DJ Extension to Cluff Mining's uranium operations in Saskatchewan, Canada. (1994)
Galmoy Mine Ireland	Provided design studies of room and pillar mine, including backfill and groundwater inflow and dewatering aspects, and assistance with and participation in public hearings for permit application for Arcon International, Ireland. Continuing with on-going reviews of the underground mining, ground control, and backfilling activities for production and permitting activities. (1993-2002)
Asarco's Mine Tennessee, US	Conducted review of room and pillar mining of Asarco's mine in Tennessee, USA. (1993)
Macassa Mine Ontario, Canada	Performed analysis of energy release mechanisms in seismically active mine for Lac Minerals in Ontario, Canada. (1992 – 1993)



Vanscoy Potash Mine Saskatchewan, Canada	Carried out assessment of groundwater inflow into Cominco's Vanscoy Mine, Saskatchewan, Canada. (1992)
Cassiar Mine British Columbia, Canada	Conducted review of mining practices of asbestos mine for Black Swan Mining Co., British Columbia, Canada. (1992)
Westray Coal Mine Nova Scotia, Canada	Conducted review of ground control practices and mine design for Curragh Resources, Nova Scotia, Canada. (1991)
Kidd Creek Mine Ontario, Canada	Performed review of options and design considerations for placing paste backfill in some areas of Kidd Creek Mine to tight fill mined voids, Ontario, Canada. (1991)
Stillwater Mine Montana, USA	Conducted review of mining practices at platinum mine, including assessments of the mining method and the ground control, blasting, and backfill practices, Montana, USA. (1991)
McArthur River Project Northern Territories, Australia	Provided design of room and pillar mine based on computer stress analysis of pillar loads and prevention of domino pillar collapse, and ongoing review of McArthur River mining activities for MIM, Australia. (1991 – 1996)
Missouri Leadbelt Mines Missouri, USA	Carried out review of proposed boundary mining between The Doe Run Co.'s mines and Asarco's mine, Missouri, USA. (1990-1997)
Fraser Mine Ontario, Canada	Carried out review of rock mechanics and ground control aspects of future cut-and-fill mining of Falconbridge's Fraser Mine, Ontario, Canada. (1990)
McArthur River Project Northern Territories, Australia	Carried out review of proposed shaft location and potential subsidence for Mt. Isa Mine's McArthur River Project, Northern Territories, Australia. (1990)
Doyon Mine Quebec, Canada	Performed field monitoring study and general review of blasting at Lac Mineral's Doyon Mine, Quebec, Canada. (1990)
Moinho Mine Portugal	Performed computer stress analyses and stability assessment of proposed extension to Pirites Alentejanas's Moinho Mine and subsequent mining reviews including assessments of mining method, underground support, mining layout, backfill, and blasting practices, Portugal. (1990 – 1994)
Eskay Creek Mine British Columbia, Canada	Carried out assessment of stability of access decline for Corona's Eskay Creek Mine, British Columbia, Canada. (1990)
Estrades Mine Quebec, Canada	Conducted assessment and review of mining method, ground control aspects, and backfill design for Breakwater Resources' Estrades Mine, Québec, Canada. (1990 – 1991)
Highland Valley Copper Mine British Columbia, Canada	Carried out assessment of blasting practices and detailed blast monitoring for diagnostic and optimization studies for the Highland Valley Copper Mine, British Columbia, Canada. (1990)
Quirke and Panel Mines Ontario, Canada	Carried out detailed assessment of mine stability, subsidence, and impact from proposed close-out and flooding of Rio Algom's Quirke and Panel Mines, Ontario, Canada. (1990)
Elliot Lake Mines Ontario, Canada	Provided expert assessment related to boundary dispute between two mines in Elliot Lake, Ontario, Canada. (1990 – 1992)



Homestake Mine South Dakota, USA	Carried out review of shaft stability problems for the Homestake Mine, South Dakota, USA. (1989 – 1990)
The Doe Run Co. Missouri, USA	Performed detailed review and rock mechanics assessment of proposed pillar mining following placement of cemented backfill for the Doe Run Co.'s mines, Missouri, USA. (1989 to date)
Gaspe Mine Quebec, Canada	Conducted review of ground control problems, mine design, excavation sequence, and backfill for Noranda's Gaspé Mine, Québec, Canada. (1989)
Thompson Mine Manitoba, Canada	Participant in on-going review committee assessment of ground control, mine design, mining method, backfill practice, blasting practice, research programs, and research requirement for Inco's Thompson Mine, Thompson, Manitoba. (1989 – 1991)
CANMET Study Ontario, Canada	Carried out review of general assessment by Golder Associates of the stability of surface crown pillars of underground mines for CANMET, Ontario, Canada. (1989)
Nickel Plate Mine British Columbia, Canada	Performing on-going review of the interaction of old underground workings and current open pit mining of Corona's Nickel Plate Mine, British Columbia, Canada. (1989 – 1990)
Lupin Mine Northwest Territories, Canada	Carried out review of blasting practice and monitoring for diagnostic studies and optimization of blasting procedures for Echo Bay's Lupin Mine, Northwest Territories, Canada. (1989 – 1990)
Strathcona Mine Ontario, Canada	Carried out review of future mining and the application of stiff backfill to reduce stability and rockburst problems in the Deep Copper Zone of Falconbridge's Strathcona Mine, Ontario, Canada. (1989)
Caribou Mine New Brunswick, Canada	Performed review of rock mechanics, ground control, mining method, and mine design for East-West Caribou's (then Breakwater Resources') Caribou Mine, New Brunswick, Canada. (1988 – 1990)
Con Mine Northwest Territories, Canada	Responsible for design and review of in situ stress measurement program for NERCO's Con Mine, Northwest Territories, Canada. (1988)
Con Mine Northwest Territories, Canada	Carrying out assessment of rock mechanics and ground control aspects of mining in highly stressed rock at NERCO's (then Miramar's) Con Mine, Northwest Territories, Canada. (1988 to date)
Page Williams and Golden Giant Mines Ontario, Canada	Performed assessment of uncontrolled caving of sill pillar separating two mines for Lac Minerals Ltd., Ontario, Canada. (1988)
Campbell Red Lake Mine Ontario, Canada	Carried out audit of rock mechanics and ground control aspects of Placer Dome's Campbell Red Lake Mine, Ontario, Canada. (1988)
San Manuel Mine Arizona, USA	Performed assessment of blasting practice based on sophisticated blast monitoring for Magma Copper Co.'s San Manuel Mine, Arizona, USA. (1988)
Sulphurets Project British Columbia, Canada	Reviewed rock mechanics and related mine planning aspects of Northair Group's Sulphurets underground mining project, British Columbia, Canada. (1988)
Neves Corvo Mine Portugal	Reviewed rock mechanics and related mine planning aspects of Somincor's Neves Corvo Mine. (1988 – 1992)



Moinho Mine Portugal	Reviewed rock mechanics and ground control aspects for Wright Engineers, Canada, of proposed change of mining method of Pirites Alentejanas's Moinho Mine. (1988)
Black Angel Mine Greenland	Carried out detailed analysis and assessment of potential pillar collapse for Boliden Mineral, Sweden, as part of overall pillar mining study of Black Angel Mine. (1988)
Buick and No. 28 Mines Missouri, USA	Carried out detailed assessment and computer simulation of rock mechanics and ground control aspects of Doe Run Co.'s Buick and No. 28 Mines, Missouri, USA. (1988)
Missouri Lead Belt Mines Missouri, USA	Carried out independent review and development of boundary mining agreements for Cominco's Ltd.'s and Doe Run Co's adjoining underground mines in Missouri, USA. (1988)
Cannon Mine Washington, USA	Performed assessment of blasting practice based on sophisticated blast monitoring including optimization of underground blast design and minimization of surface vibrations in adjacent residential areas for Asamera's Cannon Mine, Washington, USA. (1987 – 1988)
AECL's URL Manitoba, Canada	Performed review of stress measurement program for AECL's underground research laboratory in Manitoba, Canada. (1987 – 1988)
Belle Isle Salt Mine Louisiana, USA	Reviewed problems related to the stability and flooding of salt mine in Louisiana, USA. (1987 – 1988)
Nome Lake Mine Manitoba, Canada	Reviewed rock mechanics and mine planning aspects of Hudson Bay Mining and Smelting Co.'s Nome Lake Mine, Manitoba, Canada. (1987 – 1988)
Ruttan Mine Manitoba, Canada	Conducted assessment of blasting practice based on sophisticated blast monitoring for Hudson Bay Mining and Smelting Co.'s Ruttan Mine, Manitoba, Canada. (1987)
Thompson Mine Manitoba, Canada	Conducted assessment of blasting practice based on sophisticated blast monitoring for INCO's Thompson Mine, Manitoba, Canada. (1987)
Detour Lake Mine Ontario, Canada	Reviewed proposed backfill design and placement procedures for Detour Lake Mine, Ontario, Canada. (1987)
Tennessee Chemical Co's Mine Tennessee, USA	Acted as expert witness for litigation related to mine accident caused by instabilities in underground mine in Tennessee, USA. (1987)
AOSTRA's UTF Alberta, Canada	Carried out numerical analysis simulations and assessment of underground and surface monitoring results of formation response to steam injection for recovery of bitumen at AOSTRA's UTF near Fort McMurray, Alberta, Canada. (1987 - 1990)
AOSTRA's UTF Alberta, Canada	Responsible for design, installation, and data assessment of geotechnical monitoring program for underground test facility to inject steam and recover bitumen from oil sand for AOSTRA's UTF near Fort McMurray, Alberta, Canada. (1987 – 1990)
Troya Mine Spain	Conducted review of rock mechanics and ground control aspects of Exminesa's Troya Mine, Spain, for Cominco Ltd. (1987 – 1992)



Clover Hill Mine New Brunswick, Canada	Responsible for on-going review of rock mechanics and ground control aspects of Denison Potash Co.'s Clover Hill Mine, New Brunswick, Canada. (1987 – 1990)
PCA's Potash Mine Saskatchewan, Canada	Reviewed flood problem and assessed of bulkhead design in PCA's potash mine, Saskatchewan, Canada. (1987)
Seabright Resources Nova Scotia, Canada	Reviewed ground control aspects of Seabright Resources' underground mines, Nova Scotia, Canada. (1987)
Sullivan Mine British Columbia, Canada	Carried out review of ground control aspects and computer stress analysis of Cominco's Sullivan Mine, British Columbia, Canada. (1986 to 2000)
Magmont Mine Missouri, USA	Performed ground control studies of extensive pillar collapse and future mining strategy for Cominco's Magmont Mine, Missouri, USA. (1986 – 1990)
K-2 Mine Saskatchewan, Canada	Acted as chairman of review panel regarding investigation of IMC's K-2 underground potash mine flood problem and provided technical advice on insurance matters to Alexander Holburn Beuadin & Lang, Vancouver, Canada. (1986 – 1993)
David Bell Mine Ontario, Canada	Conducted rock mechanics studies of Teck-Corona's David Bell Mine, Ontario, Canada. (1986 – 1987)
David Bell And Golden Giant Mines Ontario, Canada	Carried out assessment of stability and reviewed mining sequence adjacent to boundary pillar between Teck-Corona's David Bell Mine and Noranda's Golden Giant Mine, Ontario, Canada. (1986 – 1988)
Flin Flon Mine Manitoba, Canada	Carried out ground control studies for Hudson Bay Mining and Smelting's Flin Flon Mine, Manitoba, Canada. (1986)
Kinsenda Mine Zaire	Carried out review of ground control aspects of Kinsenda Mine in Zaire for Phillips Barratt Kaiser, Vancouver, Canada. (1986)
Suncor's Coal Mine Nova Scotia, Canada	Reviewed geotechnical studies of Suncor's proposed underground coal mine, Nova Scotia, Canada. (1985 – 1986)
Falconbridge's Sudbury Basin Mines Ontario, Canada	Conducted rock mechanics course for operating engineering staff of Falconbridge's Sudbury operations, Ontario, Canada. (1985)
Campbell Red Lake Mine Ontario, Canada	Responsible for development of computer model and training program for Campbell Red Lake Mines Ltd.'s underground gold mine, Ontario, Canada. (1985)
Cluff Lake Mine Saskatchewan, Canada	Carried out review of stability aspects, fill design, and stress analyses of Amok Ltd.'s under-cut-and-fill mining operation, Saskatchewan, Canada. (1985)
Cigar Lake Mine Saskatchewan, Canada	Performed detailed design and stability assessments of Cigar Lake Mining Corporation's proposed underground uranium mine in very weak rock, Saskatchewan, Canada. (1985 – 1991)
Key Lake Mine Saskatchewan, Canada	Conducted preliminary assessment and reviewed stability aspects of Key Lake Mining Corporation's proposed underground uranium mine, Saskatchewan, Canada. (1985 – 1987)
Elliot Lake Uranium Mines Ontario, Canada	Carried out regional stress analysis related to rock burst problems at Rio Algom's Quirke Mine and Denison's underground uranium mines, Elliot Lake, Ontario, Canada. (1985)



Ontario Government Provincial Enquiry Ontario, Canada	Reviewed international mining practice as part of Provincial Enquiry into Ground Control and Emergency Preparedness in Ontario Mines for Ontario Ministry of Labour, Canada. (1985)
Rocanville Mine Saskatchewan, Canada	Performed review of research and development studies of total extraction mining system at Potash Corporation of Saskatchewan's Rocanville Mine, Saskatchewan, Canada. (1984)
Golden Giant Mine Ontario, Canada	Provided rock mechanics and ground control consulting including stress analysis, backfill testing, and design for Noranda's Golden Giant Mine, Hemlo, Ontario. (1984 – 1988)
Falconbridge's Sudbury Basin Mines Ontario, Canada	Responsible for development of computer stress analysis system and training program for Falconbridge's underground mines, Sudbury, Ontario. (1984)
Pine Point Mine Northwest Territories, Canada	Conducted rock mechanics review of underground room and pillar operation for Cominco's Pine Point Mine, Northwest Territories, Canada. (1984)
Proposed Hydraulic Underground Coal Mine Alberta, Canada	Carried out review of ground control aspects of proposed hydraulic underground coal mine for Luscar Ltd., Alberta, Canada. (1984)
CANMET Study Ontario, Canada	Performed review of geotechnical problems associated with mining potash throughout the world using different mining methods for CANMET, Ottawa, Canada. (1984)
Heath Steel Mine New Brunswick, Canada	Reviewed rock mechanics and ground control aspects of the Heath Steel Mine, New Brunswick, Canada. (1984)
Polaris Mine Northwest Territories, Canada	Assessed pillar and hangingwall stability and analyzed behaviour of frozen shale backfill for Cominco Ltd.'s Polaris Mine, Northwest Territories, Canada. (1983 – 1993)
Salmita Mine Northwest Territories, Canada	Provided rock mechanics and ground control consulting for Giant Yellowknife Mines Ltd.'s Salmita Mine, Northwest Territories, Canada. (1983 – 1986)
Millstream Potash Property New Brunswick, Canada	Performed preliminary geotechnical and ground water review for shaft construction and initial mine design of B.P. Canada's Millstream potash property, New Brunswick, Canada. (1983)
Proposed Dominique- Peter Underground Mine Saskatchewan, Canada	Performed preliminary assessment of ground control problems and support methods for Amok's proposed Dominique-Peter underground mine, Saskatchewan, Canada. (1983)
Black Angel Mine Greenland	Conducted assessment of stability and ground control problems, and carried out investigation of potential rock mechanics problems associated with mining pillars at Greenex's Black Angel Mine, Greenland. (1983 – 1985)
Lupin Mine Northwest Territories, Canada	Providing ongoing rock mechanics, ground control, blasting, and backfill consulting studies for Echo Bay Mines' Lupin Mine, Northwest Territories, Canada. (1983 - 2002)
Stall Lake Mine Manitoba, Canada	Performed review of in situ stress measurement results and assessed ground control problems using computer stress analyses for Hudson Bay Mining and Smelting's Stall Lake Mine, Manitoba, Canada. (1983)



Balmer South Mine British Columbia, Canada	Conducted assessment of caving action of hangingwall of thick seam, underground, hydraulic coal mine and responsible for ongoing review of subsidence monitoring program of Westar Mining Ltd.'s Balmer South Mine, British Columbia, Canada. 1983 – 1984)
Selebi Phikwe Mines Botswana	Performed stress analysis and assessment of pillar stability for BCL's Selebi Phikwe Mines, Botswana. (1982 – 1984)
Copperhill Mines Tennessee, USA	Carried out stress analyses and investigation of pillar instabilities for Tennessee Chemical Company's Copperhill Mines, Tennessee, USA. (1982 – 1985)
Goldstream Mine British Columbia, Canada	Performed rock mechanics and ground control studies for Noranda's Goldstream Mine, British Columbia, Canada. (1982 – 1985)
Wesfrob Mine British Columbia, Canada	Carried out stability assessment of proposed pillar mining of Falconbridge's Wesfrob Mine, British Columbia, Canada. (1982)
Mines in Elliot Lake Ontario, Canada	Carried out detailed stress analysis and investigation of rock burst and ground control problems for Rio Algom's mines in Elliot Lake, including Quirke and Stanleigh Mines, Ontario, Canada. (1982 to date)
Con Mine Northwest Territories, Canada	Conducted rock mechanics and ground control studies for Cominco's Con Mine, Northwest Territories, Canada. (1982 – 1987)
Gaspé Copper Mine Quebec, Canada	Conducted rock mechanics and ground control studies for Noranda's Gaspé Copper Mine, Québec, Canada. (1981)
Cirque Project British Columbia, Canada	Responsible for geotechnical site investigation, design studies, and preparation of contract documents for proposed exploration adit for Cyprus Anvil Mining Corporation's Cirque property in British Columbia, Canada. (1981)
CANMET Study Ontario, Canada	Participated in development of prediction methods to determine stable excavation spans for deep mines in hard rock for CANMET, Ottawa, Canada. (1980)
AOSTRA Surmont In Situ Oil Sands Project Alberta, Canada	Carried out detailed geotechnical design study of shaft in weak uncemented sediments and tunnels in clay, oil sand, shale, and limestone horizons for Gulf-AOSTRA Surmont In Situ Oil Sands Project, Alberta, Canada. (1980)
Proposed Midwest Lake Uranium Mine Saskatchewan, Canada	Responsible for development of geotechnical model from field data for Esso Resources' proposed Midwest Lake uranium mine, Saskatchewan, Canada. (1979)
Brunswick Mining and Smelting New Brunswick, Canada	Carrying out in situ stress measurements, stress analyses, stability assessments, detailed mining studies, backfill assessments, support assessments, and blasting assessments for Brunswick Mining and Smelting's No. 12 Mine, New Brunswick, Canada. (1979 1998)
Eldorado Mine Saskatchewan, Canada	Performed initial in situ stress measurement and stability analyses for Eldorado uranium mine, Saskatchewan, Canada. (1979)
U.S. Strategic Petroleum Reserve Program Louisiana, USA	Conducted stability study of relocation of underground room and pillar salt mine to horizon above proposed oil storage facility for U.S. Strategic Petroleum Reserve Program, Louisiana, USA. (1977)
Oil Shale Mines Colorado, USA	Conducted stability design studies for proposed in situ retorting oil shale mine, Colorado, USA. (1977)

**Copper Mines**
Zambia

Conducted stability studies of underground copper mines and hangingwall caving mechanisms, Zambia. (1975)

PROJECT RELATED EXPERIENCE – UNDERGROUND EXCAVATIONS FOR CIVIL ENGINEERING AND ENERGY PROJECTS

**Upper Mamquam
Hydroelectric Project**
British Columbia,
Canada

Provided input on tunnel stability and support, hydrogeology, slope stability, bulkhead design and construction aspects for Canadian Hydro Developers' Upper Mamquam Hydroelectric Project for the designers and project managers Canadian Projects Limited (2002 – 2003).

**Cayoosh Creek
Diversion Tunnel**
British Columbia

Conducted a review and assessment of the long term stability and integrity of the Cayoose Creek Diversion Tunnel for Stl'atl'imx Nation Hydro in response to reports prepared by BC Hydro. (2001)

**Desert Crossing
Project**
Arizona, USA

Directed detailed project studies for the site investigation, design, drilling, solution mining, stability, water supply, construction, operation, and cost estimation aspects of a feasibility study of a multi-cavern natural gas storage project forming part of the Desert Crossing gas storage and transportation system for Skipping Stone Consultants. (2001 – 2002)

**Pingston Hydroelectric
Project**
British Columbia

Provided input on tunnel and shaft stability and support, hydrogeology, slope stability, bulkhead design and construction, watering-up and drawdown plans, and monitoring programs for Canadian Hydro Developers' Pingston Hydroelectric Project for the designers and project managers Canadian Projects Limited (2001 – 2007).

**Machupicchu
Hydroelectric Project**
Peru

Carried out review of underground power station and tail race tunnel that had flooded because natural damming of the river just downstream as a result of a major landslide and debris flow (1999).

**UK Nirex Ltd. United
Kingdom**

Carried out review of precedent experience in permanent and temporary (non-entry) excavations in mines and civil engineering facilities in Canada and Zambia. Undertaken for Geo-Engineering on behalf of UK Nirex Ltd. as part of UK nuclear waste program. (1994 – 1996)

**Short Course in Rock
Mechanics
Indiana, USA
Harlan Diversion
Tunnels**
Tennessee, USA

Conducted five-day short course in rock mechanics for civil engineering and mining at Purdue University, Indiana, USA. (1990)

Conducted one-week rock mechanics and blasting course and development of rock mechanics and blasting training program for underground hydroelectric projects in India for United Nations Development Program, New Delhi, India. (1987)

**Rock Mechanics and
Blasting Course**
New Delhi, India

Conducted one-week rock mechanics and blasting course and development of rock mechanics and blasting training program for underground hydroelectric projects in India for United Nations Development Program, New Delhi, India. (1987)

Natural Gas
USA

Performed preliminary assessment of geotechnical aspects related to the development of underground facilities and barriers to store natural gas in aquifers, USA. (1986)

Dam Foundation
Montana, USA

Carried out review of stress analyses to assess stability and deformations in foundation of dam in Arizona for Morrison Maierle, Montana, USA. (1986)



UNDP Rock Mechanics Course New Delhi, India	Offered one-week rock mechanics course and development of rock mechanics training program for underground hydroelectric projects in India for United Nations Development Program, New Delhi, India. (1986)
Bhumibol Hydroelectric Project British Columbia, Canada	Carried out review of insitu stress measurement program conducted at Bhumibol hydroelectric project site in Thailand for Crippen Consultants Ltd., British Columbia, Canada. (1986)
Kiambere Underground Hydroelectric Kenya	Carried out review of insitu stress measurement program conducted at Kiambere underground hydroelectric project site for Foundation Skanska Joint Venture, Kenya. (1984 – 1985)
Vancouver Rapid Transit System British Columbia, Canada	Conducted review of design aspects and performed regular inspections of underground excavations for Vancouver rapid transit system for Hatch Associates Ltd., British Columbia, Canada. (1984)
Nuclear Waste Program USA	Carried out geotechnical studies related to underground excavation and design of monitoring systems for shafts and tunnels in salt and tuff formations for nuclear waste program, USA. (1984)
Guavio Underground Hydroelectric Colombia	Performed review of insitu stress measurement program conducted at Guavio underground hydroelectric project site for Ingetec, Colombia. (1984 – 1985)
Rogers Pass Rail Tunnel British Columbia, Canada	Responsible for design studies and assessment of stability of CP Rails Rogers Pass Rail Tunnel through a section of the Rocky Mountains, British Columbia, Canada. (1984)
Proposed Cordon del Plato Hydroelectric Project Argentina	Acted as consultant to Agua y Energia on geotechnical aspects of the proposed Cordon del Plato hydroelectric project in Argentina. (1980)
Rio Grande Hydroelectric Pump Storage Scheme Argentina	Was Site Engineer responsible for design and construction supervision of caverns, tunnels, and shafts for Rio Grande Hydroelectric Pump Storage Scheme, Argentina. (1979)
U.S. Strategic Petroleum Reserve Program Louisiana, USA	Carried out study of solution-mined underground caverns in salt domes to assess stability of facilities to store crude oil for U.S. Strategic Petroleum Reserve Program, Louisiana, USA. (1978)
Colombo Plan Scheme Himalaya Mountains	Acted as expert under Colombo Plan Scheme for U.K. Overseas Development Ministry to provide assistance and to educate engineers in India in the geotechnical design of hydroelectric power stations in the Himalaya Mountains. (1977)
U.S. Strategic Petroleum Reserve Program Louisiana, USA	Carried out study of underground room and pillar salt mine to determine suitability for storage of crude oil for U.S. Strategic Petroleum Reserve Program, Louisiana, USA. (1977)

PROJECT RELATED EXPERIENCE – SLOPE STABILITY

Kumtor Mine Kurgistan	Provided input to an assessment of the sudden failure of the pit wall in permafrost at Kumtor Mine for Cameco Corporation. (2002)
Cobrizo Mine Peru	Carried out review of interaction of underground mining and major surface landslide at Centromin's Cobrizo Mine, Peru. (1997)



Colombo Plan Scheme India	Conducted study and back-analysis of large rockslide on Sutlej River, India, adjacent to an abutment of a partially completed dam sponsored by U.K. Overseas Development Ministry, Colombo Plan Scheme, India. (1978)
Island Copper Mine British Columbia	Responsible for stability study of pit walls separating open pit mine from adjacent tidal inlet for Utah Mine's Island Copper Mine, British Columbia, Canada. (1976)
Proposed South Haystack Open Pit Coal Mine Wyoming, USA	Performed stability study of pit walls for Rocky Mountain Energy Co.'s proposed South Haystack open pit coal mine, Wyoming, USA. (1976)
Proposed Open Pit Copper Mine Arizona, USA	Responsible for strength assessment and design of pit walls in sheared and weathered rock for Conoco's proposed open pit copper mine, Arizona, USA. (1976)
Twin Buttes Open Pit Copper Mine Arizona, USA	Performed stability study of pit walls for Twin Buttes open pit copper mine, Arizona, USA. (1975)

PROJECT RELATED EXPERIENCE – HYDROGEOLOGY

Galmoy Mine Ireland	Carried out groundwater inflow and dewatering studies of Galmoy Mine and providing assistance with and participating in public hearings for permit application for Arcon International, Ireland. (1993 to date)
McArthur River Uranium Mine Project, Saskatchewan, Canada	Performed assessment of groundwater control measures, including grouting and freezing, for Cameco's McArthur River Project for feasibility study and permit application for uranium mine, Saskatchewan, Canada. (1994 to date).
Akzo Salt Mine, New York USA	Reviewed pillar collapse and mine flooding of Akzo Salt Mine for Commonwealth Insurance, Vancouver, Canada. (1994 to date)
Vanscoy Potash Mine Saskatchewan, Canada	Performed assessment of groundwater inflow into Cominco's Vanscoy Mine, Saskatchewan, Canada. (1992)
PCA's Potash Mine Saskatchewan, Canada	Reviewed flood problem and assessed of bulkhead design in PCA's potash mine, Saskatchewan, Canada. (1987)
K-2 Mine Saskatchewan, Canada	Acted as chairman of review panel regarding investigation of IMC's K-2 underground potash mine flood problem and on-going review of remedial measures for Alexander Holburn, Saskatchewan, Canada. (1986 – 1993)
Gulf-AOSTRA Surmont In Situ Oil Sands Project Alberta	Conducted groundwater hydrology studies required for engineering design of proposed shaft in weak, uncemented sediments, and tunnels in limestone for Gulf-AOSTRA Surmont In Situ Oil Sands Project, Alberta, Canada. (1980)
Proposed North Butte Underground Uranium Mine Wyoming, USA	Carried out studies of mine inflow, mine depressurization, and environmental impact on groundwater hydrology for Cleveland Cliffs Iron Co.'s proposed North Butte underground uranium mine in Wyoming, USA. (1979)
Proposed Pumpkin Buttes Uranium Mining Development Wyoming, USA	Conducted baseline surface and groundwater hydrology studies for 400 sq. mile area for Cleveland Cliffs Iron Co.'s proposed Pumpkin Buttes uranium mining development in Wyoming, USA. (1978)

**South Haystack Open
Pit Coal Mine**
Wyoming, USA

Performed surface and groundwater hydrology study for environmental and engineering purposes for Rocky Mountain Energy Co.'s proposed South Haystack open pit coal mine, Wyoming, USA. (1976)

**Proposed
Underground Oil Shale
Mine**
Colorado, USA

Carried out groundwater hydrology study and mine inflow prediction for proposed underground oil shale mine, Colorado, USA. (1975)

PROJECT RELATED EXPERIENCE – SURFACE MINING AND MINING ENVIRONMENTAL STUDIES

Ruttan Mine
Manitoba,
Canada

Conducted studies of the stability and potential for subsidence and caving of the Ruttan Mine, and provided input into the closure plan, for Hudson Bay Mining and Smelting. (2002)

Britannia Mine
British Columbia,
Canada

Provided input on underground mining, hydrology, hydrogeology, mine inflow, tunnel stability and support, bulkhead design, reservoir operation, pressure and flow monitoring of underground reservoir, permitting, contaminated waste rock disposal, and water treatment plant sludge disposal aspects of environmental clean up and construction and operation of water treatment plant at the Britannia Mine site. (2001 – to date)

Antimina Mine
Peru

Carried out assessment and design of bulkhead, in drainage tunnel, at the base of tailings dam, for Bechtel Corporation. (1999)

PROJECT RELATED EXPERIENCE – GEOTECHNICAL/THERMODYNAMICS

AOSTRA's UTF
Alberta, Canada

Performing analyses of coupled heat flow, pore fluid flow, and stress-strain response of oil sands and underlying limestone to assess impact of injecting steam into oil sands to extract bitumen as part of AOSTRA's UTF project, Alberta, Canada. (1987 to date)

Echo Bay Mines
Northwest
Territories, Canada

Conducted assessment of methods and practicality of backfilling mine with ice, and reviewed potential for ice to flow down stopes under gravity for Echo Bay Mines, Northwest Territories, Canada. (1983)

**Atomic Energy of
Canada Ltd.**
Alberta, Canada

Carried out study of potential novel problems which may arise from constructing a nuclear power plant adjacent to an in situ steam injection facility for Atomic Energy of Canada Ltd., in Alberta, Canada. (1982)

**Gulf-AOSTRA Surmont
In Situ Oil Sands
Project**
Alberta, Canada

Performed assessment of potential impact on shaft and tunnels of proposed high pressure and high temperature steam injection in adjacent oil sands for Gulf-AOSTRA Surmont In Situ Oil Sands Project, Alberta, Canada. (1980)



PROFESSIONAL AFFILIATIONS

Registered Professional Engineer, British Columbia
Member, Canadian Institute of Mining, Metallurgy and Petroleum
Member, Canadian Geotechnical Society

LECTURES

Sixth Canadian Geotechnical Colloquium Speaker. Lecture titled "Designs Philosophies for Underground Excavations in Rock for Civil Engineering Projects". Montreal, 1982.

PUBLICATIONS

- Robertson, P.K., Sasitharan, S., Cuning, J.C., and Sego, D.C. "Shear-Wave Velocity to Evaluate In Situ State of Ottawa Sand," Journal of Geotechnical Engineering, 1995, ASCE, 121(3): 262-273.
- Burman, B.C. and Hammett, R.D., 1975. "Design of Foundations in Jointed Rock Masses." Proc. 2nd Australia-New Zealand Conference on Geomechanics, Brisbane, pp. 83-88.
- Hammett, R.D. and Hoek, E., 1981. "Design of Large Underground Caverns for Hydro-Electric Projects, with Particular Reference to Structurally Controlled Failure Mechanisms". Recent Developments in Geotechnical Engineering for Hydro Projects. Proc. ASCE International Convention, New York, pp. 192-205.
- Mathews, K.E., Hammett, R.D., and Stewart, B.S., 1982. "Case Examples of Underground Mine Stability Investigations. Proc. 1st International Conference on Stability in Underground Mining, Vancouver, Aug. 1982.
- Hammett, R.D. and McKervey, G.W., 1983. "Application of Three-Dimensional Stress Analyses to Optimizing Pillar Stability and Mining Layout at Copperhill, Tennessee." Presented at the 1983 SME-AIME Annual Meeting, Atlanta, Georgia, March 1983.
- Dunbar, W.S. and Hammett, R.D., 1983. "Application of Visco-Elastic Boundary Integral Method to the Analysis of Potash Mining Schemes." Presented at Potash '83, Saskatchewan, October 1983.
- Hammett, R.D., 1987. "Geotechnical Practice in Mining." Canadian Geotechnical Society Centennial Volume, presented at Canadian Engineering Centennial Convention, May 1987.
- Hammett, R.D., LeJuge, G.E. and Forsyth, W.W., 1988. "Diagnosis and Optimization of Blasting Problems and Procedures Through Blast Monitoring." Presented at 90th Annual General Meeting of CIM, May 1988.
- Hammett, R.D., 1990. "Application of Numerical Modelling to Mining in Canada." Presented at 92nd Annual General Meeting of CIM, May 1990.
- Forsyth, W.W., Stacey, P.F., and Hammett, R.D., 1990. "The Application of



Advanced Blast Monitoring Technology in the Optimization of Production Blasting." Presented at 13th Annual Meeting of District 6 of CIM, Sept. 1990.

Hammett, R.D., 1992. "Experience from Prediction and Performance Assessments of Underground Excavations in Mining." ISRM Rock Mechanics, Turin, Italy.