

Isobel Clark BSc MSc DIC PhD FSS FSAIMM FIMM CEng

A professional Mining Engineer who specialises in the technical evaluation of mineral resources and reserves at all stages in the life of a mine, I have almost 40 years of experience in practical application of computer-based design and evaluation methods.

With proven communication skills honed by training non-specialists and reporting to clients, my ideal occupation is in a hands-on, supervisory and/or mentoring role within a technical services or consultancy environment.

Personal Details

Born: 1948, London, England

Business address: Geostokos (Ecosse) Limited, Alloa Business Centre,
Whins Road, Alloa FK10 3SA, Scotland

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Summary of Professional Experience

1998 to 2010: Director, Geostokos (Ecosse) Limited

- Provision of training courses in geostatistics at introductory and practical levels;
- Development of teaching materials for teaching and self-learning including the book series "Practical Geostatistics 2000";
- Provision of expert services in the application of statistical and geostatistical methods in environmental, agricultural, wetland and similar applications.

1983 to present: Director and Principal Consultant, Geostokos Limited

- Specialist consultant in the evaluation of Mineral Resources and Reserves for commodities ranging from coal to diamonds worldwide;
- Experience in providing reports under JORC, SAMREC and NI43-101 codes;
- Short courses and seminars in geostatistics provided as open courses, in-house courses and one-to-one practical training.

2000/2002: Visiting Professor, Camborne School of Mines, University of Exeter, England

- A purely honorary appointment

1996 to 1997: Visiting Professor, Department of Mining Engineering,
University of the Witwatersrand, Johannesburg, South Africa.

1989 to 1996: Senior Lecturer, Department of Mining Engineering,
University of the Witwatersrand, Johannesburg, South Africa.

- Responsible for supervision of research students up to PhD level plus graduate and undergraduate teaching of Technical Valuation methods. Also provisional of professional development courses to professional geologists, mining engineers and mine surveyors.

1973 to 1982: Lecturer, Dept of Mineral Resources Engineering,
Royal School of Mines, Imperial College, London.

- Responsible for supervision of research students up to PhD level plus graduate and undergraduate teaching of Technical Valuation methods.

1971 to 1973: Research Assistant in "Statistics applied to Mineral Resources",
Dept of Mining and Mineral Technology (as was), Royal School of Mines,
Imperial College, London.

1970 to 1971: Assistant statistician, Department of Education and Science, UK Civil Service.

Academic Qualifications

In addition to formal qualifications, I regularly attend relevant conferences to learn new methods, theory and applications. I also attend seminars and meetings of the various professional societies of which I have membership. For example, in May 2010 I attended a one day workshop on "bias in measurement error" held by the Biometrics Society in London.

- 1979** Ph.D. in Engineering, University of London
"Geostatistical Reserve Estimation in Cornish tin mining"
Diploma of Imperial College, awarded in conjunction with Ph.D.
- 1970** M.Sc. in Biometrics, University of Reading.
- 1980** Diploma in Educational Broadcasting, University of York.
- 1969** B.Sc. in Pure and Applied Mathematics, Strathclyde University, Glasgow.

Membership of Learned Societies

- 1970** Fellow of the Royal Statistical Society (FSS)
- 1974** Member of the Biometrics Society (associate member from 2001)
- 1976** Member of the Institution of Mining and Metallurgy, London (MIMM)
Membership carries qualification as 'Chartered Engineer' (CEng)
Transferred to Fellowship in **1988** (FIMM), now FIOMMM
Member of the Editorial Board for Mining Technology
- 1976– 2001** Member of the International Association of Mathematical Geology
Council member 1984--1989, National member for South Africa.
- 1978– 2000** Fellow of the Institute of Mathematics and its Applications (FIMA)
Membership carries qualification as 'Chartered Mathematician' (CMath)
- 1979– 2000** Associate Member of the Society of Mining Engineers of AIME
- 1988** Member of the Geostatistical Association of South Africa (committee, **1996**)
- 1994** Fellow of the South African Institution of Mining and Metallurgy (FSAIMM)

Recent Publications

- In Preparation **With W.V. Harper**, "Practical Geostatistics 2000 -- Volume 2"
- 2010 "Statistics or geostatistics? Sampling error or nugget effect?", SAIMM Journal, June 2010
- 2008 **With W.V. Harper**, "Practical Geostatistics 2000: Case Studies"
- 2006 **W.V. Harper, senior author**, "Visualization Tools To Aid In The Understanding Of Geostatistics", Proceedings of 7th International Conference on Teaching Statistics, Salvador, Bahia, Brazil, 2-7 July 2006. Editors Allan Rossman, Beth Chance. International Association for Statistical Education and International Statistical Institute, Voorburg, The Netherlands. 2006, ISBN-10:90-73592-24-0
- 2003b **With Rebecca Klaus** "From point data to density maps: the application of spatial statistics in ecological impact assessment", EcIA Science & Best Practice July 2006, Bath Spa University, England (presentation only)
- 2003a "Geostatistics: estimation or simulation?", IAMG 2003 Portsmouth UK. September 7-12, 2003, invited paper.
- 2002c **W.V. Harper, senior author**, "Geostatistical Analysis in Residential Environmental Testing", ASTM Symposium On Methods For Evaluation Of Hardened Field Concrete, Miami, 2002.
- 2002b "Using relationships between measurements to improve prediction: illustrated by a case study in aquifer pollution", in Theoretical developments and applications of spatial analysis in the environmental, earth and agricultural sciences (joint meeting of the British Society of Soil Science and Geostats UK, Reading, March. [invited speaker]
- 2002a "A practical approach to the application of geostatistical estimation", Environmental Statistics Study Group of the RSS, January [invited speaker]
- 2001b **W.V. Harper, senior author**, "Sichel's Compound Poisson", Revista de Estatística, (the Journal of the Portuguese National Statistical Institute), 2001.
- 2001a "Applying Geostatistics in the Real World", IAEG 2001 Weekend Course, Waterford, Ireland, May [Estimation and classification of mineral resources and ore reserves: the state of the art]
- 2000h **With W.V. Harper**, "Practical Geostatistics 2000 -- Answers to Exercises", (December 2000)
- 2000g **with G.H. Lind (senior author)**, "Assessing Pillar Geometries in the Witbank and Highveld Coalfields Using Geostatistical Techniques", Coal Indaba, November
- 2000f **with W.V. Harper**, "Practical Geostatistics 2000", Ecosse North America, Columbus Ohio, August 2000
- 2000e "EcoSSe - Eco Spatial Statistical evaluation", Envirosoft 2000, Bilbao, Spain, June.
- 2000d "The Mine Call Factor - conditional bias at its worst", 6th International Geostatistics Congress, Cape Town, RSA, April (*poster*)
- 2000c "Geology and statistics - striking the balance in the real world", MRE21 symposium in honour of Alwyn Annels, Cardiff, Wales, March, (*keynote speaker*)
- 2000b "Erratic highs -- a perennial problem in resource estimation", SME Annual Meeting, February.
- 2000a **with NO Lotter & CT O'Connor**, "The Relative Bias Errors of Gravimetric Fire-Assaying Practice for Platinum-Group Elements in Bushveld Merensky Ore at Rustenburg", SME Annual Meeting, February.

Consultancy (partial list of projects)

Ad hoc advice on mineral sands applications, for Shell Minerals, RSA.
Advice on sampling at Richards Bay Minerals, RSA.
Advice on valuation and sampling procedures for Nelson Gold, Tajikistan.
American Mineral Fields Int. Ltd., supervision of feasibility study --- valuation and geology
Assessment of Alexander Bay Diamond Mine, RSA
Assessment of stockpiles at Norilsk, Osmium, London.
Audit of resources, tantalite deposit, Mozambique
Battelle Pacific Northwest Laboratories, Richland, Washington;
Blyvooruitzicht Gold Mining Co. Ltd., audit of annual reserve statement
Collahuasi Copper Mine, Chile;
Evaluation of mining resources, Hartebeestfontein Mine, RSA
Evaluation of resources for Wadi Medden Project, Yemen.
Ferguson Lake Ni/Pt project, Nunavut, Canada
Fergusson Stewart, Johannesburg, evaluation of Joel Mine.
Freda-Rebecca Mine, Zimbabwe for Cluff Minerals (and later Ashanti GoldFields).
General Mining Union Corporation, Johannesburg;
Ghanaian Australian Goldfields, geostatistical modelling and advice on valuation
Hartley Platinum, BHP Zimbabwe, peer review.
Hochschild PLC, Lima, Peru – conditional simulation for mine planning
Hope Brook Gold, Cornerbrook, Newfoundland;
Investigation of problems with Mine Call Factor for Libanon Mine, RSA.
ISCOR Mining, audit of valuation for deposit in Zaire
Johannesburg Consolidated Investments Ltd, Johannesburg;
Lisheen Zinc/Lead project, Eire;
Lonrho Zimbabwe, advice on evaluation of small gold deposits
MIMCO, RSA, evaluation of gold mine.
MineNet RSA, evaluation of resources and reserves at Skorpion project, Namibia
Mineral resource and reserve valuation for Skorpion Zinc project in Namibia.
ONWI, Battelle Memorial Institute, Columbus, Ohio;
Oryx Mine, Gengold, peer review of estimation methods.
Palabora Mine, underground development, RTZ Management Services, Johannesburg.
Pancontinental Mining, Western Australia
Petrovavlovsk Plc, Blagoveshchensk, Russia
Potgietersrus Platinum, JCI, benchmark evaluation.
Public statement of remaining reserves at the Droogebult Mine, RSA.
Re-evaluation of resource evaluation for South Crofty Mines, Cornwall
Resource evaluation advice, platinum dumps, Norilsk area for a German consortium
Resource evaluation studies for Lonrho Platinum, South Africa.
Resource Exploration, evaluation of projects in Zaire
Stillwater Platinum Mine, Montana USA, grade control problems.
Study of sampling methods and calibrations for Namco Diamond Mining, Cape Town.
Tenke Fungurume project, Congo audit of computerised database
Terrasciences Inc., Denver, Colorado;
Tilden Magnetite, Michigan USA
Transalta Utilities, Calgary, Alberta
Vaal Reefs Exploration & Mining Co. Ltd., audit of annual reserve statement
Valuation advice for the Ayanfuri Project, Ghana for Cluff Minerals.
Valuation of Mineral Sands project, California, USA.