***Curriculum Vitae***

**Christopher c. Hamilton**

**Professional Experience:**

**Process Business Development Manager / Chief Mineralogist,**

**Process Mineralogical Consulting Ltd. May 2018- present**

Responsible for providing technical leadership in PMC operations, projects and new business development. With relevant industry experience and specific experience and skills in laboratory protocols and best practices, a key role I fulfill in PMC is in the provision of high-quality data as well as independent Interpretation and value-added reporting towards enabling clients with a full-spectrum Ore Body Knowledge program. We aim to both **identify and properly elucidate mineralogical problems** by providing ongoing Consulting and Troubleshooting Services in an interdisciplinary analytical/geological/processing context towards practical solutions/outcomes

**Service - Systems for Research November, 2013-April, 2018**

**Hamilton, Ontario**

# *Applications Specialist/Scientist, Automated Mineralogy*

* Principle Contact, Natural Resources for SFR/FEI Automated Mineralogy Systems, Canada.
* Providing ongoing support to 15 Canada-wide laboratories using QemSCAN and MLA technology, ranging from University, to Corporate R&D and Commercial Laboratories. Fielding and screening troubleshooting issues for the Engineering/Service group. Support and training provided to new and existing clients in both the specialized nature of the Software Systems and the Microscopes, as well as advanced training and consulting on Process Mineralogy and assisting in developing and validating protocols and data reporting and interpretation.
* Conducted demonstrations of AM techniques for interested parties as well as consulting and recommendations for continued application and defining the value-proposition.
* Also responsible for technical sales support for SEM and other products (TOF-SIMS, XRF, Surface Science Instruments) to the Mining/Raw Materials Sector.

**Activation Laboratories, Ltd. June 2009 to October 2013**

**Ancaster, Ontario**

# *Manager, Geometallurgy/Mineralogy*

* Commissioned and Managed a new Laboratory with both MLA and QEMSCAN Automated Mineralogy (AM) technologies in Actlabs. Managed a team of 4 and charged with creating and providing services to both the Exploration Sector and New Business for Actlabs’ Global portfolio.
* Developed Laboratory & Exploration protocols for adopting quantitative mineralogical methods for advanced exploration programs involving AM, Geochemistry and Quantitative XRD.
* Managed projects from Canada, America, South America and Mongolia, ranging across industrial raw materials, base- and precious-metal deposits. Worked closely with multiple clients at the VP and management level to provide rapid turnaround time and value-added services.
* Also worked as part of the Laboratory QA/QC and Root-Cause Troubleshooting Team for Global Operations.

**Barrick Technology Centre July 2007 – May 2009**

**Vancouver, BC, Canada**

*Chief Mineralogist*

* Commissioned and Managed an MLA-Based Mineralogy Department within Barrick, aimed at developing cross-disciplinary methods for Barrick projects, particularly pertaining to identifying opportunities for improving recovery by characterizing gold deportment in Tailings.
* Developed new protocols and combined techniques for Au-deportment studies aimed at reducing the need for expensive and time consuming external services/methods. A workflow was adopted to include gravity upgrading (Knelson and Superpanning), Desliming and Diagnostic Leaching (DL) to benchmark studies including MLA technology to more rapidly and precisely determine Gold Deportment in Ores and Products. DL protocols were optimized and properly evaluated by way of quantitative XRD and MLA studies to reveal important gangue- and other controls relevant to processing (e.g. Autoclave through to Calcine and preg-robbing for Cyanidation practice).
* Provided troubleshooting and miscellaneous mineralogical services to Capital Projects within the Barrick portfolio, from Alaska to Africa and South America.

**SGS Mineral Services - Lakefield Research Limited July 2000 to June 2007**

**Lakefield, Ontario, Canada**

## Consulting Mineralogist (2006/7) Advanced Mineralogy Facility - SGS Mineral Services

## Senior Mineralogist (2000-2006) SGS Lakefield Research Ltd.

* Managed the QemSCAN Instrument, trained a core staff contingent and integrated the technology within existing Process Mineralogy projects.
* Undertook mineralogical investigations of wide-ranging industrial and mining products in support of internal metallurgical projects primarily, but also in establishing external commercial business opportunities. This led to the development of the Advanced Mineralogy Facility post-2004.
* Integrated AM into project management teams with Metallurgical Engineers/Mineral Processors to identify and elucidate mineralogical constraints in processing flowsheets. Notable examples included successful integration with the San Nicolas Project in Mexico, improvements to the Lac des Ilse Mine in Ontario, and improved integration with the broader SGS GeoMetallurgy Initiative.
* Responsible for quality and timely completion of technical reports, ongoing training for the growing AMF Group and reviewing and editing reports for accuracy, integrated interpretation and evaluation of mineralogical data obtained from QemSCAN with Metallurgical results for predictive and diagnostic metallurgy.
* Spent a 3-month period commissioning and start-up of the SGS-Brisbane AM Service in support of the Olympic Dam Expansion Project in Australia (2005). Trained staff in all aspects of QemSCAN sampling, operations and reporting, as well as Process Mineralogy applications.

**Lakefield Research Africa/GoldFields Mining and Development (GFMD) Laboratories Ltd. 1997 - 2000**

**Johannesburg, South Africa**

*Assistant Chief Mineralogist*

* Prior to the acquisition of GFMD Laboratories by SGS/Lakefield, I set up a QemSCAN Laboratory and Managed the System and provided Project support as overseen by Project Leaders in Metallurgy and the Mineralogy Manager. Work was conducted on a range of commodities, from Ti-Sands, Diamond Tills to Exploration Programs in South America (Cu-Au Porphyries in particular) and plant audits and related Ore Characterization for the Northam Pt-Mine, as well as refinery products for Pt, Au and Zn.
* It was with GFMD that I first learned of QemSCAN applications to large Exploration programs, particularly Epithermal and Porphyry systems.

**Anglo Platinum Research Centre 1994 - 1997**

**Johannesburg, South Africa**

*Assistant Chief Mineralogist*

* Managed a QemSCAN unit with responsibility for **Plant Audit projects** for several different plants within the Anglo Platinum group. Undertook project management, on-site reporting and ongoing technology transfer initiatives by comparative site-studies. Was involved in sampling and metal accounting programs to establish recovery and ore-characteristic correlations and controls of geological parameters on plant performance.
* I was immersed in systemic, size-by-size studies within the Amplats R&D group, and charged with attending ongoing plant support meetings, optimization studies and new directives to ensure the adoption of QemSCAN work at all levels. Major findings at any one site were thus not only presented to site staff, but also to other operations and company-wide workshops and technical meetings to ensure technology and knowledge transfer and – where necessary – to assist in projects to devise and test validity of applications. In the last 6 months of my employment there, a corporate-wide GeoMetallurgical program was begun, in which I played a part in outlining Ore-characterization methods to include grind parameters and not just flotation characteristics.

**GENCOR Ltd. Laboratories 1991 - 1994**

**Springs, South Africa**

*Principal/Assistant Chief Mineralogist*

Progressed from junior mineralogist to Manager, QemSCAN, performing various projects for various Gold Mines around Johannesburg, Impala Platinum and other mineralogical troubleshooting duties. The broad categories and duties were:

* Gold Tailings and Ore Characterization studies primarily to determine links and correlations between Geological and Metallurgical characteristics for plant monitoring, control and optimization. Ongoing ore differences were established to explain and better understand the causes of Plant upsets, variance in Diagnostic Leach testing and miscellaneous mineralogical services.
* Using techniques of XRD, SEM-EDS and Optical Microscopy for Miscellaneous troubleshooting projects, as well as routine Diamond Indicator Studies for GENCOR Exploration.
* Involvement in Impala Platinum Mine and Refinery Operations. I was hired primarily due to expansion of the Impala Operations into the development of the UG-2 Reef. Initial work was conducted on a Cambridge 2000 SEM and rudimentary Image Analysis System to provide essential mineralogy and liberation determinations. However, over a two-year period an upgrade to the Mineralogy Department by adopting QemSCAN technology was deemed essential for throughput and improved precision and accuracy. I was selected to be the QemSCAN Operator/specialist and sent to Australia for initial training in 1993. Improvements to Ore Characterization methodologies were realized through a combination of between-Stope Ore Variance studies to provide a link between Geological and Predictive Metallurgical characteristics, as well as a 3-Month Plant Survey which involved determining size-by-size recovery characteristics based on Plant Feed, Concentrate and Tailings, as well as selected comparative samples of good and bad ore. I developed the size-by-size sampling methods and the QemSCAN routines for this Methodology.
* Using combined QemSCAN (QEMSEM at the time), Optical Mineralogy/Petrographic and SEM-based results, the team I was working with examined and established relationships between PGE and base metal mineralogy, as well as gangue mineralogy and metallurgical performance. Among these included the presence, relative proportions and variance in liberation characteristics of talc, sulphide- and PGM-minerals as well as the decoupling effects witnessed in both mineralogy and geochemistry as a function of particle size and mineral processing.
* The importance of matching electron microprobe and EDS mineral analyses - and learning the techniques - were essential in achieving proper metal balances and inventories in an improved geological and metallurgical context.

**ISCOR – Iron and Steel Corporation of SA 1988-1991**

**Pretoria, South Africa**

*Junior Mineralogist*

Began as a Scientist-in-Training, apprenticing in work rotations to the Senior Mineralogists in (1) Refractories and Steel Making, (2) Coke and Coal, (3) Iron Ore and Limestone and (4) Base Metals (Zn for galvanized products). I specialized in Base Metals ultimately, performing plant audit and feed characterization services for the Rosh Pinah Pb-Zn-Cu Mine in Namibia by manual point counting techniques. Received practical, in-house training on Optical Mineralogy, Image Analysis in Coke, XRD and Electron Microprobe Analysis, as well as thermal analysis and associated test-work for refractories and coal and coke.

**GRADUATE & POST-GRADUATE BACKGROUND:**

**University of Cape Town 1980-1987**

**Cape Town, South Africa**

*Laboratory Assistant, Materials Engineering (1985-1987)*

While doing my M.Sc. Degree in Mineralogy, I worked part-time in the Minerals Engineering Department as a laboratory technician for a Professor (O.E. Heckroodt) studying the inter-relationships between microtexture and mineralogy of ceramic bodies and their physical properties. Testing from abrasion resistance to hardness and thermal cycling was learned and conducted while at the same studying two Materials Engineering Courses for non-degree purposes.

*M.Sc. (Awarded 1988)*

*Thesis title: The Mineralogy, Petrography and Petrogenesis of a Suite of Mid-Ocean Ridge Basalts Dredged from the Southwest Indian Ridge (SWIR) between 16 and 26 Degrees East.*

* Analysed basalts dredged from 9 different locations by means of Geochemistry, Petrography, Mineralogy and Electron Microprobe Analysis to characterize the rocks and identify and document the variance on a within-site, between-site- and between-ridge context. The project fell within the ambit of a global research program studying crust/mantle dynamics at mid-ocean ridges in Research facilities from the USA to Europe and Japan. Studies were aimed at assessing the effects of hotspot volcanism on Plate Tectonics and my project was to compile and evaluate the identified variability in terms of pre-eruption history, crystal fractionation, and the mantle source from which the magmas originate.
* Participating petrographer/scientist aboard the German Research Vessel, the Polar Stern, on an Oceanographic Research Cruise (1986). Collected and curated dredged rocks from the last un-dredged ridge segment of the SWIR.
* Participating petrographer/scientist aboard the American Research Vessel, the RV Melville (Scripps Oceanographic Institute). Learned and observed the process of collecting and curating dredged rocks from one ridge segment of the SWIR and participated as an assistant/technician to American scientists aboard.

*B.Sc. (Hons) 1983/4. (UCT) Geology/Mineralogy.*

**Professional Qualifications:**

**FELLOW SA Institute of Mining and Metallurgy (F.S.A.I.M.M.) Since 1994**

**APGEO –** *P.Geo. Application in progress*

**Language Skills**

* Fluent in English and Afrikaans