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THE CABRI ISSUE

PREFACE

In the fall of 1999, Bob Martin initiated a project designed to honor Dr. Louis J. Cabri, who had just retired from CANMET after 35 years of service. This commemorative issue is the culmination of the collaborative input by numerous individuals, foremost among them the authors, the referees, the associate editors, and the editor, many of whom have interacted with Louis during his distinguished career.

Louis Cabri graduated with an Honours B.Sc. from the University of the Witwatersrand (South Africa) in 1955; he completed his M.Sc. in 1961 and his Ph.D. in 1964 at McGill University, and joined CANMET (formerly the Mines Branch) in the same year. During his long career at CANMET, he worked as a Research Scientist, Section Head (Program Manager) and Principal Scientist. He retired in 1999, but remains as an Emeritus Scientist with CANMET. In his early years, Louis carried out field exploration in Ghana, Sierra Leone, Zimbabwe and South Africa. After joining CANMET, he pursued phase-stability and crystal-chemistry relationships in the system

LOUIS J. CABRI

Cu–Fe–S, which led to his discovery of two new Cu–Fe sulfide minerals, mooihoekite and haycockite. He then focused on platinum-group minerals (PGM), which have been his principal interest since the early 1970s. His efforts have been directed to the characterization of PGM and their crystal chemistry, nomenclature, geochemistry and geological occurrence. He has studied many of the world's PGM deposits, both primary and placers, for example Sudbury (Ontario), Tulameen River (British Columbia), Stillwater complex (Montana), Itabira (Brazil), Noril'sk–Talnakh (Russia), Konder massif (Russia), Great Dyke (Zimbabwe), Freetown complex (Sierra Leone), and Onverwacht, the Witwaterstrand reefs, and the Merensky reef of the Bushveld complex (South Africa). Louis has published more than 150 papers or scientific notes and made more than 170 oral presentations. He edited a CIM special volume entitled *Platinum-Group Elements: Mineralogy, Geology, Recovery* (1981), and his new CIM special volume, entitled *The Geology, Geochemistry, Mineralogy and Mineral Beneficiation of Platinum-Group Elements* (2002), is ready for distribution. The latter special volume highlights his sustained research on PGM. He has written sections on PGM for many encyclopedias, has discovered 21 new mineral species, and has redefined eight others. The PGM *cabriite* was named in his honor in 1983.

Louis is very innovative. In the early 1980s, the trace-element analysis of sulfide minerals using the proton microprobe (PIXE) caught his attention. He then focused on the study of "invisible" gold and, of course, the platinum-group elements (PGE). Louis collaborated with several nuclear physicists, exchanging ideas with them and introducing them to the mineralogical applications of their instrumentation. He made many trips to the Max Planck Institute für Kernphysik (Heidelberg, Germany), BRGM (Orléans, France) and Los Alamos (New Mexico) to carry out his studies. He eventually assisted the University of Guelph in the construction of the only Canadian PIXE facility. These activities inevitably resulted in the application of other microbeam trace-analytical techniques to his research, such as secondary-ion mass spectrometry (SIMS) and laser-ionization mass spectrometry (LIMS). The studies focused on the practical benefits of mineralogical results to the mining and processing industry. Louis pioneered the application of microbeam trace-element analysis, complemented by quantitative image analysis, to study metal balances, especially those of Au and PGE, in mineral-processing circuits as a guide to metal recovery. He pinpointed how metal losses occurred in the milling circuits. The "invisible" gold in refractory sulfide gold ores became "visible", and the distribution of PGE in many milling circuits was elucidated. As a consequence, the metallurgical industry is today fully aware that the gold in refractory ores can be present either structurally bound or as tiny discrete particles in arsenopyrite and pyrite. In some instances, this information has guided the modification of processing circuits to minimize the losses of gold. His quantitative mineralogical approach contributes to mineral exploration, ore processing and metal extraction. He consults world-wide for government institutions, universities and industry on PGM and gold, and on process mineralogy. Most of his publications in the 1990s were on these subjects. He co-edited a 1998 MAC short-course volume on *Modern Approaches to Ore and Environmental Mineralogy*, and a special 1999 TMS (The Minerals, Metals and Materials Society) proceedings volume on *Analytical Technology in the Mineral Industry*.

Louis loves nuclear physics; in the mid-1990s, he started to explore the application of synchrotron radiation to mineralogy. He went to Brookhaven National Laboratory (New York) and Argonne National Laboratory (Illinois) to do his research. He was able to reproduce SIMS results with synchrotron analyses, and he found other applications for synchrotron research. Louis still collaborates with the Memorial University of Newfoundland on the development and application of laser ablation – inductively coupled plasma – mass spectrometry (LA–ICP–MS) to mineral sciences and the mineral industry. He remains as an adjunct professor at both Guelph and Memorial universities.

Unlike most people who have various speeds of work, Louis has only one speed, which is full-throttle. It can be guaranteed that whatever Louis is doing, he always devotes 100% of his energy to the project. Today, he is working as hard as he did before his nominal retirement. Louis not only commits himself to high productivity and high quality, he also demands the same from his colleagues. The work must be done with perfection and must be completed "yesterday". As his colleagues at CANMET, we were excited by his enthusiasm and challenged by his standards. Louis is very energetic, and part of that energy is directed toward writing "comments" to CANMET management, and to "discussion" papers for scientific journals, always with great scientific politeness. Despite his work-related drive, Louis contrasts that with an amiable and relaxed attitude on social occasions; we would be remiss not to mention that he and his wife Mimi have generously accommodated numerous visiting scientists and have graciously hosted many pleasant gatherings at their Ottawa home.

Louis served as the Scientific Editor of *The Canadian Mineralogist* during the period from 1975 to 1982. Initially, John Jambor was Co-Editor, and he was succeeded in 1978 by Bob Martin. In 1982, Louis relinquished

his editorial duties to become Vice-President of the Mineralogical Association of Canada (MAC). During those eight years, Louis helped to make *The Canadian Mineralogist* one of the most respected mineralogical journals in the world. During his tenure, nearly 700 manuscripts were processed, and eight special issues were published.

Louis has received many awards and honors, for example, Fellow of the Royal Society of Canada (1996), the Past Presidents' Medal and the Leonard Berry Medal of the MAC (1993), Hallimond Lecturer for the Mineralogical Society of Great Britain and Ireland (1991), Distinguished Lecturer for the MAC and the Geology Division Guest Lecturer for the Canadian Institute of Mining, Metallurgy and Petroleum (CIM) in 1979, Queen's Silver Jubilee Medal (1977), Fellow of the Mineralogical Society of America (1970), and the Society of Economic Geologists W. Lindgren Award for excellence in research (1966). He has also delivered numerous keynote addresses, lectures and short courses at many symposia and meetings in Canada, the United States, Great Britain, France, Germany, Finland, Russia, Portugal, Hungary, Brazil, Bolivia, South Africa and Australia. Louis has provided leadership in many mineralogical societies. For example, he served as Chair of the Process Mineralogy Committee of the Minerals, Metals and Materials Society and the Society for Mining, Metallurgy and Exploration, AIME (1997–1999), President of the Mineralogical Association of Canada (1984–1985), Chair of the Geology Division of CIM (1977–1978), and Chair of the Commission on Ore Mineralogy of the International Mineralogical Association (1994–1998). As well, he is a Member of more than a dozen other committees. Committee members who have worked with Louis still freshly remember his hearty recommendations at committee meetings.

Louis, throughout his career, has devoted himself to both fundamental research and the resolution of industrial problems; he has provided service and scientific leadership to the Canadian and international mineralogical communities. This special issue of *The Canadian Mineralogist,* fittingly dominated by papers on PGE mineralogy, is dedicated to Louis in recognition of his substantial contributions to science and his leadership in the mineralogical community. The articles in this issue have been contributed by researchers from around the world, and this reflects his international stature and the world-wide research collaboration that Louis has established.

This issue contains 33 papers on ore mineralogy, phase equilibria, geochemistry, crystal structure and crystal chemistry. The scope of the papers appropriately reflects the research interests of this exceptional individual. 1) *Platinum-group minerals: ore mineralogy.* Thirteen papers report on the mineralogy, occurrences, compositions and the genetic types of PGM mineralization from well-known and some of the lesser known primary and placer deposits. The primary deposits include those of the Bushveld complex (South Africa), the Uktus complex (Urals, Russia), the Baula complex (India), the Keivitsansarvi deposit (Finland), the Pilbara region (Western Australia) and the Noril'sk orefield (Russia); the placer deposits include those from Minas Gerais (Brazil), Gweru (Zimbabwe), Siberia and the Urals (Russia), and Goodnews Bay (Alaska). A new study of cabriite is also included. 2) *Phase-equilibria studies in sulfur-bearing systems.* Five papers report on PGM-related systems, among which are those of Fe–Os–S, Fe–Pt–S, Fe–Rh–S, and PtS–PdS–NiS, and the collectors of PGE in the Fe–Ni–Cu sulfide system. The authors determined the phase stability of the PGM in the temperature range from 500 to 1200°C, and applied the results to interpret the conditions of formation of PGM in natural environments. Another paper focuses on the system Zn–Fe–Ga–S. 3) *Geochemistry and ore mineralogy.* One paper focuses on the distribution of PGE in alkali basalts, and another reports on the Se, Te, As and Sb contents of the primary mantle sulfides. Other papers report on the mineralogy of sulfide ore deposits and on archeological mineralogy. 4) *Crystal structures and crystal chemistry*. This section includes a discussion of some of the specific crystallochemical aspects in the definition of end members of new mineral species. In other papers, four new mineral species are described: laflammeite, menshikovite, tischendorfite and cobaltarthurite. New data are given for bismutite and hongshiite, and for the occurrence of PGM at the Wellgreen deposit,Yukon Territory. Louis is among the authors that have contributed to this section; indeed, in a major publication that focuses on PGM, it would be most unusual if Louis were not among the contributors.

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Caption for cover photograph: A grain of cabriite, Pd_2SnCu, surrounded by complex Cu–Fe sulfides in rich massive-sulfide ore from Noril'sk, Russia. A partial rim of native silver mantles the cabriite, which contains micrometric inclusions of another PGM (bismuthoan geversite). Coarse sperrylite, fractured and infilled by silver (the sample contains abundant domains of Au–Ag alloy of variable composition) flanks the grain of cabriite above and below. The dull buff-grey phase to the left of the cabriite is cubanite, and the tawny sulfide is chalcopyrite, intergrown with minor talnakhite. The pale bluish grey veinlet at the right contains galena, and the sperrylite also is cut by a late fracture lined by magnetite. Photographed in slightly offset cross-polarized light. Horizontal field of view is 0.5 mm. The sample is described in this issue by Wilson *et al.* on page 475. Digital photomicrographs by Alan Criddle of the Natural History Museum, London, U.K.