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PREFACE

Recent technological advances have made possible the sampling and geochemical analysis of increasingly smaller masses of crystalline material. The application of these new microanalytical techniques to minerals and rocks opens up a level of detailed geological information that was heretofore masked by more primitive bulk sampling techniques. We can now conduct in situ sampling and analysis of individual growth bands within crystals, and of tiny solid and fluid inclusions trapped within crystal lattices, in many cases determining not only their composition but also their time of formation.

Because of these advances and their potential for assisting scientists in attaining a better understanding of mineralizing processes, the Society of Economic Geologists held a short course in October 1996 to highlight the diverse applications of these techniques. Attended by more than 85 people at The Nature Place Resort in Florissant, Colorado, the course brought together scientists from Australia, Europe, North America, and South Africa. It was the largest short course ever held by the SEG in conjunction with a GSA annual meeting.

This volume, like the course, is divided into four topical sections: Geochronology and Radiogenic Isotopes, Stable Isotopes, Elemental Analysis, and Fluid Inclusions. Each chapter represents an overview of the technique utilized and its practical applications to understanding mineral- and rock-forming processes. It is clear that some techniques are further along than others in terms of specific applications, but all of them are promising and have high potential for making important contributions to geologic knowledge. We hope that the volume makes members of the geologic community more aware of the microanalytical techniques and the potential applications to their own specific geologic research problems.

The conveners and editors are indebted to all of the authors for their timely efforts in the production of the short course and the resulting volume.

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BIOGRAPHIES

LOUIS J. CABRI is principal scientist at Canada Centre for Mineral and Energy Technology, Ottawa, and has performed research in mineralogy applied to ores and characterization of various industrial wastes over the past 34 years. He has been involved in the development of new microanalytical techniques for surface analysis and trace-element analyses of minerals, especially for precious metals. Cabri has also been a consultant on trace-element analytical techniques and mineralogical balances, for base metals, gold, silver, and platinum-group element ores, to industry, governments, and universities, on an international level. His work has been published in 145 peer-reviewed journals, and he is the winner of SEG Lindgren award in 1965, the Mineralogical Association of Canada's Past Presidents' Medal, and the Leonard G. Berry Medal. Cabri is a fellow of the Royal Society of Canada, Academy of Sciences.

J. L. (IAN) CAMPBELL is a professor of physics at the University of Guelph in Canada. His Ph.D. was earned in nuclear physics in 1967 at the University of Glasgow, which awarded him the D.Sc. in 1982; he received an honorary D. Tech. degree from the University of Lund in 1997. His research deals with inner-shell atomic processes and application of X-ray spectroscopy to chemical analysis. Campbell is one of the principal developers of the PIXE technique, focusing mainly on trace element analysis and imaging in the geochemical and mineralogical context, in which he has collaborated with a wide range of Earth scientists. He is co-author of the text PIXE: A novel technique for elemental analysis and Particle-Induced X-ray Emission Spectrometry, as well as over 150 journal publications.

GERRY CZAMANSKE was an undergraduate at the University of Chicago and received his Ph.D. from Stanford University in 1960. After two years of post-doctoral study and three years as an Assistant Professor at the University of Washington, he was recruited by the U.S. Geological Survey and hired full-time in 1965 as a Geologist GS-12, attaining grade GS-15 in 1978. During his 31-year career with the USGS, he carried out a broad range of field and laboratory research activities. Major areas of active research included study of the processes of magmatic evolution and ore formation trough use of comprehensive chemical analyses and application of the electron microprobe to characterize silicate and sulfide mineral phases; utilization of new techniques to better analyze geologic materials; and, in later years, studies of the ore deposits, flood volcanism, and geologic framework of the Noril'sk-Talnakh region of north-central Siberia.

ALEX N. HALLIDAY studied geology and then geophysics at the University of Newcastle-upon-Tyne, U.K. In 1976 he moved to the Scottish Universities Research and Reactor Centre where he was a post-doctoral fellow, then a lecturer. A professor at the University of Michigan from 1986 to 1998, Halliday was recently appointed as a professor at ETH Zurich, Switzerland. For many years Halliday worked in three distinct areas of isotope and trace element geochemistry—studies of silicic magmas, crustal fluid flow, and the mantle. In particular, he has developed several new approaches to the isotopic dating of diagenetic assemblages and hydrothermal mineralization. Most of his recent work involves the new technique of multiple collector inductively coupled plasma mass spectrometry and its application to the origin and early history of the solar system, studies of crustal fluid flow, and paleoceanography.

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JIM J. IRWIN obtained his B.Sc. in geology from McGill University, Montreal, in 1980, and Ph.D. in geology from the University of California, Berkeley, in 1986. Between 1986 and 1992 he was a research fellow in the Department of Physics at Berkeley, developing microstandards and studying fluid inclusions associated with a wide range of ore deposits and geologic settings using the laser microprobe noble gas mass spectrometric approach. He worked as a project scientist at Scripps Institution of Oceanography, San Diego, from 1992 to 1994. Since 1994 he has resided in Vancouver, British Columbia, active as a consultant to and director of companies in the resource exploration industry.

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JILL DILL PASTERIS received her undergraduate degree in geology from Bryn Mawr College in 1974. She then spent a year studying ore microscopy at the University of Heidelberg, Germany, working under Dr. Paul Ramdohr. In 1980, she completed a Ph.D. at Yale University, doing thesis research on the opaque oxide phases of a kimberlite pipe in South Africa. In the same year, she joined the faculty of the Earth and Planetary Sciences department at Washington University in St. Louis, where she has remained. Her work involves various aspects of fluid-rock interactions as they pertain to igneous and metamorphic rocks and, especially, to the formation of igneous ore deposits. She and her students have focused on Cu-Fe-Ni sulfide and Fe-Ti-oxide deposits. With colleague Brigitte Wopenka, Pasteris set up a laser Raman microprobe laboratory in 1983, which they have used for the study of natural fluid inclusions, synthetic fluid inclusions and gas mixtures, microsamples of solid phases, and specific types of aqueous fluids.

PHILIP M. PICCOU is a research scientist at the Laboratory for Mineral Deposits Research, University of Maryland. His interests include field studies of silicic volcanic and plutonic rocks; the use of accessory phases in the determination of magmatic, hydrothermal, and ore-forming processes; chemical modeling of ore-forming processes; microanalysis of minerals; experimental simulation of magmatic-ore systems (involving Au, Cu, etc.). He employs a multidimensional approach involving field observations, modeling, and experimentation, to solve problems in ore genesis.

LEE R. RICIPUTI received a B.S. degree in geology from Carleton College in 1985 and M.S. and Ph.D. degrees in Geology from the University of Wisconsin-Madison in 1987 and 1991. After spending two years in a joint research appointment at Oak Ridge National Laboratory (ORNL) and the University of Tennessee-Knoxville, he joined the research staff at ORNL full-time, and is currently a staff scientist in the Chemical and Analytical Sciences Division. His current research focuses on application of secondary-ion mass spectrometry to investigate micrometer-scale isotope and trace element distributions in order to better understand mass transport processes in geologic settings using both natural and experimental samples. Riciputi is also interested in improving analytical capabilities through a better understanding of the fundamental sputtering/ionization processes occurring in secondary-ion mass spectrometry.

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