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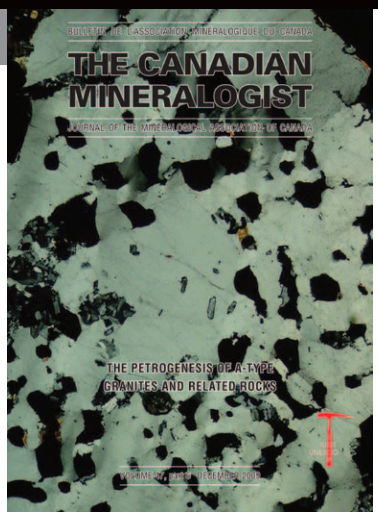
THE PETROGENESIS OF A-TYPE GRANITES AND RELATED ROCKS

Granites come in different flavors. Granitic suites of orogenic (O) character differ in fundamental ways from suites of anorogenic (A) granites, just like Oranges differ from Apples. Those of A type are less well understood and appreciated than those of O type, not only because they do not get much "air time" in university curricula, but also because they are inherently more challenging to understand from several points of view. There are standard metaluminous A-type granites, some displaying a rather reduced mineralogy, whereas others crystallized from an oxidized magma. To complicate matters, mildly peraluminous variants may be found also. In other intrusive complexes, the metaluminous members of the suite may be associated with peralkaline granites and related volcanic products of comenditic or pantelleritic tendencies. It is not unheard of to find nepheline-normative intrusive units closely associated with the peralkaline granites. And these suites may well be mineralized, for example, in tin, molybdenum, niobium, and the rare earths.

The December 2009 issue of *The Canadian Mineralogist*, a thematic one entitled *The Petrogenesis of A-Type Granites and Related Rocks*, was an outgrowth of the "Symposium on Magmatism, Crustal Evolution, and Metallogenesis of the Amazonian Craton" held in Belém, Brazil, in 2007. Many articles focus on Brazilian suites of Proterozoic age, but there are also fine contributions on Finnish, Norwegian, and Czech examples. Drs. Robert Dall'Agnol and Tapani Rämö acted as guest editors. The volume gave me detailed insight into recent interpretations into what is going on petrogenetically. I will single out two areas that excited me to the point of wanting to "get involved." The first concerns the real challenge of explaining the mineralization at the Pitinga mine in northern Brazil. Two groups of authors, Costi et al. and Bastos-Neto et al., have investigated the mineralized Madeira granite, of peralkaline flavor, and come to rather different interpretations about the relative



merits of fractional crystallization, liquid immiscibility, and hydrothermal processes to explain what they found. I was thrilled to edit these juxtaposed articles, and to realize that there are still interesting studies begging to be done to resolve the issues. As the Pitinga Sn–Nb mine is in production and will soon start to process the lens of massive cryolite, the questions raised go beyond the realm of academic discussions and do have a socioeconomic dimension.

I was also fascinated to read in detail about the long-term efforts of T. Andersen and his coinvestigators to systematically sample zircon in A-type granites in southwestern Fennoscandia. By carefully monitoring the Lu–Hf systematics of zircon in A-type granites emplaced in the interval 920–1170 Ma, three different crustal sources could be identified. The initial Hf isotope composition of the igneous zircon is compatible with mixing of Paleoproterozoic and Mesoproterozoic Fennoscandian crustal material with juvenile material derived from the sublithospheric depleted mantle. So there is hope! The petrogenetic antecedents of A-type granites **can** be decoded!

The final IGCP-510 symposium will take place in August 2010 in Helsinki. It promises to be an exciting exchange of views!

Robert F. Martin, Editor
The Canadian Mineralogist

2009 MAC TRAVEL AND RESEARCH GRANTS

MAC awarded 15 student travel and research grants in 2009 for a total amount of $12,125. Four grants were awarded to undergraduate students: Melissa Anderson (Brandon University), Yee Ping Chau (University of Calgary), Darren LeFort (Saint Mary's University), and Tingting Wang (University of Waterloo); five to MSc students: Suzanne Byron (University of Alberta), Taryn Gray (St. Mary's), Varina Smith (McGill University), Albert Stoffers (Carleton University), and Eva Wadoski (University of Maine); five to PhD students: Christopher Charles (University of Toronto), Colin Cooke (University of Alberta), Matthew Izawa (University of Western Ontario), Dawn Kellett (Dalhousie University), and Adrian Van Rythoven (University of Toronto). We congratulate these deserving students and present highlights of their reports:

Suzanne J. Byron (University of Alberta) participated in the 10th Biennial Meeting of the Society for Geology Applied to Mineral Deposits (SGA), held in Townsville, Australia. She presented the results of her MSc in a talk entitled "Giant Quartz Vein Zones in the Great Bear Magmatic Zone, Northwest Territories, Canada." Her studies were conducted under the supervision of Dr. S. A. Gleeson, and were focused on petrography, cathodoluminescence, fluid inclusion microthermometry, and stable isotopes of mineralized (Cu ± U) and non-mineralized giant quartz-vein systems. She also attended a field trip entitled "Breccias, Fluids and Copper Mineralization in the Mt. Isa and Cloncurry Region, NW Queensland," where she found many similarities between the hydrothermal and IOCG deposits in Australia and the deposits in the Great Bear magmatic zone.

Colin Cooke is a PhD candidate at the University of Alberta. With financial assistance from a MAC student travel grant, Colin presented a talk and a poster at the 6th International Symposium on Ecosystem Behavior (BIOGEOMON) in Helsinki, Finland. Colin's talk summarized recent efforts aimed at using lake-sediment geochemistry to reconstruct the over 1500-year history of mining and metallurgy at Cerro de Pasco, Peru, which was once the world's largest silver mine. In his poster, Colin presented biogeochemical results from a unique ~200,000-year-old lake core from the Canadian Arctic. His results help to place 20th-century environmental change in a long-term perspective and highlight the role human activities have played.

Darren LeFort, with financial aid provided by a MAC travel grant, travelled to Granada, Spain, where he presented the findings of his bachelor's thesis at the 20th European Current Research on Fluid Inclusions Conference. Fluid inclusion studies are fast becoming an important method for interpreting geological systems and processes. His thesis at St. Mary's University in Halifax, Nova Scotia, documented the genetic link between a low- to intermediate-sulfidation epithermal-style process and an alkalic Cu–Au porphyry system at the Mt. Milligan Cu–Au deposit in British Columbia.

Taryn Gray, a second-year master's student at Saint Mary's University, Halifax, attended the Joint Assembly meeting in Toronto. She was especially interested in the sessions "Complex Processes of Metal Enrichment in Ore-Forming Systems," chaired by Jean-François Moyan and Jacob Hanley, and "Recent Advances in Trace-Element and Isotopic Microanalysis of Accessory Minerals," presided by Robert Linnen and Lee Groat. She also used a portion of the grant to fund radiogenic (Nd–Sm) isotope work to further solve the "source" problem in her research. As she is comparing the geochemical and petrographic variation exhibited in two different volcanic complexes in New Brunswick, it is imperative that she demonstrate any variability in the composition of the source rock(s).

Matthew Izawa, a PhD student at the University of Western Ontario, demonstrated that bioalteration textures in basaltic glasses from in situ oceanic crust of the Ontong-Java Plateau are associated with fine-grained titanite (Izawa et al., submitted to *The Canadian Mineralogist*). This study, however, was performed using a ~50 µm micro-XRD beam, and therefore each analysis contains many hundreds of individual bioalteration textures. A logical next step is to determine the mineralogy within a single tubular bioalteration structure. To this end, he has prepared electron-transparent ultrathin sections across a tubular structure using a focused ion beam and is in the process of characterizing these sections using a variety of electron, X-ray, and ion microbeam techniques. This research was greatly assisted by funding from the Mineralogical Association of Canada for preparation of the ultrathin sections.

Dawn Kellett, a PhD candidate at Dalhousie University, received a MAC research grant to date in situ monazite from the Himalayan orogen by the U(–Th)–Pb method at the NERC Isotope Geosciences Laboratory, UK. The dated samples are tectonites associated with the South Tibetan detachment system (STDS), a low-angle, normal-sense detachment system that formed parallel to and coeval with continental collision. The resulting monazite ages were combined with thermobarometric estimates to construct pressure–temperature–time paths for footwall and hanging wall tectonites, and these results are compatible with numerical model predictions that suggest the STDS was the upper boundary of a lateral, low-viscosity channel.

Dirk Schumann, a PhD student at McGill University in Montreal, participated in the 14th International Clay Conference, held in Castellaneta Marina, Italy (13–20 June 2009). He was an invited speaker at a session on the Cretaceous–Paleogene and Paleocene–Eocene boundary events. He presented his work on newly discovered "giant" magnetofossils in a talk entitled "Gigantic Biogenic Magnetite in Boundary Clays at the Paleocene–Eocene Thermal Maximum" (see Schumann et al. 2008, Proc. Nat. Acad. Sci. 105: 17648-17653). These new and hitherto unknown forms of magnetofossils were extracted from clay-rich sediments deposited during the Paleocene–Eocene thermal maximum in an area that is now the coastal plain of New Jersey, USA. He also presented a part of his PhD-related research on high-resolution transmission electron microscopy investigations of synthetically produced and naturally occurring 2:1 layer silicates.

Varina C. Smith (McGill University) received funding from MAC to help her collect data from vesuvianite crystals using a single-crystal X-ray diffractometer at McMaster University. Unit cell parameters were obtained on pairs of nonequivalent prismatic forms. The data collected through the diffraction study contributed another line of evidence for lowered symmetry in vesuvianite from Jeffrey Mine, Asbestos, Québec. This complemented the rest of her MSc thesis project, in which she investigated the role of growth steps in inducing disequilibrium using optical microscopy, atomic force microscopy, and electron microprobe analysis.

Albert Stoffers, an MSc student at Carleton University, used his MAC research grant to carry out oxygen isotope work on 20 volcanic-rock samples from the northern Sierra Nevada. Very little work has been done on volcanic rocks located between Mt. Lassen and Lake Tahoe, leaving a substantial gap in our understanding of the tectonic and volcanic evolution of the ancestral and modern Cascade arcs. The transition between the two may be abrupt, signifying a sharp lithospheric or slab boundary, or it may be gentle, suggesting a temporal change in geochemical characteristics as opposed to a geographical change. Albert will use whole rock, trace element, isotope, and petrographical data to evaluate the nature of the transition between the modern and ancestral arcs.

Eva Wadoski (University of Maine) attended the 2009 Joint Assembly in Toronto, where she presented a poster entitled "Compositional Evolution of Tourmaline-Group and Associated Minerals from Pegmatites in the Larsemann Hills, East Antarctica" in the session "Tourmaline: An Ideal Indicator of Its Host Environment." Her participation provided her an opportunity to receive valuable feedback, which she incorporated into her thesis manuscript. Her poster presented part of her master's research, which combined microstructural observations with chemical composition data from six borosilicates (tourmaline-group minerals, prismatine, dumortierite, grandidierite, boralsilite, and werdingite). By examining the reaction textures and chemical variations within tourmaline-group minerals and their associated borosilicates, she will evaluate the changes that occur in B-rich anatectic pegmatites.