Using biotite composition of the Devonian Mount Elizabeth Intrusive Complex, New Brunswick, as a proxy for magma fertility and differentiation in W-Mo-Au-Sb mineralized magmatic hydrothermal systems

ZEINAB AZADBAKHT, DAVID LENTZ, AND CHRISTOPHER MCFARLANE

Department of Earth Sciences, University of New Brunswick, P.O. Box 4400, Fredericton, New Brunswick E3B 5A3, Canada <zeinab.azadbakht@unb.ca>

The Early Devonian (418 ± 1 Ma, monazite U-Pb) Mount Elizabeth intrusive complex, New Brunswick, Canada, is a multiphase metaluminous to weakly peraluminous, high K calc-alkaline body that shows within-plate affinity. The complex consists of apparently contemporaneous igneous suites including a mafic suite, an eastern peraluminous granite suite, and a western alkali granite suite. The eastern part comprises a compositionally and texturally homogeneous biotite granite, whereas the western part is mostly heterogeneous and contains five different units. The most abundant unit of the western suite is a mediumto coarse-grained alkaline equigranular granite. This complex is poorly exposed so that most of the available interpretations, including inferred contact relationships, are based on geophysical data. It should be added that no mineral occurrences have been reported so far from this complex.

Fresh biotite from this intrusion was analysed from core to rim by electron microprobe, and laser ablation-ICP-MS at the University of New Brunswick to test whether biotite preserves a record of magma evolution in terms of majorand trace-element and halogen compositional variations. Subhedral to elongate biotite phenocrysts are less than 700 µm long and reddish brown in colour indicative of a reduced I-type source. A calc-alkaline affinity is also suggested by biotite major element classification schemes. Biotite is locally altered to chlorite along cleavage planes, and typically contains iron oxides, monazite, ilmenite, apatite, xenotime, and zircon as mineral inclusions.

Results of electron microprobe and laser-ablation ICPMS studies indicate that biotite grains are homogeneous in major elements; however, they show variation in trace elements from core to rim. The biotite grains investigated have the highest Sn, W, Sb, and Mo concentrations recorded thus far among Devonian granitoid intrusions of New Brunswick (130, 40, 1, and 3 ppm, respectively). There is no systematic correlation between major elements including Fe_{Tot}, or Fe_{Tot}/Ti and any of these trace elements. To further study trace-element distribution, a biotite from each of the phases was mapped with laser-ablation ICP-MS revealing patchy Ba, Rb, and Cs zoning. These patterns are interpreted to be a result of localized hydrothermal alteration and intracrystalline volume diffusion in these biotite grains. The intracrystalline distribution of Sn, W, Mo and Sb is homogeneous. Furthermore, halogen contents analysed by EPMA indicate that hydroxyl is the dominant component of hydroxyl site followed by fluorine. It also showed that these biotites formed from strongly contaminated and reduced I-type granite. As a result, high concentration of Sn in biotite is interpreted to be caused by crustal contamination, and low-temperature hydrothermal processes (sub-solidus) rather than being magmatic in origin.

Atlantic Geology, 2015, Volume 51, Number 1
41st Colloquium & Annual General Meeting 2015
doi: 10.4138/atlgeol.2015.005