SEG 2017 Conference

Biotite geochemical analysis in the Sn-W-Mo-Bearing Mt. Douglas leucogranite, southwestern New Brunswick, Canada: Analysis of metallogenic indicies

Nadia Mohammadi*, Dave Lentz, Chris McFarlane, Zeinab Azadbakht

*University of New Brunswick, Fredericton, Canada, NB, Email: nadia.mohammadi@unb.ca

Biotite, as one of the principal carriers of the metals such, Sn, W, and Mo in its lattice, has been considered for this study to discriminate the barren least fractionated unit Dmd1 of the Mt. Douglas Granite from the fertilized Sn, W, Mo, and Zn bearing unit, Dmd3. The Mount Douglas intrusion (~ 370 Ma) is composed of a suite of peraluminous leucogranitic rocks affected by extreme fractional crystallization that produced compositionally and chronologically three different intrusive units, previously defined as Dmd1, Dmd2, and Dmd3. Of these three units, only Dmd3 as the most differentiated phase, and then Dmd2, are associated with variable economically interesting endogranitic Sn, W, and Mo deposits. *In situ* laser ablation quadrupole inductively coupled plasma-mass spectrometry (LA Q-ICP-MS) measurements using 24 µm crater beam size guided by electron microprobe analyses were applied on biotite of each unit. The data reveal interesting results demonstrating not only an extreme fractional crystallization trend increasing from Dmd1 to Dmd3, but also the association of the most fractionated unit, Dmd3, to mineralized greisen veins. The combined geochemical data reveal that siderophyllite-type biotite shows an extreme enrichment characteristic of Dmd3 with incompatible elements, such as Rb, Y, and REE together with other valuable elements, in which their concentration (ppm) is incredibly higher than Dmd1; these elements are Zn (597, 1937), Li (687, 1539), Pb (35, 532), Nb (52, 352), Cu (9.7, 59), Sn (11.5, 52), Sc (44, 138), Ga (54, 124) Ta (1.2, 37), W (1.3, 8.7), Tl (8.9, 22), Th (4, 88), U (3.5, 71), Mo (0.04, 0.25), and Sb (0.06, 0.84), in which the first number in parentheses is the average value of the element in Dmd1 and the second one is for Dmd3. The breakdown of the biotite lattice and conversion to muscovite or sericite during magmatic-hydrothermal processes, i.e., greisenization in the Mt. Douglas system may be one of the most important factor producing the mineralized greisen veins in Dmd2 and Dmd3. The data are accompanying with fluorine-chlorine activity of fluids, in which the F/Cl ratios decreasing from Dmd1 (ave. 14.6) → Dmd2 (ave. 7.7) → Dmd3 (ave. 2.8). Increases in major elements, such as Al, Fe, and Mn, from Dmd1 to Dmd3 and decrease in Mg, and compatible elements, including Ni, V, Sr, Ba, and Co is consistent with fractional crystallization. This process is manifested by increasing [Fe/(Fe + Mg)] ratios toward Dmd3 as the highest evolved unit: 0.67 → 0.88 → 0.91. The highest evolved character of the Dmd3 is indicated by REEs data as well. They show an enriched chondrite-normalized flat "birdwing shape" REE pattern with negative Eu anomaly. The highly evolved Dmd3 with the most pronounced negative Eu anomalies (Eu/Eu*=0.04), and the lowest normalized light (LREE) to heavy (HREE) rare earth ratio $[(La/Yb)_N = 2.9]$ might be related to more fractional crystallization of biotite grains of this unit. The data is consistent with the whole rock geochemical data of the Mt. Douglas granite.