Petrographic observations and evaporate-mound analysis of quartz-hosted fluid inclusions: Applications to assess metal fertility in granites

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The Devonian South Mountain Batholith (SMB), Nova Scotia, is a large (7300 km2), contiguous, epizonal granitoid intrusion consisting of 13 coalesced plutons hosting a variety of mineralization (Sn-W-Mn, Cu-Au). Given the hydrothermal nature of this mineralization, it might be expected that a geochemical fingerprint of the fluids could be preserved as fluid inclusions (FIs) in the granites on a scale equal to or larger than the mineralized zones. This study seeks to investigate this possibility using the SMB to assess granite fertility by integrating petrographic features of FIs and their chemistry via SEM-EDS analysis of evaporate mounds. Data from this work will then be used to establish a mineral-fertility indicator which may in theory be applied to any granitoid environment. The protocol uses bedrock samples from each square of a 10×10 km grid superimposed on the SMB. These samples were organized into 16 groups, each group representing 1 of 16 NTS map sheets. Results reported here include the analysis of samples from 3 of these 16 groups (e.g., 21A/09, 21A/16, and 11D/12). Petrographic observation of the FIs from all samples reveal: (1) the FIs are secondary (i.e., they display linear arrays along fracture planes); (2) the long-axis lengths vary between <1–50 µm, but predominately fall between 5–20 µm; (3) liquid (L)-vapour (V) ratios in FIs range between 95:5 and 90:10; 4) L–V type FIs are common with rare L- V-Halite types also present. Inclusion-rich quartz grains (i.e., magmatic quartz) were cut from ~200 µm thick wafers of the granite samples and subsequently heated in a 500 °C oven to promote FI decrepitation and form salt mounds. SEM- EDS semi-quantitative analyses of the mounds were then obtained. The diameters of the evaporate mounds are 2 to >100 µm and X-ray mapping indicates that mounds may be heterogeneous. Chemically the evaporate mounds are invariably multi-component and are dominated by Na-Ca-K, but in consistently different proportions which obviates the need to treat the data in multi-component space. When plotted together, therefore, distinct inclusion populations are observed: a Na-rich fluid, a Na-Ca-rich fluid, and a Na- K-rich fluid. Minor cations, in descending order, include Fe, Mn, Cu, Zn, and Sn. The dominant anions are Cl and F, but minor sulphur occurs in select samples.

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