Preliminary investigations of Nb in melt-fluid systems using *in situ* X-ray spectroscopy

Adam Jeremy Layman[1] and Alan J. Anderson[2]
1. Department of Earth Sciences, Dalhousie University, Halifax, NS, B3H 4J1 <alayman@dal.ca> ¶ 2. Department of Earth Sciences, St. Francis Xavier University, Antigonish, NS, B2G 2W5 <aanderso@stfx.ca>

Knowledge of Nb partitioning between coexisting aqueous fluid and silicate melt is needed to model the geochemical behaviour of Nb in ore deposits and other crustal rocks. Previous experimental studies have focused mainly on the solubility of Nb in silicate melts. However, Nb mineralization is known to occur in fenites and other metasomatic rocks, and evidence of Nb mobilization by aqueous fluids at submagmatic temperatures is indicated by the presence of Nb-rich minerals in some hydrothermal veins. *In situ* studies, over a range of geologically relevant pressures and temperatures using Synchrotron radiation X-ray fluorescence (SR-XRF) are in progress to investigate the geochemical behaviour of Nb in different melt-fluid systems. Synthetic Nb-bearing granitic glasses and four different fluids having various compositions and densities provide the starting materials used in our preliminary experiments. SR-XRF of samples within a hydrothermal diamond anvil cell (HDAC) permits separate analyses fluids *in situ*, at elevated T and P. Starting experimental fluids include distilled water with 1000 ppm Br, distilled water with no Br, 0.5 M Na_2CO_3 with 500 ppm Br, and 1 M Na_2CO_3 with 1000 ppm Br. Br serves as an internal standard for XRF analysis. XRF spectra are quantified using a fundamental parameters program and the known concentration of Br in the fluid to calculate the concentration of Nb via relative peak intensities. The quantification routine incorporates the X-ray path media (diamond, air) and lengths, solvent composition, and incident energy level to determine the concentration of the desired element.

Relatively high density fluids (carbonate and distilled water, ≥ 0.95 g/cm^3 and ≥ 0.965 g/cm^3, respectively) render a single aqueous-siliceous fluid phase. The aqueous-siliceous fluid (±carbonate) contains up to 25 ppm Nb. Carbonate-bearing fluids acquire Nb from coexisting silicate melts at lower pressures (0.85 g/cm^3). In contrast, Nb is not strongly partitioned from a melt into pure water. The Nb concentration in a single phase fluid incorporating Nb glass in a 1 M carbonate fluid (ρ =

Copyright © 2015 Atlantic Geology

0.95 g/cm^3) is 25 ppm, corresponding to an initial glass-to-fluid ratio of 0.05 (by mass). Nb concentration in the aqueous fluid decreases with decreasing temperature and pressure, from 19 ppm at 600°C (≈7 kbars) to ≤ 3 ppm at 400°C (≈3.5 kbars)

Carbonatites are the primary ores for Nb. Nb is also concentrated in alkaline igneous rocks and pegmatites. Our initial results show that a carbonate alkaline fluid coexisting with a melt provides an alternate/parallel host or transport medium. Carbonate-charged aqueous fluids may play a significant role in the formation and distribution of some Nb ores.