

Picrite-driven cratonization: a perspective from the NeoArchean Ungava craton

DEJAN MILIDRAGOVIC^{1*}, DON FRANCIS¹, AND DOMINIQUE WEIS²

¹McGill University, Earth and Planetary Sciences, Montreal QC
dejan.milidragovic@mail.mcgill.ca (*presenting author)
don.francis@mcgill.ca

²Univ. British Columbia, EOS, PCIGR, Vancouver BC
dweis@eos.ubc.ca

Zoned ultramafic/mafic plutonic rocks emplaced at mid-crustal depths occur scattered across the disparate terranes of the Ungava craton of the Archean Superior Province. These Quilinaaraaluk (Q-suite) intrusions are coeval with the ca. 2.74-2.72 Ga pyroxene-bearing granitoids and high-K granitoids that dominate the Ungava craton [1], and their wide spread distribution suggests that mantle-derived magma may have played a key role in cratonization of the northern Superior province at the end of Archean. The Q-suite intrusions are small, irregularly-zoned cumulate bodies that include a spectrum of lithologies, ranging from olivine-dominated adcumulate-mesocumulate cores to more evolved gabbro(norites). Their parental magmas appear to have been H₂O-rich as indicated by the abundance of oikocrystic amphibole in the mesocumulate rocks. Electron microprobe analyses of olivine (Fo_{max} = 85) from peridotitic cores across the peninsula, suggest that the parental magmas were enriched in Fe relative to present day picritic magmas. Although the Q-suite intrusions intrude a number of isotopically distinct terranes (Boily et al. 2009), their trace element signatures are strikingly similar across the entire 300+ km width of the Ungava Craton. Despite the Fe-rich composition of their parental magmas, Q-suite rocks are characterized by “calc-alkaline” trace element signatures, with relatively flat (MREE/HREE)_{PM}, elevated (LREE/MREE)_{PM}, and strong depletions in the HFSE, in particular Nb and Ta (Fig. 1). Furthermore, the pyroxene-bearing granitoids have compositions that span the gap between the coeval Q-suite and high-K granitoids, indicating intimate interaction between mantle-derived magmas and crustal melts. Geochemical, mineralogical and field data thus suggest that the craton-wide emplacement of Fe-rich picritic magma with “calc-alkaline” trace element affinities may have been responsible for the crustal melting episode that stabilized the Ungava craton at the end of the Archean.

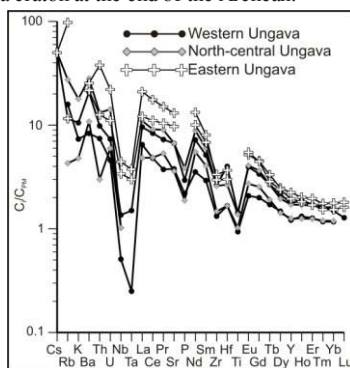


Figure 1: Primitive mantle-normalized trace element abundances in representative Q-suite websterites and wehrlites

[1] Maurice et al. (2009) *Prec Res* 168, 45-65. [2] Boily et al. (2009) *Prec Res* 168, 23-44.

Li and B isotopic composition of basement rocks, Dawn Lake area, Athabasca Basin, Saskatchewan

ROBERT MILLAR^{1,*}, IRVINE R. ANNESLEY^{2,3}, ROBERTA L. RUDNICK⁴, XIAOMING LIU⁴, AND KEVIN ANSDALL³

¹Saskatchewan Research Council, Saskatoon, Canada,
millar@src.sk.ca (* presenting author)

²JNR Resources, Saskatoon, Canada, jnrirvine@sasktel.net

³University of Saskatchewan, Saskatoon, Canada,
kevin.ansdall@usask.ca

⁴University of Maryland, College Park, United States of America,
rudnick@umd.edu, xliu1235@umd.edu

Recent literature suggests Li isotopic fractionation can occur during weathering, hydrothermal alteration, igneous and metamorphic processes [1], while the B isotopic signature preserved in refractory minerals, such as tourmaline, can aid in determining the source of fluids and P-T conditions during crystallization [2]. The objectives of this research are to determine the $\delta^7\text{Li}$ and $\delta^{11}\text{B}$ of relatively fresh to strongly altered basement lithologies in the vicinity of uranium mineralization in the Athabasca Basin (SK, Canada) and to evaluate if bulk isotopic analysis of Li and B can provide insight into the fluids that precipitated this mineralization with implications as a possible vectoring tool.

The largest high grade uranium deposits in the world are found within the Athabasca Basin of northern Saskatchewan, although the source of the uranium and the ultimate depositional mechanism are still highly debated. A suite of samples from the Dawn Lake area (12.9 M lbs @ 1.69% U₃O₈) include fresh to strongly altered graphitic pelitic gneiss and granitic pegmatites. Li concentrations from bulk chemical analysis range between 76 and 369 ppm, whereas B concentrations vary between 62 and 915 ppm. The elevated concentrations of Li and B are related to the presence of hydrothermal clay minerals and tourmaline, while the latter is also present as earlier formed magmatic and/or metamorphic minerals. The significant concentrations of Li and B were more than adequate for isotopic analysis, $\delta^7\text{Li}$ measured by MC-ICP-MS relative to L-SVEC display values between +4‰ and +13‰ for pelitic and graphitic pelitic gneiss and +6.2 to +18.6‰ for granitic pegmatites. The $\delta^{11}\text{B}$ measured by HR-ICP-MS relative to NBS951 was determined for granitic pegmatites to be in the range from -5.3 to 1.6 ‰, whereas the $\delta^{11}\text{B}$ for metasediments range from -0.8 to 3.5 ‰. There is no correlation between the elemental concentration of Li and B and the isotopic composition, but large variations in $\delta^7\text{Li}$ and $\delta^{11}\text{B}$ may be due to mixing of magmatic/metamorphic and hydrothermal components (eg., [3]) in these bulk samples. Further work will aim to unravel the cause of the isotopic variability and determine whether $\delta^7\text{Li}$ and $\delta^{11}\text{B}$ of bulk samples can aid in vectoring towards U mineralization.

[1] Teng et al. (2006) *American Mineralogist* 91, 1488-1498. [2] van Hinsberg, Henry and Marschall (2011) *The Canadian Mineralogist* 49, 1-16. [3] Mercadier, Richard and Cathelineau, (2012) *Geology*, doi: 10.1130/G32509.1