



Origin of the pegmatites and associated uranium mineralization from the CAGE province (North Québec)

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The north Quebec area studied is located in the western part of the Torngat Mountains (Fig.1). Uranium mineralizations are observed in metasediments, mainly localized in the Lake Harbour group which consists of calcitic and dolomitic marbles, paragneisses, quartzites, calc-silicate rocks and metabasalts injected by pegmatites (Verpaalst et al., 2000). The objective of the study is to constrain the genesis of the pegmatites (Fig.2) and associated U mineralization.

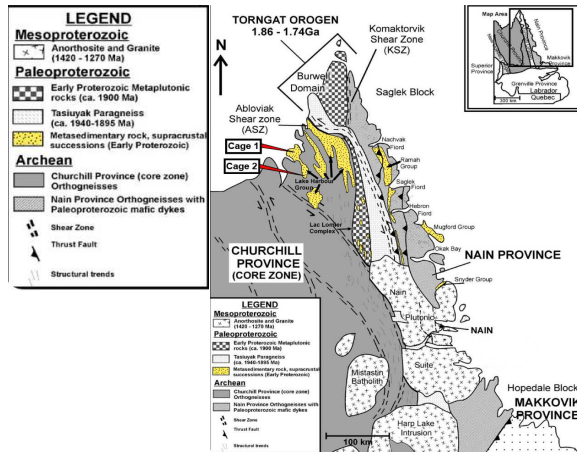


Figure 1: Major geological Units of the Torngat, Churchill and Nain Provinces, and localisation of the Cage area (after Van Kranendonk, 1996). Paleoproterozoic metasedimentary rocks were metamorphosed during the Torngat (Hudsonian) Orogen (~ 1.8 Ga).

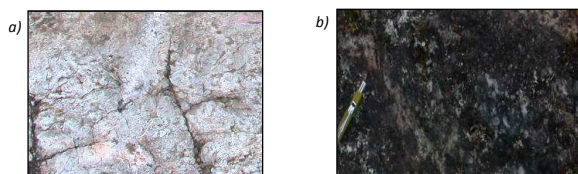


Figure 2: pegmatite samples: a) Bp area; b) Ip area

2. Isotopic Rb-Sm and Sm-Nd behavior in different pegmatites

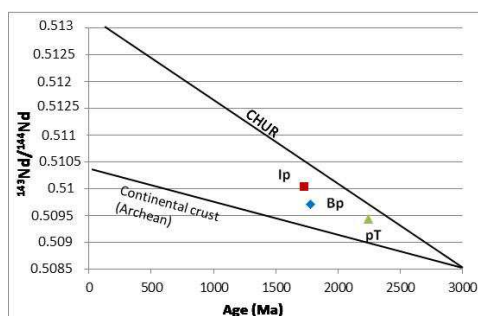


Figure 8: $^{143}\text{Nd}/^{144}\text{Nd}$ vs. age (Ma) : shows pegmatite (dated at 1727 Ma for Bp and 2241 Ma for pT) isotopic composition variations.

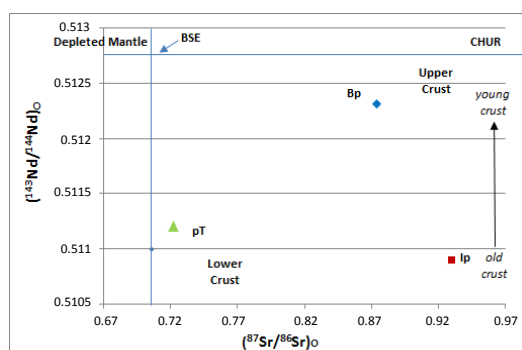


Figure 9: $^{143}\text{Nd}/^{144}\text{Nd}$ vs. $^{87}\text{Sr}/^{86}\text{Sr}$ isotope correlation diagram, showing the relative position of depleted mantle and enriched upper and lower crust (BSE: Bulk Silicate Earth $^{87}\text{Sr}/^{86}\text{Sr} = 0.7052$).

1. Major elements and REE preliminary study

Two U-rich pegmatites : pT and Ip

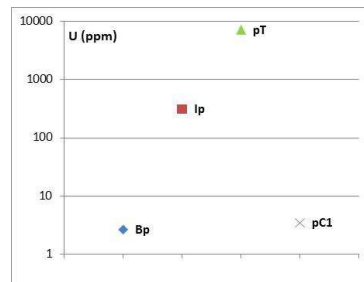


Figure 3: U contents of the different pegmatites Neto (2010).

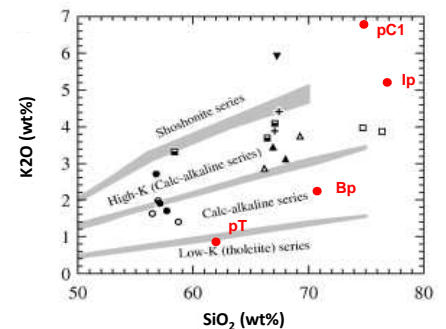


Figure 4: The subdivision of subalkalic rocks using the K_2O vs silica diagram (Rickwood, 1989).

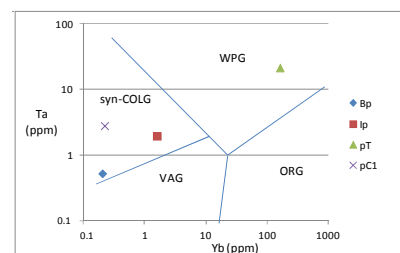


Figure 5: Diagrams showing the fields of volcanic arc granites (VAG), syn-collisional granites (syn-COLG), within-plate granites (WPG) and ocean-ridge granites (ORG) (after Pearce et al., 1984).

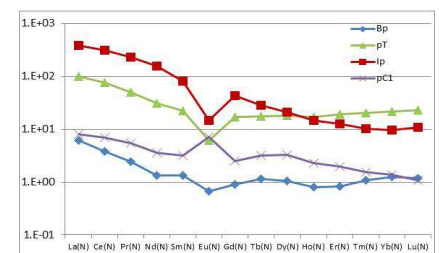


Figure 6: REE Patterns (chondrites CN normalized by Anders and Grevesse, 1989) of the various pegmatites. The Eu anomaly is controlled by the abundance of plagioclase.

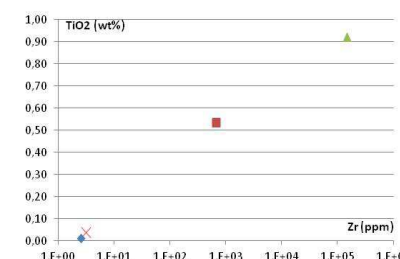
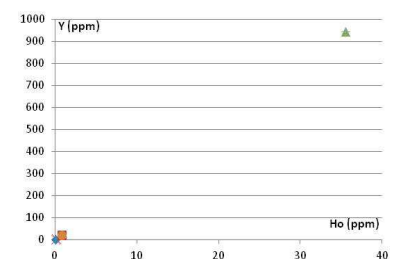


Figure 7: Any variation in the ratio TiO_2/Zr reflects heterogeneity of the source (Bougault et al., 1980) with possible mixing of different sources and/or contamination. Bivariate plot of the Ho/Y can approximate the ratio of the elements in the source (Sun and McDonough, 1989).



Conclusions

- The pegmatites of the Cage area (north Québec) share similar characteristics as the Rössing alaskite from Namibia, of anatectic origin (Cuney and Kyser 2008).
- The heterogeneity of the geochemical characteristics for these first pegmatites favour a syn-metamorphic model (partial melting) where U enrichment has a magmatic origin (melts and fluids injected in metasediments to form the pegmatites). The carbonate rocks have played the role of chemical barrier, for the crystallization of the pegmatites and trapping of uranium.
- Among the studied pegmatites, the pT one is particularly enriched in U (Fig.3), it is the only one with a within-plate granites signature (Fig.5). It shows that it clearly comes from a different source (extremely rich in plagioclase) as the other pegmatites (Fig.7) with possibly a lower continental crust signature.
- The evolution lines of the pegmatites probably intersect because their source is not derived from a single component (two more primitive CHUR type and the other the host rock) (Fig.8). The Sr data suggest that the pegmatites were derived from a continental crust partial melting, a more enriched source for pT and Ip which have also higher U, Ti and REE contents (Fig.9). The Sr-Nd isotopes signature of these two pegmatites highlights the earlier origin of their source.

References: Bougault et al., (1980). Phil. Trans. R. Soc. Lond., A 297, 203-213; Cuney and Kyser 2008; Neto J. (2010). Thèse de doctorat Université Henri Poincaré, Nancy-1. 202 p.; Pearce et al., (1984). J. Petrol., 25, 956-983; Rickwood (1989). Lithos, 22, 247-263.; Sun and McDonough (1989). In: Saunders A.D. and Norry M.J. (eds.), Magmatism in ocean basins. Geol. Soc. Lond. Spec. Pub. 42, 313-345; Verpaalst et al., (2000). Rapport RG 2000-2 du Ministère des Ressources naturelles du Québec.