Geophysical Research Abstracts
Vol. 17, EGU2015-6449, 2015
EGU General Assembly 2015

The role of partial melting and syn-orogenic deformation in the pre-concentration of uranium and thorium. The example of the CAGE District (Northern Quebec).

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This contribution aims to discuss the relationships between metamorphism, deformation and U-Th mineralization within the orogenic crust, from millimeter to kilometer scale and during the whole P-T-t evolution. The study area is the CAGE district along the paleoproterozoic Torngat orogen (Northern Quebec) made of 2.1 Ga metasedimentary rocks, marbles and paragneisses, deposited upon a 2.5 Ga orthogneissic basement. Several types of U-Th mineralizations have been reported within the middle crust highly metamorphosed and deformed during the Torgnat orogeny (1.9-1.8 Ga). An integrated study with field, geophysical, structural, petrological, geochemical and thermochronological analyses enable a reconstitution of the tectono-metamorphic setting of these U-Th mineralizations and of the mechanism responsible for their pre-concentration into the orogenic crust.

The petrological analysis allows us to build a clockwise P-T-t-D evolution with peak pressure conditions at 7.5 - 10 kbar and 725 - 750 ° C and peak temperature conditions at 5-6 kbar and 800-850°C. This high grade metamorphism and widespread partial melting developed within a single dextral transpressive regime. The structural analysis suggests strain partitioning responsible for a S-C-C' like architecture observed at all scales. Aeromagnetic, radiometric and field observations revealed that U-Th mineralizations are mainly focused along the kilometer scale C and C'-type shear zones. The age of crustal partial melting was constrained by U-Pb LA-ICP-MS analyses on zircon and monazite within migmatitic paragneiss and orthogneiss between 1841 $\pm$ 5 and 1828 $\pm$ 7 Ma. Younger U-Pb ages at around 1810-1750 Ma have been reported on monazite and titanites within the crustal scale shear bands (C and C' like). Results obtained on mylonitic metacarbonaceous and metapelites within kilometer scale shear zones suggest that late shearing formed during retrograde evolution at decreasing temperature after peak metamorphism. The δ13C and δ18O results obtained on calcite and graphite within a marble suggest temperature of 650-770°C for undeformed zones and 470-550°C in mylonitic shear zones. Within some shear zones within paragneiss, the metamorphic assemblages and disappearance of monazite suggest a possible hydrothermal alteration after the circulation of an acidic fluid under subsolidus condition.

We propose a metallogenic model for remobilization of U and Th in response of syn-orogenic partial metling and deformation of a continental crust. During peak metamorphism, partial melting is responsible for a passive concentration of monazite in migmatitic paragneiss. Crystallization of anatectic melt released hydro-magmatic fluids that will move along the shear zones toward higher structural levels. These fluids are responsible for dissolution of monazite under sub-solidus conditions. The subsequent U-Th-rich fluids will precipitate U-Th along shear zone, within pegmatites, skarn or marbles. This process may act as strong pre-concentration mechanism process for world-class U-Th deposits.