Geochemistry of uraninite from the Elliot Lake and Wits basins : New insights on the source of uranium

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Major and trace element geochemistry of uraninite and associated accessory minerals from the Witwatersrand (South Africa) and Elliot Lake (Canada) basins have been studied to characterize the source(s) of the U mineralization.

The earliest uranium mineralization corresponds to uraninite grains within quartz-pebble conglomerate reefs of the Dominion Group and the Witwatersrand Group deposited from 3.09 to 2.71 Ga, and of Elliot Lake Group deposited from 2.45 to 2.3 Ga. Uraninite appears as angular to well rounded grains (Elliot Lake and Dominion reefs) up to 200 µm wide, associated with pyrite, titanium oxides, chromite, columbite-tantalite, zircon and monazite, or as micronscale euhedral crystals within carbon seams (West Rand and Central Rand reefs). Secondary Ti-U associations and brannerite are also quite common.

Major and trace elements in uraninite have been analyzed by electron and ion microprobes (CAMECA SX100 and IMS-3f). The high Th content (0.95 to 12.21 wt% ThO_2) and the variation of Th contents between individual uraninite crystal are characteristic of their ultimate derivation from various types of granitic source. Uraninite composition is also variable in the different reefs depending both of the source rocks and of the degree of post-depositional alteration processes. The Witwatersrand uraninite compositions are close to those issued from peraluminous leucogranites (low Th), and the Elliot Lake ones are close to higher temperature magmas (high Th). REE patterns are also characteristic of magmatic uraninite: high ΣREE (10^3 chondrites), weak fractionation of the REE with a flattened bell shape pattern and a negative Eu anomaly corresponding to plagioclase fractionation in the magmatic source. U-Pb dating by SIMS of the uraninites reveals a strong and variable Pb loss consecutive to later hydrothermal alteration event(s).

The geochemical signature of the uraninites from the Dominion and Elliot Lake Groups demonstrates their derivation from granites/pegmatites enriched in U, and their mechanical accumulation in paleoplacers. Granitoids sufficiently enriched in uranium able to crystallize uraninite have to have existed as soon as 3.1 Ga. This work further support the anoxic character of the Earth atmosphere prior to the youngest uraninite-bearing reef deposition (>2.3 Ga).

Tephra as an absolute dating and correlation tool for Antarctic ice cores

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Eruptions from Antarctic stratovolcanoes have produced widespread volcanic ash (tephra) layers that were deposited over large areas of the East and West Antarctic ice sheets. These eruptions and subsequent deposition of tephra take place over very short time intervals (several weeks to years), and create widespread time-stratigraphic markers that are preserved within ice sheets which may then be sampled by ice cores. If a known ash is correlated between ice cores, the climate records of the cores may be very precisely chronologically linked. Ice core tephra that can be correlated to a dated volcanic eruption provide a climate-independent chronological marker within the core, although one limited by relatively high error of radioisotopic dating techniques. Of the many volcanoes that protrude through the West Antarctic ice sheet, Mt. Takahe and Mt. Berlin have been the most active ash-producers over the last 500,000 years. Mt. Takahe erupted a number of recent trachytic ashes, including events at 8.2±5.4 ka, 93.3±7.8 ka and 102±7.4. Young eruptions from Mt. Berlin have been sampled and dated in the crater region at 10.3±5.3, 18.2±5.8, 25.5±2.0. A nearby blue ice site located on the shoulder of the ice-filled summit crater of Mt. Moulton exposes a total of 48 tephra layers, mostly from Mt. Berlin. Eight of the tephra layers at the Mt. Moulton site have been directly dated potassic feldspar phenocrysts using the $^{40}Ar/^{39}Ar$ method, to (in stratigraphic order from top to base of the blue ice section) 10.5±2.5; 24.7±1.5; 92.1±0.9; 104.9±0.6;118.1±1.3; 135.6±0.9; 225.7±11.6; and 495.6±9.7 ka. Tephra layers found at Mt. Moulton have been identified in the Siple Dome ice core [1,2,3], as well as in the Vostok and EPICA-Dome C ice cores [4,5,6]. Mt. Moulton tephra layers are likely to be found in future Antarctic ice cores, providing absolute chronology as well as cross-correlation between ice cores. An abundance of Mt. Berlin tephra layers are present in the ice spanning Termination II, and these may provide important links between ice cores in this important time interval.

[1] Dunbar *et al*. (2003) *J.. Geop. Res*. **108**, B2374. [2] Kurbatov *et al*. (2006) *J. Geop. Res*. **111**, D12307. [3] Taylor *et al.* (2004) *J. Glaciol*. **50**, 453. [4] Basile *et al*. (2001) *J. Geophys Res.* **106**, D31915. [5] Narcisi *et al*. (2006) *Quat. Sci. Rev.* **25**, 2682. [6] Narcisi *et al*. (2005) *EPSL* **239**, 253.