

## Detrital sediments of the ca. 3.77 Ga Nuvvuagittuq Supracrustal Belt, Québec (Canada)

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The Eoarchean Nuvvuagittuq Supracrustal Belt (NSB) in northern Québec is dominated by Ca-poor amphibolites, with minor ultramafic schists, banded iron-formations (BIFs), quartz-biotite schists and other rocks of sedimentary protolith [1]; these were brought to amphibolite facies metamorphic conditions in the Archean [2]. Whereas most amphibolitized mafic igneous rocks contain hornblende (*sensu lato*), a pale (low-Ca) cummingtonite amphibolite (*Amc*) unit predominates in the NSB [2]; this unit reportedly preserves deficits in  $^{142}\text{Nd}/^{143}\text{Nd}$ , indicative of an ancient (pre-4.28 Ga) source [3]. Other unusual geochemical characteristic of the *Amc* rocks include more variable concentrations of most major oxides (e.g.  $\text{SiO}_2$  ranges from 45- 60 wt.%;  $\text{MgO}$  4-16 wt.%), elevated  $\text{K}_2\text{O}$ , and lower  $\text{FeO}$  concentrations when compared to 'normal' hornblende amphibolites.

We interpret these major geochemical differences as consistent with an origin for the *Amc* units from weathered (basaltic) volcanoclastic deposits. Lack of intrusive field relationships supports this interpretation. Conspicuous absence of chemical fronts at contacts between *Amc* and hornblende amphibolites argues against a later metasomatic origin for the *Amc*. Oxygen isotopic analyses are underway to test this interpretation. In places, the *Amc* units host thin (<0.5 m thick) fuchsitic quartzites (>75wt.%  $\text{SiO}_2$ ; >50 ppm Cr) which share the deformational history of the belt. The quartzites have chemical affinities with previously described quartz-biotite ('conglomeratic?') schists [3], and are unlike BIFs. Detrital zircons from these quartzites provide a maximum age for the NSB at 3.77 Ga, virtually syn-formational with the minimum age provided by zircons in cross-cutting orthogneisses [4]. We propose a rapid evolution for the NSB, with komatiitic and basaltic volcanism, and volcanoclastic deposition interspersed with detrital and chemical sediment deposition during times of quiescence. This tectono-sedimentary style resembles other younger and better preserved Archean succession such as those preserved in the Barberton and Abitibi greenstone belts.

- [1] O'Neil *et al.* (2007) *Dev. Precamb. Geol.* **15**, 219–250.  
[2] Cates & Mojzsis (2009) *Chem. Geol.* **261**, 98–113.  
[3] O'Neil *et al.* (2008) *Science* **321**, 1828–1831. [4] Cates & Mojzsis (2007) *EPSL* **255**, 9–21.

## Measurement of cation exchange capacity in shale using radiographic detection of Cesium

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Cavé *et al.* [1] describe a simple, non-destructive, radiography method for estimating 1D, spatially-resolved porosity profiles, and pore-diffusion coefficients ( $D_p$ ) in geological materials. Here we present an extension of the radiography technique to provide estimates of the CEC for intact samples of Ordovician shale from southwest Ontario, Canada.

Measurements of CEC are commonly conducted on disaggregated samples using batch methods that may overestimate the *in situ* CEC. In addition, when the natural pore water is saline, it can be difficult to quantify ions on exchange sites that are a small fraction of the total dissolved solids.

The present technique utilizes measured changes in X-ray absorption properties of a sample as CsCl tracer solution diffuses through the rock pores. A quantitative relationship is established between the measured X-ray absorption and the combined mass of Cs in the pore fluid and on exchange sites. This relationship allows for the measurement of 1D, time-series profiles for Cs mass versus distance during the tracer diffusion experiment. The profiles are interpreted using the reactive transport code MIN3P to estimate the CEC. Initial results for a shale from southwest Ontario (porosity 10.9%) indicate  $\text{CEC} = 14.6 \pm 0.4 \text{ meq}/100\text{g}$ .

- [1] Cavé *et al.* (2009) *J. Contam. Hydrol.* **10**(1-2), 1–12.