

Rhenium-Osmium Isotope Geochronology of the Neoproterozoic Fifteenmile Group, Coal Creek Inlier, Yukon, Canada

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New ¹⁸⁷Re-¹⁸⁷Os isotope data on organic rich mudrocks from the Neoproterozoic Fifteenmile Group, Coal Creek Inlier, Yukon, Canada provide direct age control for biomineralizing scale microfossils [1] and the termination of the Bitter Springs isotopic stage in northwest Canada. The uppermost Reefal Assemblage of the Fifteenmile Group has a preliminary ¹⁸⁷Re-¹⁸⁷Os isochron age of 752 ±44 Ma (2σ; Model-3; MSWD 4.2; ¹⁸⁷Os/¹⁸⁸Os_i 0.42 ±0.22). The obtained age is identical within error to ¹⁸⁷Re-¹⁸⁷Os ages from the correlated Wynniatt Formation, Victoria Island, Canada [2]. This result is also in good agreement with known U-Pb TIMS zircon analysis which brackets the sampled portion of the Upper Fifteenmile Group between 811.0 and 717.4 Ma [3]. If the ~750 Ma age model is correct, the Bitter Springs isotopic stage could be younger or extend longer than previously thought (~800 Ma). A younger age for the Bitter Springs Stage may also impact global paleogeographical reconstructions based on anomalous global paleomagnetic records from the Bitter Springs stage [4]. These measurements also represent an important benchmark for the ¹⁸⁷Os/¹⁸⁸Os_i composition of Neoproterozoic seawater. The ¹⁸⁷Os/¹⁸⁸Os_i record is an emerging seawater proxy which has the ability to trace rapid climatic perturbations [5]. This proxy record can provide independent confirmation of climatic fluctuations observed in important Neoproterozoic ⁸⁷Sr/⁸⁶Sr, δ¹³C reference sections [6]. Further ¹⁸⁷Re-¹⁸⁷Os work on samples from the Fifteenmile Group is ongoing.

[1] Cohen *et al.* (2011) *Geology* **39**, 539-542. [2] van Acken *et al.* (2012) *MinMag*, Abstract #272. [3] Macdonald *et al.* (2010) *Science* **327**, 1241-1243. [4] Swanson-Hysell *et al.* (2012) *Am. J. Sci.* **312**, 817-884. [5] Turgeon & Creaser (2008) *Nature* **454**, 323-326. [6] Halverson & Shields-Zhou (2011) *Geol. Soc., Lon. Mem.* **36**, 51-66.

How bugs get their food: Linking mineral surface chemistry to nutrient availability

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The bio-acquisition of mineral-bound key nutrients by microorganisms is currently of great interest because of our desire to understand soil nutrient cycling. It has been shown that fungi seek out nutrient sources through expansive mycorrhizal networks, acting as biosensors for 'tasty snacks'. The mechanism by which fungi extract nutrients from minerals is by combining bio-mechanical forcing of the structure [1] with subsequent chemical alteration [2]. Usually, release of nutrients from minerals is discussed in terms of bulk chemical content. Here, we present data showing the importance of the surface composition of biotite, a key terrestrial source of primary nutrients (in particular potassium), to influence nutrient availability. This gives us new insights into the mechanisms by which microorganisms weather minerals, aiding in soil formation.

A suite of batch potentiometric and electrokinetic titrations (pH 1-12 and 25 °C), were carried out to determine the surface chemistry and reactivity of biotite by quantifying protons consumed and metals released. Potassium was found to be preferentially removed from the biotite surface down to an average depth of ~ 20 nm at all pH values. A slight pH dependency of this removal and the proton consumption profile suggest a significant portion of K was removed from the structure immediately upon contact between the biotite surface and the fluid. The existence of such a K depleted surface suggests that microorganisms are required to physically break the mineral structure to access nutrients from newly created surfaces. Our data set underpins the need for an initial bio-mechanical forcing of the mineral surface prior to its chemical alteration, leading to increased weathering.

[1] Bonneville *et al.* (2009) *Geology* **37**, 615-618. [2] Bonneville *et al.* (2011) *GeoChim. Cosmochim. Ac.* **75**, 6988-7005.