Re-Os geochronology of the Neoproterozoic Coppercap and Twitya Formations: Implications for the Rapitan-Sturtian glaciation

A.D. ROONEY[1]*, F.A. MACDONALD[2] AND D. SELBY[1]

[1]Earth Sciences Department, Durham University, DH1 3LE, UK (*correspondence: alan.rooney@durham.ac.uk)
[2]Department of Earth & Planetary Sciences, Harvard University, Cambridge MA, 02138

The late Neoproterozoic Windermere Supergroup of NW Canada is a ~7 km thick mixed carbonate-siliciclastic succession deposited on the margin of Laurentia. The Coppercap Formation of the Coates Lake Group consists of ~300 m of TOC-rich limestone that unconformably underlie glaciogenic deposits of the Rapitan Group. U-Pb zircon ages below and within the Rapitan Group in the Yukon constrain the onset of the Rapitan glaciation to ca. 717 Ma. The Rapitan Group is conformably overlain by the Twitya Formation, which is ~900 m thick and consists predominantly of carbonate and siliciclastic turbidites.

A 21 m interval of organic-rich carbonate of the Coppercap Formation yields a Model 1 depositional isochron age of 733 ± 4 Ma. Further Re-Os geochronology of a ~2 m interval of organic-rich carbonate of the Twitya Formation yield a Model 1 depositional isochron age of 655 ± 26 Ma. Combined with U-Pb zircon data, these ages constrain the minimum duration of the Rapitan glaciation to 36 Myrs.

Initial Os isotope composition (Os_i) derived from the Re-Os isotope data of the Coppercap Formation reveals an unradiogenic Os_i (0.14) for seawater prior to the Rapitan glaciation. This unradiogenic Os seawater signal may be derived from the erosion of basalts of the underlying Little Dal Group as well as the Gunbarrel magmatic events, and hydrothermal vents associated with rifting during the break-up of Rodinia. The Os_i data from the Twitya Formation yields a radiogenic composition (~0.83) suggesting that post-glaciation; the crustal Os flux from rivers exerted a strong influence on ocean Os composition. These data are consistent with Sr isotope data, which show a large increase to more radiogenic values across the Rapitan-Sturtian glaciation.

Both the Re-Os isochron age and the Os_i data for the Twitya are identical, within uncertainty, to that of the Aralka Formation, which overlies the glaciogenic Areyonga Formation of Central Australia suggesting that de-glaciation was broadly penecontemporaneous, and that the Sturtian and Rapitan glaciations are correlative. The Re-Os geochronology and Os_i data presented here has profound implications for our understanding of Late Proterozoic ocean chemistry and the Snowball Earth hypothesis.

Synchrotron XAS and XRF study of microbially reduced arsenic and iron in iron-based remediation media

ROBERT A. ROOT[1]*, FERNANDO J. ALDAY[2], SAHAR FATHORDOOBADI[2], WENDELL P. ELA[2] AND JON CHOROVER[1]

[1]Department of Soil, Water and Environmental Science, University of Arizona, Tucson AZ, USA (*correspondence: rroot@email.arizona.edu)
[2]Department of Chemical and Environmental Engineering, University of Arizona, Tucson AZ, USA

Arsenic remediation technologies exploiting the high affinity of ferric (oxy)hydroxides for oxyanion sorption has resulted in a significant increase in the volume of arsenic-bearing solid residuals generated by drinking water utilities. These iron sorbents widely utilized for water treatment may be legally disposed in municipal solid-waste landfills if they pass the USEPA toxicity characteristic leaching procedure (TCLP). However, conditions in a mature landfill are biotic and generally suboxic where iron and arsenic may be reduced and released to the leachate; a consequence not simulated with the TCLP test. To examine the effect of biotically induced reducing conditions, controlled flow through column experiments were used to simulate conditions similar to those found in a landfill. Upflow 30 cm x 2.5 cm reactors were packed with 15 g (dry wt.) ferric arsenate sludge (Fe:As = 20:1; pH 7-8) and 73 g of 0.8 mm glass beads then reacted for 432 days (864 pore volumes) with a synthetic landfill leachate containing nutrients (e.g. components: $[SO_4]$ = 64μM, [Na] = 12 μM, [CO3]= 24 μM etc.) and a consortium of microorganisms from an anaerobic digester sludge collected from a water treatment plant.

Columns were sub-sectioned and investigated with Synchrotron X-ray absorption spectroscopy and fluorescence microprobe (μXRF) to determine the bulk As, Fe, and S speciation and to spatially resolve As and Fe species with energy difference μXRF mapping. Reducing conditions prevail at the inlet of the column and the primary iron phase there is siderite, whereas vivianite, green rust and ferric (oxy)hydroxide form as the conditions become more oxic. Arsenic is present as As (III) and As (V) sorbed to ferric (oxy)hydroxide in suboxic and oxic environments respectively. When the columns are run at sulfate influent concentrations increased from 64 μM to 2.1 mM, the primary iron and arsenic phases are amorphous iron sulfide (FeS) and realgar (AsS), indicating sulfate and iron concentrations are important for As sequestration in landfills.