The evolution of the marine Zn reservoir: Comparing the proteomic and sedimentary records

L.J. ROBBINS[1]*, S.V. LALONDE[2] AND K.O. KONHAUSER[1]

[1]1-26 Earth Science Bldg., Univeristy of Alberta, Edmonton, Ab. T6G 2E3, Canada (*correspondence: lrobbins@ualberta.ca)

[2]European Institute for Marine Studies, Technopôle Brest-Iroise, Place Nicholas Copernic [2]9280 Plouzané, France (stefan.lalonde@univ-brest.fr)

Banded iron formations as proxies for Zn

In the transition-metal complement of living cells, zinc plays a central role. It is the most common inorganic co-factor employed by eukaryotic metalloenzymes, and second or equal to iron in prokaryotic metalloenzymes [1]. In Eukarya, many Zn-binding proteins appear to have evolved relatively recently, leading to the proposal that limited marine Zn availability prior to the Neoproterozoic may have impacted the course of eukaryotic evolution [1]. We seek to evaluate this hypothesis by examining sedimentary proxies for the evolution of the marine Zn reservoir over geological time, specifically Precambrian banded iron formations (BIF), younger ironstones and exhalites. By combining the BIF record with experimental results for Fe-Zn-Si co-precipitation we are able account for the competitive effects of silica during absorption. We present estimates of seawater Zn concentrations from the Archean through to the modern; while there appears to be mild enrichment in the Phanerozoic, we extrapolate Archean Zn concentrations that are roughly comparable to modern. These findings have strong bearing on potential consistency between genetic and geological records for the evolution of Earth's surface environment.

[1] Dupont *et al*. (2010) *PNAS* **107**, 10567–10572.

Rheological constraints on the deformation of Snake River-type ignimbrites: An experimental study

GENEVIEVE ROBERT[1]*, GRAHAM D. ANDREWS[2], JIYANG YE[1] AND ALAN G. WHITTINGTON[1]

[1]Department of Geological Sciences, University of Missouri – Columbia , Columbia, MO, USA (*correspondence: genevieve.robert@mail.mizzou.edu)

[2]Department of Earth and Environment, Franklin and Marshall College, Lancaster, PA, USA

We have studied the rheology of two ashfall units associated with the eruption of the pervasively rheomorphic Grey's Landing (GL) ignimbrite (a Snake River-type ignimbrite) from the Miocene Rogerson formation, Snake River Plain volcanic province, USA. Lava-like lithofacies of the GL ignimbrite are either crystallized, devitrified, or perlitized, and do not necessarily represent the original material that came out of the vent to be subsequently deposited, welded and deformed by flow (rheomorphism). We therefore chose to use the fused basal co-ignimbrite ashfall tuff (GLB) and the upper co-ignimbrite tuff (GLU) as potential 'starting material' for the GL ignimbrite. The basal ash is laminated, moderately porous (~15%), and contains 10–20% crystals; in contrast the upper ash is massive, nearly aphyric, glassy and contains ~5% porosity.

We measured the apparent viscosity of each unit over ~835-1005°C, a range of temperatures relevant to eruption and deposition of these ignimbrites. The viscosities of the upper and lower units converge in the low-temperature range (~835°C) and diverge at higher temperatures (at 900°C, the viscosity of GLU is $10^{10.3}$ Pa s whereas that of GLB is $10^{10.8}$ Pa s).

Strains ranging from 10 up to 1000 are recorded in the Grey's Landing ignimbrite. However, our viscometry results suggest that dry melts making up the deposit either require unreasonably high stresses (>1MPa) or long deformation timescales (days to weeks) inconsistent with field observations to produce the observed strain in the deposit. It follows that dissolved water reducing the viscosity of the pyroclasts at the deposition temperature and/or strain heating keeping temperatures high or even increasing temperatures during deposition and deformation are necessary to explain the field observations. Models investigating the relative contributions of dissolved water and strain heating in facilitating rheomorphism will be presented.