Microbial and redox evolution in the Neoproterozoic of Australia

A. J. M. JARRETT[1*], S. W. POULTON[2], M. GIORGIONI[1], AND J. J. BROCKS[1]

[1]Research School of Earth Sciences, The Australian National University, Canberra, ACT 0200. (* correspondance: amber.jarrett@anu.edu.au)

[2]School of Earth & Environment, University of Leeds, LS2 9JT, United Kingdom.

Availability of oxygen and a stable redox environment may have been major factors in the evolution of the Ediacaran biota [1]. Therefore, much research is focused on tracing the co-evolution of life and the redox state of marine environments through the Neoproterozoic. The Centralian Superbasin in Australia is one of the few places in the world where it is possible to study body fossils, redox conditions as well as molecular fossils in sediments ranging from the ~850 Ma Bitter Springs Formation to the Cambrian. The thick siliciclastic or evaporitic successions were deposited in a marine intracratonic basin and include evidence for two Snowball Earth events.

Here we provide first insights into the redox state of the Centralian Superbasin using Fe speciation data. In mid-shelf or deeper waters, our results document a major transition from a predominantly unstable ferruginous water column to a marine basin persistently oxygenated by at least 580 Ma. Therefore, the Centralian Superbasin became oxygenated at a time similar to other major basins worldwide [2].

We also complement the redox record with biomarker data from ~850 Ma to 570 Ma successions. We speculated that the transition from unstable redox conditions to persistently oxic conditions would also mark a transition to eukaryotic dominated ecosystems. Despite excellent organic preservation and the presence of abundant bacterial biomarkers, we did not find any evidence for a complementary increase in eukaryotic biomass. Thus, although oxygenated mid-shelf environments significantly predate the Ediacaran biota in Australia, eukaryotes such as algae and sponges did not become a dominant part of these oxic marine ecosystems for at least 20 Ma after full oxygenation [3, 4]. Therefore, the rise of eukaryotes to ecological dominance in the Neoproterozoic was not solely dependent on the availability of a stable oxygenated water column.

[1] Johnston *et al*.. (2012) *EPSL* **25-35,** 335-336. [2] Canfield *et al*. (2008) *Science* **321**, 949-952 [3] Grey (2005) *Mem. Assoc. Aust. Paleo*. **31,** 1-43. [4] Pawlowska *et al*. (2013) Geology **41,** 103-106.

Sealing time: Numerical simulation of water-rock interaction in volcanic systems

JASIM A.[1]*, WHITAKER F.[1], RUST A.C.[1] AND SCOTT T.B.[2]

[1]School of Earth Sciences, University of Bristol (*alia.jasim@bristol.ac.uk)

[2]University of Bristol, Interface Analysis Centre

Clogging of porosity around active volcanos influences fluid flow paths, degassing processes and rock strength, altering the response of the volcano to deeper perturbations as well as meteoric recharge events. Water-rock interactions in systems characterised by significant gradients in temperature and pressure lead to the destabilisation of primary igneous minerals and precipitation of secondary phases. The objective of this research is to use RTM to provide a rigorous foundation for the development of a conceptual model describing the complexity of the interactions between circulating hydrothermal fluids and andesitic country rock.

Preliminary 1D simulations using TOUGHREACT permit identification of key controls, quantitative evaluation of their effects and interactions between different controls. The modelling is constrained using data from the well-studied andesitic composite Soufrière Hills Volcano (SHV) on Montserrat. Temperature is a key control on reaction kinetics and, in combination with effective reactive surface area (RSA) of component minerals, controls the evolution of mineralogy and porosity over time. Moreover we can evaluate key feedbacks between the effects of this paragenesis on permeability and the flow of fluids supplying reactants and removing alteration products. RTM simulations offer answers to questions such as; how long does the plagioclase take to disappear from the andesite? What is the rate of change of the porosity? Key challenges are better understanding of RSA and kinetics of reactions. Preliminary results allow us to start thinking about the effects of water-rock reactions in altering transport of mass and heat and implications for volcanic response and slope stability.

This work contributes to building a holistic understanding of volcanic systems within the framework of the VUELCO project (Volcanic Unrest in Europe and Latin America: phenomenology, eruption precursors, hazard forecast, and risk mitigation).

DOI:10.1180/minmag.2013.077.5.10