Competition between microbial and abiotic Fe(II) oxidation: A kinetic modeling approach

M. SETO[1]* AND P. VAN CAPPELLEN[2]

[1]Dept. of Information and Computer Science, Nara Women's University, Nara 630-8222, Japan, seto@ics.nara-wu.ac.jp (*presenting author)

[2]Ecohydrology Research Group, University of Waterloo, Waterloo, Canada

Neutrophilic Fe(II) oxidising bacteria (FeOB) are ubiquitous in soils and sediments. It has been proposed that under low oxygen conditions they are able to successfully outcompete abiotic Fe(II) oxidation. Not only do FeOB catalyse Fe(II) oxidation, they may also hinder the autocatalytic growth of Fe(III) oxides, possibly through the binding of Fe(II) and Fe(III) to cell surfaces or extracellular polymeric substances. We present a simple kinetic model of neutrophilic Fe(II) oxidation, which explicitly accounts for the inhibitory effect of FeOB on the autocatalytic Fe(II) oxidation pathway. The model comprises kinetic equations for the different forms of Fe in systems with and without FeOB. The microbial Fe(II) oxidation rate is assumed to be a function of the FeOB cell concentration, the O_2 concentration, and the cell-bound Fe(II) concentration. The latter is related to the aqueous Fe(II) by an isotherm. In the proposed model, cell-bound Fe(II) and Fe(III) are intermediates in the transformation of aqueous Fe(II) to Fe(III) oxides. The validity of the model is statistically examined, using data of Fe(II) oxidation batch experiments in the presence of the bacterium *Leptothrix cholodnii* Appels [1]. The observed microbial Fe(II) oxidation kinetics are well described by the model. Compared to the abiotic experiments, the presence of the bacteria increases the initial Fe(II) oxidation rate by nearly a factor of 3, but decreases the subsequent autocatalytic Fe(II) oxidation rate by about 50%. The results suggest that neutrophilic FeOB may broaden their geochemical niche by slowing down the autocatalytic growth of Fe(III) oxides in low O_2 environments.

[1] Vollrath *et al*. (2012) *Geomicrobiol J*., **29**, 550-560

Sr-Nd isotope geochemistry of the troctolitic-gabbroic Bell Rock Range, Giles Complex, central Australia

R. E. B. SEUBERT[1], R. R. KEAYS[1], S. M. JOWITT[1] AND A. G. TOMKINS[1]

[1]School of Geosciences, Monash University, Clayton, VIC 3800, Australia, roland.seubert@monash.edu

The Mesoproterozoic Giles Complex of the Musgrave Province, central Australia, forms part of the c. 1075 Ma Warakurna Large Igneous Province. Here, we provide new Sr-Nd isotope data for a troctolite-gabbro member (Bell Rock Range) of the Giles Complex and compare them with other members of the Giles Complex; these data provide new insights into the formation and evolution of this under-researched magmatic province.

The most primitive melt within the Bell Rock Range is represented by a sample from the top of the intrusion that has an initial εNd value of +4.8, higher than the main troctolitic body of the range (εNd of -0.3 to +1.3), and εNd values of the gabbroic-ultramafic Wingellina Hills, Ewarara, Kalka and Gosse Pile intrusions range from -5.1 to +0.5 [1]. In comparison, the basal part of the Bell Rock Range has εNd values of -4 to 1.1, identical to later dykes that cross-cut the range, and indicative of formation from magmas that underwent crustal contamination or were derived from an enriched mantle source. Although the troctolites at Bell Rock Range yield a range of εNd and MgO values, they have relatively uniform initial $^{87}Sr/^{86}Sr$ values compared to all other lithologies in our database.

These data shed new light onto the petrogenesis of the Giles Complex, and indicate that it is unlikely that any of the the magmas that formed this complex were derived from a depleted region of the mantle. The magmas that formed this complex must have either been sourced from an enriched region of the mantle or have undergone variable crustal contamination, resulting in the range of isotopic compositions observed within this suite of co-magmatic rocks.

The relatively uniform $^{87}Sr/^{86}Sr$ compositions of the Bell Rock Range troctolites suggests that they represent an uncontaminated end-member style of Giles Complex magmatism, whereas gabbroic-ultramafic cumulates in the same area represent true mixing between mantle-derived melts and crustal rocks indicative of significant crustal contamination. These findings will contribute to an understanding of the tectonic setting of the Giles Complex.

[1] Wade (2006) PhD thesis, University of Adelaide, Australia.

DOI:10.1180/minmag.2013.077.5.19