Microbially enhanced ore weathering and surface anomaly development

K. LESLIE[1], C. IHLENFELD[2], C. OATES[2], J. BARR[2] AND D.A. FOWLE[1]

[1]Department of Geology, University of Kansas, Lawrence KS 66049, USA (kleslie@ku.edu)
[2]Geochemistry Division, Anglo American plc, 20 Carlton House Terrace, London, SW1Y5AN, United Kingdom

Biogeochemical processes in the subsurface have been found to affect the dispersion and accumulation of metals in soils overlying buried mineralized systems [1, 4]. Specific zones of metal accumulation, along with other secondary signals (such as isotopic anomalies, high pH and redox contrast, variations in microbial activity, gas flux and electrochemical anomalies) [1-5] have been used to successfully vector towards mineralization. Several models explaining the formation of these secondary features currently exist; electrochemical processes, expulsion of groundwater, dispersion of gas, and biogeochemical cycles [1, 4]. As microbiological processes play a significant role in many of these anomaly-developing processes, we hypothesize that the presence of microorganisms will enhance the mobility of metal ions in the subsurface.

Metal release from buried mineralization was examined in flow-through columns containing a variety of ore types (Cu porphyry, Magmatic Ni, Cu-Zn VMS) and a consortium of biogeochemically relevant microorganisms (Fe, S-oxidizers, Methanogens, Methanotrophs, Sulphate-reducers and Fe-reducers). Greater metal release was observed from all ore types, in comparison to un-inoculated controls. To examine the accumulation of metals in overlying soils we added soil and rock cover to the same ore types and microbial consortium used previously. Higher metal content was associated with the soil phase in the columns that had been inoculated. These results suggest that microbial processes may control metal dispersion and accumulation in the subsurface.

[1] Cameron *et al*. (2004) *Geochem-Explor Env A* **4**, 7–32. [2] Hamilton *et al*. (1998) *J Geochem Explor* **63**, 155–172. [3] Hamilton *et al*. (2004) *Geochem-Explor Env A* **4**, 33–44. [4] Kelly *et al*. (2006) *Econ Geol* **101**, 729–750. [5] Mann *et al*. (2005) *Geochem-Explor Env A* **5**, 201–210.

Time scales of magma differentiation and implications for the growth rate of the Torres del Paine laccolith

J. LEUTHOLD[1]*, O. MÜNTENER[1], L. BAUMGARTNER[1], B. PUTLITZ[1], M. OVTCHAROVA[2] AND U. SCHALTEGGER[2]

[1]Mineralogy and Geochemistry, University of Lausanne, Switzerland (*correspondence: julien.leuthold@unil.ch)
[2]Earth and Environmental Sciences, University of Geneva, Switzerland

The spectacularly exposed Torres del Paine laccolith (Southern Patagonia) has been constructed by successive injections of mafic and granitic melt batches. The sill complex is connected, at its western border, to a dike complex, interpreted as the laccolith feeder zone. A key unknown in sill complexes is the mechanism by which individual mafic and differentiated magma pulses are linked and assembled over time. We present high precision CA-ID-TIMS U-Pb data on mafic rocks zircons to constrain the time scales of differentiation. Feeder zone gabbronorite and Px-Hbl-gabbronorite with cumulate Px and Plg textures, display distinct positive Eu anomalies. Incompatible trace elements have been modelled to establish a fractionation relationship between mafic and granitic rocks. Zircon grains from the feeder zone gabbroic units have been dated at 12.59±0.01Ma, equivalent to the laccolith top granitic units, with a reported age of 12.59±0.02Ma [1]. Detailed field and petrographic studies evidence distinct Hbl-gabbro and diorite units within the laccolith, accreted sequentially. They display ages ranging from 12.47±0.01Ma for the lower Hbl-gabbro, 12.45±0.01Ma for diorite sills and 12.43±0.01Ma for upper Hbl-gabbro and diorite, all distinctly younger than the basal granite (12.51±0.03Ma [1]). These data show that, while the laccolith granitic complex is built up by under-accretion, the mafic complex itself grows by over-accretion, via amalgamation of successive sills. Emplacement dynamics involves a complex interplay between mafic and granitic magmas generating a volume of ~100km^3 over a time scale of ~160'000 years.

[1] Michel *et al*. (2008) *Geology* **36**, 459–462.