

Impact of the boundary processes on Si, Ca and Mg inputs to the ocean

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One of the main research interests in studying earth element cycles is to constrain the chemical balance of the ocean, directly related to its capacity to absorb greenhouse gases as CO₂. Most of the chemical elements present in seawater are lithogenic: after weathering, they enter into the ocean via the rivers, atmosphere or remobilisation of material deposited on continental margins. The potential of margins as significant sources of elements was recently emphasized by field and modelling works, suggesting that a mechanism of exchange at the margins -called "Boundary Exchange" (BE) - is the main control of the Nd isotope oceanic distribution [1,2]. BE requires the co-occurrence of an addition of elements from the margin to the sea with a removal of elements from the sea to the margin. Our best estimate of Nd inputs balancing the global oceanic Nd isotope budget implies the dissolution of 3 to 5% only of the material deposited on the margins.

What could be the impact of this dissolution on more soluble elements as Si, Ca and Mg, all playing a major role in the ability of the ocean to control the greenhouse gas content of the atmosphere, and hence the climate ? We assume that margin sediment deposits are mostly made of suspended load transported by the large rivers, which is a lower limit since it does not take in account other sediment vectors as small rivers for example. Dissolving 5% of this flux yields the following inputs to the ocean: between 2.5 and 7.8 Tmol/y of Si, 0.5 to 1.8 Tmol/y of Ca and 0.6 to 1.8 Tmol/y of Mg. Si flux due to this sediment dissolution is equivalent to the dissolved river input, 10% for Ca and 23% for Mg of the river ones, respectively. Impacts of these Si, Ca and Mg new oceanic balances on climate models are discussed.

[1] Lacan and Jeandel, *EPSL*, 2005. [2] Arsouze *et al. Chem Geol.*, 2007.

Experimental determination of the solubility of gold (Au) in intermediate arc magmas

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Cu-Au-Mo deposits represent major metal resources known to be spatially and temporally associated with intrusive arc magmatism, and in particular with adakites. Although the bulk of the ore metals seem to originate from the magmas, there is as yet no consensus on processes responsible for their concentration. The fact that primary ore minerals are predominantly sulfides has led to the suggestion that sulfur may play an important role in metal enrichment processes at the magmatic stage. Here, we conducted high-pressure/temperature experiments (0.4 GPa, 1000°C) on 3 natural dacitic magmas from the Philippines (two adakites and one typical calc-alkaline composition) over a wide range of fO₂ (~NNO-1 to ~NNO+3), as measured by solid sensors. The experiments were carried out in pure Au capsules, the latter also serving as the source of gold, in the presence of variable amounts of H₂O. Both S-free and S-bearing (~1 wt% S added) experiments were performed. Charges consist of dominant silicate melt quenched to glass plus minor silicate phases (mostly Cpx). All S-bearing charges are saturated with either sulfides or sulfates, depending on the fO₂. Our data show that Au solubility in S-free charges is very low (30-240 ppb) but increases with fO₂. In S-bearing charges Au contents reach much higher values, ranging from ~500 to 5200 ppb depending on the fO₂, the most reduced charges being the gold-richest. Also, the behaviour of Au w.r.t. sulfur appears to be radically different according to the fO₂. No significant difference of Au solubility is observed between adakitic and non-adakitic melts in both S-free and S-bearing charges. A major consequence of this study is that sulfide crystallization does not scavenge all Au present in the magma, but allows gold-enriched residual magmas to be emplaced in the upper crust. Additional experimental runs are currently being performed at higher pressures (> 1 GPa), that should lead to important supplementary data and results.