Phengite control on subduction magmatism in the western trans-Mexican volcanic belt

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A new geochemical study of the western Mexican arc corroborates the existence of a narrow potassic volcanic front that parallels the Middle American Trench [1], but that is gradually replaced by intraplate high-Nb rocks to the north and by typical calc-alkaline products to southeast. High-K rocks are very primitive and enriched in incompatible trace elements, but have lower HREE contents than more evolved calc-alkaline and high-Nb volcanoes. Potassic rocks also show slightly more enriched Nd and Pb isotopic compositions than the other suites at similar Sr isotopic ratios. Interestingly, potassic rocks display higher Rb/Cs and Ba/Cs ratios than the calc-alkaline and high-Nb groups, as well as unusually high Nb/Ta ratios (up to 25) that correlate positively with Rb/Ta, Zr/Ta and Gd/Yb. These variations are not compatible with different extents of peridotite melting, but they are also inconsistent with the traditional view of a phlogopite-rich mantle [1] unless mica is totally consumed during melting, and a Ta-bearing phase such as rutile remains in the mantle residue together with garnet. Such an assemblage is unlikely in the source region of alkali-rich, primitive hydrous magmas [2], but it is precisely what would be expected during phengite breakdown in deeply subducted slabs that leave a rutile-bearing eclogite at the time of melt segregation [3]. The magmatic diversity of western Mexico can thus be reconciled with the release of chemically distinct subduction agents that are closely related to the prograde metamorphic transformations that affect the steeply subducting Rivera plate. Decoupling of a shallow slab-fluid with low Rb/Cs ratios would induce melting of the peridotite mantle wedge and produce the typical calc-alkaline volcanoes, whereas a deeper slab-derived melt (or supercritical fluid) with higher Rb/Cs, Gd/Yb and Nb/Ta ratios would contribute to the formation of potassic magmas.

[1] Carmichael *et al.* (1996) *CMP* **124**, 302-333. [2] Ryerson & Watson (1987) *EPSL* **86**, 225-239. [3] Schmidt *et al.* (2004) *EPSL* 228, 65-84.

Stability of adsorbed Cu onto illite from kinetic desorption rate data: Influence of pH, ionic strength, and organic ligands

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Adsorption is one of the most important mechanisms controling the fate of metals in the aquatic surface environment. The stability of surface complexes vary greatly and metals adsorbed onto mineral surfaces may be easily drawn back into solution again. This study pretends to investigate how certain solution parameters such as pH and ionic strength (IS), and organic ligands such as citric acid, influence the stability of Cu adsorbed onto illite surfaces.

The experiments used a continuous flow-through reactor loaded with 0.5 g of illite (CMS IMt-1) in the size range of 0.4 – 20 µm, corresponding to a suspension of approximately 13 g/l. Input solution flowed, from base to top, through 0.2 µm membranes with a flow rate of 0.7 l/min. An initial blank solution with only the required pH (4.5 and 5.5) and IS (10^{-4} and 10^{-3}M) is kept flowing until the system reaches a steady-state, being then substituted by an equivalent solution with Cu (and citric acid). The solution flows until the system becomes saturated. Then, the system is reverted to the original blank solution. Therefore, measured output Cu concentrations with time follow a break through curve (BTC). Numerical integration of the BTC relative to the theoretical curve for an inert species gives the total adsorbed and desorbed Cu.

Desorption rates vary between $0.9\text{-}2.0\times10^{-10}$ mol/m^2/min, and for equivalent desorption times only 23% and 37% of Cu did desorbed at pH 4.5 and 10^{-4}M and 10^{-3}M IS, respectively. At pH 5.5, these values changed to 6% and 29%, correspondingly. In the presence of citric acid, the most important complex in solution would be $Cu(OH)Cit^{2-}$, and thus one is able to increase Cu adsorption at pH 4.5 and 10^{-4}M IS by as much as 9%. However, for either higher IS or pH total adsorption decreases up to almost 70%. Desorption rates also decreased by nearly one order of magnitude, and the amount of desorbed Cu also decreased in all experiments, suggesting the greater stability of Cu surface complexes in the presence of citric acid.

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