

Geochemistry of K, Rb, Cs, N and $\delta^{15}\text{N}$ in metasediments of a cold subduction zone: implication on fluid circulation.

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Although it is widely accepted that a slab component is involved in island arc magmatism, controversy persists about the processes (fluid phase transport, slab-melt or both) by which this component is transferred into the overlying mantle and at which depth these processes occur. K, Rb and Cs, which are large-ion-lithophile elements, and N, as NH_4^+ , are sensitive to fluid circulation and have been shown to be powerful tracers of fluid-rock interactions. In order to trace fluids released during subduction, K, Rb, Cs, N content and $\delta^{15}\text{N}$ were measured on several calcareous metapelites from the Schistes Lustrés complex (Western Alps). These samples represent an homogeneous sequence of pelagic sediments subducted to different depths (from 0 to 90 km). Constancy of K/N (≈ 15), K/Rb (≈ 400) and K/Cs ($\approx 10\,505$) molar ratios in protoliths and metamorphic rocks implies that none of these "fluid-mobile" elements was lost through devolatilization processes. It suggests that, if any, fluid circulation was limited to sample scale (centimeter or less) and that the rocks behaved like closed systems. Nitrogen content (between 226 and 1637 ppmN) and isotopic composition ($\delta^{15}\text{N}$ between 3.1 and 4.8 ‰) do not show any specific evolution with increasing metamorphic conditions. Variations of $\delta^{15}\text{N}$ and N-content together with K, Rb and Cs content, are observed and reflect protolith inheritance. These results differ from previous studies (Bebout and Fogel, 1992; Mingram and Bräuer, 2001) where nitrogen was found to be progressively devolatilized and enriched in ^{15}N during subduction, N-content decreasing from 1000 to < 100 ppmN and $\delta^{15}\text{N}$ increasing from 1 to 10 ‰. Both of these results can be conciliated if the thermal structure of the subduction zone is considered. Whereas previous studies dealt with subduction zones of high-T path ($\approx 15^\circ\text{C.km}^{-1}$), the present study concerns a low-T path ($\approx 8^\circ\text{C.km}^{-1}$), which is representative of most of the current subduction zones. The present results suggest that the whole of N, K, Rb and Cs is subducted at least until 90 km in depth.

In metasediments, these elements occur mainly in phengitic muscovites. For the thermal structure considered herein, experimental data show that phengite is stable up to 9 GPa (≈ 300 km). Accordingly high amounts of these elements may be recycled through the mantle via subduction zones. Hydrogen isotope data are presently investigated to strengthen these statements and will be presented at the conference.

Etch pits and leached layers on iron-silicate surfaces during siderophore-promoted dissolution

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Introduction and Methods

Atomic force microscopy (AFM), X-ray photoelectron spectroscopy (XPS), and vertical scanning interferometry (VSI) were used to investigate Fe-silicate surfaces after incubation in buffered growth medium for 46 days with the siderophore desferrioxamine mesylate (DFAM) or with the soil bacterium *Bacillus* sp. Previous studies have shown that these bacteria, which use Fe as a micronutrient, adhere to surfaces and release a siderophore that mobilizes Fe from hornblende when grown in an Fe-deficient growth medium (Kalinowski et al., 2000). In this work, a glass was synthesized to provide a homogeneous and smooth surface chemically similar to hornblende. Stoichiometry of release of Fe and Al relative to Si into solution were calculated (see Stillings and Brantley, 1995) and compared to the surface chemistry.

Results and Discussion

Analyses of the filtered solutions revealed negligible Fe and Al release in abiotic control experiments, significant release of Fe and Al in experiments containing DFAM, and Fe below detection in experiments containing bacteria. Low Fe in biotic experiments is consistent with uptake of Fe by the bacteria. AFM and VSI analyses reveal widespread, small etch pits and greater root mean squared (RMS) roughness on the DFAM-exposed surfaces and localized, larger etch pits on the bacteria-exposed surfaces. XPS and solution analyses indicate stoichiometric release of Al but preferential release of Fe (relative to Si) from the substrate in the presence of DFAM or bacteria.

Conclusions

Surface and solution chemistry as well as the distribution and size of microbial etch pits compared to those formed by DFAM suggest that the microbial pitting may be caused by siderophores concentrated in microbial biofilms. This hypothesis will be tested.

References

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