

Microchemical investigation of K-feldspar megacrysts: clues to magma dynamics in a plutonic environment.

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Aim of the study

Isotopic and multi-elemental fingerprinting of zoned feldspars have received increasing attention in order to understand the multi-stage evolution of magmas from their source to emplacement. Where whole-rock analyses fail to explain the complexity of magmatic systems, processes such as magma mixing, fractional crystallisation and crustal contamination can be recorded in individual crystals through sequential isotopic and trace element zoning (e.g. Davidson & Tepley, 1997).

We report here a detailed study of K-feldspar megacrysts from the young (7 Ma) Elba monzogranite (the Monte Capanne pluton) in the Tuscan Magmatic Province, Italy. Previous studies (e.g. Poli et al., 1989) have shown the importance of magma mixing in the genesis of the Tuscan plutons. K-feldspar megacrysts occur throughout the intrusion, as well as in related enclaves and dykes. SEM investigations have revealed the occurrence of idiomorphic resorption zones within some megacrysts, corresponding to major dissolution events.

Laser Ablation ICP-MS and EPMA results

LA-ICP-MS and electron microprobe analyses of zoned megacrysts reveal trace element zoning (mainly Ba, Sr, Rb, Pb, P, Ca, Cs and LREE) with particularly large variations across growth interruptions. A great variety of zoning patterns is observed. These are compatible with a magma mixing model with repeated injections of mafic magma in the system. Trace element comparisons between K-feldspar regions coreward and rimward of resorption zones suggest that episodes of dissolution of early-formed crystals correspond to episodes of feldspar nucleation, involving complex crystal transfer between chemically distinct batches of magma. For instance, the participation of a high Rb, LREE, Cr and Pb magma with lamproitic affinities seems to be possible. The feldspar rim chemistry is compatible with a model of crystallisation of a feldspar-dominated assemblage, with a marked decrease in Sr and Ba. The role of crustal contamination and volatile components will also be discussed, with particular reference to the Cs content.

References

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Trace Metals and Fe-Mn Cycling

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Iron and manganese play important roles in the biogeochemical cycling of trace elements at oxic/anoxic interfaces in lakes because of the formation of hydrous oxides. The conventional view, derived from numerous laboratory experiments, is that surface complexation is the key process by which trace metals are scavenged. However, if one can find in the literature numerous measurements of bulk water dissolved and particulate concentrations, little observations have been made of individual environmental particles concentrations and, even less so, of the chemical characterization of the molecular structure of Fe, Mn, and associated trace metals. We present past and recent results of the investigation of the morphology and chemical structure of Fe and Mn oxides using analytical electron microscopy –AEM- and X-ray Absorption Spectroscopy –XAS.

Results

The observations of Fe and Mn rich particles collected at oxic/anoxic interfaces show that most often the core of the particles is constituted of biogenic organic matter. In the case of Mn these particles are associated to bacteria (Lienemann *et al.*, 1997, Taillefert *et al.*, 2002) and in the case of Fe by either microbes (Perret *et al.*, 2000) or by organic fibrils (Taillefert *et al.*, 2000). These particles contain variable concentrations of trace metals, and the oxidation state of either Fe or Mn or some other metals, e.g., Co is also variable. This indicates that these elements undergo redox reactions when associated in the inorganic/organic moieties.

Conclusions

These results stress the need to make microscopic observations and spectroscopic analyses of Fe and Mn rich particles in lakes to understand better their role in the biogeochemical cycles of metals.

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