

A depleted lithosphere component in the Hawaiian plume: Noble gas evidence from plume-related mantle xenoliths

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Garnet pyroxenite (GPX) xenoliths from Salt Lake Crater, Oahu, are interpreted as high-P cumulates (60-90 kms depth) of Hawaiian plume-derived basaltic melts [e.g. 1,2]. Two generations of secondary melt/fluid inclusions document two distinct episodes of metasomatic overprint: (1) Young, immature and irregularly shaped “type-A” inclusions represent nephelinitic host magma, trapped along poorly sealed cracks during eruption some 0.3 Myrs ago. (2) Old, mature and polygonal “type-B” inclusions aligned along well-sealed cracks document pre-eruptive metasomatism of the mantle. LA ICP-MS analyses of “type-B” inclusions indicate high contents in siderophile and chalcophile trace elements including the PGEs. TEM and spectroscopic evidence shows that, after trapping, a highly reducing C-O-H-S-Cl-rich melt differentiated into a CO₂-rich gas phase, “basaltic” glass and nm-sized “exotic” minerals including nano-diamond, native Fe and Cu, PGE minerals, and corundum [3]. Combined step-heating, TEM and isotope data reveal a distinct degassing behaviour of both inclusion types. Highly “depleted” [e.g. 4] noble gas signatures of type-B inclusions (⁴⁰Ar/³⁶Ar ≈ 12000, ³He/⁴He ≈ 7 R/Ra, ²¹Ne/²²Ne ≈ 0.05, ²⁰Ne/²²Ne ≈ 12) indicate generation of the trapped melts within a depleted MORB-type mantle and are compatible with the presence of old, recycled, depleted lithosphere intrinsic to the Hawaiian plume, as also suggested by the Hf-Nd-Sr isotope systematics of the GPX host [1] which the melts infiltrated. Alternatively, the melts may have originated from upper mantle material incorporated into (or enveloping) the Hawaiian plume.

References

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Interaction of gypsum and As(V)_{aq} at different pH ranges

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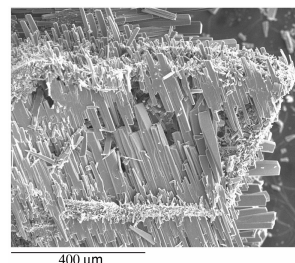
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This research is focused on the study of As(V)-gypsum interactions in aqueous solution within different ranges of pH and concentration. The main goals of this study are: 1) to evaluate the capacity of gypsum to remove arsenic from aqueous solutions; 2) to understand the nature of the processes by which the removal takes place and, 3) to characterize the solid phases derived from these interactions. Although the mobility and toxicity of arsenic in the environment has been abundantly studied, the crystal-chemistry, thermodynamic properties and solubility products of arsenates continue to be poorly known. This lack of data is an important handicap because an in-depth study of arsenate mobility in natural systems requires a precise knowledge of the solid phases that may or may not precipitate, as well as their crystal-chemistry, and their solubility.

The study has been carried out at different pH ranges using batch experiments. The aqueous solutions were characterized by AAS, ionic chromatography, and ICP-AES. The solids were characterized using SEM-EDS, powder, grazing incidence, and single-crystal XRD.

Figure 1: pharmacolite (CaHAsO₄·2H₂O) overgrowth on gypsum.



The results show that at high pH (>10.5) there is a virtually complete removal of As(V) due to the surface precipitation of amorphous Ca₃(AsO₄)₂·nH₂O and crystalline NaCaAsO₄·7.5H₂O. In contrast, the effectiveness of the uptake process is very low at lower pHs, as it involves the surface precipitation of different calcium arsenates (guerinite, sainfeldite, pharmacolite, ferrisite). The study included determinations of solubility products, growth morphologies, and epitaxial relationships. In addition, structural characterization by single crystal XRD has been carried out for NaCa₂H(AsO₄)₂·6H₂O and NaCaAsO₄·7.5H₂O.