

Bacterial mineral-metalloid redox transformations in aneobic environments

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Jarosite minerals are of environmental importance as trace metal scavengers and are involved in metal cycling. A number of metal species can be incorporated into the jarosite structure, including selenium (Se). Se is a trace nutrient, but is toxic in relatively low doses to humans, microbes, and other fauna[1]. Se is present in aqueous systems in its two oxyanion forms; selenate and selenite (SeO_4^{2-} & SeO_3^{2-}). The sulfate group can be completely substituted for selenate in jarosite minerals ($\text{NaFe}_3(\text{SO}_4)_x(\text{SeO}_4)_{2-x}(\text{OH})_6$). Under certain environmental conditions (e.g. pH, ionic strength, anaerobic environment), bacteria use these metals as potential electron acceptors mobilization and reduction from iron hydroxy sulfate minerals. Several species of bacteria have been observed to reduce Se oxyanions to nanoparticulate elemental Se, which is insoluble under most conditions. This pathway potentially poses a vector for mobilization and transport at Se-contaminated sites. The mechanisms pertaining to this research along with toxicity thresholds to model organisms will be discussed.

[1] Winkel (2011) *Environmental Science & Technology* **46**, 571-579.

Diamond-forming fluids: The trace-element perspective

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Diamond-forming high-density fluids (HDFs) of different major-element composition share similar incompatible-element characteristics, regardless of their host diamond provenance. All have fractionated REE patterns and variable, mostly negative, anomalies (PM normalized) in K, Rb, Cs, Ti, Zr, Hf, Nb, Ta, Sr and Y relative to Ba, Th, U and REEs of similar compatibility. Two principal patterns, "Planed" and "Ribbed", are characterized by differences in the highly incompatible elements from Ce–Pr. The two patterns are best distinguished using co-variation diagrams of (La, Ce)/(Nb, Rb) vs (U, Th)/(Nb, Rb).

Similarities of canonical ratios, Nb/(Th, U, La) and K/U, between MORB and OIB samples and HDFs with "Planed" patterns suggest that an asthenospheric source for these HDFs is plausible. This idea is strengthened by calculating the composition of sources in equilibrium with "Planed" patterns of silicic HDFs which range between the DMM and more fertile parts of the convecting mantle. The direct production of HDFs with "Planed" patterns by melting the asthenosphere with no need for a pre-metasomatized source, avoids the circular "chicken and egg" reasoning that has plagued diamond and kimberlite genesis. Such asthenosphere-derived enriched fluids can metasomatize the lithosphere to produce the old and new enriched sources that are needed to explain the formation of kimberlites and metasomatized xenoliths.

We suggest that the "Ribbed" incompatible-element pattern in HDFs evolved during percolation of HDFs with "Planed" patterns through a previously metasomatized lithosphere that carries accessory phlogopite, ilmenite and rutile. HDFs that are trapped in growing diamonds very soon after entry retain their "Planed" trace-element characteristics. If they percolate and interact with the accessory minerals, they acquire the "Ribbed" pattern before they are sealed in microinclusions in diamonds. This model explains the decoupling between major- and trace elements in HDFs and the resemblance of incompatible-element patterns of HDFs from different mantle localities; the averaging of large volumes of mantle rocks smooths the effect of small-scale heterogeneities in the subcontinental lithosphere.