

'Table' vs 'Bench': Trace elements in fibrous diamonds

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Fibrous diamonds encapsulate pristine metasomatic high-density fluids (HDFs) of silicic, carbonatitic and saline compositions. In general, the trace element patterns are similar in all HDFs. The REEs are fractionated and most samples show variable negative anomalies of Sr, Ti, Zr, Hf and Y relative to the corresponding REE. Larger diversity exists in the highly incompatible elements (Cs-La), where two patterns are distinguished: one is mostly flat with no significant anomalies and shows a moderate decrease of concentrations with decreasing ionic radius ('Bench'); the other ('Table') has elevated Ba, U, Th and LREE and depleted Nb, Ta, K, Rb and Cs. The two can be best distinguished by the ratios (Nb, Rb)/(La, Pr, U, Th).

The similar signature of incompatible elements in diamonds-forming fluids from various mantle localities, well separated in space and time, the persistence of 'Table' and 'Bench' patterns in HDFs of such diverse major-element compositions and the uniform carbon isotopic composition of fibrous diamonds is fascinating. We seek to explain these features, which require collection from a large source region and/or interaction of the HDFs with a relatively large volume of mantle rocks.

The Nb/(Th, U, La) ratios in HDFs with 'Bench' patterns fall within a narrow range and are similar to MORB/OIB/PM values. This smooth pattern can be approximated by very small degree of melting of a source with PM trace element concentrations. In HDFs with the more fractionated 'Table' patterns the above ratios deviate from the strict MORB/OIB/PM range and decrease by ~2 orders of magnitude with decreasing Nb content. The patterns can be closely produced by low-degree partial melting of a metasomatised continental lithosphere with carbonate, phlogopite and rutile as accessory phases.

Searching for a possible relation between the two patterns, we examined fractional crystallization and percolation. Major elements allow only <20% phlogopite removal from HDFs with 'Bench' patterns, not enough to produce the high depletion in alkalis of the 'Table' patterns. Percolation of a melt with a 'Bench' pattern through SCLM rocks with the above accessory phases does lead to evolution of a 'Table' pattern, with minimal changes to the major elements.

Contrasting sediment and water geochemistry between low and very high arsenic affected areas in Murshidabad, West Bengal, India

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Arsenic contamination of shallow groundwater is among the most severe environmental and health threats in SE Asia. Murshidabad, an eastern district in West Bengal, India, where groundwaters are highly As-affected (up to ~4000 µg/l), was chosen as our study area. Objectives were: (1) characterize sediment cores and groundwaters in areas with contrasting As concentrations; (2) describe the extent of spatial variability of dissolved As concentrations in shallow (< 60m) aquifers; (3) identify source (s) of aquifer recharge to understand the bioavailability and mobilization of As from sediments to groundwaters. Surface (0-2m) and core (2-40m) sediments and water from shallow and deep tubewells, irrigation, ponds, and major rivers were collected during two field seasons.

The low-As Pleistocene terrace sediments are orange-brown, whereas the high-As Holocene floodplain sediments are grey. Mineralogical examination reveals the Pleistocene sediments as mainly quartz and feldspars coated with Fe (III) oxides/hydroxides, whereas the Holocene sediments also contain clay minerals, micas, amphiboles, carbonates, and accessories. Sequential extractions show As present chiefly in specifically-sorbed phases and associated with amorphous and poorly-crystalline hydrous oxides of Fe (Al and Mn). Hydrochemistry shows reducing conditions in high-As waters (high Fe, HCO₃⁻, PO₄³⁻, NH₄⁺, As (III):As_T; low NO₃⁻, NO₂⁻, Cl⁻, SO₄²⁻); low-As areas showed converse relationships with these values. The complex spatial variability of dissolved As levels may result from variable flow paths induced by well-pumping and seasonal flooding, buried As-rich lenses, distribution of microbial communities, etc. Stable isotope values for δ²H and δ¹⁸O in water samples plot on the local meteoric water line between summer monsoon and dry season precipitation, indicating the high As groundwater originates as local precipitation that has not experienced any appreciable evaporation. Furthermore, the stable isotopes demonstrate that the high As groundwaters are not recharged by local pond waters, which have undergone substantial evaporation.