Isotopic investigation into the role of surface waters in promoting arsenic release in Bengali groundwaters

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Hazardous geogenic arsenic in shallow groundwaters (GW) extensively utilised as drinking waters in southern Asia are widely thought to have been mobilised via the microbially mediated reductive dissolution of Fe(III) bearing minerals, driven by the consumption of organic matter (OM) [1]. The nature and provenance of this OM, however, is a subject of intense debate. Harvey *et al*. [2] has suggested that modern, surface derived OM, drawn into the reducing aquifers following the extensive abstraction of shallow GW over the last few decades, is accelerating the arsenic release process. This is consistent with the observation [3] of ^{3}He/^{3}H ages of < 60 years at depths of up to 150 m at some sites. Sengupta *et al*. [4] however argue against the importance of surface derived organics in mobilising arsenic.

We present here data collected from a well documented arsenic hotspot in the Nadia District of West Bengal, where massive groundwater abstraction has been proceeding for decades. As concentrations exceed the WHO provisional MCL of 10 µg/l in 18 of 22 samples. δ^{18}O and δD of shallow (< 30 m) GW suggests a contribution of evaporated surface waters [5]. Preliminary tritium results contrast tritium dead water from a deep (>50 m) regional aquifer with some tritium activity observed in shallow As prone waters, consistent with modern recharge to shallow GW. Additional δ^{13}C provides further complementary information with which to determine the relative importance of surface water contributions to GW. These data directly address the issue of the role of surface waters containing modern OM contributing to arsenic mobilisation in this region.

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Chlorine isotopes as tracers of slab fluxes in arc magmas

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It is now evident that there are systematic variations of δ^{37}Cl in the products of arc volcanism, which can be usefully resolved by SIMS or gas source mass spectrometry [1, 2].

Although recent data imply that that MORB-source mantle has light δ^{37}Cl (as low as -3.0‰; [1, 3]), this signal may be quickly erased in the axial MOR environment by interaction with shallow seawater-derived hydrothermal fluids that contain near 0‰ δ^{37}Cl. However, where Cl is heavily influenced by subduction input, magmas often develop intrinsically high initial Cl concentrations - making them relatively insensitive to Cl addition during shallow assimilation and emplacement. For example, in the Lau backarc basin, olivine-hosted melt inclusions from the Valu Fa Ridge appear to preserve a record of measurable heterogeneity of δ^{37}Cl attributable to very fine-scale processes within discrete melting and melt transport systems [1].

Now that measurable δ^{37}Cl variations have been recognized in arc volcanism, the next endeavor will be the detailed elucidation of the δ^{37}Cl compositions and cycling of the available Cl reservoirs in the subduction factory. Particularly intriguing is the exact mechanism of accumulation and transport of an inferred heavy δ^{37}Cl reservoir in marine sediments that provides the counterpart to the very light δ^{37}Cl observed in marine pore waters.

Studies that combine δ^{37}Cl with other light stable isotopes (e.g., δ^{11}B) should prove especially useful in the examination of Cl cycling, particularly with respect to processes inferred to involve initial release during slab dewatering followed by storage in the down dragged mantle wedge.

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