Multiple neutron-rich stellar sources to the solar system – An isotope synthesis

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Short lived decay systems provide powerful tools to unravel the earliest history of the solar system and its planetary bodies. The unequivocal interpretation of ages derived from these decay systems and their anchoring to an absolute timescale, however, depend on a homogenous distribution of the short lived radioactive parent nuclides throughout the solar system. Recent findings of nucleosynthetic isotope anomalies for a multitude of elements [e.g. 1, 2] call into question a homogeneous and well mixed character of the solar nebula. Other elements apparently lack such anomalies [e.g. 3, 4]. Identifying the cause of this discrepancy will improve the conception of the earliest evolution of the solar nebula. It was proposed that the distinct physicochemical properties of different presolar carrier phases (i.e. volatility, sensitivity to O_2–fugacity), which incorporate different elements, may have caused part of this discrepancy by inducing a bias during mixing processes in the solar nebula [3, 4]. The elements Hf, Zr, and Ti share almost identical cosmochemical and geochemical behaviours and hence should be incorporated into the same presolar carrier phases if synthesized together. Thus, for these elements, secondary effects resulting from physicochemical fractionation processes in the solar nebula can be distinguished from primary nucleosynthetic anomalies resulting from a separate synthesis of elements in distinct stellar environments. Whereas an excess of nuclides from a neutron-rich stellar source has been reported for Ti and Zr [e.g. 1], no nucleosynthetic Hf isotope anomalies have been resolved yet [3]. This suggests that the neutron-rich Hf nuclides were synthesized and injected into the solar nebula separately from those of Ti and Zr and that $^{182}Hf/^{180}Hf$ was distributed homogeneously throughout the solar nebula.

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Regional modeling of groundwater flow and arsenic transport in the Bengal Basin: Effects of sorption on safe groundwater use

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Tens of millions of people in the Bengal Basin of Bangladesh and India are drinking groundwater from shallow depths with As concentrations above health standards. Deeper groundwater (>150m) is generally low in As, and a potential source of As-safe water for the region. The sustainability of this resource is dependent on pumping-induced changes in the flow system and attenuation or release of As along flowpaths. *In situ* push-pull tests and laboratory batch experiments indicate that sorption of dissolved As is substantial in deep, oxidized sediments in Bangladesh (Radloff *et al*. this session).

A regional groundwater flow and solute transport model of the Bengal Basin was constructed to assess the large-scale functioning of the deep groundwater flow system, the vulnerability of deep groundwater to pumping-induced migration from above, and the effect of sediment sorption on sustainability. Current and potential future pumping schemes were simulated and both groundwater flowpaths and time before As breakthrough evaluated. Results of advective flow modeling indicate that limiting deep pumping to domestic supply only (with irrigation supply contained to shallow zones or discontinued) may allow an infinitely sustainable source of As-safe water for more than 42% of the As-affected area, and in more than 84% of the area, advective travel times from high-As zones to deep wells would be greater than 1000y. Dispersive transport reduces the time before As detection in unsustainable areas and slightly increases the extent of the deeper aquifer zone affected by As. However, consideration of sorption representative of the measured range in deeper sediments substantially increases the time before As appears in deep pumping wells, indicating that sediment chemistry can provide important protection of water supply where oxidized sediments exist. Simulations also indicate that pumping of deep groundwater for irrigation purposes substantially increases the area vulnerable to As contamination in deep wells and greatly reduces the time before As breakthrough, even when sorption is considered.