Fluoride mobilisation in India

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Fluoride is a geogenic element with a very narrow terapeutic interval. In drinking water it protects against caries when approaching 1 mg/l. However, in warm climates and with a large dependance on the local water source dental fluorosis is seen at concentrations just above that concentration and skeletal fluorosis at just 3-4 mg/l. India is one of the countries that has serious problems with groundwater high in fluoride. 20 M people are affected by fluorosis and another 45 M exposed to excess fluoride. Groundwater with excessive fluoride are now discovered in new areas, such as Kerala and Assam [1]. Hydrogeochemical modelling indicates that fluoride solubility in groundwater is governed by fluorite, primary or as secondary precipitates. In semi-arid areas where calcrete precipitates from soilwater and groundwater a sequence from recharge to discharge areas is seen with calcitic calcrete, Mg-rich calcrete and dolomite rich in fluorine, presumably as fluorite [2]. In an undulating terrain it is possible to catch the groundwater before it is too enriched in fluoride. There is a clear relation between pH and fluoride. The area of alkaline soils is increasing due to poorly managed irrigation projects without proper drainage [3] (Srinivasulu *et al.* 2005). About 9-11 M ha are salt affected in India. Out of this about 25 % are sodic soils with a high pH. Alkalinisation of soil is a slow process but could with water logging be very fast. There are many reasons to combat sodicity in soils from agricultural point of view. Trace element availability for crops decrease. Large portions of Indian soils are zinc deficient for crops (www.zincharvest.org). Mobilisation of selenium is still another adverse effect observed [4]. A conventional treatment of sodic soils is application of gypsum. Phytoremediation is another measure [5], Fluoride removal has not been a success in India, especially not in community water supply where poor maintenance has made plant nonfunctioning. Water harvesting has on the other hand mostly given good results and could be combined with gypsum treatment.

[1] Kotoky *et al*. (2008) *Fluoride* **41** 72-75. [2] Jacks *et al*. (2005) *Appl. Geochem.* **20** 221-228. [3] Srinivasulu *et al.* (2005)Srinivasulu *et al.* (2005) Irrig. Drain. Syst. **19** 61-70. [4] Yadav *et al*. (2008) *J. Environ. Manage.* **75** 129-132. [5] Quadir *et al*. (2005) *Soil Use Manage.* **21** 173-180.

Osmium in extreme EM2 lavas: Implications for recycled sediment vs eclogite in the Samoan mantle

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The Samoan island chain is an active, age-progressive hotspot located ~100 km north of the northern terminus of the Tonga subduction zone. Samoan lavas have long been known to host a component with enriched (high) $^{87}Sr/^{86}Sr$, and this has been attributed to the presence of recycled continental crust-derived sediment in the Samoan mantle [1, 2].

In order to test the hypothesis that the Samoan mantle hosts a component of recycled sediment, we measured Os-isotopes in a suite of geochemically well-characterized lavas with known ages of eruption. Osmium isotopes are highly sensitive to recycled materials in the oceanic mantle sampled by intraplate lavas. Samoan shield-stage lavas exhibit little $^{187}Os/^{188}Os$ variation, as determined previously with a fusion-flux technique [3] .We employed Carius tube dissolution techniques to further test this hypothesis by reducing Os blanks and examining isotopically-extreme lavas.

We measured $^{187}Os/^{188}Os$ and Re and Os concentrations in 19 Samoan lavas. There is a positive relationship between $^{187}Os/^{188}Os$ and $^{87}Sr/^{86}Sr$ in the sample suite, an observation that is consistent with the presence of a recycled continental crust component in the most isotopically-enriched Samoan EM2 (enriched mantle II) lavas. The sample anchoring the EM2 portion of the Samoan array has radiogenic $^{87}Sr/^{86}Sr$ (0.71141) and moderately radiogenic $^{187}Os/^{188}Os$ (0.1318; 83 ppt Os). This important sample is quite fresh exhibits a low LOI (loss on ignition) value of 1.9 wt.% and a Rb/Cs ratio (118) typical of that found in fresh Samoan lavas.

The only moderately radiogenic Os in the Samoan EM2 lavas severely limits the amount of ancient eclogite in their sources. The composition of the Samoan lavas is best modelled as a mixture of peridotite and sediment, with little or no recycled eclogite [4].

[1] White & Hofmann (1982) *Nature* **196**, 821-825. [2] Jackson *et al*. (2007) *Nature* **448**, 684-687. [3] Workman *et al*. (2004) *G-cubed* **5**, doi:10.1029/2003GC000623. [4] Class, Goldstein & Shirey (2009, submitted) *Earth Planet. Sci. Lett.*