

## Cadmium isotope constraints on nutrient cycling in the Peruvian Oxygen Minimum Zone

Z. XUE<sup>1</sup>, M. REHKÄMPER<sup>1</sup>, T. VAN DE FLIERDT<sup>1</sup>,  
P. GRASSE<sup>2</sup> AND M. FRANK<sup>2</sup>

<sup>1</sup>Department of Earth Science and Engineering, Imperial College, London SW7 2AZ, UK

<sup>2</sup>Leibniz-Institute of Marine Sciences, IFM-GEOMAR, D-24148 Kiel, Germany

The distribution of dissolved seawater Cd is correlated with that of phosphate [1], presumably because Cd is a key marine micronutrient. This interpretation is supported by the observation that biological uptake of Cd from seawater is associated with considerable isotope fractionation. Nutrient depleted surface waters typically exhibit fractionated Cd isotope compositions with  $\epsilon^{114/110}\text{Cd}$  values of up to +40 relative to deep waters (with  $\epsilon^{114/110}\text{Cd} \approx +2.5$ ), due to the enrichment of isotopically light Cd in biological materials [2, 3, 4] ( $\epsilon^{114/110}\text{Cd}$  is given relative to NIST 3108 Cd).

The RV Meteor cruises M77-3 and M77-4 (12/08-03/09) were carried out to study the interplay between hydrographic conditions and biogeochemical processes in the oxygen minimum zone (OMZ) of the coastal upwelling area off Peru. Seawater samples for Cd concentration and isotope analyses were collected at 9 stations. Results are currently available for two depths profiles from about 4°S and 6°S, which probe an OMZ that extends between depths of <200 m to >600 m.

In both profiles, Cd is only moderately depleted in surface waters (~0.1 nM). The concentrations rise rapidly in the subsurface to ~0.5 nM at depths of less than 150 m and then moderately to maximum values of ~1 nM at ~1000 m. The Cd data display an excellent correlation ( $r^2 = 0.95$ ) with phosphate contents and both Cd and phosphate are negatively correlated with O<sub>2</sub> at depths of <600 m. The impact of the OMZ on the cycling of Cd at these sites is further corroborated by the Cd isotope results. The surface waters of both profiles display only limited Cd isotope fractionation ( $^{114/110}\text{Cd} \approx +7$  to +8), which is best explained by upwelling of unfractionated Cd-rich water masses to the surface ocean. The slight fractionated Cd isotope compositions that are observed at intermediate depths (~500-1200 m) are unusual and may reflect either incomplete remineralization of (isotopically light) biological material within the OMZ and/or mirror a distinct isotopic signature of the Peru-Chile Undercurrent.

[1] Boyle (1988) *Paleoceanography* **3**, 471. [2] Ripperger *et al.* (2007) *EPSL* **261**, 670. [3] Lacon *et al.* (2006) *GCA* **70**, 5105. [4] Schmitt *et al.* (2009) *EPSL* **277**, 262.

## Environmental effects of an abandoned Antimony mine on the water basin of Aq-Darreh Mine Valley, Takab, Northwest Iran

ABDOLMAJID YAGHUBPUR AND YOUSEF RAHIMSOURI

Department of Geology, Tarbiat Moallem Univ. 49 Mofateh Av. Tehran, Iran (ayaghubpur@yahoo.com)

The abandoned antimony mine of Aq-Darreh is located 42 km northwest of Takab in western Azerbaijan State, northwest Iran. The oldest rock units (probably Precambrian in age), exposed in the mine valley and partly in the mine adits are black-shale layers composed mainly of clay minerals, quartz, with traces of silt-size feldspar, carbonate cement, organic matters and opaque minerals, mainly pyrite. The black shale is overlain unconformably by Oligomiocene age layers of yellowish green clayey limestone with interlayers of sandstones, gypsum bearing bands and conglomerate. Quaternary alluvium, aragonite sedimentation of local springs and terraces are the youngest rock units in the mine district.

11 samples of surface waters, 13 samples of sediments, 30 samples of surface and agricultural soils and 6 samples of plants and plant grains were collected from the mine district and prepared for different chemical analyses.

The analytical results of the water, sediments, soils and plant samples indicated a relatively high concentrations of toxic elements such as As and Sb. Also the concentration of Hg in the sediments and agricultural soils is relatively high, but since the water in the mine area is characteristically neutral to slightly alkaline, the concentration of Hg in the water samples is quite low. The concentration of As in the major river of the area (Aq-Darreh river), is more than 60 times of the average concentration of this element in the world water rivers. Also the concentration of Sb is about 3 times more than the average concentration of Sb in the world water rivers, therefore the Aq-Darreh river water is one of the very contaminated river waters in the world. In some parts of the mine district the amounts of As (more than 8000ppm) and Sb (more than 400 ppm) in soils are also very high. Therefore the surface soils of those parts of the mine area are very contaminated and are not suitable for use in agricultural purposes.