

Uptake of heavy metals, and arsenic by an aquatic plant in the vicinity of the abandoned Ervedosa tin mine (NE Portugal)

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This paper focuses on the uptake of heavy metals, and arsenic by an aquatic plant (*Ranunculus peltatus* Schrank) growing in the Tuela river in the vicinity of the abandoned tin mine of Ervedosa in the north region of Portugal. At mine, tin-bearing quartz veins with cassiterite and sulphides were exploited for tin (Sn) and arsenic trioxide (As₂O₃), until 1969. The waters at the mining site are affected by AMD, with high conductivity and significant As and metal (Co, Cu, Ni, Pb, Zn, and Cd) concentrations.

The elemental concentrations in plants were determined by ICP-MS. Water samples were analysed by GFAAS (graphit furnace AAS).

Table 1- Elemental concentrations in water and plant samples (water in µg/l and plant in mg/kg dry wt).

Samples	As	Co	Cu	Ni	Pb	Zn	Cd
1 Water	n.d.	0.56	37.1	49.1	0.60	118	0.14
1 Plant	8.47	7.96	37.6	21.1	4.46	78.6	0.40
2 Water	n.d.	0.63	38.7	23.3	13.7	225	3.15
2 Plant	6.36	18.4	103	50.8	3.10	268	13.8
3 Water	n.d.	0.60	16.2	32.5	0.71	147	1.77
3 Plant	73.8	66.7	342	108	7.56	1440	57.9
4 Water	0.30	0.64	13.3	1.78	1.65	142	0.17
4 Plant	20.2	36	156	66.5	3.43	879	31.6

The analytical data obtained (Table 1) demonstrate low pollutant concentrations in fluvial water. However, the trace elements are considerable concentrated in the plant samples. The heavy metal, and arsenic concentrations in the plants exceed the corresponding concentrations in the habitat (water) by tens of thousand times. Concentration factor (CF), as a ratio of a chemical element content in plants (C_p) to its content in the corresponding habitat (C_{ph}), was used to estimate the extent of heavy metals, and arsenic concentration by plants (CF=C_p/C_{ph}).

The plant studied can be used to decrease the heavy metals, and arsenic amounts into the aquatic environment affected by acid mine drainages. On the other hand, this aquatic plant can enter the food chains, presenting a potential danger for animal and human health.

Iron isotope variations in Holocene Baltic Sea sediments

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Sediments from the Gotland basin in the Baltic Sea display variations in their bulk Fe isotopic compositions from -0.27 ± 0.09 ‰ to $+0.21 \pm 0.08$ ‰ for $\delta^{56}\text{Fe}$ (differences in $^{56}\text{Fe}/^{54}\text{Fe}$ relative to the IRMM-14 standard). Deposits formed in freshwater with oxygenated bottom water before ~8000 years B. P. display identical Fe isotopic signatures as oxic marine sediments and igneous rocks. In contrast, samples from the more recent brackish water and periodically euxinic units have significantly lighter $\delta^{56}\text{Fe}$ values by ~0.2 ‰ on average (6 samples). Data for Fe/Al provide additional information about the cause for the shift in Fe isotopic compositions.

Enrichments in Fe/Al are characteristic for euxinic sediment deposition and can be used as a paleoredox proxy (e.g. Lyons and Severmann, 2006). Negative $\delta^{56}\text{Fe}$ values are associated with enrichments in Fe/Al in the Gotland Deep, as has also been reported from the Black Sea (Lyons and Severmann, 2006; Severmann *et al.*, 2006a), implying that negative Fe isotopic signatures could be characteristic for euxinic sediment deposition. Enrichments in Fe/Al can be explained by transport of reactive Fe from the shelf to the euxinic basin where it is transferred to the sediment by pyrite formation in the water column (e.g. Raiswell and Anderson, 2005). This is supported by pyrites with mean $\delta^{56}\text{Fe}$ values of -1.1 ± 0.2 ‰ in the Gotland Deep. Reactive Fe is derived from oxides and benthic ferrous Fe that is produced by dissimilatory iron reduction and that is suggested to be associated with negative $\delta^{56}\text{Fe}$ values (Severmann *et al.*, 2006b). Therefore, our data support the suggestion of Lyons and Severmann (2006) that Fe isotopes can be used to fingerprint the Fe enrichment process by shelf to basin shuttling of Fe. If negative Fe isotopic signatures are characteristic for euxinic sediment formation, widespread euxinia in the past might have shifted the Fe isotopic composition of the ocean towards more positive $\delta^{56}\text{Fe}$ values.

References:

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