Metals pollution of the ancient harbor of Tyre (Lebanon)

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Ancient metal pollutions are well documented by records of lead or copper concentrations in ice (e.g. Hong *et al.,* 1996 [1]) or ombrotrophic peat (e.g. Shotyk *et al*., 1998 [2]). They originated first in the domestication of fire and second in the discovery of mining and metallurgy (Nriagu, 1996 [3]). The study of archeological contamination of soils and sediments allow to extend the prediction of metal contamination at the millenial scale and to evaluate their potential environmental risk. Tyre northern harbor appears as a suitable setting for such a study, as sediments were deposited in a confined, low energy environment, and acted as a receptacle for the waste produced locally by the activities occurring upstream in the city, via particulate transport, during the last two millenia. Several metals and metalloids profiles, obtained by ICP-MS measurements of harbor sediments are presented here, and used to address the question of the behavior of these elements in a confined, coastal environment. The anthropogenic pollution record, obtained after normalisation by non anthropogenic elements associated with metals and metalloids in the sediments (Th and Nd) is coherent with the history of metals during Antiquity, in terms of the differential onset of metals pollution (e.g. early Pb and late Zn), of the alloys used in the city (e.g. tin bronze) and of the timing of pollution. Apart from their archeological implication, these observations suggest that despite disturbances, mostly due to harbor maintenance, the sequence of metals and metalloids inputs is rather well preserved and perturbation by diffusion does not exceed a few cm even for porous sandy material contaminated 2000 years ago. Other sources of metals and metalloids enrichment are distinguished, using normalisations and ESR spectroscopy of manganese. The apparent lack of post-depositional mobility of metals and metalloids in the sequence is striking, and opens questions concerning the speciation of metals and metalloids in such a suboxic marine setting over the last two millenia.

[1] Hong *et al.* (1996) *Sci. Tot. Environ*. **188**, 183-193. [2] Shotyk *et al.* (1998) *Science* **281**, 1635-1640 [3] Nriagu (1996) *Science* **272**, 223-224.

Neodymium isotopic composition of North Atlantic Fe-Mn oxides

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Neodymium leached from the ferromanganese (Fe-Mn) oxide coatings on lithogenic material is thought to record the Nd isotopic (ε_{Nd}) signature of the overlying water mass [1]. North Atlantic Deep Water (NADW) and Antarctic Bottom Water have distinct ε_{Nd} values of -13.5 and -8.0, respectively, thus Fe-Mn oxide coatings have been used to reconstruct large-scale Atlantic circulation [1]. The major components to North Atlantic Deep Water, Iceland Scotland Overflow Water, Denmark Straits Overflow Water, and Labrador Sea Water, also have distinct ε_{Nd} values (-8.4, -8.2, and -14.5, respectively) [2], which suggests that Fe-Mn oxide coatings from northern North Atlantic sites could be used to examine the variability in NADW components that has been observed using other proxies [3,4]. However, according to our core top study, proximal sources of easily-leached volcanogenic ash add a complication for the use of the leaching method on sediments from the northern North Atlantic. Fe-Mn leachates from core tops close to Iceland, or directly downstream from Icleand, have ε_{Nd} values up to +3.1, while Fe-Mn leachates from more distal sites record ε_{Nd} values which match modern bottom water. Volcanogenic material does not appear to be transported to the mid-latitude central North Altantic, making this an ideal location for using ε_{Nd} to track changes in NADW.

Preliminary records of Fe-Mn leachate ε_{Nd} have been generated from cores CHN82-23PC, in the central North Atlantic, and VM27-17, in the western North Altantic. These records suggest that the ε_{Nd} value of NADW may have varied on orbital time-scales, possibly due to variations in the relative fluxes of NADW components, or due to changes in continentally derived inputs.

[1] Piotrowski *et al.* (2005) *Science* **307**, 1933-1938. [2] Lacan & Jeandel (2005) *Geochem., Geophys., Geosys.*. **6** (12) 1-20. [3] Duplessy *et al.* (1988) *Paleoceanography* **3** (3) 343-360. [4] Hillaire-Marcel *et al.* (2001) *Nature* **410**, 1073-1077.