Magnetic properties of the Anllóns riverbed sediments: relation to metal contamination

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Introduction: In this study, an in-depth magnetic study was carried out (i.e. thermomagnetic curves and hysteresis loops) in 13 riverbed sediments of the Anllóns basin (NW Spain). Association to heavy metal concentrations was also analyzed.

Methods: Thermomagnetic curves for heating and cooling cycles were obtained in air atmosphere. The saturation remanence - saturation magnetization (*Mrs*/*Ms*) and coercivity of remanence - coercive force (*Hcr*/*Hc*) ratios were also obtained from hysteresis loops (-6000 to 6000 Oe) measured at room temperature.

Results: Most thermomagnetic curves show two phase transitions at 250–350 and 450–550◦C (fig. 1a). The first one may indicate the inversion of maghemite to hematite. The second one corresponds to the transformation of hematite to a strong magnetic phase in presence of organic matter [1] revealed by the highly irreversible cooling curve. *Mrs*/*Ms* and *Hcr*/*Hc* ratios are shown in the Day plot of fig. 1b. The tightly grouped data for the Anllóns River lie in the middle range of the synthetic MD+SD mixing curves [2]. The Anllóns group also overlaps the clay fractions (<2μm) of the Luochuan paleosols (China), with a dominant maghemite fraction [3].

Discussion: The present study proves that there is neither a linear relationship between heavy metal and the *Mrs*/*Ms* ratios, which increase as the grain sizes of magnetite decrease. The association between concentration of heavy metals and magnetic parameters may be due to the incorporation of contaminants into the crystalline structure of magnetite and/or hematite-rich fly ashes (≤1μm) produced by point and/or diffuse anthropogenic sources. Therefore, the pollutant load released and accumulated in sediments, may sometimes be related to a fraction of fine-grained magnetic minerals. In these cases a link between heavy metals and grain size would be expected [4].

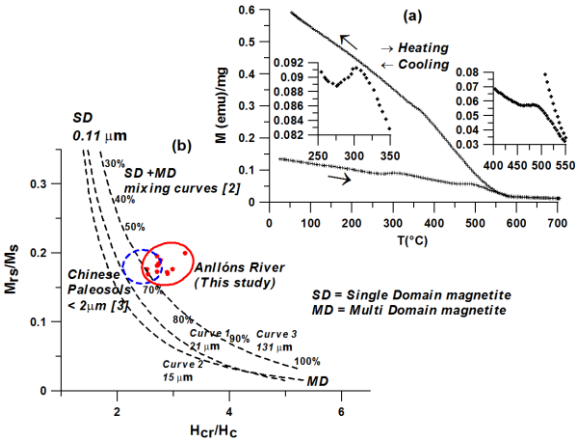

Figure 1: a) Thermomagnetic curve for a sample from the Anllóns riverbed b) Day plot showing the Anllóns River hysteresis data (red dots)

Conversely, this association may be also due to a later incorporation, via adsorption, of heavy metals on the surface of the magnetic carriers already present in the sediments. This mechanism could be the one that applies to this study since maghemite is usually a byproduct of weathering or low-temperature oxidation of detrital, pedogenic and/or anthropogenic magnetite. In this case the pollutant load would be rather linked to the bulk magnetic susceptibility, a first order measure of the amount of ferrimagnetic minerals in soils and sediments.

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