

# Occurrence and mobility of metals in sediments from mountainous catchments: a case study in the River Douro basin (Northern Portugal)

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**Introduction:** The management of sediments-associated contaminants, concerning quality and quantity, is still a significant issue in European Rivers. In this context, little attention has been given to mountainous rivers; it is well known that mountainous rivers contribute with significant sedimentary loads, transported in short periods of time, in response to short precipitation episodes. In Portugal there are few integrated studies, on sediment quality and quantity, at the catchment scale, as had been remarked in the Report on SedNet Round Table discussion [1], especially in the River Douro Basin. Most of the area drained by this transboundary River, and its tributaries, is developed in a mountainous landscape.

Our contribution presents results of a research study developed in one of the tributaries of the River Douro, the River Corgo catchment (studied area of 295 km<sup>2</sup>, up to the gauge station of Ermida). The River Corgo traverses Vila Real city and encounters the River Douro in Régua, in the West limit of the Douro Region – classified as UNESCO World Heritage. The altitudes vary between 200-1400m. The bedrock is composed of crystalline rocks and the land use is mainly forest and agriculture, with scattered urban settlements.

The global objective is to investigate the dynamics and availability of sediment pollutants in mountainous rural rivers, in a temperate climate. At the regional scale it is an important study, because as a consequence of the geological setting, most of the water used in human consumption comes from dammed reservoirs, and, as mentioned above, there is also a lack of knowledge of pollution at basin scale in the Douro Region, and about the amount of contaminants that are introduced in fluvial systems.



**Fig. 1:** Locality of River Corgo catchment in the Douro Basin in Portugal (modified from [2]).

**Methods:** The results reported in this study derive from a geochemical survey of active fluvial sediments (<63µm fraction), with the aim of characterising the spatial and temporal distribution of the contents of Cd, Co, Cr, Ni, Cu, Zn, Pb, Fe and Mn, in the catchment. To assess possible different origins of metals (natural vs. anthropogenic), and potential availability, a sequential chemical approach was used (modified BCR procedure [3]); the element concentrations were obtained by ICP-AES.

**Results and discussion:** Copper, Zn and, in particular, Pb show higher concentrations in the most labile fractions, which are higher where the total contents are also higher, suggesting an important contribution of anthropogenic activities to the total contents in the sediments. Chromium and Ni are the main metals from a lithological source, with relatively higher contents in the residual fraction, and the lowest in the most mobile fractions. The spatial distribution pattern of metal contents [4] shows that higher contents of metals in the most mobile fractions occur along the main courses of the major tributaries, in particular in the flatter reaches, where finer sediment preferentially accumulates. In sampling sites located in the vicinity of point pollution sources, there is an increase of sediment bound-metal contents, which indicates that even in more energetic streams the sediments are able to control, to a significant extent, the levels of metals in the fluvial water.

The pollutant dispersion and transport in this kind of mountainous fluvial environment is governed by multiple interrelated factors difficult to control over time. Every rainy season, the finer sediments are moved downstream in the drainage network, representing a considerable contribution of metals in the mainstream river Douro.

**References:** [1] SedNet (2007). Report on the SedNet Round Table Discussion, 27p.; [2] INAG (2001) Plan of River Douro Hydrographic Basin, 545p.; [3] Rauret, et al. (1999). *J. Environ. Monit.*, 1, 57-61; [4] Reis, A. R. (2010). Occurrence and mobilisation of non-organic micro-pollutants in mountainous riverine systems. PhD Thesis (unpublished), University of Trás-os-Montes e Alto Douro, Vila Real, 453 pp.