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Dispersal of natural and anthropogenic lead through submarine canyons at the Portuguese margin

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Submarine canyons are active conduits for the transport of particulate matter, including attached natural and anthropogenic heavy metals, from the coastal zone to the deep sea. As part of the projects HERMES (EU 6th FP) and “Lead in canyons” (Dutch Science Foundation), we analyzed multicore top sediments and sediment trap material from the Portuguese margin Nazaré and Setubal-Lisbon canyons for lead concentrations and stable isotopic composition. Our objectives are to determine lead distribution patterns, to assess the relative role of natural and anthropogenic sources from isotopic fingerprints, and to compare temporal snapshots from sediment traps with the integrated longer-term sedimentary signal.

Three-isotope plots for the entire dataset imply continuous mixing between anthropogenic contaminants (low 206Pb/207Pb, high 208Pb/206Pb) and one or several unpolluted crustal end members. The anthropogenic signature appears more pronounced in the Setubal-Lisbon canyon system, consistent with its proximity to industrialized areas and to the Tagus River. In both canyon systems, the anthropogenic influence decreases, to a first approximation, with increasing water depth.

Sediment trap data for the upper Nazaré canyon, characterized by cyclic sediment resuspension, transport and redeposition under the influence of tidal currents, reveal highly variable lead isotopic signatures.

For the lower Nazaré canyon, sediment trap samples with low (pelagic) mass fluxes display a relatively ‘polluted’ isotopic signature consistent with published lead isotope data from regional surface waters. By contrast, surface sediments of the lower canyon

appear less polluted; their lead isotopic composition resembles the ‘crustal’ isotopic signature of a single high mass flux event attributed to the passage of a sediment gravity flow at the trap site. Accordingly, episodic large mass flux events dominate the integrated sedimentary signal and dilute the anthropogenic component in the distal part of the canyon.

Similar distinctions between sediment trap and surface sediment data cannot be made for the Setubal-Lisbon canyon system, which is consistent with independent evidence for less active sediment resuspension and down-canyon transport.