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Toxic metal dispersion in mining areas: from point source to diffusion pollution. The case of the Mt. Amiata Hg mining district (Southern Tuscany - Italy): new results.

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Rivers draining mining areas may contribute to the diffusion of contaminants through their dispersion and accumulation into different morphological river units. The Paglia River's catchment (southern Tuscany) hosts the SE portion of the Mt. Amiata mercury district, the third most important worldwide (exploited from 1880 to 1980 with a total production of 100,000 tonnes Hg) before becoming a tributary of the Tiber River, which directly flows into Mediterranean Sea. The goals of this study are: 1) to recognize and distinguish different morphological units along the Paglia River watercourse, 2) to determine spatial/temporal distribution and concentration of Hg (and other toxic elements, particularly As) in different units.
The analysis of morphological units was made by mapping their evolution from the beginning of mining activity (1883) to present day along 43 km of the Paglia watercourse defining eleven morphological sections across this river, and one across one of its tributaries, the Siele Creek, which drains various Hg mines located upstream. Four fundamental morphological/sedimentary unit types have been distinguished: stream sediments, bar, floodplain, and terraces. The latter occur in various orders and age: Pleistocenic, pre-mining (i.e. dating before 1880), and coeval to the mining activity. A total of 100 samples were taken from the various units in the selected transects, georeferenced and then analyzed for their Hg and As contents by ICP-OES. Arsenic contents generally never exceed 10 mg/kg. The observed ranges are: stream sediments 4.1÷8.2 mg/kg; bars 4.1÷6.6 mg/kg; floodplains 3.8÷6.6 mg/kg; terrace coeval with mining activity 3.2÷10.1 mg/kg.
Hg contents in present-day stream sediments and bars are extremely variable (0.2÷27.5 and 1.4÷22.4 mg/kg respectively), and show a sharp increase at the confluence with Siele Creek. Floodplain sediments may reach up to 98 mg/kg. Terraces coeval with mining activity also show variable Hg contents (0.1÷66.9 mg/kg), whereas older terraces (Pleistocenic and pre 1880) show low Hg concentrations (0.05÷5 and 0.05÷1.1 mg/kg, respectively), within the natural geochemical background level of Mt. Amiata region (2÷6 mg/kg after Rimondi (2013 - Ph.D Thesis, Univ. of Florence - Italy). Our estimates indicat that along the 43 km of analyzed Paglia River reach, the various sedimentary units contain a total mass of about 60 tons of Hg. The largest amount of Hg is hosted by terraces coeval with mining activity (about 74% of total Hg), whereas minor amounts are stored in the floodplains (about 26%). Present day stream sediments and bars contribute to a negligible extent to the Hg mass balance in the Paglia system, because of the limited thickness of fine sediments deposited. During large floods, heavily contaminated materials resulting from these terraces and floodplains can be partially eroded and then transported further downstream, contributing to the diffusion of the pollutants toward the sea. Future goals of the study will include the determination of the vulnerability of fluvial reaches, and the formulation of hypothesis for controlling the erosion and the deposition of toxic materials.