

Environmental Impact of Abandoned Mining Activities in the Monte Amiata district (Italy) and Implications for a Sustainable Environmental Management

Hala Chmes², Francesco Ciani², Pilario Costagliola¹, Pierfranco Lattanzi¹, **Guia Morelli**¹, Alessia Nannoni², Valentina Rimondi²

¹National Research Council, CNR, Geoscience and Earth Resources Institute - IGG, Florence, Italy, ²Department of Earth Science, University of Florence, Florence, Italy

Increasing demand of metal resources should deal with site-specific management to prevent environment degradation, mainly due to the release of potentially toxic trace elements (PTE) to freshwater systems.

In the Mt. Amiata mining district (Italy), the 3rd former Hg producer worldwide, epithermal deposits were historically exploited (Hg, Sb) without management strategies. After 40 years from mine decommissioning, a legacy of contaminated sediments affects river channels/floodplain (Paglia-Tiber and Fiora rivers). In the upper Paglia River floodplain the interplay of mine waste deposition and changes of river morphology in the last 130 years formed a 20 km² contaminated area (Hg up to 100 mg/kg); its tributaries still supply Hg (up to 5400 mg/kg) to the main streams. In the Fiora River up to 3300 mg/kg Hg were observed in stream sediments.

Erosion of overbank sediments, intensified by extreme flood events driven by climate change, represent long-term PTE intermittent sources, with a long-distance impact up to the Mediterranean Sea, an important biodiversity hotspot and a food reservoir. The mass loads of Hg to the Sea from the whole district could be as high as 6.6 t/year.

The extent of contamination and low resilience suggest that river self-restoration seldom occurs in extensively exploited mining areas and, clean-up remediation strategies are not feasible. Management solutions should consider the coexistence with pollution, ensuring minimum risk for anthropogenic activities, also considering the opportunity of revising legislations on local PTE thresholds. A sustainable mitigation approach in the Paglia River is the cultivation/harvesting of riparian biomasses, since they store PTE (Hg up to 59.9 mg/kg), limit overbanks erosion and can be used for energy production. This is a pragmatic choice applicable to similar non-remediable areas to minimize the transport of PTE and a cost-effective circular remediation solution.