Acid water problem: Mining districts from Tuscany (central Italy)

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Acid mine drainage (AMD) is a major source of water contamination in metal- and coal-mining districts worldwide. AMD is a natural consequence of mining activity where the excavation of mineral deposits (metal bearing or coal), below the natural groundwater level, exposes sulphur-bearing compounds to atmospheric O_2 and water. The most common reactions that lead to the production of AMD involve the chemical and biological oxidation of metal sulfides contained in mine waste heaps, active or abandoned mine workings, or in tailings piles left over from the processing of sulfide ores. Chemicals used for treating AMD after formation are hydrated lime, pebble quicklime, caustic soda, soda ash briquettes, and ammonia. Each chemical reacts differently with a specific AMD. Therefore, it is essential that each AMD source has be treated and evaluated chemically/physically to determine which is most environmentally sound, efficient and cost effective. In this study a geochemical survey of mine waters discharging in the main mining districts of Tuscany (central Italy) was carried out to establish their geochemical features to provide information on AMD processes at mining-impacted sites in order to supply a background information necessary to the scientists responsible for assessing remediation technologies.

The composition of Mercury's crust from MESSENGER observations

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The MErcury Surface, Space ENvironment, GEochemistry, and Ranging (MESSENGER) spacecraft has returned a wealth of data since it began orbiting the innermost planet more than two years ago. Imaging observations reveal a surface shaped by widespread volcanism that produced both flood lavas and pyroclastic deposits [1]. Geochemical measurements from X-ray and gamma-ray spectroscopy show Mercury's crust to be chemically distinct from those of the other terrestrial planets and rich in volatile elements [2-4]. Mg/Si ratios are generally higher, and Al/Si and Ca/Si ratios lower than typical crustal materials on other planets; there is no evidence for a lunar-like, feldspar-rich crust. The abundance of sulfur is surprisingly high (~1–4 wt %), which most likely indicates that Mercury formed under highly reducing conditions, and is consistent with the low total surface Fe abundance (1–2 wt %) [4,5]. Correlations between Mg/Si, Ca/Si, and S/Si suggest that MgS and CaS are important crustal minerals. The average K/Th ratio and Na abundance are similar to those of other terrestrial planets, ruling out some high-temperature models of Mercury's formation. The high abundance of volatiles likely plays a key role in the formation of "hollows", enigmatic shallow depressions observed only on Mercury [6]. Substantial chemical heterogeneity is also observed [7,8]: high-reflectance smooth volcanic plains are, on average, enriched in Al, Na, and K and depleted in Mg, Ca, and S, relative to older, darker terrains. The observed compositional variations most likely reflect intrinsic differences in the magmas that produced the surface materials, as well as possible thermal redistribution of K and Na from hot surficial regions to colder ones. The Fe abundance also appears to be heterogeneous on 1000-km scales and is uncorrelated with other elements [5].

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