Atmospheric sources of potentially toxic elements in the northeastern U.S.

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Our study identified Zn smelters and coal fired power plants as anthropogenic sources of atmospherically transported elements in West Virginia (WV). Both smelters and power plants are known sources of atmospheric S, As, Zn, Pb, and Hg. WV lies downwind from coal-fired power plants located along the Ohio River Valley and prior to 1970, WV hosted a large smelter. We studied reservoir cores, soils and rocks from Hinkel (HIN) Reservoir in Harrison County, and Miletree Run (MTR) Reservoir in Roane County. HIN is within 10 km of a former Zn smelter, now a superfund site. Pb, As, S, Cd, Ge, Hg, PAH's, and magnetite all peak in HIN sediments deposited at about 1970 (dating by ^{137}Cs method). These constituents all occur at levels that could not have been supplied by local rocks. The soil and sediment hosted magnetite is dominantly spherical; a morphology produced by combustion. Cd correlates with Zn, As, Pb, and S. in reservoir sediments and is elevated in soil samples. Because Cd is enriched in smelter ZnS but not in coal combustion products, it is likely that the smelter was the source of HIN trace element anomalies. In contrast, data from MTR indicate inputs from power plants which are >50 km distant. Like Hinkel reservoir, there are also significant shifts in trace elements and magnetite that cannot be explained by local rock sources. Magnetic separates from this reservoir are also dominated by spherical combustion-produced magnetite. Covariance over the period 1930 to 1980 between magnetite and S with U.S. SO_2 production (which comes dominantly from coal combustion) is strongly suggestive of a significant atmospheric input into Miletree Run reservoir sediments. Additional data suggest that coal fired power plants have left an impact on the sediments and soils of the region. The USGS maintains a national database of stream sediment analyses. Stream sediments from the Ohio River Valley, the site of many coal-fired power plants, are enriched in Zn, Pb and As. This distribution does not correlate with local rock types and likely came from power plants. Similarly, the USGS national soil geochemistry database shows significant As enrichment downwind from the power plants of the Ohio River valley

How and why do rocks turn black – A history of surface biogeochemistry

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It is not astounding, that scientists like Charles Darwin, Alexander von Humboldt and Justus von Liebig worked and published on the topic of spectral changes of rock surfaces. None of them, however, was aware of the fact that these alterations influence the albedo of planet Earth to a measurable extent. These visible spectral changes on rock surfaces have been described in a set of specific terms, the most important ones being cataract crust, patina, and rock varnish. After a brief historical overview we describe the complex interrelated microbial, chemical and physical processes leading to spectral changes of rock surfaces. They evoke the impression of a large range of “colors” from light yellow to orange, red, brown, grey, and totally black. We (and others) have studied such rock surfaces from polar to equatorial areas, from hot and cold deserts to high mountains and on highly stressed surfaces of cultural monuments. Invariably we found that specific poikilotrophic and poikilophilic microorganisms were involved in the changes. Further, we analyzed the chemical and mineral compounds involved in patina formation by means of AAS, GC-MS, HPLC-MS, EPR, and other analytical tools. These substances (invariably under severe biological impact) are: iron and manganese hydroxides, oxides, oxalates, air-borne particles, carotenoids, and melanins. Several other compounds (e.g. mycosporines) are under investigation. However, their potential impact on spectral changes has not yet been established. The importance of the physical, chemical, and mineralogical changes of large surface areas of Earth (and other planets?) still is to be analyzed. However, temperature and Greenhouse effects can already be postulated. The potential of recognizing microbial impact on a planetary scale via satellites is discussed.

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