

Characterization of atmospheric dust in the Gulf of Aqaba

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It has been extensively documented that atmospheric dust is a major source of nutrients to the open sea and major oceanic gyres. However, the contribution of airborne material to the nutrient budget of coastal marine environments was usually neglected because their supply from continental surface runoff was considered adequate. The Red Sea is a sea located in an extremely arid region with virtually no runoff input, and therefore provides an ideal site to investigate the role of airborne dust in nutrient budget. The major objective of this study is to quantify the role of atmospheric dust in the nutrient balance of the oligotrophic waters of the Gulf of Aqaba (northern Red Sea). This quantification is needed for the estimates of the sources of "new" production during summer stratification in this marine environment.

Weekly samples of suspended dust have been collected continuously for more than two years in the northwestern corner of the Gulf of Aqaba, on the pier of the Interuniversity Institute for Marine Sciences, Eilat, Israel. After collection, samples underwent sequential dissolution in order to dissolve first water-soluble salts, then carbonates and oxides, and finally Al-silicates. Dust load vary seasonally from low values in the late summer to higher values in the fall, and highest values in the early spring. The mineral fraction in the dust is composed mostly of carbonates, Al-silicates (mostly clays), and quartz. Occasionally the dust samples contained elevated concentrations of anthropogenically-emitted metals (e.g., Pb, Cu, Zn) which could be attributed to sources from both Israel and Jordan. Elemental ratios of the dust indicate seasonal and synoptic-control on the sources of the dust which in turn determine the solubility of the dust. The dust loads (the chemical composition multiplied by the calculated depositional flux) points on its potential role in providing nutrients during the summer to the oligotrophic waters of the gulf.

Evolution of Arsenic mineralogy through sulfide oxidation at the Ketza River mine, Yukon, Canada

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The evolution of As-bearing minerals during sulfide oxidation was characterized in detail using samples from drill cores and outcrops at the Ketza River mine.

Pristine gold-bearing sulfide samples consist mainly of arsenopyrite, pyrite and pyrrhotite. Arsenopyrite is the main As-bearing phase. Pyrite contains less than 300 ppmw As.

Observations from partially oxidized rocks reveal that pyrrhotite is the least stable sulfide typically replaced by a mixture of FeS₂ and iron oxyhydroxide followed by pyrite that oxidizes mainly to iron oxyhydroxide. Adsorbed arsenic content of the iron oxyhydroxide in these partially oxidized samples is typically low (< 2 wt%), confirming that most of the arsenic is still retained in the pristine arsenopyrite. However, when pyrite oxidation occurs in contact with chlorite, there is localized formation of a Fe-aluminosilicate phase showing a strong affinity for As with contents up to 6 wt%. This crystalline phase has a well-defined chemistry with equal molar amounts of arsenic and phosphorous suggesting that both may occupy specific structural sites.

In contrast to the iron sulfides, destabilization of arsenopyrite is late and associated with a major oxidizing event, most likely in an acidic environment, that redistributed most of the arsenic in large continuous scorodite aggregates. When in contact with muscovite-rich areas, numerous small crystals of jarosite with As content up to about 5.5 wt% are formed locally within scorodite. In some instances, small crystals of Bi arsenate (BiAsO₄) are also observed. Complex assemblages of iron oxyhydroxides (goethite, lepidocrocite, amorphous) in oxidized rocks contain up to 10 wt% of As.

Characterization of an auriferous oxidized ore sample illustrates that the scorodite aggregates can be progressively destabilized during percolation, through pores, of fluids with higher pH buffered by the dissolution of the carbonates from the limestone wallrock. Going towards a pore, scorodite progressively breaks down to amorphous Ca-Fe arsenates. Finally, rosettes of fibrous arseniosiderite and, locally, euhedral crystals of pharmacosiderite are lining the pores.

Detailed textural, chemical, and structural characteristics of these different As-bearing phases and the implications for their relative stabilities will be presented. Analogies with the mineralogy observed in tailings from the old mine operation will also be discussed.