

Provenance tracing of aerosols in the South Atlantic Ocean using Pb and Nd isotopes and select trace and rare earth elements

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The atmosphere is an important pathway of delivering nutrients to ocean surface waters. These nutrients can play a vital role in marine biogeochemical processes and ultimately the global carbon cycle. However, our understanding of the atmospheric inputs and their influences on marine micronutrient cycles is limited, particularly in the South Atlantic, a region where models predict widely variable fluxes of micronutrients to the ocean from the atmosphere.

Moreover, in recent years it has become clear that atmospheric emissions from cities and human activities, such as road traffic and industrial plant emissions, can significantly impact atmospheric inputs and thus alter micronutrient fluxes to the ocean. Although air quality studies have been carried out for some cities bordering the South Atlantic Ocean, including São Paulo and Buenos Aires, the impact of emissions from such cities on marine micronutrient budgets has not been studied in detail.

Here, we present rare earth and select trace element data as well as results from Pb and Nd isotope analysis of sediments, volcanic ash, road dusts, aerosol filters and lichens from Patagonia, recent Cotopaxi, Chaitan and Puyahue volcanic eruptions, and the cities of São Paulo, Buenos Aires and Johannesburg. All sites are potential atmospheric aerosol sources for the South Atlantic Ocean. The rare earth and trace element concentration data and the isotopic results allow characterisation of the different source sites with adequate resolution to distinguish between South American and Southern African as well as anthropogenic and natural aerosol sources. This provenance information will be applied to interpret the first comprehensive geochemical data set (comprising rare earth, other trace element concentrations, and Pb, Nd isotope compositions) for aerosol filters collected in the South Atlantic Ocean at approximately 40° S during the UK GEOTRACES cruises D357 and JC068.

Mineralogy and origin of uranium deposits from central Jordan

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Secondary uranium surficial mineralization is hosted by travertine and calcrete in central Jordan [1]. The paleocirculating water in the combusted bituminous marl has oxidized the dissolved V⁴⁺ to V⁵⁺ and fixed the uranyl-ion as uranyl vanadate in strelkinite and metatyuyamunite. Carnotite was favored depending on the availability of K in solution. The uranyl vanadate minerals were precipitated from highly alkaline solutions during the dry periods after the precipitation of the thick travertine deposits.

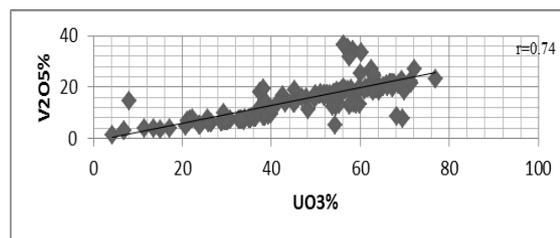


Figure 1: EDS results: UO₃ vs V₂O₅ correlation of the uranium minerals

Discussion of Results

U and V are associated in the same mineral phases as indicated in the figure above. The travertine is an evidence for discharges of hyperalkaline groundwater in the past [1]. Oxidizing alkaline circulating water oxidized dissolved V⁴⁺ to V⁵⁺, and mobilized uranium as uranyl complexes before the precipitation of uranium vanadate minerals as strelkinite and tyuyamunite and carnotite.

[1] Khoury (2012) *Environmental and Earth Science*. **65**:1909-1916.