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The ($^{234}U/^{238}U$) compositions and trace element concentrations of sequential leachates of atmospheric dust collected in the northern Red Sea between 2009-2019

GIL LAPID[1] AND ADI TORFSTEIN[2]

[1]The Interuniversity Institute for Marine Sciences in Eilat
[2]Hebrew University of Jerusalem

Presenting Author: gil.lapid@mail.huji.ac.il

Atmospheric dust plays a key role in shaping global climate by affecting the radiative budget, modulating precipitation, and serving as a significant source of limiting nutrients to the oceans. At present, the primary source of atmospheric dust in the world is the Sahara-Arabia desert belt. The mineral composition of dust varies both spatially and temporally, but can be generally divided into Al-silicates, Mg-carbonates, Fe-Mn oxides, Ca-carbonates and water-labile phases.

Here, we report ($^{234}U/^{238}U$) compositions and trace element concentrations in five sequentially leached phases of 20 dust samples collected in the Gulf of Aqaba, northern Red Sea, between 2009-2019. The sampling site is located between the Sahara and the Arabia Deserts and is exposed to frequent dust storms, whose source is identified through air mass back trajectories. The ($^{234}U/^{238}U$) ratio is sensitive to the weathering history of the samples, which reflects the combined effects of their provenance, transport pathways and chemical weathering rates. The sequential leaching steps included water, followed by 0.1N HNO_3, hydroxylamine hydrochloride, 3N HNO_3, and a mixture of concentrated HNO_3-HF. These leachates successfully extracted the water labile phases, Ca-carbonates, Fe- and Mn-oxides, Mg-carbonates and silicate phases, respectively.

The water labile phase displays the highest ($^{234}U/^{238}U$) values between 1.11-1.32, roughly corresponding with seawater composition (~1.14). The Ca-carbonate and silicate phases, which incorporate most of the U, display an overall ($^{234}U/^{238}U$) range of 0.93-1.03, and the Mg-carbonates and Fe-Mn oxides display values of 0.97-1.09 and 0.95-1.08, respectively. Combined, the ($^{234}U/^{238}U$) ratios and trace element distributions allow to determine the characteristic chemical and isotopic composition of each of the dust phases and associate them with different geographic regions and dust flux regimes. The results are further investigated using a principal component analysis and comparison to previously published results.

This is the first report of the uranium isotopic composition of atmospheric dust from the Arabian and eastern Saharan Deserts, and coupled with the trace element abundances in the different mineral phases, the results allow us to reconstruct the geochemical history of different dust sources, and determine aeolian trace element fluxes in this region.