Using the $^{234}U/^{238}U$ Uranium Isotope Activity Ratio as an Indicator of the Dead Sea Response to Holocene Climate

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The Dead Sea is a terminal hypersaline lake whose watershed is located within two distinct climate zones: the Mediterranean and the Sahara-Arabian. With no natural outflows, the Dead Sea composition and level are sensitive to changes in climate. A 450 m core collected as part of the ICDP-Dead Sea Deep Drilling Project in 2010-2011 provides a record of climate in the Levant over the last ~220,000 years. The lithology of the core and the isotopic ratios of the authigenic minerals reflect shifts between a wetter glacial climate and more arid interglacial periods. The Holocene, a relatively dry interglacial period in the Levant, is marked by thick intervals of halite, gypsum, and detritus, while the wetter glacial periods are marked by aragonite, detritus, and gypsum. Here, we present $^{234}U/^{238}U$ data on Holocene age aragonite samples. Water sources in the Dead Sea drainage basin have variable $^{234}U/^{238}U$ activity ratios, ranging from ~1.5 for the Jordan River and western sources to ~1.1 for floods and eastern sources. Therefore, the $^{234}U/^{238}U$ activity ratios recorded in the authigenic minerals reflect changes in lake composition that resulted from variations in the relative contributions of different water sources. The $^{234}U/^{238}U$ activity ratios in the authigenic phases during the Holocene show that, in general, the contribution of water to the Dead Sea was similar to the present-day and mainly through the Jordan River. However, there is some variability, indicating intervals of increased aridity reflected by thick halite layers and marked by decreased Jordan River runoff and increased contributions from floods and eastern sourced runoff. An example occurred near the beginning of the Holocene at ~10 ky, when the $^{234}U/^{238}U$ activity ratio shifts to very low values <1.2 during the precipitation of a thick halite layer.