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Uranium isotopic composition and constraints on the provenance of the Qinghai-Tibet Plateau's surface dust

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The production and emission of aeolian dust can provide key information on the contemporary and historical links between geological evolution and climate. Here we use $^{234}U/^{238}U$ isotope ratios and the uranium (U) comminution age method on samples collected from Qinghai-Tibet Plateau (TP) surface dust and glacier snowpack/cryoconites to determine the erosion and potential transport provenance of the dust, regardless of petrological origin. The spatial variation of the ($^{234}U/^{238}U$) isotope ratios of TP dust showed relatively high values in the Songpan-Ganzi-Hoh Xil, Himalayan and the Kunlun-Qaidam-Qilian terranes, while showing relatively low ($^{234}U/^{238}U$) values in Lhasa and Qiangtang terranes, but among all samples the highest value appeared in the glaciation zone. Dust collected from nearby glacial areas with rugged terrain (e.g. the Qilian and Himalayan Mountains) have higher ($^{234}U/^{238}U$) values than those collected in the topologically flat non-glacial areas. These differences are consistent with elevated erosion rates and dust comminution-transport processes in glacial areas, which yield a major source for large quantities of fresh comminuted particles. Compared to sediments from other regions of the globe, the ($^{234}U/^{238}U$) values of the typical aeolian sinks (such as loess on the Loess Plateau and ice core dust, etc.) are generally lower in comparison to areas with high elevations where erosion rates are high. The ($^{234}U/^{238}U$) isotope values of TP dust tend to fall between the high-elevation sites and the dust sinks, indicating the combined influence of short comminution times (tectonics, landscape dynamics, and glacial erosion) and long residence time on the TP. When compared with other central Asian dust sources, U-Nd-Sr isotope signatures in TP dust are distinct and can be thus used as an effective tracer of dust provenance. Using uranium isotopes, we show that dust originating from the TP undergoes long-range transport and constitutes potentially significant component of the Asian and Northern Hemisphere atmospheric dust load.