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Geochemical records of continental weathering/erosion from the eastern Arabian Sea and their responses to the Indian Summer Monsoon since 1.2 Ma

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The significant interactions between the solid Earth and the climate system have attracted increasing attention from the geoscience community in recent years. In this study, clay mineralogy, Sr–Nd isotopes, and major and trace elements of clay-sized siliciclastic sediments at International Ocean Discovery Program Expedition 355 Site U1456 drilled in the eastern Arabian Sea have been investigated to reveal the sediment provenances and reconstruct the erosion/weathering patterns in Western Himalaya and Peninsular India in response to the Indian summer monsoon since 1.2 Ma over orbital timescales.

The clay mineral assemblages at Site U1456 mainly consist of smectite (~59%) and illite (~33%), with minor chlorite (~5%) and kaolinite (~3%). Provenance analyses based on clay mineralogy and Sr-Nd isotopic compositions indicate a two end–member mixture from the Indus River (20–90%) and rivers draining the Deccan Traps (10–80%). Temporal variations in provenance proxies suggest an abrupt increase in terrigenous input from the Indus River during MIS 12, which may have resulted from a physical erosion event in the Himalayan region. α^{Al}_{K} at Site U1456, which is calculated as Al/K ratio of the study sample versus Al/K ratio of the upper continental crust, can be generally used to reflect the chemical weathering intensity in the source regions. Over orbital timescales, periods of intensification of the Indian summer monsoon are closely coupled with enhanced chemical weathering and physical erosion/runoff in the source regions. Wavelet and spectral analyses of the α^{Al}_{K} record show strong periodicities at 125, 35, 29, and 23 kyr, with significant ~100–kyr cycles established beginning at ~0.7 Ma, suggesting the significant control of both Northern and Southern Hemispheric processes. The long–term evolution of α^{Al}_{K} and siliciclastic mass accumulation rate at Site U1456 reveals significant fluctuations in monsoon–induced silicate weathering and erosion during ~1.2–0.7 Ma, indicating an enhancement of the Indian summer monsoon with increased variability in association with the Mid–Pleistocene Transition.