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Source to sink approach to weathering characterization and quantification for the Himalayan erosion system.

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The detrital sediments accumulated in foreland basins store the insoluble part of the continental erosion. This represents the best source of information on past weathering processes. Provided we can assess the compositions of the source rocks and detrital sediment reservoirs, the simple difference between source rocks and detrital sediments can quantitatively indicate the weathering intensity and characterize the critical cations delivered to the river system and oceans. In reality, this exercise is hampered by the difficulty to determine average compositions of sources and sinks. Sources can be approached from geological data on the eroded basin as well as from modern river analogs of the past erosion system. Rivers sediments are an excellent way to integrate the diversity of lithologies in continental scale basins but they are also modified by chemical weathering and they need to be complemented by the dissolved load of the river. Detrital sediments represent the final product of erosion and are principally biased by size and density sorting processes occurring during transport and ultimately by post-deposition diagenetic alteration.

In the Himalayan Basin, sediments accumulated in the Bengal Fan offer a unique archive to study past erosion with access to Miocene to present sediments with minimum diagenetic effects. These sediments are essentially derived from the Ganga-Brahmaputra river system and source tracers such as Sr and Nd isotopic compositions or dense mineral thermochronology tracing demonstrate a long-term stability of the source rock compositions with variable mixing between Himalayan crust and South Tibet terranes. Weathering characterization includes mineralogical (clay and major minerals) as well as isotopic tracing that reveal the main trends. Quantitative approach is based on source tracing using Nd isotopic compositions, major element compositions of the silicate fractions of sediment and modeling of the sediment sorting that exerts primary control on the compositions. Applied to sediment recovered during the IODP Expedition 354 in the Bengal, this reveal that silicate weathering declined significantly from Miocene to present and allows to estimates weathering rates and fluxes of critical cations for the carbon cycle such as Ca and Mg.