The origins and histories of metasedimentary units in the core of the Himalaya

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We present an integrated geochemical dataset on rock units from the core of the Himalaya that provides insights into the Proterozoic to Mesozoic palaeogeography and stratigraphy of the region. Our study combines bulk-rock Sr-Nd isotopic analyses on pelitic metasediments with U-Pb and Hf data on detrital zircons from psammitic rocks in the same units. Additional constraints are drawn from dating of zircons from igneous bodies at critical positions in the stratigraphy.

Bulk-rock Sr-Nd isotopic data

Whole rock isotopic data show a bimodal distribution: Palaeoproterozoic metasediments have εNd(500) values below –17, whereas Neoproterozoic and younger metasediments have εNd(500) above –13. The latter group encompasses several mapped units, including the High Himalayan Crystalline Series (HHCS). We distinguish all these units from the Inner Lesser Himalaya (ILH), the Palaeoproterozoic metasediments with more negative εNd values. Sr data suggest that a thermal event affected the HHCS and OLH units at ca. 500 Ma, but not the ILH.

Detrital zircon data

U-Pb ages of detrital zircons also show bimodality, implicating two distinct original crustal sources in the region. All units contain zircons of Palaeoproterozoic-Archaean age (2.6-1.8 Ga), but only Neoproterozoic and younger units contain a younger detrital zircon population (1.1-0.8 Ga) as well. Hence these sediments represent a mixture of detritus from two different source regions, while the older ILH sediments were only fed by the older of these sources, probably exposed around the restricted rifts in which the ILH initially accumulated. Lu-Hf isotopes indicate that this old source contributed zircons formed by melting of Archaean crust (3.4-2.6 Ga), whereas zircons from the younger source region were derived from melting Palaeoproterozoic (2.1-1.7 Ga) crust. Appropriate older sources are currently exposed in cratonic India, while the younger source remains obscure.

Igneous zircon data

U-Pb dates on a variety of minerals, including uraninite, record the crystallization ages of 1.87 Ga and 824 Ma metagranitoids in the ILH and HHCS respectively, providing important constraints on the units' depositional ages, as well as some implications for the India-Asia collision and Himalayan architecture.