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Abstract

Sedimentological and provenance data from the lower Miocene–Pliocene Dumri Formation and Siwalik Group in western Nepal provide new information about the timing of thrust faulting and the links between erosional unroofing of the Himalaya and the Cenozoic $^{87}Sr/^{86}Sr$ record of the ocean. In western Nepal, the Dumri Formation is an ~750–1300-m-thick fluvial sandstone and overbank mudstone unit. The Siwalik Group is >4200 m thick and consists of a lower member (>850 m) of 2–12-m-thick fluvial channel sandstones and oxidized calcareous paleosols, a middle member (>2400 m) of very thick (>20 m) channel sandstones and mainly organic-rich Histosols, and an upper member (>1000 m) composed of gravelly braided river deposits. Paleocurrent data indicate that middle Miocene–Pliocene rivers in western Nepal flowed southward, transverse to the thrust belt, throughout deposition of the Siwalik Group. No evidence was found for an axial fluvial trunk system (i.e., the paleo-Ganges River) in Siwalik Group sandstones. A major increase in fluvial channel size is recorded by the transition from lower to middle Siwalik members at ~10.8 Ma, probably in response to an increase in seasonal discharge.

Modal petrographic data from sandstones in the Dumri Formation and the Siwalik Group manifest an upsection enrichment in potassium feldspar, carbonate lithic fragments, and high-grade metamorphic minerals. Modal petrographic analyses of modern river sands provide some control on potential source terranes for the Miocene–Pliocene sandstones. The Dumri Formation was most likely derived from erosion of sedimentary and low-grade metasedimentary rocks in the Tibetan (Tethyan) Himalayan zone during early Miocene emplacement of the Main Central thrust. The presence in Dumri sandstones of plagioclase grains suggests exposure of crystalline rocks of the Greater Himalayan zone, perhaps in response to tectonic unroofing by extensional detachment faults of the South Tibetan detachment system. During deposition of the lower Siwalik Group (~15–11 Ma), emplacement of the Dadeldhura thrust sheet (one of the synformal crystalline thrust sheets of the southern Himalaya) on top of the Dumri Formation supplied abundant metasedimentary lithic fragments to the foreland basin. A steady supply of plagioclase grains and high-grade minerals was maintained by deeper erosion into

the Main Central thrust sheet. From ~11 Ma to the present, K-feldspar sand increased steadily, suggesting that granitic source rocks became widely exposed during deposition of the upper part of the lower Siwalik Group. This provenance change was caused by erosion of passively uplifted granites and granitic orthogneisses in the Dadeldhura thrust sheet above a large duplex in the Lesser Himalayan rocks. Since the onset of deposition of the conglomeratic upper Siwalik Group (~4–5 Ma), fault slip in this duplex has been fed updip and southward into the Main Boundary and Main Frontal thrust systems.

We obtained 113 U-Pb ages on detrital zircons from modern rivers and Siwalik Group sandstones that cluster at 460–530 Ma, ~850–1200 Ma, ~1.8–2.0 Ga, and ~2.5 Ga. An abundance of Cambrian–Ordovician grains in the Siwalik Group suggests sources of Siwalik detritus in the granites of the Dadeldhura thrust sheet and possibly the Greater Himalayan orthogneisses. The older ages are consistent with sources in the Greater and Lesser Himalayan zones. An overall upsection increase in zircons older than 1.7 Ga suggests increasing aerial exposure of Lesser Himalayan rocks. None of the detrital zircons (even in the modern river samples) yielded a Cenozoic age that might suggest derivation from the Cenozoic Greater Himalayan leucogranites, but this may be attributable to the inheritance problems that characterize the U-Pb geochronology of the leucogranites.

When compared with recent studies of the $^{87}Sr/^{86}Sr$ composition of paleosol carbonate nodules and detrital carbonate in paleosols from the Siwalik Group, the provenance data suggest that erosion and weathering of metamorphosed carbonate rocks in the Lesser Himalayan zone and Cambrian–Ordovician granitic rocks of the crystalline thrust sheets in central and eastern Nepal may have played a significant role in elevating the $^{87}Sr/^{86}Sr$ ratio of middle Miocene synorogenic sediments in the Indo-Gangetic foreland basin and the Bengal fan, as well as global seawater.

GeoRef Subject

Asia metals Cenozoic alkaline earth metals sandstone Indian Peninsula strontium

Tertiary clastic rocks paleosols Sr-87/Sr-86 Himalayas isotope ratios Siwalik System stable isotopes sedimentary rocks isotopes Nepal geochemistry Neogene

First Page Preview

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Index Terms/Descriptors

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