

Be -Sr -Nd erosion patterns in the Narayani watershed, Central Nepal, viewed through the Valmiki Siwalik section

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^{10}Be - Sr - Nd erosion patterns in the Narayani watershed, Central Nepal, viewed through the Valmiki Siwalik section

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Climate variability and glacial extension may have led to a global increase of erosion rates at the Quaternary transition (Zhang et al. 2001). This potential increase may have impacted mountain building and also climate through feedback effects. However, the existence of strengthened erosion during the Quaternary is debated, particularly for the Himalaya. While the high relief of the range drives monsoonal precipitations that produce a major erosional flux on Earth (Milliman and Syvitski 1992), the existing records yield contrasting results. Addressing the question of Quaternary accelerated erosion both requires the application of new approaches and investigation of new archives.

Here, we present a new Siwalik record. The sections are located in the central Himalaya, South of Chitwan Dun, where local rivers have entrenched the Himalayan sediments exhumed by the uplifting Siwalik fold. The sections expose sediments of a paleo-fan that we assume to have been fed by the Narayani-Gandak river, one of the major Transhimalayan rivers. The studied sections present a cumulated thickness of ~4000 m and consist in almost continuous sandy to fine fractions of sedimentary rocks. The depositional ages were constrained by a magnetostratigraphy analysis and range from ca. 8 Ma to < 0.8 Ma.

To determine the paleo-erosion, we quantified the in-situ ^{10}Be cosmogenic nuclide concentrations in the 125-250 μm quartz fraction of the sedimentary rocks (e.g. Charreau et al. 2011). By measuring ^{36}Cl in feldspar, we checked that the contribution of recent exposure to ^{10}Be concentration was minor. We computed paleo-concentrations, which range from 5000 to 40’000 at/g and average 10’000 at/g.

We then analysed the provenance stability and potential recycling with Sr-Nd isotopes and major elements respectively. Major elements show a transition at ca. 1 Ma, with SiO_2 increasing from 75 to > 85% and Na/Al decreasing from 20% to < 10%. Na depletion in young sediments reflects an increase of weathering and may be indicative of a transition from direct deposition of sediments from the Himalaya to recycling of proximal sources, i.e. from Siwalik fold denudation.

The εNd and ^{87}Sr/^{86}Sr isotopic signatures of the sediments range from -19.5 and -17.5, and from 0.75 to 0.78 respectively. These signatures are similar to modern Narayani-Gandak sands (-19 and 0.75 on average respectively). They are interpreted as resulting from a rather steady mix of Himalayan formations, with 50 to 90% High Himalayan contributions.

Based on these results we assumed the cosmogenic production rates during the past were similar to the present value across the Narayani watershed at least until 1 Ma. The derived paleo-erosion rates of the Narayani watershed range from 0.5 to 4 mm/yr, around an average of 1.8 mm/yr. This corresponds to an average time scale of 1 kyr. The average paleo-erosion rate is similar to modern values (Lupker et al. 2012). However, the paleo-concentrations and the paleo-erosion rates display significant dispersion, with large (+100%) fluctuations of at high frequency (< 0.3 Ma). This dispersion could highlight the naturally stochastic character of erosion even for a large watershed in a range apparently dominated by tectonic processes.

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