Magnetic polarity stratigraphy of Siwalik Group sediments in Nepal: Diachronous lithostratigraphy and isochronous carbon isotope shift

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The middle Miocene-Pliocene Siwalik Group was deposited in the Himalayan foreland in response to uplift and erosion in the Himalayan fold-thrust belt (Zeitler1985, Hodges and Silverberg 1988, DeCelles et al 1998). Thermal demagnetization experiments demonstrate that laminated (probably paludal) siltstones yield paleomagnetic data useful for tectonic and magnetostratigraphic studies, whereas other lithologies yield data of questionable reliability (Ojha et al. 2000). Magnetostratigraphic data were acquired from 297 sites within a 4200-m thick section of Siwalik deposits at Surai Khola (27.8° N; 82.7° E). The observed sequence of polarity zones correlates with the geomagnetic polarity time scale (GPTS) from chron C5n to chron C2n. This geochronologic calibration indicates that the lower-middle Siwalik lithostratigraphic boundary at Surai Khola occurs at 7.5 Ma, using the GPTS of Cande and Kent (1995). This boundary is characterized by an abrupt increase in the thickness of coarse-grained channel sandstones and other sedimentological indicators of increased wetness of the floodplain. The cause of the change in depositional character at the lower-middle Siwalik boundary could be either tectonic (an increase in subsidence rate) or paleoclimatic (Cerling et al. 1997, Quade et al. 1995, Harrison et al. 1993). Data from other sites in the Nepal foreland, however, suggest that the change is highly diachronous, probably ruling out the paleoclimatic explanation (Hoorn et al. 2000, Quade et al. 1995, 1997). At Muksar Khola (26.9° N; 86.4° E), 111 paleomagnetic sites from a 2600-m thick section define a polarity zonation that correlates with the GPTS from chron C4An to chron C3n. At this locality, the lower-middle Siwalik lithostratigraphic boundary occurs at 8.8 Ma. Previously published results from Bakiya Khola (27.1° N; 85.2° E) indicate that this section was deposited from chron C5n to chron C3n and the lower-middle Siwalik lithostratigraphic boundary occurs at 9.2 Ma. The lithostratigraphic lower-middle Siwalik boundary is thus time transgressive by at least 1.7 Ma. along strike in the Himalayan foreland of Nepal. On the other hand, at Surai, Muksar, and Bakiya kholas, a shift in $\delta^{13}C$ in paleosol carbonate occurs within chron C3Ar at ~6.8 Ma, indicating that the carbon isotopic shift is isochronous. This isotopic shift has also been observed in Siwalik Group sediments of Pakistan (where the isotope shift appears to commence slightly earlier) and oceanic deposits of the Bengal Fan (Cerling et al 1993, France-Lanord and Derry 1994). The shift in carbon isotopes is interpreted as an ecological transition from dominantly C_3 plants (trees) to dominantly C_4 plants (grasses).

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