The Paleogene record of Himalayan erosion; Burma and Bangladesh

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The record of sediment eroded from a mountain belt provides a valuable archive of an orogen's early evolution. Yet identification of an archive which records the Palaeogene erosion of the Himalaya's southern flanks remains enigmatic. In the western Himalaya, orogenic-derived material has been identified in the Indus Fan as far back as Mid Eocene, although the precision of dating is poor, and the proportion of material derived from north of the suture zone rather than the Himalaya's southern flanks is likely high (Clift et al. GSA Bulletin 2001). For the eastern-central Himalaya, no significant Palaeogene sediments eroded from the orogen's southern flanks have been documented. In the foreland basin, a disconformity represents much of the Paleogene (Najman Earth Science Reviews 2006). In the Bengal Basin, the Oligocene deposits are of disputed provenance (Johnson and Nur Alam GSA Bulletin 1991; Uddin and Lundberg GSA Bulletin 1998). In the Bengal Fan, the onset of turbidite sedimentation can be dated no more precisely than approximately the Eocene-Oligocene boundary based on extrapolation of accumulation rates at ODP Site 116, and "post Paleocene" by seismic correlation of a dated unconformity on the Ninetyeast Ridge into the adjacent basin (Curray et al. Marine and Petroleum Geology 2003 and references therein). It has also been proposed that the Palaeogene Indo-Burman Ranges represent Palaeogene Bengal Fan material offscraped into an accretionary prism (Curray et al. AAPG Memoir 1979) but this provenance is disputed (Mitchell J. Geol Soc London 1993).

We undertook a detailed provenance analysis of the Indo-Burman Ranges in Burma and Bangladesh, and identified a major difference in composition between Palaeogene and Neogene rocks. Whilst the Neogene Indo-Burman Ranges (west of the Kaladan Fault, in both Bangladesh and Burma) are clearly Himalayan-derived (Allen et al. in review, Allen et al. in press), the Paleogene rocks contain a much higher proportion of arc-derived material, most probably derived from the Burman arc to the east (Allen et al. in press).

In the Bengal Basin we have identified earliest evidence of Himalayan detritus at 38 Ma (Najman et al., in press), determined using an integrated provenance approach utilising seismic data and a number of isotopic and geochemical techniques. Detrital mineral lag times show that exhumation of the orogen was rapid by 38 Ma. The identification of sediments shed from the rapidly exhuming southern flanks of the eastern-central Himalaya at 38 Ma, provides a well dated accessible sediment record 17 Myrs older than the previously described 21 Ma sediments in the foreland basin in Nepal (DeCelles et al. Tectonics 2001). Discovery of Himalayan detritus in the Bengal Basin from 38 Ma: 1) resolves the puzzling discrepancy between the lack of erosional evidence for Paleogene crustal thickening that is recorded in the hinterland; 2) invalidates those previously proposed evidences of diachronous collision which were based on the tenet that Himalayan-derived sediments were deposited earlier in the west than the east; 3) requires that models of Himalayan exhumation (e.g. by mid crustal channel flow) be revised to reflect vigorous erosion and rapid exhumation by 38 Ma, and 4) provides evidence that rapid erosion in the Himalaya was coincident with the marked rise in marine 87Sr/86Sr values since ~40 Ma. Whether 38 Ma represents the actual initial onset of vigorous erosion from the southern flanks of the east-central Himalaya, or whether older material was deposited elsewhere, perhaps now buried beneath the thrust stack, remains an open question.

References

Allen R, Y Najman, A Carter, D Barfod, M Bickle, H Chapman, E Garzanti, G Vezzoli, S Ando and Parrish R. In press. Provenance of the Tertiary sedimentary rocks of the Indo-Burman Ranges, Burma (Myanmar): Burman arc or Himalayan-derived? *Journal of the Geological Society of London,* [In press]

Allen R, Y Najman, E Willett, A Carter, D Barfod, E Garzanti, J Wijbrans, M Bickle, G Vezzoli, S Ando, G Oliver and J Uddin. New seismic, biostratigraphic and isotopic constraints to the geological evolution and sedimentary provenance of the SE Bengal Basin, Bangladesh. *Basin Research,* [in review]

Najman Y, M Bickle, M BouDagher-Fadel, A Carter, E Garzanti, M Paul, J Wijbrans, E Willett, G Oliver, R Parrish, H Akhter, A Allen, S Ando, E Chisty, L Reisberg and G Vezzoli. In press. The Paleogene record of Himalayan erosion, Bengal Basin, Bangladesh. *Earth and Planetary Science Letters,* [In press]