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Neogene Himalayan erosion regime and climate recorded in the Bengal Fan at 8°N (IODP Exp. 354)

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The Indian monsoon and tectonic both control the Himalayan erosion. Tectonic generates uplift and maintain high elevation of the range and earthquakes weaken the mountain front. Monsoon seasonal intensity controls the glacier cover, landslide activity, river incision, vegetation cover, and export of sediments towards the floodplain. The monsoon also exerts a primary control on the chemical erosion as weathering rates are clearly dependent upon river discharge. In the floodplain, sediment export is also tightly controlled by climate. The seasonality and intensity of the monsoon generate discharge high enough to ensure the efficiency of river transport of sand-rich sediments to the delta and shelf (Lupker et al. JGR, 2011).

IODP Expedition 354 allowed to drill a series of seven sites along an E-W transect at 8°N in the Bengal fan. This generated a comprehensive record of Himalayan erosion since 20 Ma. Bengal fan sediments are dominated by turbidites characterised by high accumulation rate and variable grain size raging from clayey silt to sand. Plio-Pleistocene turbidites reveal frequent channel levee deposition with massive sand deposition in inter-levee intervals. Overall, sand represents at least a third of the fan deposition. Turbidites are intercalated with hemipelagic sediments characterised by low accumulation rates, 20 to 50% of biogenic carbonates, fine grains and bioturbation. Turbidites have petrographic and geochemical signatures characteristic of sediments derived from the Himalaya such as the Ganga and Brahmaputra rivers that supply the fan (see A. Galy et al. this session). Major and trace element geochemistry show relatively stable compositions throughout the Neogene and Quaternary. They reveal a very weak regime of chemical weathering with no significant variation through time. Concentrations in mobile elements such as Na and K relative to Al are significantly higher than in modern river and northern fan sediments. This suggests that weathering and/or soil erosion are amplified in the modern time. Detrital carbonate concentration vary significantly with higher concentrations during the Miocene then falling during the Plio-Pleistocene. This suggests either a change in the exposition of Tethyan series in Himalaya or significantly lower chemical weathering during Miocene. Finally, clay composition is dominated by illite which also differs with the present Ganga which is rich in smectite. The record at 8°N contrasts with the ODP Leg 116 record at 1°S in the distal fan, which from 7 to 1 Ma shows a high degree of weathering associated to lower accumulation rates. The record at 8°N indicates that these variations do not reflect changes in the continental source basin but rather reflect a change in the turbiditic export.

The Bengal Fan record at 8°N suggests that an erosion regime dominated by physical erosion able to drive large amount of sand and silt with low weathering was established at least 20 Ma ago and remained relatively stable in spite of the global climate variations. These observations suggest that erosion sustained by a highly seasonal climate able to ensure rapid transport of sediments such as the monsoon was already active 20 Ma ago.