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Hemipelagic and turbiditic deposits constrain lower Bengal Fan depositional history through Pleistocene climate, monsoon, and sea level transitions

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ABSTRACT

The Bengal Fan contains the most complete record of Himalayan climate and tectonics. As the largest fan system of the world it is fed by the Ganges-Brahmaputra river systems. International Ocean Discovery Program (IODP) Expedition 354 cored seven sites along an east-west core transect at 8°N in the lower Bengal Fan. We studied the Pleistocene sections of these sites to provide constraints on the depositional history of the last 1.25 Ma. Low-resolution bio- and magnetostratigraphic constraints identified two regionally-extensive hemipelagic units and intercalated turbidite deposits that provide a chronostratigraphic framework for the 320 km transect. Using a combination of lithostratigraphy and sediment physical properties that vary on orbital timescales, we tuned high-resolution data sets to the LR04 benthic $\delta^{18}O$ isotope stack to obtain new constraints on the timing of depositional changes.

Above the underlying Unit 1, which consists of Early to Middle Pleistocene turbiditic deposits, we divide four more units for the last 1.25 Ma: Unit 2, a Middle Pleistocene hemipelagic layer deposited at all sites from Marine Isotopic Stages (MIS) 37 to ~17 (~1.24–0.68 Ma) during the entire time of the Mid-Pleistocene Transition, when the Bengal Fan depocenter must have been distal to our transect; Unit 3, mostly turbidites with some intercalated hemipelgic sediments deposited from ~MIS 16–~13 (~0.68–0.48 Ma), with sandy lithologies only found at the easternmost site on the west flank of the Ninetyeast Ridge; Unit 4, massive turbiditic sediments that started to dominate deposition with the Mid-Brunhes Transition (~MIS 12) until MIS 7/8 (~0.48–0.25 Ma), when the channel-levee system was focused east of the 85°E basement ridge at 8°N; and Unit 5, a Late Pleistocene hemipelagic layer at the top that spans MIS 7/8–1 (~0.25 Ma to present) while the turbidite deposition was focused west of the 85°E basement ridge at 8°N. We find evidence that, on these timescales, deposition across the lower Bengal Fan changed with the evolution of Pleistocene climate, monsoon and sea-level history and hence responded to external controls on sediment accumulation and fan architecture rather than only fan-internal, autocyclic mechanisms.

1. Introduction

IODP Expedition 354 cored seven sites along an east west oriented 320 km long transect at 8°N in the lower Bengal Fan (France-Lanord et al., 2016). The core transect is anchored between the Ninetyeast Ridge to the east (Site U1451) and the currently active channel to the west (Site U1454; Fig. 1). Among the major expedition objectives are to study the Neogene fan evolution and the impact of the monsoonal system and sea-level changes on sediment supply, as well as the fan architecture and development.

In this study, we concentrate on achieving these goals for the Pleistocene sections for which two thick regionally extensive hemipelagic layers were deposited across the transect. Establishing high-resolution constraints on the Expedition 354 chronostratigraphy is paramount yet complicated given the discontinuous nature of turbiditic deposits and sediment reworking. The stratigraphy of each site is largely dominated by local depositional processes related to the proximity of that site to the active channel-levee system. Yet, the physical properties are largely consistent

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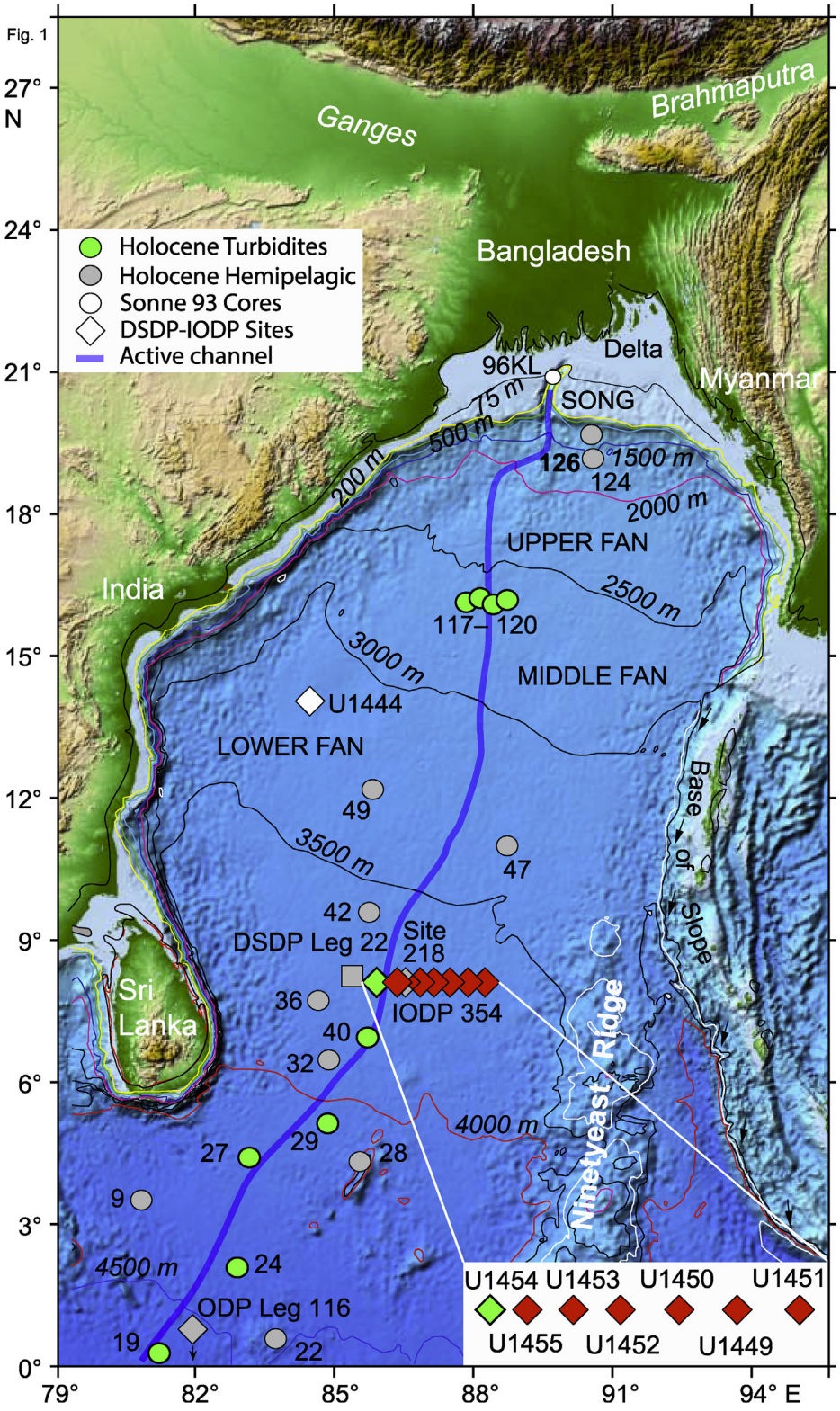

Fig. 1. Map of the Bengal Fan with core locations. Diamonds indicate the core transect of IODP Expedition 354 at 8°N (France-Lanord et al., 2016). Additional core locations are mostly from Sonne Expedition 93 (Weber et al., 1997a, 1997b, 2003). Underlying shaded relief is ETOPO1 data (http://maps.ngdc.noaa.gov/viewers/bathymetry). Note that core top sediments with turbidites (mostly Holocene) are restricted to locations close to the main channel, whereas hemipelagic core top sediments occur farther away from the main channel on the basin plains.