

The Late Quaternary Avulsion History of the Ganges and Brahmaputra River, Bengal Basin, Bangladesh: Application of Sr Geochemistry

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The Ganges and Brahmaputra River, which drain the crystalline rocks of the High Himalayas, Lesser Himalayas and Tibetan Sedimentary Series, have transported the major portion of late Quaternary sediments to the Ganges - Brahmaputra (G-B) delta, Bangladesh. These major lithologic groups also have distinctive Sr concentrations, which can be useful to understand the effect of South Asian climate variability on river avulsion and abandonment, and shifting provenance sources for the G-B delta. From previous studies, it appears that Sr concentrations below 110 ppm generally represent sediment input from the Ganges. Above 150 ppm typically represents Brahmaputra sediments, whereas intermediate concentrations represent a mixture between the two. Sr concentrations of Pleistocene sediment collected from 12 boreholes across the G-B delta are well above 150 ppm and are presumed to indicate transport by the Brahmaputra alone. In contrast, the Sr concentration of Holocene sediment collected from these boreholes shows a wide variation in Sr concentration, increasing from west to east. Based on Sr concentrations of the Holocene sediments, the G-B delta can be divided into three deltaic zones - the eastern, central and western delta. The eastern delta contains Ganges input during Holocene alone, with a maximum Sr concentration of 119 ppm. The central delta is a mixing zone between the Ganges and Brahmaputra Holocene sediments. In the western delta, Holocene sediments were deposited only by the Brahmaputra and contain high Sr concentrations >158 ppm. The Sr concentrations of these borehole sediments at different depths from all over the G-B delta supports a model where the Brahmaputra was the principal source of sediment deposited in the delta during the Late Pleistocene. Decreasing Sr concentrations in the Early Holocene sediments in the western delta suggest that the Ganges River avulsed from the West Bengal of India into the western G-B delta in Bangladesh. The avulsion of the Ganges is associated with a similar shift of the Brahmaputra to the east, possibly indicating a basin wide reorganization of the river channels. By the late Holocene, the Ganges and Brahmaputra Rivers and the G-B delta had developed their present course and delta morphology. This application of river avulsion to distinguish the fluvial-deltaic sequence provides a first-order understanding of the deltaic evolution and stratigraphic sequence development in a high-yield, tectonically active setting.