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High Barium Flux from Gomati River Basin (Ganga Alluvial Plain) and its implications to Ganga Fluvial System

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The Ganga Fluvial System is often considered as influencing world ocean chemistry through its unique river water chemistry and flux properties from weathering of the Himalayas [1]. The Gomati River, a tributary to Ganga Basin has been selected for the study to understand the regional magnitude of dissolved Barium (*dBa*) flux to the Ganga Fluvial System. The Gomati River is a 900-km long groundwater-fed river and drains 30,437 km² area located in between the interfluvial region of Ganga and Ghaghara rivers of the Ganga Alluvial Plain. The river basin experiences a warm and humid sub-tropical climate with four prominent seasons: the monsoon (Jun.-Sep.), the post-monsoon (Oct.-Nov.), the winter (Dec.-Feb.) and the summer (Mar.-May). Thirty-six river water samples along with measured discharge data have been collected during June 2009-May 2010 from the distal part of the river basin at Chandwak (25°35' N, 83°00' E) for the analysis of Ba concentration by ICP-MS.

The average *dBa* concentration in the Gomati River water is 0.68 μmol/L which is significantly higher than that of the average world river water (0.17 μmol/L). During the monsoon season at peak flood discharge, the *dBa* concentration increases from 0.68 μmol/L upto 2.46 μmol/L. These concentrations have very significant correlation ($r^2=1.00$) with the rising flood discharges and, therefore, could be used as an excellent proxy record for flood water discharge. During the monsoon season, the Gomati River transports *dBa* as high as 1.4×10^5 mol/day. The estimated annual discharge-weighted *dBa* flux is 5.2×10^6 mol/y and is characterized by high seasonality; contributing 82% of the flux during the monsoon and the post-monsoon seasons. The annual *dBa* flux is comparable with the *dBa* flux of the Ganga and

Yamuna (another tributary) together at the Himalayan foothills (5.4×10^6 mol/y), ~10.5% of the *dBa* flux from the Ganga River at Bangladesh (49.5×10^6 mol/y) and ~0.052 % of the Global riverine Ba flux to ocean [2]. The contribution of *dBa* flux (10.5%) of the Gomati River is significantly higher given its smaller drainage area (3.1%) and annual water discharge (1.3%) to the Ganga Fluvial System (Fig. 1).

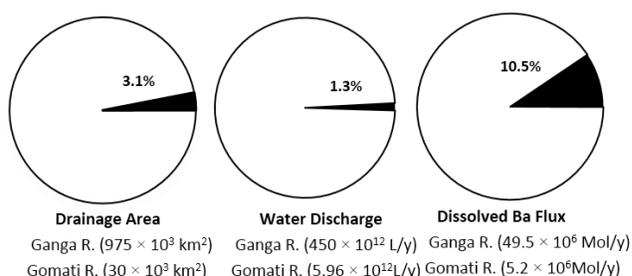


Figure 1: Pie diagram showing the contribution of the Gomati River Basin in the drainage area, the annual water discharge and dissolved Ba flux to the Ganga fluvial system in Bangladesh (Data source: [2] and present study)

In the Gomati River basin, Ba is classified as moderately mobile element with Mobility Index (0.36). The Ba mobilisation rate is 173 mol/km²/y which is ~3 and ~2 times higher than the Ganga River System and the global value, respectively [2]. The Ba concentrations displayed significant correlation with Fe, Si, Al and K that provide a basis for the major sources and significant contributor of Ba in sediments of the Gomati River Basin through monsoon controlled chemical weathering processes of silicate minerals mainly Ca-feldspar, muscovite and biotite.

The present study implies that rivers of the Ganga Alluvial Plain have significant contribution and impact on Ba cycling and flux of the Ganga Fluvial System as a whole.

References:

[1] Chesley *et al.* (2000) *Earth Planet. Sci. Lett.* (179) 115-124

[2] Dalai *et al.* (2002) *Geochemistry Geophysics Geosystems* 3(12) 1076

