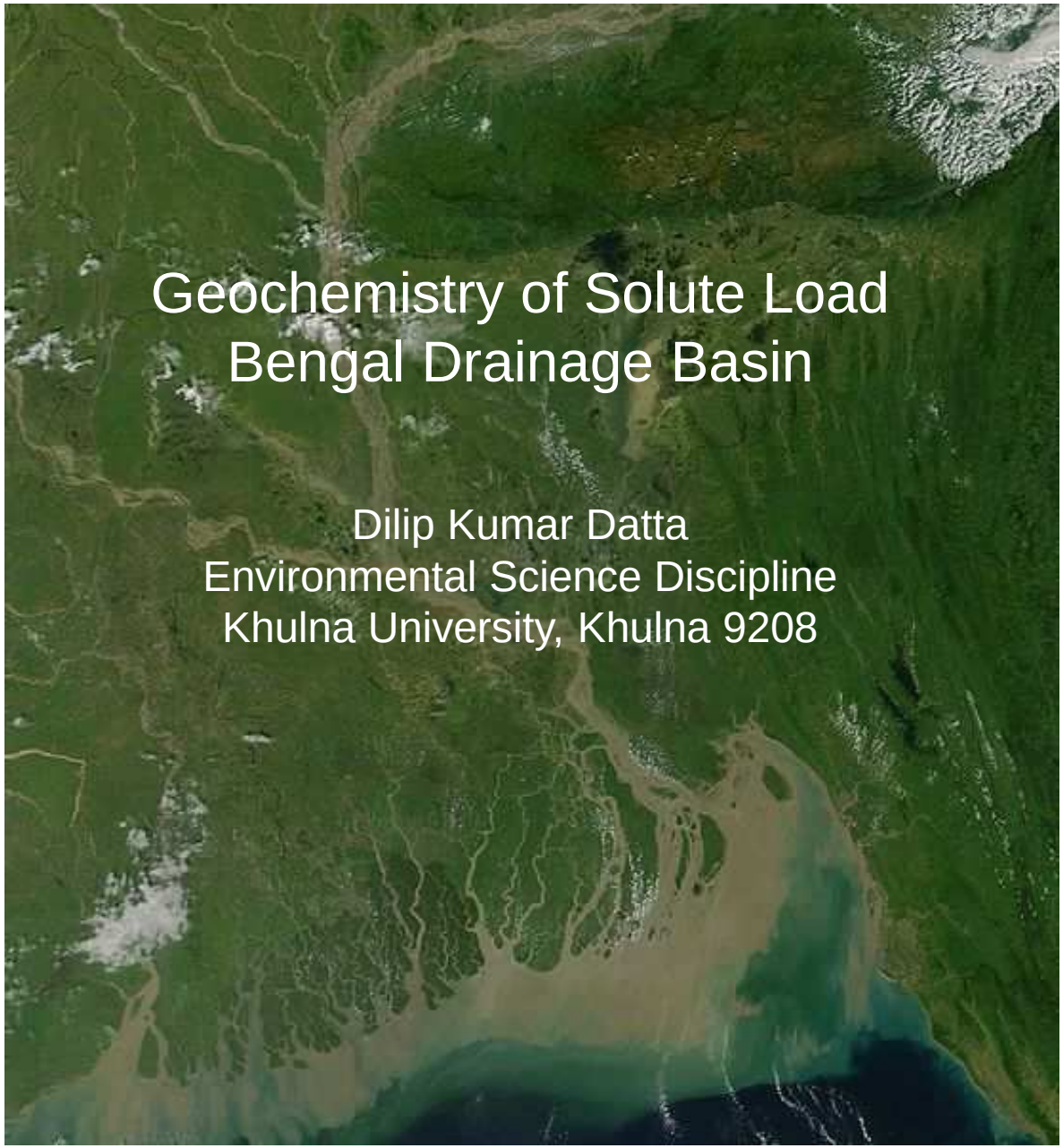

Geochemistry of Solute Load Bengal Drainage Basin

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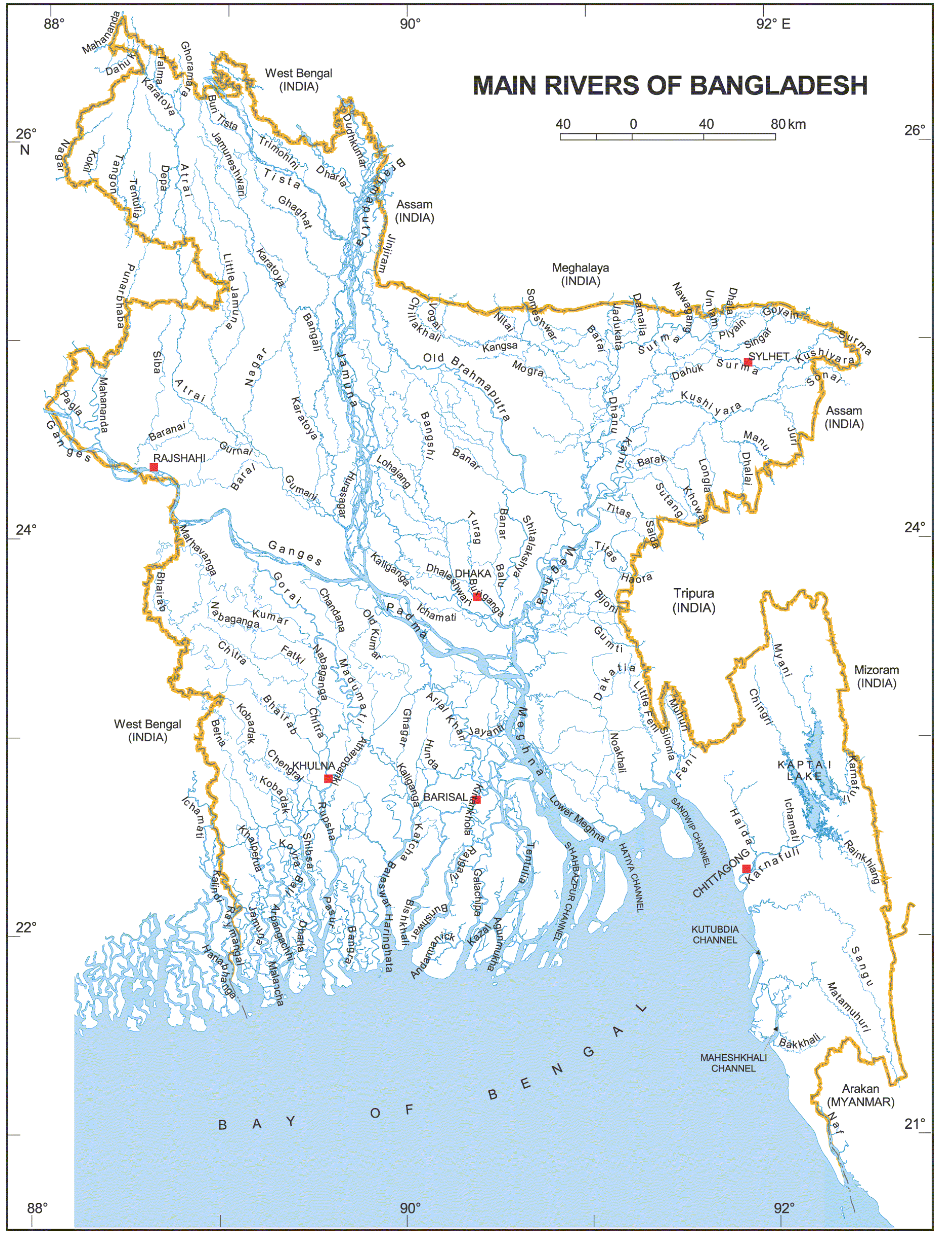
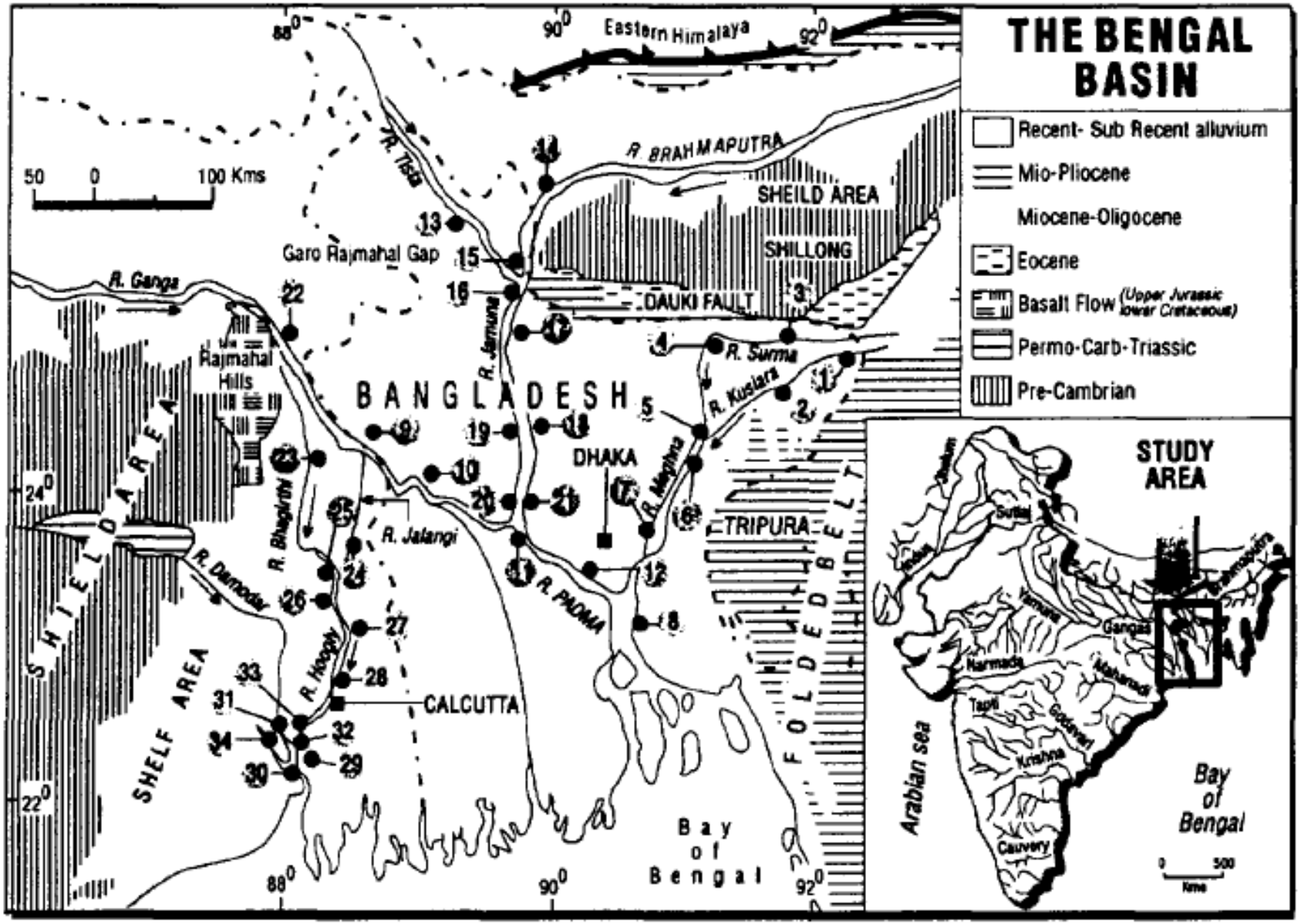
MAIN RIVERS OF BANGLADESH

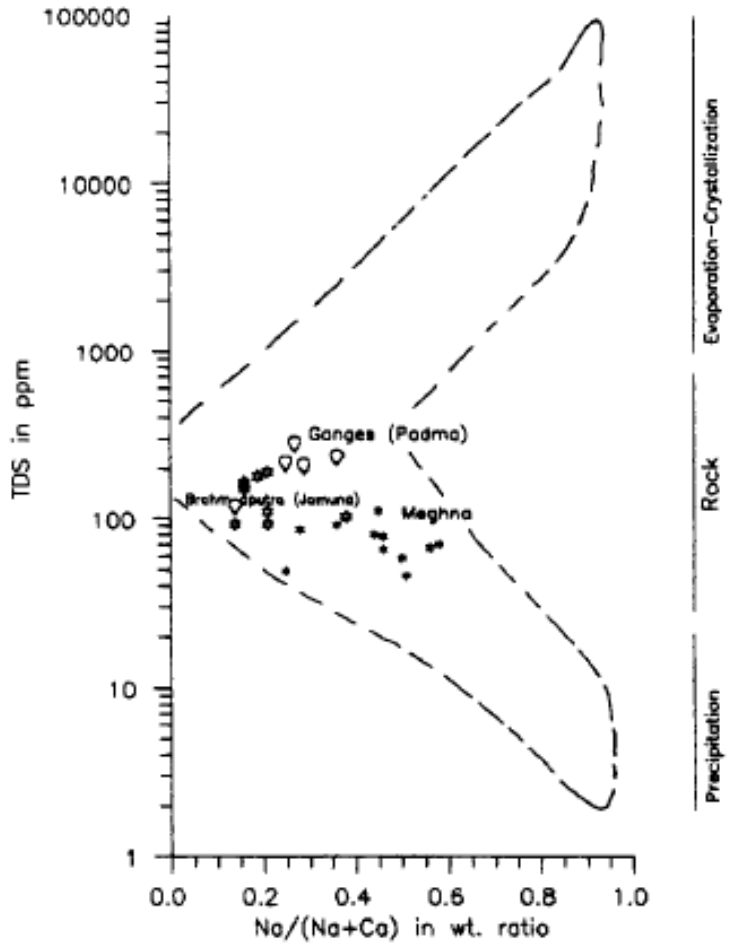



THE BENGAL BASIN
Recent- Sub Recent alluvium
Mio-Pliocene
Miocene-Oligocene
Eocene
Basalt Flow (Upper Jurassic lower Cretaceous)
Permo-Carb-Triassic
Pre-Cambrian
Eastern Himalaya
R. BRAHMAPUTRA
R. Tista
SHEILD AREA
SHILLONG
DAUKI FAULT
Garo Rajmahal Gap
R. Ganga
R. Jamuna
R. Surma
R. Kusiara
Rajmahal Hills
BANGLADESH
DHAKA
R. Meghna
TRIPURA
FOLDED BELT
R. Bhagirathi
R. Jalangi
R. Damodar
R. Hoogly
R. PADMA
SHIELD AREA
SHELF AREA
CALCUTTA
Bay of Bengal
50 0 100 Kms
88°
90°
92°
24°
22°
STUDY AREA
Arabian sea
Bay of Bengal
Jhelum
Sutlej
Yamuna
Ganga
Damodar
Narmada
Mahanadi
Tapti
Godavari
Krishna
Cauvery
0 500
Kms

- Location of sampling stations are selected and representative of the river course.
- Distributed uniformly throughout the Basin
- Depends on land traffic and logistics
- Avoiding the sites of instant tributary effects
- Avoiding apparent sources of pollution

General Chemical Character

- The pH (range 6.97 – 8.25) represents the ‘abrasion pH’ of most of the major minerals.
- The TDS of the Ganges, Brahmaputra and Meghna shows significant spatial and temporal variations.
- The Ganges has the largest transport-limited denudation regime and has the highest TDS (117-277 $mg.L^{-1}$) and cation contents (1521-4043 $\mu mol.L^{-1}$), followed by the Brahmaputra (TDS 93-190 $mg.L^{-1}$; cations 1068-2508 $\mu mol.L^{-1}$) and the Meghna (TDS 46-112 $mg.L^{-1}$; cations 643-1440 $\mu mol.L^{-1}$)


100000
10000
1000
100
10
1
TDS in ppm
0.0
0.2
0.4
0.6
0.8
1.0
Na/(Na+Ca) in wt. ratio
Ganges (Padma)
Meghna
Evaporation–Crystallization
Rock
Precipitation

The high concentrations of alkali earth elements Ca and Mg (64-88% of total cations), the high alkalinity (bicarbonate 67-88% of total anion) and the high {(Ca+Mg)/(Na+K)} and HCO_3/SiO_2 mole ratios (1.8-7.3 and 3.6-15.9 respectively) suggests dominance of carbonate weathering in the basin.

- Ecosystem of global conservation value along coastal Bangladesh:
- The *Sundarbans,* The St. Martins, The Meghna estuarine system etc. which are potential natural renewable resource base and also biodiversity hot-spots and provides the economic foundation for a common property resource – the fisheries in the Bay of Bengal.
- The rivers contributing to the coastal Bangladesh have deep sea connection through the *Swatch of No Ground* (a deep sea canyon) and thus have the potential to influence the tropical marine ecosystem due to chemical load. Thus any perturbation – of ex-situ and/or in-situ origin in the river systems of Bangladesh has far-reaching spatial and temporal environmental consequences.

- The GBM system is responsible for the major contribution. The river system contributes about 5% (152 x 10^6 t.yr^{-1}) of the annual global chemical flux to the oceans. This flux includes only the major dissolved elements and does not include the yearly flux of dissolved fluoride (about 115 x 10^3 t.yr^{-1}) and dissolved phosphate (about 105 x 10^3 t.yr^{-1}). The Ganges and Brahmaputra are notable for their high Uranium concentration and considerable amount of dissolved Uranium, Thorium and Radium may reach the coast of Bangladesh *via* these rivers.
- The GBM river system contributes about 4.5% (about 1330 $Km^3.yr^{-1}$) of the total annual freshwater flux to the oceans, ranked fourth among world rivers in annual discharge to the seas.
- The GBM river system is also one of the highest sediment dispersal system of the world and trans port about 1060 million tons of sediments to the coast each year. Appreciable amount of inorganic nitrogen have been recorded in the sediments.

- Significant amount of elemental flux to the coastal Bangladesh also takes place through ground water transport. Dowling et al. (2003) observed that As (40.70%) and Mn (29.40%) are the two major elements constituting the bulk of trace metal flux. They suggested that groundwater discharge into coastal oceans are significant source of trace metals and may influence the global isotopic balance.

- Datta (2005) has elaborated to major sources of pollutants to the freshwater ecosystems in Bangladesh. The recent trend in food production and use of agrochemicals suggests that the freshwater ecosystem in Bangladesh are important sink for unused agrochemicals. Industrial establishments with virtually no waste treatment facilities provide source of both organic and inorganic pollutants. Significant amount of inorganic nitrogen have been observed (ca. about 0.03 to 0.10 $mg.g^{-1}$) in the bottom sediments of the Bengal Drainage Basin and in and around the *Sundarbans*.
- However, there are records of marine fish analysis from the Bay of Bengal and the results show that the concentrations of heavy metals are much below the permissible limits for toxic elements.

- Anthropogenic sources that may have significant contribution to the geochemistry of the solute load are industrial wastes (also includes the waste from ship-breaking yards), sewage disposal, solid waste, agrochemicals, waste due to landuse changes, oil spillage etc. A rough estimate of PCB released from ship-breaking yards at *Sitakund*, Chittagong is 22.5 tons annually has been reported. However waste generating from cities is a major concern and creating some pollution hot-spots in Bangladesh.
- However these hot-spots will be discussed in separate presentation.

Rivers	Discharge ($Km^3. yr^{-1}$)	Basin Area (X 10^6 Km^2)	Av TDS (ppm)	TDS flux (x10^6 $t.yr^{-1}$)	CDR (t Km^{-2} $.yr^{-1}$)
Ganges (Padma)	350.5	980	221	78	79
Ganga	393	975	178	70	72
Brahmaputra (Jamuna)	654.5	580	101	66	114
Brahmaputra	609	580	100	61	105
Meghna	151.5	80	52	8	99
Indian Average	1700	4000	161	274	68
Huanghe	41	752	496	20	27
Amazon	5500	6300	41	223	35
Zaire	1230	4104	29	36	9
World Average	26000	101000	115	2990	30

Thanks