Dynamics of Carbon and Nitrogen influx in large river system: Isotopic study from river Ganga, India

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Freshwater flux transport large amount of carbon (dissolved and particulate, organic and inorganic) and nitrogen (Dissolved) from continent into the ocean, contributing significantly to the global carbon and nitrogen cycle. The present sources and sinks of naturally as well as anthropogenically produced C and N compounds in the global carbon and nitrogen cycle remains enigmatic. Among the carbon sources in the river ecosystem, the dissolved inorganic carbon (DIC) constitute major component of carbon influx from land to ocean. These fluxes are significantly influenced by the terrestrial and estuary processes. The isotopic composition of DIC can be used to understand the sources and cycling of carbon in rivers and estuaries. In this study, $d^{13}C$ of DIC in river water of Ganga has been used to understand the dissolved inorganic carbon sources into the river. The river Ganga (2500 km) is the largest river of the Indian subcontinent which originates from the Gangotri glacier and drains into Bay of Bengal through its vast delta in the Sunderban. The $d^{13}C_{DIC}$ of river water were measured from source (Gomukh) to sink (Bay of Bengal) of the river Ganga for pre and post-monsoon period. The seasonal variation in the $d^{13}C_{DIC}$ shows enriched isotopic values in pre-monsoon compared to post-monsoon samples, indicating increased biological activities in the riverine system during pre-monsoon. A varied enrichment factor in the $d^{13}C_{DIC}$ values were observed for upper, middle and lower stretch of the river Ganga which might be indicating different sources contributing water in different stretch of the river Ganga. The $d^{18}O$ value of river water, ground water and rain water were used to delineate the different sources of water into the river Ganga. The water budget of the river Ganga shows high glacier melt in the upper stretch, high ground water influx in middle stretch and high rain water input in lower stretch of the river Ganga.

On similar note, the dissolved form of nitrogen in river water (NO_3^-) also significantly impacts the riverine as well as costal ecosystem. The increased influx of nitrate changes the competition between species causing disruption in the biological diversity. The lower stretch of the river Ganga receives maximum rain water input; therefore the region becomes prone to pollutant as result of surface runoff from the catchment areas. The isotopic composition of dissolved nitrate in water can be used to delineate the sources of NO_3^- into the riverine system. The $d^{15}N$ and $d^{18}O$ of the dissolved nitrate in river water from the lower stretch (Kolkata) of the river Ganga indicates the input of anthropogenic activities (pollutant) to river water. The data indicates manure from septic pipe lines as major source of dissolved nitrate present in the river Ganga.

Keywords: DIC, Ganga river, nitrate isotope, India

