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Use of stable isotopes, organic and inorganic chemistry to identify pollution sources and weathering processes in two small tropical rivers in southwestern India

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The two main objectives of this study were to assess pollution dynamic from organic and inorganic major ion chemistry and stable isotopes ($\delta^{15}\text{N}$ and $\delta^{18}\text{O}$) and to determine the weathering processes using carbon isotopes in two tropical river basins, i.e. Nethravati and Swarna, along southwest coast of India. These short length river basins (around 100 km) are characterized by high annual rainfall, warm temperature, high runoff (~3300mm) draining Precambrian basement rocks composed of greenstones, granitic-gneiss, charnockite and meta sediments. Intense silicate weathering is induced by high runoff and warm temperature (Gurumurthy et al., 2012).

In this study, stable isotopes ($\delta^{15}\text{N}$ & $\delta^{18}\text{O}$) of organic molecules from sewage and agricultural effluents, and carbon isotopes ($\delta^{13}\text{C}$) of dissolved organic carbon (DOC) and dissolved inorganic carbon (DIC) were measured to trace agricultural and domestic pollution and to identify the sources of inorganic carbon and the nature of chemical weathering in these river basins. Carbon isotopes measured on DIC reveals sources of carbon into the river, such as carbonate/silicate weathering of rocks, mineralization of organic matter from C_3/C_4 plants, soil and atmospheric CO_2 .

The nitrate and phosphate levels remain low, with values ranging from 5 to 9 μM , and 0 to 2 μM respectively. The $\delta^{13}\text{C}_{\text{DIC}}$ values range from -9.03 ± 0.99 for the Swarna basin to -8.08 ± 0.78 for the Nethravati basin. These values point to a mixing of carbonate and silicate weathering products with a dominance of C_3 vegetation, prevalent in the Western Ghats. The DOC values for both river basins are very low and very close: 0.72 ± 0.09 mg/L (Swarna river) and 0.62 ± 0.11 mg/L (Nethravati river). This indicates that the contributions of organic matter from the adjacent forests and the flood plains are very low during the sampling period. The analysis of organic acids reveals low amount of Oxalate and Acetate, and trace of Malate and Tartaric acids.

The dissolved and particulate organic carbon (DOC and POC) concentrations are very low in these two rivers. During the dry season, river discharge is mainly supplied by groundwater with generally low contents in dissolved and particulate fractions. Even if we observe low concentration, we measured higher DOC and POC in the Swarna river. These higher DOC concentrations are accompanied with lower SUVA value. This indicates that more labile DOC (less aromaticity) is exported within this basin during dry season. C/N values in POC also show that the organic carbon is "fresher" and is probably more autochthonous than in the Nethravati river. Indeed, C/N value are closer of an autochthonous production (C/N : 2-6) than allochthonous one (C/N: 8-20). These observations can be explained as the Swarna watershed land use is more agricultural than in Nethravati. Agricultural lands generally export significant amount of nutrients to rivers and participate to enhance autochthonous productivity. Autochthonous organic carbon production is more labile and less aromatic

Reference

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