Title:	Spatio-Temporal Dynamics of Sedimentary Organic Matter in Aquatic Systems: An Integrative Molecular Approach.
Authors:	Behera, Diptimayee.
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Abstract:	Aquatic systems play a pivotal role in the global carbon cycle, sequestering organic carbon through sedimentation influenced by both autochthonous and allochthonous sources. However, human activities such as deforestation, land-use changes, population growth, and pollution significantly alter organic carbon dynamics within these ecosystems. Understanding the intricate interplay between natural and anthropogenic influences on aquatic organic carbon is crucial for effective ecosystem management and climate change mitigation. Biomarkers, originating from specific biological sources, offer quantitative evidence for changes in vegetation, human-environment interactions, and biogeochemical cycling. Among these biomarkers, n-alkanes and isoprenoids have emerged as significant indicators due to their structural diversity and resilience to degradation. This study focuses on characterizing sedimentary organic matter (SOM) in three distinct aquatic environments across the Indian subcontinent: Renuka Lake (a lake system), Markanda River (a river system), and the Mandapam Group in the Gulf of Mannar (a marine-terrestrial interface). By analyzing SOM in these regions, we gain insights into the origins and composition of organic matter, as well as the extent of anthropogenic influence. n-Alkanes, varying in chain lengths, provide valuable insights into the sources of sedimentary OM, with indices such as the Carbon Preference Index (CPI), Terrigenous to Aquatic ratio (TAR), and Average Chain Length (ACL) quantitatively assessing these sources. Isoprenoids like pristane, phytane, and C 20 highly branched isoprenoid (C 20 HBI) further enhance our understanding of depositional environments and biological communities. Additionally, we evaluated various compound groups indicative of human activities to assess anthropogenic impact, including unresolved complex mixtures (UCMs), hopanes, steranes and anthropogenic compounds such as polycyclic aromatic hydrocarbons (PAHs), phthalates, and linear alkylbenzenes (LABs). Results indicate common sources of anthropogenic influence, such as sewage discharge, shipping, laundering, recreational and religious activities, and biomass burning. Furthermore, we implemented this understanding with combination to multi-proxy approach such as satellite imagery and palynological investigations over temporal scales by analyzing a sediment core retrieved from Renuka Lake. This helped us examine the long-term interaction between aquatic systems and their surrounding environments, investigating how aquatic ecosystems respond to catchment modification and regime shifts over time. Overall, the present work emphasizes the importance of characterizing organic composition in aquatic systems to comprehend their functioning, human impact, and inform ecosystem management strategies forcarbon balance and environmental mitigation. This study also offers a simplified and cohesive means of delineating natural and anthropogenic influences in aquatic systems.
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