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Influence of primary mineral (feldspar) and weathering originated secondary minerals (kaolinite and gibbsite) on fate of nanoplastics in riverine environment

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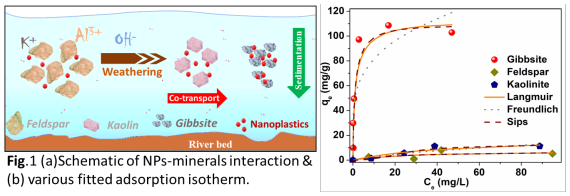

Fig.1 (a)Schematic of NPs-minerals interaction & (b) various fitted adsorption isotherm.

Recent scientific evidence foretell the massive accumulation of emerging contaminant i.e., nanoplastics (NPs) in freshwater, especially in riverine systems. The majority of NPs research has been concentrated on the marine environment. Despite the probability of NPs sedimentation or co-transportation, only a handful of work has been done in understanding their behavior and stability in freshwater. Mineral surfaces present in freshwater can interact with NPs and may alter their fate (Fig.1a). Therefore, for the first time, we have focused on understanding NPs interaction with weathering sequence of minerals in freshwater under varying geochemical conditions, which is crucial for developing an understanding of major components that governs the transport and fate of NPs. Primary mineral feldspar and weathering originated secondary minerals, i.e., kaolinite and gibbsite were investigated for interaction with NPs under batch adsorption experiments. Adsorption isotherm results (Fig.1b) revealed that all three minerals had shown a continuous increase in the sorption capacity with an increase in NPs concentration, gibbsite showed maximum sorption of NPs (108.1 mg/g) compared to feldspar (7.7 mg/g) and kaolinite (11.9 mg/g). The impact of environmental parameters like varying major ions, pH, humic acid, and natural aqueous matrix, i.e., river water, on the mineral-NPs interaction was studied in detail. FTIR spectroscopy of reaction precipitate revealed that hydrogen bonding and complexation played a vital role in gibbsite-NPs interaction. Also, microscopic analysis studies suggested strong gibbsite-NPs interaction. Results also conclude that in the presence of secondary amorphous mineral gibbsite, NPs can undergo sedimentation in the freshwater system due to achievement of point of zero charge at 250 mg/L of gibbsite concentration. In contrast, feldspar and kaolinite have limited interaction with NPs due to negative surface charge, which can increase the possibility of co-transportation and mobility of NPs in the freshwater system. This study also revealed that apart from surface charge of minerals, there size, crystalline and amorphous nature also play vital role in adsorption of NPs. Higher sorption of NPs on gibbsite, further increases an opportunity to use gibbsite as potential adsorbent for removal of NPs from aqueous environment [1].

References:

[1]Choudhary, A., et al. 2021, *Sci Totl Env ,151831.*