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Geospatial investigation of fluoride (F^-) contaminated sites with respect to responsible hydro-geochemical characteristics and assessment of human health hazard in West Bengal, India

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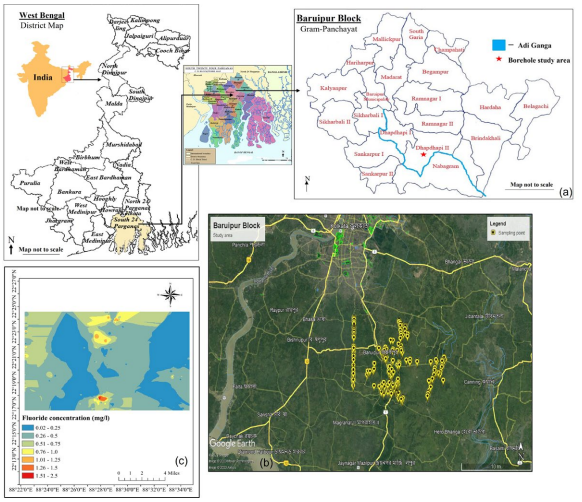

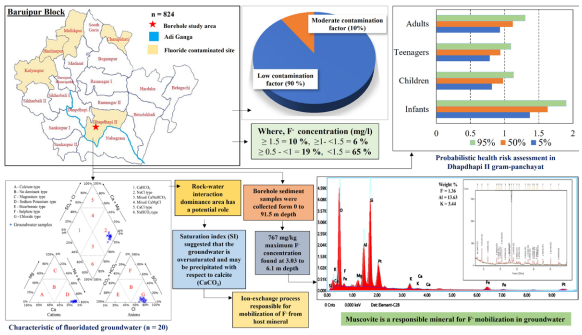

Fluorine is an abundant trace element in the natural environmental condition, and it generally occurs in form of fluoride (F^-) in groundwater [1]. The adverse consequences of F^- is mostly prevalent among the world's population in tropical regions, where the climate ranges from dry to humid condition [2]. Due to the presence of F^- in groundwater, nearly 260 million persons are affected worldwide including India and the number of affected populations increasing with time being [3,4]. F^- enrichment in groundwater of the lower Gangetic plain in West Bengal, India is a major concern for the inhabitants. Groundwater F^- contamination and its toxicity has been reported earlier in this region but lack of knowledge about the hydro-geochemical attributions of F^- mobilization as well as futuristic health risk caused by fluoridated water. Different hydro-geochemical models like Piper and Gibbs diagram, Chloro Alkaline plot, Saturation index have been applied to better understand the responsible characteristics for F^- leaching in groundwater. Maximum F^- concentration was observed 44% >1.5 mg/l in Dhapdhapi-II gram-panchayat. Piper diagram revealed a strong saline condition in groundwater. Gibbs diagram determined that host rock/silicate-water interaction plays a significant role behind F^- mobilization. Chloro Alkaline plot indicates a relationship between the ion-exchange process. Saturation index suggests that the groundwater is oversaturated and can be precipitated. Depth-wise fluoride distribution of borehole study expressed that all the cations in sediment samples are closely interlinked with F^- <18.3 m depth. Mineralogical studies revealed that muscovite is the responsible mineral source for F^- mobilization in groundwater. A risk assessment study has disclosed a severe health hazard (THQ >1) in an order of infants > adults > children > teenagers through ingestion of F^- tainted groundwater. Figure 1 represent as a systematic graphical representation. Regular monitoring of groundwater quality is suggested for reliable source drinking water in the studied area.

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[3] Feng, F., et al. (2020). Environmental Science and Pollution Research, 27(28), 34840-34861.

[4] Kumar et al. (2017). water science, 31(2), 215-229.