

DISCUSSION

ARSENIC RICH PHASES IN AQUIFER SEDIMENTS FROM SOUTHERN WEST BENGAL by P.K. Mukherjee, Taraknath Pal, S. Sengupta and S. Shome.
Jour. Geol. Soc. India, v.58, pp.173-176, 2001.

R.K. Bandyopadhyay, Publication Division, Geological Survey of India, Eastern Region, Kolkata, comments:

The authors have identified 25-30 m thick clay cap and peat layers in the sediments belonging to Ganga-Padma delta of southern Bengal wherein arsenic concentration is high. Authors call this a 'Safe Zone' because, despite having high concentration of arsenic, the clay cap and associated peat layers do not release arsenic to the adjoining groundwater. This is their observation, but they have not given any explanation as to why arsenic prefers to remain arrested as a particulate constituent in the ambit of this clay cap and peat layers.

The authors have identified illite, biotite, chlorite and siderite concretions as additional sources of arsenic, whence the arsenic came in the groundwater "under suitable

conditions". Furthermore, the authors insist that "with subtle changes in conditions, all these arsenic traps". These sentences lack clarity. They must spell out very categorically what exactly they mean when they write, "under suitable conditions" or for that matter "with subtle changes in conditions". In scientific disquisition, evasive or ambiguous language should be discouraged. It seems that their focus is on the fluctuation of pH values and consequent emergence of acidic ambience in the realm of groundwater, which eventually would facilitate adsorption/desorption of arsenic from clay mineral surfaces or facilitate dissolution of clay minerals, biotite and siderite that would favour releasing arsenic and cause its consequent solubilisation. Available data pertaining to the pH value of groundwater in published literature, however, do not indicate that the pH value of the groundwater has ever

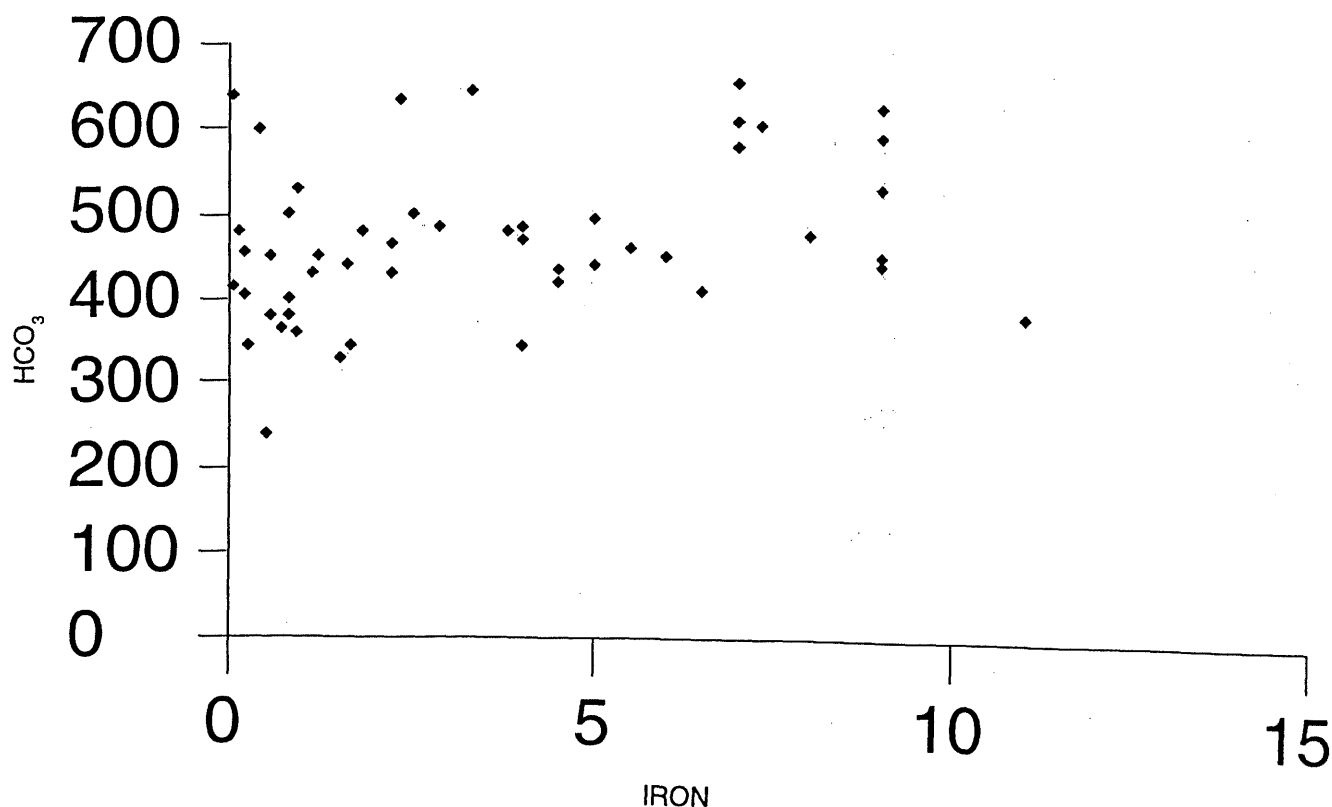


Fig.1

dropped below 7 (Deshmukh et al. 1971; Saha et al. 1997). As such, the question of siderite dissolution at $\text{pH} < 7$ does not arise. At the same time, whenever the pH of the groundwater is 7, i.e., it is above the ZPC (zero point charge) of the clay mineral, the surface of the clay minerals would have negative charge. ZPC of most of the clay minerals is normally within 5 (Appelo and Postma, 1993). In aqueous solution, arsenic occurs as oxyanion, and hence it would not be adsorbed onto clay surfaces at $\text{pH} > 7$. Destruction (dissolution) of clay structure and also biotite depends on abrasion pH value which are 7-8, 7-9 and 7-9 for illite, chlorite and biotite respectively (Rösler and Lange, 1972). The pH of the groundwater ranges between 7 and 8 and as such may not favour complete destruction of clay minerals by release of arsenic therefrom.

Finally, neither iron shows positive correlation with bicarbonate nor there is any possibility of the emergence of acidic condition in the realm of groundwater. Estimated correlation coefficient (r) between Fe and HCO_3 by the undersigned attaching graphical plotting between Fe and HCO_3 is 0.27 ($n = 50$; $p = 0.05$ for Nadia District, 1993-94) (Fig. 1). The correlation coefficients of Ca- HCO_3 , Mg- HCO_3 and Na- HCO_3 and As- HCO_3 are 0.87, 0.66, 0.98 and 0.46, respectively. It has already been stated that the pH value of the groundwater of this area has rarely dropped below 7. That is, whatever the authors have postulated regarding the emergence of the acidic condition in the groundwater, does not seem to be tenable. Furthermore, siderite stability necessitates high Fe concentration, high to medium reducing condition, high bicarbonate concentration and low Ps^-/PHs^- value (Garrels and Christ, 1965). Available data from the groundwater of the study area are very much in conformity with the requisite data necessary for maintaining siderite stability. High concentration of iron and bicarbonate do not necessarily indicate that their source has siderite dissolution. The source of iron may be from different iron-bearing minerals that are present in the

aquifer, while HCO_3 may have come from the oxidation of organic carbon along with carbonate dissolution.

In science, theory should follow data. Predilection for particular theory may obfuscate the reality.

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reply:

In all the published discussion on arsenic contamination of groundwater in the Bengal delta, the site for the element in the aquifer sediments has remained a point of debate. The purpose of the short communication was to describe components of the aquifer in which arsenic is fixed. This being the sole purpose, it was not felt necessary to give any explanation as to why arsenic prefers to stay in the clay layers. R.K. Bandhyopadhyay, in the second paragraph of his discussion, discloses that he is aware of the explanation.

The authors have suggested that the components identified by them, being host for the arsenic, could be responsible for causing high values in groundwater under suitable conditions. The conditions suitable are subjects of research which are currently being pursued by the authors and it did not seem necessary to outline them in the short note. The pH changes anticipated may be seasonal and the available intensity of monitoring does not permit any quantification as mentioned by Bandyopadhyay. This is an aspect which is currently being monitored by the authors. The authors are not sure about the reliability of data regarding correlation of Fe and HCO_3 presented by Bandyopadhyay. The short communication uses published data from Bangladesh to justify the hypothesis presented.

We agree with Bandyopadhyay that "in science theory should follow data". It appears that he has missed the data presented in the short communication and erroneously read the entire matter as theory.

References

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