Statistical Correlation between Iron (Fe) and Arsenic (As) and Probabilities of their Conjugate Occurrences in Groundwater from two Different Areas of West Bengal (southern part), India –

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Introduction

Contents of Arsenic (As) and Iron (Fe) in the ground water in parts of West Bengal (South) India were observed and their relationship was established (Sengupta et al., 2017) between Fe and As; they were fitted linearly but inversely. In the present study instead of liner, non-linear curve fitting between Fe and As have been carried out, taking Iron (Fe) as independent variable and Arsenic (As) as dependent variable. The study has been extended to some other parts further south in West Bengal (Table 1) and non-linear relationship has been established between Fe (independent variable x) and As (dependent variable y). Further, probabilities of both Fe and As have been calculated under Normal Distribution pattern for both the cases, i.e. area given in Table 1 of (Sengupta et al., 2017) and in the present study (Table 1).

Theory

Let the values from Table 1 are fitted to a polynomial function of degree m (<n) of the form

$$Y = a_0 + a_1 x + a_2 x^2 + \ldots\ldots\ldots + a_m x^m \quad (1)$$

The values of coefficient, a_j obtained from these equations

In the present case 2nd order equation have been fitted (i.e. m = 2) of the form

$$y = a_0 + a_1 x + a_2 x^2 \quad (2)$$

(Davis 1973; Mayer 1975)

Solving for a_0, a_1 and a_2 the regression equation between y and x i.e., As and Fe is

$$y = 150 + 16x + 2x^2 \quad (3)$$

For different values of x i.e., Fe, values of y i.e., As have been computed and are shown in right-hand column of Table 1

Table 1

Sample Number		Fe (ppm)	As (ppb) (observed)	As (ppb) estimated
TW/WS/79	Lalbani	6.5	250	340
TW/WS/60	Banomalipara	4	300	246
TW/WS/100	Phalia	8	400	406
TW/WS/96	Kalinagar	9	450	456
TW/WS/85	Kobla	9	500	456

The correlation coefficient between As (observed) and As (estimated) is calculated to be 0.83 which is quite reasonable and correlation between Fe and As (observed) has also been determined. The correlation coefficient is 0.8

Next, the probabilities of different areas have been computed. Area in Table 1 (Sengupta et al 2017) in Govindapur, Lalmath, Kashinathpur, Bejpur and Natun Gram in the district of South 24 Parganas, West Bengal where Fe lies between 1.6 to 12 (PPM) and As varies from 125 to 350 (PPB). Probability of Fe is 0.83 , i.e. 83% probability of occurrences of Fe in the above area.

Similarly, probability of As between 125 to 300 (ppb) is 0.86 i.e. probability of occurrences of As is 86% in that area.

In the present study, i.e. further south of above given in Table 1, probability of Fe between 4 to 9 (ppm) is 74% and probability of As between 250 to 500 (ppb) is about 80%. All the integration have been carried out numerically.

Results and Discussion

The correlation coefficient between Fe and As in the present area is 0.8 which is less than 0.9, suggest fitting for 2nd order curve between them. The field evidences of subsurface aquifer sediments from southern belt of West Bengal lend support to the mathematical assessment of Fe and As. The higher contents of As are found to be associated with magnetic fractions like iron oxide, iron hydroxide, illmenite, illite while low in feebly magnetic fraction and negligible in non-magmatic fractions. This also indicates association of varying amount of Fe with As.

Ubiquitous presence of iron bearing complexes and minerals and its associations with As from different depths of aquifer may be explained in terms of a high value of probabilities of their presence in the ground water.

Data collected during the period 1992 – 1995 (GSI report). Five sets of data from South 24 Parganas district have been considered.

References

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