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MEDICAL GEOLOGY INDIA NEWSLETTER

Geological Survey of India

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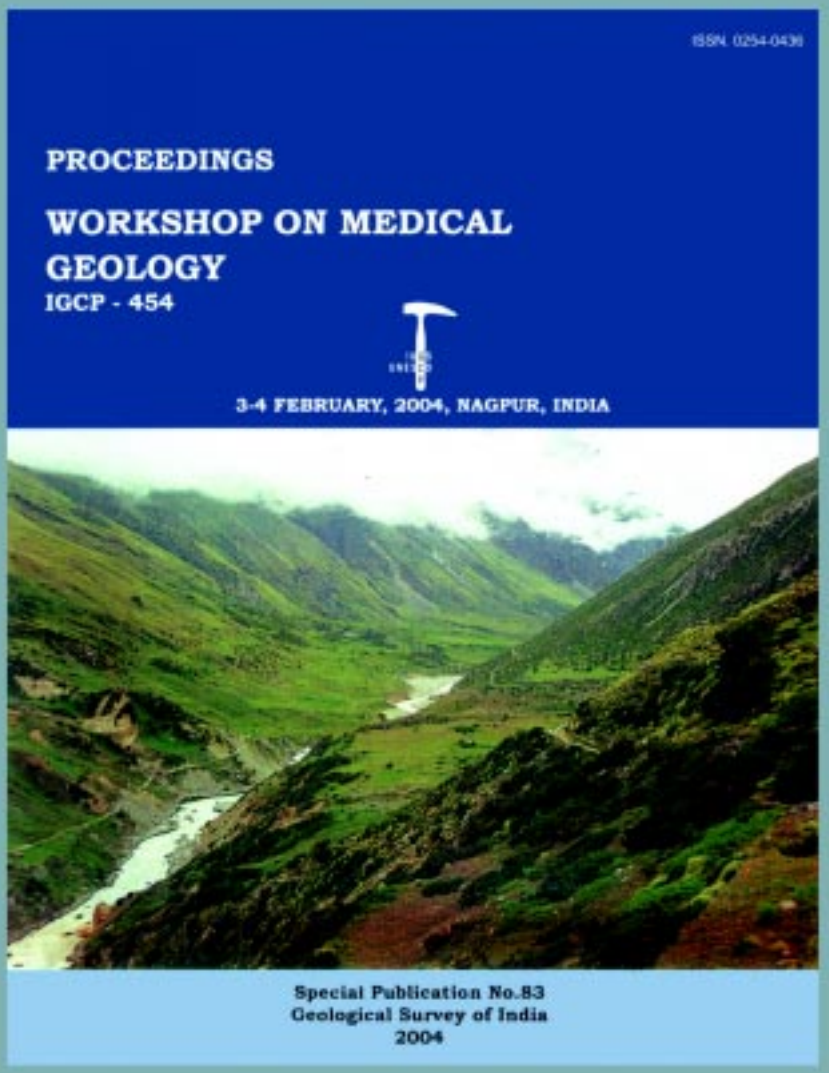

Inside this issue:

भारतीय भूवैज्ञानिक सर्वेक्षण के अधिकारिओं द्वारा संकलित

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Front Cover : Cover photo of Proceeding Volume, Workshop on Medical Geology, IGCP-454 (GSI Spl. Pub. No. 83)

Editor's Column

The humble beginning of 'Medical Geology INDIA News letter' Vol. 1 No.1 (October, 2006) is the culmination of efforts by all our fellow colleagues who are actively working in this field, pursuing to bring it to focus the vitality and utility of such studies in India.

The inaugural issue contains the first-hand information on all such accounts including a brief information of the prevalent diseases in India which are geogenic in nature.

Geological Survey of India being the Nodal Department for International Geological Correlation Programme (IGCP) in India, carried out IGCP-454 programme on medical geology (2000-04). Under the aegis of IGCP-454, the Department successfully achieved its objective and brought out a workshop volume (GSI Spl. Pub. No. 83) which is the first of its kind in India, and second in the international scenario. The volume has received wide acclamation from both national and international fora. Many national organisations consider Geological Survey of India as the Nodal Department on medical geology. This bestowed responsibility gave us strength and courage to pursue the objective in collaboration with various departments. It was urgently felt that fruits of such activities should reach everybody. GSI thus decided to bring out the first issue of 'Medical Geology India Newsletter'. I hope, this issue and upcoming issues will meet the aspirations of many and fulfil the targeted goal.

I have no hesitation to add and invite suggestions for modification of the 'Newsletter' for its betterment. A page will be added specifically and earmarked for Readers' Forum in all subsequent issues.

VIVA MEDICAL GEOLOGY

B. Sengupta
Editor-in-Chief

Information on GSI Special Publication No. 83

The volume containing 60 full papers encompassing themes on (a) diseases related to fluorine and iodine and their geological linkages (b) arsenic and mercury pollution in water – a growing menace (c) health hazards due to effluent release from industries and mines (d) fertilizer- and pesticide-related pollution (e) radioactive minerals and health hazards and (f) case studies.

Price : Rs. (Indian) 219.00 / US $ 12.00 / £ 6.00

NWGMG Members' Desk

Information on IGCP – 454 on Medical Geology

Medical geology is defined as the science dealing with the relationship between natural geological factors and health problems in men and animals, including the understanding of the interference of ordinary environmental factors on the geographical distribution of such health problems.

Therefore, Medical geology is a broad and complex subject that requires interdisciplinary contributions from different scientific fields for understanding the causative factors and its mitigation.

International Geological Correlation Programme (IGCP) – 454 on medical geology covers the aspect of establishing such relationship involving a number of countries with its headquarters at Sweden. The participating countries are: - Australia, Brazil, Bulgaria, Cameroon, Canada, China, Czech Republic, Finland, Germany, Greece, India, Kenya, Mexico, Netherlands, Norway, Poland, Romania, Russia, Saudi Arabia, Slovak Republic, South Africa, Sri Lanka, Sweden, Tanzania, Ukraine, United Kingdom, United States, Yugoslavia, Zambia and Zimbabwe.

Original proposal on medical geology was mooted and presented by O. S. Selinus, Geological Survey of Sweden, P.B 670-SE-75128 Uppsala, Sweden and P. Bobrowsky, B.C., Geological Survey Branch, P.B. 9320, station Provential Government, Victoria, British Columbia, Canada V8W9N3.

Aim of the Project

The main objective of the project is to bring together scientists including medical practitioners working in the field of medical geology and related issues, stressing the importance of geoscientific factors such as toxic elements in soil, water and air, naturally occurring metals and non-metals, pathways from air to water to food, examination of the environment and transport mechanism, etc. and all those which affect the health of the biota.

The project intends to focus on a number of geo-environmental topics including requirements of various elements (metals and trace elements) – the ultimate source of which is earth – in human and animal lives.

Geogenic Diseases in India

The geogenic processes leading to ill health is a major challenging task in India with an area of 3287263 sq.km and having a population of over 1 billion spread over 35 states and Union territories having varied geological domain. The land-water ecosystem developed in response to geological, geochemical and hydrodynamic processes vary from place to place. Thus, concentrations of various elements also vary. Areas of excess / deficient concentration of essential trace elements and heavy metals related to health are therefore not well defined. Although no systematic studies have so far been carried out to establish geological linkage with diseases, case histories of endemic diseases are reported from different parts of India.

Three major endemic diseases on account of geogenic reasons are related to deficiency or excess concentrations of arsenic, iodine and fluorine.

Arsenic Pollution

Arsenic contamination in ground water affecting major parts of southern West Bengal is well known. Abnormal concentrations (above permissible limit of 50 ppb) of arsenic in ground water is reported from a 400-km-long and 60-km-wide belt covering seven districts of West Bengal. Arsenic contamination is also reported from areas in Chhattisgarh, Bihar, U.P. and Tamil Nadu.

Arsenic pollution in Bengal basin extends from Kaliachak in Malda district in the north to Ramnagar under Baruipur block of South 24-Parganas district in the south. Ground water occurring mainly within shallow aquifer, in general 20-60 m below ground level (bgl) contains arsenic varying from <.05 ppm to 1 ppm. Higher concentration of arsenic to the tune of 3500 ppb (3.5 ppm) as dissolved pollutants within the depth range of 13 to 128 m bgl is also reported. Surface water, shallow unconfined ground water in dug wells and deeper aquifer below the contaminated layers generally show arsenic content below toxic limit.

Studies show that sedimentary column of Holocene age are the most affected geological unit of Bengal delta plain. Isotope studies have indicated the age of shallow aquifer layers, 20-50 years, whereas the deeper aquifer is as old as 5000-11000 years. Geochemistry of arsenic contaminated water indicates its alkaline nature (pH being above 7) – calcium-bicarbonate type with high concentration of Fe. There is a positive correlation of arsenic with Ca, Mg, HCO_3, Fe and negative correlation with Cl and S in arsenic-rich ground water. As^{+3} is more prevalent than As^{+5}.

Regarding the source area for arsenic, various suggestions have been put forward. The Rajmahal hills in the north-west, Himalayas on the north, coal-bearing Gondwana rocks of West Bengal, Bihar and Jharkhand and apatite (phosphorite) deposits in Singhbhum area could be potential source.

Hydrogeochemical studies of arsenic dispersal in surface water and sediments of middle reaches in Ganga basin in parts of Uttar Pradesh, Bihar and M.P. were undertaken between Banda district (U.P), parts of Sidhi district, M.P. and parts of Shahabad and Rohtas districts in Bihar.

However, in absence of large-scale database of trace-element analysis of the constituent rocks and sediments no positive correlation could be worked out.

The mobilization of arsenic in ground water as one study suggests could be due to (i) the oxidation of arsenopyrite on one hand and (ii) the reduction of ferric hydroxides on the other. During transportation, dissolved arsenic occurs in the +5 oxidation state and adsorbed onto detrital particles.

A concerted effort of focussed geochemical mapping and geochemical modelling of arsenic behaviour should produce desired results.

Goitre Endemicity

Goitre is caused due to deficiency of iodine in human beings and animals. The minimum iodine intake recommended is 0.075 mg/day. According to an estimate taken a few decades ago, about 70 million people were suffering from iodine deficiency disorder (IDD) globally. The present scenario is much improved due to high intake of iodised salt and improved socio-economic conditions.

In India, goitre endemicity is confined to the sub-Himalayan tract. In major parts of the country deficiency of iodine in soil-water ecosystem is due to (i) heavy rainfall, (ii) steep gradient and poor vegetation cover resulting in quick run-off and little time for transfer of iodine. Deficiency of iodine in source areas is also related to the chemical composition of rock and soil.

The goitre-eradication programme should include (i) tapping of deeper aquifer, (ii) effective control of flood menace, (iii) soil conservation, and (iv) educating people for modified dietary habits.

Fluoride Endemicity

Fluoride endemicity is caused due to deficient / excess intake of fluoride. About 96% of the fluoride in the body is found in bones and teeth. The range of fluoride intake, as per WHO standard, is 0.5 –1.5 mg/litre. Fluoride is beneficial between 0.8 – 1.0 mg/litre for calcification of dental enamel of children below 8 years of age. Dental caries occur due to fluoride deficiency, while it causes dental and skeletal fluorosis if taken in excess of 1.5 mg/litre and 3.0 mg/litre respectively. The intake of fluoride is largely through drinking water. The fluoride in soil-water ecosystem is derived from various sources viz. parent rock, fluorine-rich volcanic ash, thermal power plant, industrial effluent and fertilizer.

The survey carried out indicates more than 62 million people spread over the 16 states of India, namely Jammu & Kashmir, Punjab, Haryana, Delhi, Uttar Pradesh, Rajasthan, Gujarat, Madhya Pradesh, Maharashtra, Karnataka, Andhra Pradesh, Kerala, Tamil Nadu, Orissa, Bihar, Jharkhand and Assam are affected by fluoride endemicity. Fluoride endemicity is most prevalent in states of Andhra Pradesh, Tamil Nadu, Maharashtra, Karnataka, Rajasthan and Uttar Pradesh.

The geological linkage of fluoride being released

in aqueous system is as vague as its distribution or its point of concentrations. The various studies carried out so far identified major linkage grouped into three broad classes, viz.

1. Fluoride enrichment in the drainage basin from source rocks like fluoride-bearing granite and within the structural basin indicating geological-cum-tectonic control of the fluoride concentration in an area.
2. The Quaternary sediments with volcanic ash containing high fluoride are geochemically reactive with Na replacing Ca in aqueous system resulting in enriched pockets.
3. Use of fertilizers in agricultural field and industrial effluent causing surface/ground water contamination locally.

In India, the socio-economic status plays a vital role amongst the sufferers. The lack of knowledge of fluoride related diseases and social control at times lead to widespread sufferings. Abandoning the source is a welcome move besides clinical assistance.

A multidisciplinary approach on fluoride problem is urgently required. The geochemical mapping of the country may help in identifying the (i) fluoride-rich pockets (ii) the source, (iii) dispersions and mode of concentrations, etc and finally preparation of a multi-layered fluoride map of India in order to suggest remedial measures.

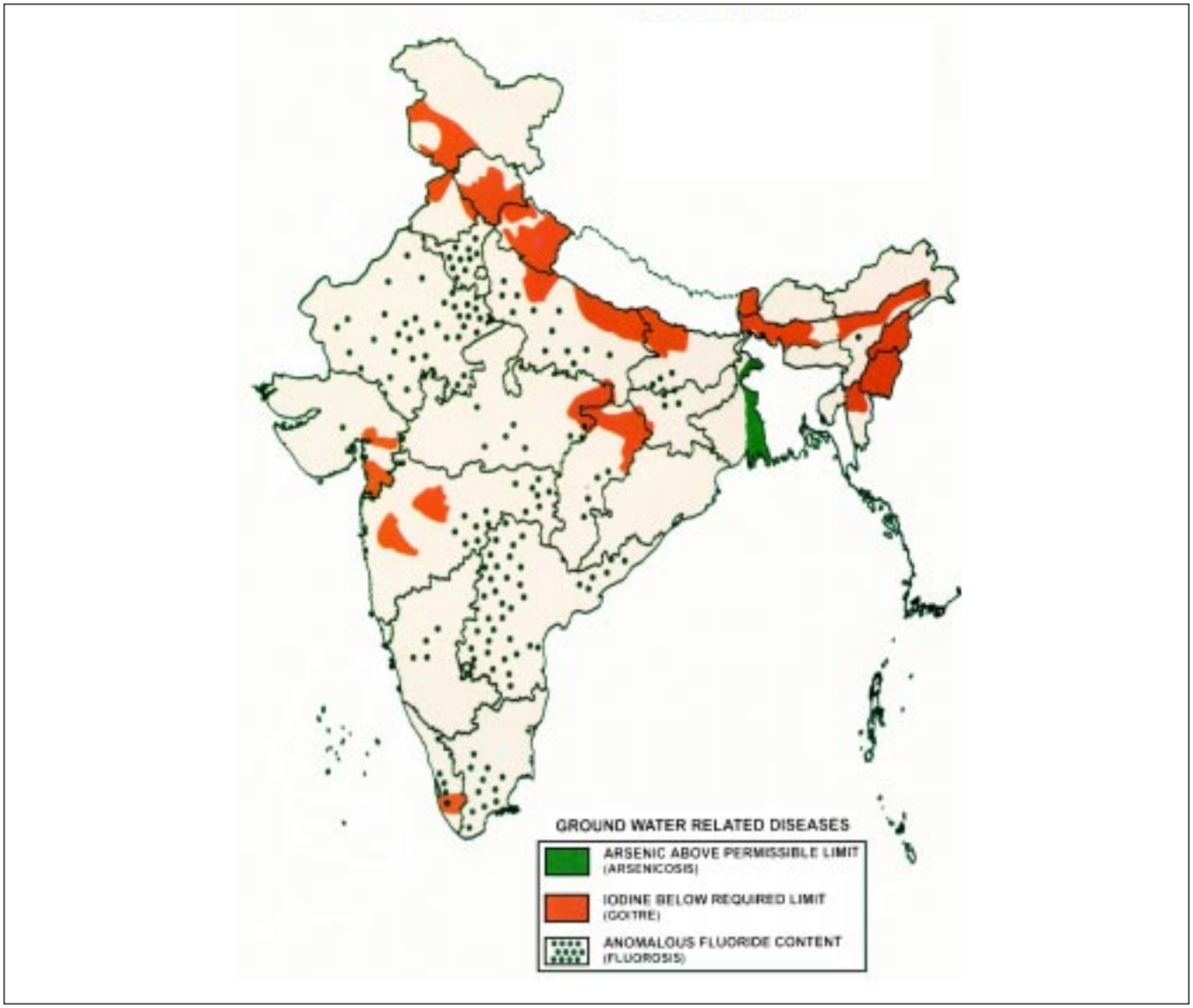

Fig. 1. Endemic areas in India (arsenicosis, goitre and fluorosis).

Invited articles

MEDICAL GEOLOGY: AN OVERVIEW OF GSI ACTIVITIES

M. K. Mukhopadhyay
Former Chairman, IGCP-454 and Acting Director General, GSI (Retired)

The Geological Survey of India (GSI) was identified by the International Union of Geological Sciences (IUGS) as the nodal agency for research and study on medical geology in India and the IGCP-454 Project on medical geology was taken up by the Geological Survey of India, during 2000-2004. A considerable part of the work was carried out under the Chairmanship of Shri Om Prakash, former Deputy Director General, GSI and myself. Shri B. Sengupta, Deputy Director General, GSI was the convener of the project.

The National Working Group (NWG) members of the Project, comprising scientists from Geological Survey of India, University professors and medical practitioners, interacted in a number of meetings. An action plan for generating base line data for current and future studies in medical geology was formulated. As GSI has been working on environmental investigations related to medical geology since 1980, it was felt necessary to compile all the available data and reports of GSI on geogenic health hazards caused by arsenic, fluorine, iodine, mercury, etc so that the compilation work may act as a valuable document on medical geology related work carried out in India. In the process, compilation on arsenic contamination in ground water from the states of West Bengal, Bihar and Madhya Pradesh; fluoride contamination from parts of Rajasthan, West Bengal, Bihar, Orissa, Uttar Pradesh, Maharashtra, Madhya Pradesh, Andhra Pradesh, Tamil Nadu, Karnataka, Gujarat covering a considerable part of India, iodine deficiency disorders (IDD) in the Himalayan foothill tracts of India; nitrate pollution of ground water in Maharashtra, mercury pollution in Karnataka and Goa were completed. The activities on medical geology were also taken up as part of annual programme of GSI.

It was felt necessary by the NWG to exchange notes in a National Workshop on Medical Geology. Thus a workshop on Medical Geology was organized at Nagpur, India on 3rd and 4th February, 2004 which witnessed participation of scientists of Geological Survey of India, World Health Organisation (WHO) and many other reputed Institutes of India, including National Environmental Engineering Research Institute (NEERI), Atomic Minerals Division (AMD), National Bureau of Soil Survey and Land Use Planning (NBSSLUP), Sanjay Gandhi Post Graduate Institute of Medical Sciences (SGPGI), Apollo Hospitals, Central Ground Water Board (CGWB), National Institute of Nutrition (NIN), Jawaharlal Nehru University (JNU) and others.

The proceeding volume of the workshop containing 60 full papers on the themes like (a) diseases related to fluoride and iodine and their geological linkages, (b) arsenic and mercury pollution in water – a growing menace (c) health hazards due to effluent release from industries and mines; (d) fertilizer- and pesticide-related pollution; (e) radioactive minerals and health hazards, and (f) case studies was released on 6th December, 2004 by the Director General, GSI at Lucknow in the presence of Dr. Jose A Centeno, Senior Scientist, Armed Forces Institute of Pathology (AFIP), USA and Dr. R.B. Finkelman, Senior Scientist, USGS.

Further, as a follow-up to a decision of the NWG members of IGCP-454, a 9-day-long training programme on medical geology was organized successfully by GSI Training Institute at Lucknow during 09.09.2004 to 17.09.2004. The Course material included introduction on various aspects of medical geology, geochemical attributes of various

rock types with regard to release of toxic elements, major geogenic diseases in India, interaction, speciation and bioavailability of elements as well as biogeochemical analytical monitoring in the field of medical geology, application of different analytical techniques for medical geological studies, role of trace elements in health-related problems, arsenic problem in West Bengal, kidney stone problem and its propensity in northern India, podoconiosis, fluoride endemicity problems, cadmium and manganese pollution, environmental impact assessment related to health hazards, etc. The course was attended by scientists from Geological Survey of India. The National Working Group members of IGCP-454 as well as experts in the field of medical geology in India delivered the lectures.

To remain updated with the global scenario and to interact with international counterparts, a short training course on medical geology (metals, health and the environment) conducted by Dr. Jose A. Centeno and Dr. R. B. Finkelman was also organized by GSI under the aegis of IGCP-454 at Lucknow during 6-8 December, 2004. The training course covered four broad themes, namely (a) environmental health: sources of exposures and effects of toxic metal ion; (b) environmental pathology, geochemical studies and health effect; (c) trace-element speciation, detection and methods, and (d) special topics on environmental toxicology, medical geology and human health research. The informative lecture sessions included 16 presentations which generated a lot of interest amongst 122 participants representing various departments / academic institutions and individuals. Certificates of attendance were given away to the participants.

In the interactive open session, organized after completion of the training course, distinguished delegates from GSI and other organizations recommended that by virtue of (i) GSI's long association with studies related to medical geology, and (ii) its office network covering the entire country, GSI should act as a lead agency / nodal agency in India to pursue studies in medical geology and act as a repository of all data. It was also recommended to form a Regional Council on Medical Geology (RCMG) with representatives from various departments in India as its members to maintain close liaison with the International Medical Geology Association (IMGA).

At present GSI is trying to form the Regional Council on Medical Geology (RCMG) to bring together all the scientists, individuals and institutions to one platform under a common CHARTER under RCMG-India. Constitution of RCMG-India shall fulfil the basic requirements to become a member country under the aegis of IMGA. Formal approval for the RCMG - India with GSI as Nodal Agency is awaited from Ministry of Mines, Government of India.

Director General, GSI, has constituted a National Working Group on Medical Geology (NWGMG) with a view to proliferating the activities on medical geology in India in general and GSI in particular under the convenership of Shri Basudev Sengupta, Dy. Director General, IR & HR, GSI.

It is earnestly hoped that the endeavour by the NWGMG members to bring out the first issue of "Medical Geology INDIA Newsletter" will go a long way in creating awareness among scientists and general public to identify causes and ameliorate effects of geogenic diseases in the society.

Erstwhile Committee of IGCP-454: Medical Geology (2000-2004)

Chairman

Shri Om Prakash , Dy DG, ER, GSI, Kolkata (upto December, 2002)
Dr. M. K. Mukhopadhyay, Dy DG, ER, GSI, Kolkata (w.e.f. February, 2003)

Convener

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Shri D. K. Mukhopadhyay, Geologist (Sr.), E.R., GSI, Kolkata
Shri H. Kariyanna, Geologist (Jr.), SR, GSI, Bangalore

A Note on Arsenic Investigation Undertaken by GSI Eastern Region in Malda District

Sutanu Sarkar

Arsenic concentration in ground water above the permissible limit of 0.05 mg/lit has been reported in Malda district since eighties. Since then, sporadic work in and around the affected area has been carried out by GSI from time to time. A two-year scientific study has been initiated during F.S. 2004-06 in Malda district to evaluate geological and geochemical processes responsible for high arsenic values in aquifer sediments and its subsequent release into ground water.

The study emphasizes two broad aspects which include delineation of spatial distribution of high arsenic zones (>0.05 mg/lit) with sub-zones with the help of E-Merck arsenic measurement kit in toposheets on 1:50,000 scale and to decipher the possible source of such contamination. An area of about 2270 sq.km was covered during 2004-05 in English Bazar, Manikchak, Old Malda, Gajol and Kaliachak blocks. About 2,855 water samples drawn mostly from tubewells, depth ranging from 12m to 107m below ground level were analysed for As concentration. Data revealed that high As zones (contaminated zones). The shallow aquifers in the flood plain area are interconnected, unconfined sand bodies. On the other hand, Pleistocene Barind Formation in old Malda-Gajol blocks is blanketed by red brown clay forming confined aquifer occurring below 35m which yields As-free water (safe zone). Data further revealed that pH of water samples varies from 6.83 to 8.35 and Eh from 82 to 503. Based on chemical analysis, the ground water is classified as Ca-HCO_3 type. The safe and contaminated water indicates no significant difference in terms of concentration of different cations and anions as well as physical properties.

For further understanding of aquifer lithology and collection of aquifer sediment samples, two boreholes of 60m each were drilled in the high As zones of Manikchak and Kaliachak blocks. The aquifer is characterised by fining upward grey micaceous sand sequence with coarse gravel at the bottom and a few thin (10-15 cm) brown clay lenses with calcareous concretion. The lithology indicates fluvial deposit comprising mainly channel-fill sediments.

Sediment samples were collected as undisturbed core in PVC pipes all through the boreholes. Selected samples underwent mechanical sieving (-60 and +250 ASTM) followed by hand magnetic separation and isodynamic separation in different current and tilt conditions and then mineralogical study of separated grains under XRD and SEM/EDX. Chemical analysis of these separated grains have also been undertaken. Besides quartz, iron-coated silica, magnetite, ilmenite, muscovite, biotite, felspar, amphibole, calcite and dolomite have also been identified by XRD as well as by EDX. A possible biogenic structure has been identified under SEM. However, no As phases could be identified.

Contrary to the existing knowledge, high As concentration to the tune of 0.15mg/lit was found to occur in water samples collected from Kalindri river, a partially aggraded channel with stagnant water, during May, 2005. However, post-monsoon analysis of the same samples yield very low As content of 0.04 mg/lit. Likewise in Kaliachak area also, high As value of 0.3 mg/lit was detected in surface water.

The investigation was continued and completed during F.S. 2005-2006. Further work on the analysis and interpretation of data collected during this season is under progress.

SELECTED REFERENCES
BOOK ON ESSENTIALS OF MEDICAL GEOLOGY

''Essentials of Medical geology" is published by Elsevier (Academic Press). Chief editor. O.Selinus. Associate Editors : Ulf Lindh. Ron Fuge, Brian Alloway. Pauline Smedley. Jose Centeno and Bob Finkelman. There are 60 distinguished authors from around the world. About 50% are geoscientists while the rest are medicos, veterinarians and other scientists. The volume is 820 pages in full colour. The target readership for the book comprises junior to senior undergraduates and educated decision-makers. The main objective is to emphasize the importance of geology in health and disease management in humans and animals. Essential features:

- Addresses key topics at the intersection of environment science and public health.
- Developed by 60 experts from 20 countries and edited by professionals from the International Working Group on Medical Geology.
- Includes 200+ colour photographs and illustrations, chapter introductions, and references for further reading and an extensive glossary.
- Written for a broad group of people, ranging from students, researchers, and medical professionals to policy makers and the general public.

The price is below 100 USD. Order forms and other information can be downloaded from the website www.medicalgeology.org or from Elsevier: http://books.elsevier.com/bookscat/links/details.asp?, isbn=0126363412.

: Courtesy IMGA Newsletter :

UPCOMING EVENTS

GeoHealth2006: Methods in Practice28th – 30th November 2006, Rutherford Hotel, Nelson, New Zealand

In November 2006 Public Health Intelligence (PHI) will be hosting the international conference GeoHealth 2006. It will focus on how GIS and spatial epidemiological methods are of practical benefit to public health. Conference papers will cover topics from both the research and policy perspectives, ranging from spatial epidemiological research to information for public health policy. http://www.moh.govt.nz/moh.nsf/wpg_index/-GeoHealth2006

9th International Conference on the Biogeochemistry of Trace Elements(9th ICOBTE)

An interdisciplinary conference dedicated to link biosphere phenomena to physical & chemical reactions in the pedo and lithosphere in Beijing, China, 15-19 July, 2007.
http://www.conference.ac.cn/icobte.htm

ISTERH/NTES Conference on TRACE ELEMENTS IN HEALTH AND DISEASE

to be held on the beautiful island of Crete 2007
http://www.angelfire.com/nd/isterh/suggestions.html

33rd International Geological Congress in Oslo, Norway

At least one full session in medical geology
One short course in medical geology
Several business meetings of IMGA and related groups
August 2008,
www.33igc.org

Natiponta, Bethuadahari, Nadia dist.
Photo : Pradip Kr. Mukherjee
Asst. Geologist, C.P.L, GSI.

Jompukur, Nadia dist.
Photo : Pradip Kr. Mukherjee, Asst. Geologist, C.P.L, GSI.

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INDIA NEWSLETTER

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GUIDELINES FOR CONTRIBUTORS

Articles, book reviews, accounts of conferences & workshops, short pieces of news and information of popular interest on the subject, photographs with details are invited. Write-up, articles should be sent to the Editor as per guidelines below:

- Write up should not exceed two pages in Times New Roman 12 point text and/or figures and tables.
- Editorial Board holds the right to accept/reject or suitably edit the write-up before incorporating.
- Summaries of previously published articles are acceptable with due acknowledgement.
- Write-up submitted for publication should be original; that submission for publications implies, been it has not already published or submitted for publication elsewhere.
- List of references should be kept short, with details obtainable from the contributor.
- Preferably, in Word 2000 format in electronic form with one hard copy.
- Word graphics format desirable. Figures may be in colour, but all figures should also be legible, if converted to black and white.
- Brief BIODATA of the contributor

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