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MEDICAL GEOLOGY NEWSLETTER

Cogeoenvironment Working Group on Medical Geology
Newsletter No. 4

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- RADON
- SOIL NUTRIENT DEFICIENCIES AND MJD
- MANGANESE MADNESS
- EAST AFRICAN DATABASE
- HOUSE PAINT

An abandoned open pit coal mine, at Valea lui Neag (see page 14, Report on the 3rd International Conference of the Danube-Kris-Mures-Tisa Euroregion "Environment and Health").

Inside this issue:

MESSAGE FROM THE CHAIRMAN

GEOMED 2001, Zambia

A major activity this year was the meeting in Zambia organized by the School of Mines, University of Zambia under the auspices of the International Union of Geological Sciences (IUGS), IGCP #454, UNESCO, UNEP, United States Armed Forces Institute of Pathology, United States Geological Survey, and the Geological Survey of Sweden. GEOMED 2001 brought together more than 50 geoscientists and medical scientists from around the world. Africa was especially well represented with participants from Angola, Kenya, Malawi, Niger, South Africa, Tanzania, Uganda, Zambia, and Zimbabwe, with overseas delegates from Australia, Canada, England, Germany, Japan, Lithuania, Norway, Poland, Romania, Russia, Sweden, and the United States of America. The inter- and multi-disciplinary experts comprised geoscientists, medical practitioners, veterinarians, environmental economists and engineers, and social scientists.

After a warm welcome by the local chairperson, Dr. Daniel Nkhuwa (University of Zambia, Lusaka, Zambia), the meeting was officially opened by Dr. Thomas Schlüter (UNESCO, Nairobi, Kenya), who emphasized the aim of the IGCP #454 project on Medical Geology to become an internationally well known project reaching more developing countries. Representing the Geological Society of Africa and secretariat for GEOMED 2001, Dr. Imasiku Nyambe (University of Zambia, Lusaka, Zambia) emphasized the importance of sharing knowledge between eastern and southern Africa.

A main part of the meeting in Lusaka was a short course and seminar under the auspicies of IGCP #454 Medical Geology, ”Metals, health and the environment”. An extensive syllabus was produced, about 300 pages, covering many aspects on Medical Geology. This syllabus was handed over to all 50 participants. Short Course Leaders were Dr. José A. Centeno, Chief, Biophysical Toxicology Division, United States Armed Forces Institute of Pathology , Washington DC and Dr. Robert B. Finkelman, Coal Quality Coordinator, Research Scientist, United States Geological Survey, Reston, VA, USA

Following the short course, "The Role of Geomedicine in the 21st Century", GEOMED 2001 a one-day workshop on medical geology work in eastern and southern Africa was opened. Many African researchers presented work going on in different African countries. More detailed information will be put on the website and will also be published in journals and newsletters.

The Third East and Southern Africa Regional Workshop on Medical Geology was also discussed.
The venue of the next meeting will be Dar es Salaam, Tanzania. It was also decided at the meeting to form an **East and Southern Africa Association of Medical Geology (ESAAMG)**. Members of an Executive Committee were chosen to represent several African countries.

Publications

Information and news on the working group has been published in different journals, for example Episodes. Recently the British Geological Survey published a special issue of their journal Earthwise (No 17). The theme was Geology and Health including many examples of medical geology and a one page presentation of the working group. This issue is strongly recommended.

Website

The website is updated, at least twice monthly and has about 700 visitors a month and I have got several new members and contacts through this site. I mailed all members some time ago on information on your interests, topics of research etc. I intend to include this information on the website as well making it easier for you to contact each other. **Please mail me this information and it will be included on the site.**

ICSU

After the success of the short course in Zambia we have applied for money from ICSU for having more courses in different countries in 2002. I am glad to say that one of the very few approved applications was ours on short courses on medical geology. Planning is now proceeding.

Newsletter

The newsletter is planned to be published each November and May. However we rely on material from you, so please send shorter papers, information etc., to the editor (Dr. David C. Elliott at delliott@cadvision.com). There will probably be funds for printing the next four issues of the newsletter.

Book

The work with the book on Medical Geology is proceeding. At the end of this year (2001) most of the manuscripts will hopefully be mailed to the editors. Then the important task of reviewing and editing will start. In November 2002 the final manuscript will be sent to Academic Press and the book will be published hopefully before summer 2003.

Finally I hope that all of you regularly have a look at the website, send material to the newsletter and also mail me if you have any questions. The more contacts the better!!

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EDITOR'S COMMENTS AND GUIDELINES FOR AUTHORS

Many thanks to the authors of the articles in this and previous editions of the Medical Geology Newsletter. Please keep sending me material.
I would like to establish some guidelines for future Newsletters. Please remember that this is a Newsletter, not a refereed journal, and also that we are limited to 16 pages.

Articles should:

- Usually be a maximum of two pages of Times Roman 12 point text and/or figures and tables.
- May be edited to fit them into the space available in the Newsletter or for clarity.
- Should not have been published previously, although summaries of previously published articles may be acceptable.
- Lists of references should be kept short, and longer lists should be obtainable from the author, preferably by being posted on the net.
- Preferably in Word 2000 format, although I can I can handle a number of other formats.

In addition to full articles, I am interested in receiving short news items: book reviews, accounts of conferences & workshops, etc., upcoming meetings, and, **especially**, interesting pieces of news and information.

The next Newsletter is due in April 2002, so please send me your contributions by the end of February 2002 at the latest, preferably earlier.

Please note the Chairman's request to send him your research interests. This may be published in a future edition of the Newsletter if there is room, but an up to date version is on the website.

Finally, best wishes to our Chairman of the Medical Geology Committee, Olle Selinus, in his recovery from a recent heart attack.

Dr. David C. Elliott, Newsletter Editor

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AN INTRODUCTION TO “THE RADON HOTLINE

Gavin Gillmore, Director Radon Research Group, School of Environmental Science, University College, Northampton, UK

Introduction.

A number of members of IGCP 454 might be interested to know of a new website that has come on line fairly recently. The Radon Hotline (www. radonhotline.org) Internet site is owned by the non-profit making Hotline Limited, and operated as a partnership between The Radon Council and University College Northampton (UCN).

This site has been constructed to disseminate radon gas related information to the public and professionals. The web pages aim to answer initial queries concerning radon gas and remediation methods. Information on radon and the associated health and construction issues is also included.

There is a publications page which gives access to two recent Radon Council publications: The Radon Guide and a list of Radon Contractors, Suppliers & Consultants. Also included are details of other publications available directly from The Radon Council and details of a range of recent academic papers by members of staff at University College Northampton. These publications include “A need to reduce the radon gas hazard in the UK" by a previous Chairman of the Council (Papworth, 1997) and "The Radon Manual” (Phillips, 1995). The many academic publications include “Hazards, Geology, and Exposure of Cave Users: A Case Study and Some Theoretical Perspectives” by Gillmore *et al*., (2000).

It is intended that this site will become a "one stop shop" for radon information and as such the links page provides access to a number of important radon gas Internet sites.

Virtual Radon Exhibition

An annual virtual conference will be held on this website lasting several days in the near future. A proceedings volume will be produced from this virtual conference and will be issued with an ISBN number and posted on the site for a set period of time (probably 3 months). Copies of the proceedings will be made available for purchase from UCN Publications with a small charge to cover costs. There will also be an annual competition open to all. The site will display the best radon project submissions. A small award will
be presented by a sponsor for the best paper/article.

The Radon Council

The Radon Council came into being in 1990 in response to a request contained in the Interim Report of the Parliamentary Select Committee on Indoor Pollution, which called upon industry to provide a solution to the radon problem. It is the Independent non-profit making Regulatory Body for the radon industry and should not be confused with a trade association.

The first objectives were to identify the "cowboy" operators and dubious training courses then in practice. Later there followed a first edition of a training manual and an agreed Code of Practice for the industry. The Council has now drawn up an Approved List of Contractors offering advice and services involving remedial work for radon gas.

University College Northampton (UCN)

UCN is one of the leading research institutions in radon related matters and has an extensive programme. Current projects include; radon monitoring and remediation; cost effectiveness of remediation; modelling of radon ingress to the built environment; post-remediation / housing studies; radon and skin cancer; radon, geology and ecotoxicology - caves and mines in the UK; radon, archaeological excavation and caves in Sarawak; radon in mines in Jordan; radon in schools in the UK and Poland; radon in NHS properties. These projects have resulted in an extensive list of academic publications to date.

UCN has also instigated the University Radon Network (URN) to encourage co-operation between UK research teams. The Radon Research Group at UCN (Director, Dr Gavin K. Gillmore) consists of 8 UCN academic staff, one visiting fellow, 4 external academics, 2 postgraduate students and a further 5 external research members. This research group can call upon expertise from the fields of Environmental Science, the Built Environment, Information Technology, Environmental Economics, Law and Housing Policy / Public Protection. UCN is also a participating member of the International Geological Correlation Programme (IGCP) project number 454 on "Medical Geology".

Universities Radon Network

Within UK Universities there is a significant amount of academic research occurring on radon. However, much of that research is piecemeal and rarely is it part of a long term programme. Universities should be driving the agenda and implementation of radon research programmes that deliver answers to many of the pressing problems. University College Northampton has instigated the formation of the University Radon Network (URN). This forum will enable UK researchers to identify key areas of research and to work together in new and dynamic programmes that will move forward the radon agenda. There are currently 8 members of URN.

Useful Internet Links

There are also lists of useful internet links, such as the National Radiological Protection Board (NRPB), the Department of the Environment, Transport and Regions (DETR), the National Physical Laboratory (NPL) and The Health and Safety Executive (HSE). Other links include The Buildings Research Establishment (BRE), the USA Environmental Protection Agency (EPA)

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HEALTH EFFECTS AND INDOOR RADON RISK REDUCTION

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Editor's Note. This is a summary of a longer paper that was originally submitted. Please contact the author for more details

1. Radon is a radioactive gas that is an environmental concern because it poses a health hazard due to its link to lung cancer. Radon is derived from the decay of uranium and can accumulate indoors. Once inhaled, particles with radon progeny move into the upper respiratory system and find their way to the bronchial tissue where direct bombardment by energetic alpha particles from radioactive decay causes damage to sensitive lung tissue. Anything that increases the number of airborne particles to which radon progeny can become attached and inhaled into the lungs increases the risk. The ingestion of radon dissolved in water may contribute to development of some types of cancer. It is uncertain whether radon in water poses a direct health threat, but there is concern over high levels of radon in ground water contributing to radon in indoor air. The frequency of lung cancer deaths in

uranium deposits workforce is associated with duration of work underground, and cumulative exposure to radon.

2. This paper shows the high ingenuity of tools that permit both the express control of radon within an air medium, and detailed investigation of the content and transformation of radon, thoron and their derivates. A new principle of forming the detection blocks (many section detector) has been used in this apparatus. This construction permits the active area of detectors to be increased many times without deterioration of their dividing ability on energy. The apparatus will measure not only the spectra of α - particles but the activity of β - particles too. The advantages can be summarized as permitting new aspects of complex-geochemical studies of the indoor radon levels of various areas of regions.

3. A detailed study of the distribution of radon in soil gas and ground water will provide information on radon migration and give a higher degree of protection to the local population. It will permit radon hazard zones to be reliably isolated in a short time, as well as the evaluation of the radon hazard within building sites and prospective building zones.

4. A number of methods can be used to reduce elevated radon levels in a home. These methods fall into two categories: (i) preventing radon from entering the house, and (ii) removing radon (or decay products) after entry. The specific method chosen depends upon the initial radon concentration, as well as house design and construction. Methods of permanent radon reduction include: (i) increasing ventilation by using ventilators, (ii) sealing soil-gas entry routes to restrict entry of radon into a house, (iii) ventilating soil to withdraw radon, (iv) altering pressure differentials between the house and soil to restrict flow of soil gas into a house, and (v) cleaning air to remove radon-decay products (which are solid particles). Once appropriate radon-reduction methods are chosen and implemented, diagnostic tests should be conducted to ensure that radon levels have been sufficiently reduced. An effective method of hazard reduction is preventing radon from entering a structure. Restricting radon entry may be difficult in existing buildings, but is advisable for new construction (particularly in areas that have a high-hazard potential). New structures may incorporate methods to restrict radon entry by minimizing: (i) soil-gas entry pathways, and (ii) indoor-outdoor pressure differences, since these differences are the driving force for soil gas to enter a home. Features can also be incorporated during construction that facilitates radon removal after home completion.

5. The methods of reducing elevated indoor-radon levels can be used in different situations. Radon-hazard-potential maps will be used to organize and prioritize testing in existing buildings and to indicate where radon-resistant construction should be considered in new building. They will serve as a scientific-theoretic basis for working out optimum natural protective measures, and ecological-geochemical optimization of soil by the management of radon concentration.

Acknowledgements

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NEWLETTER CONTRIBUTIONS

Articles, short news items, book reviews, upcoming conferences and workshops, accounts conferences and workshops, interesting bits of news and information. Please send to delliott@cadvision.com

SOIL NUTRIENT DEFICIENCIES IN AN AREA OF ENDEMIC OSTEOARTHRITIS (MSLENI JOINT DISEASE), MAPUTALAND, SOUTH AFRICA

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Abstract

Unusually high incidences of dwarfism and endemic osteoarthritis, termed Mseleni Joint Disease (MJD), occur in the sandy coastal plain of Maputaland. This rare disease begins with stiffness and pain in the joints and progresses to varying degrees of disability, with some of the afflicted requiring aid in walking and others without the ability to walk at all. Almost 3% of the local population of adults are dwarfs, while 38% of women and 11% of men have MJD. The disease is typified by a combination of multiple epiphyseal displasia, polyarticular osteoarthritis, and protrusio acetabuli, with earlier stages of MJD displaying osteoarthritis and advanced cases typified by severe joint surface irregularity. Medical studies since the early 1970s have examined haemotological, radiological, mycotoxicological, and genetic factors, but have remained inconclusive in determining the aetiology of MJD or the dwarfism. These have included extensive interviews, data collection and interpretation, but until recently no comprehensive examination of environmental factors was completed.

Two geochemical studies to date have examined the nutrient status of soils in the Mseleni area. Environmental factors were initially investigated with a 30 km east-west transect through the high incidence area of MJD, and found the distribution of available nutrient concentrations to be extremely variable. This suggests the possibility of the existence of isolated pockets of land where deficiencies may be acute. The average concentrations of available soil Ca, K, P, Zn, and Cu were found to be deficient (at 250, 9, 1.9, 0.4, and 0.4 mg kg^{-1}, respectively) while B and Mn were considered low (at 0.4 and 4.5 mg kg^{-1}, respectively).

A second study was aimed at determining the elemental status of soils in the Mseleni area and the nutritional composition of plants grown in the soil. Plant growth trials with a subtractive element technique confirmed these deficiencies in maize (*Zea mays*) for P, K, Ca, Mg, Cu and Zn (at 1.1, 3.1, 3.8, and 2.7 g kg^{-1} and 3 and 14 mg kg^{-1}, respectively).

Currently, work is focusing on the spatial distribution of selected trace elements throughout high and low prevalence areas. Two transects, one running 75 km north-south and the other 50 km east-west, have given indications of P, Cu, and Zn deficiencies overall, and K and Se deficiencies in the high incidence area. These are being confirmed on a site-specific basis with sampling of gardens at individual houses.

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"MANGANESE MADNESS" CLUES TO THE AETIOLOGY OF HUMAN BRAIN DISEASE EMERGES FROM A GEOLOGICAL ANOMALY

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A pleasant aspect of Captain Mathew Flinders circumnavigation of Australia in 1803 was that he was generally well received by the aboriginal inhabitants at dozens of scattered communities along the continent's enormous coastline. That changed dramatically, however, when he ventured into the Gulf of Carpentaria, in Australia's Northern Territories. As the ship approached one of the larger islands, one of a cluster of several located in the western end of the gulf, the ships company were entranced by the blue colour of the waters in one particular bay. They promptly named it Blue Mud Bay. Launching a small boat to make an inspection onshore, they were surprised at the aggressive behavior of the local inhabitants . The belligerent reception of the shore party caused alarm among the crew of HMS Investigator. Captain Flinders recorded in the ships log, "They come at us very strangely... sending off their children and women and approaching with spears held in a threatening fashion."

The brilliant hue from the waters of the pristine bay owed its origin to huge deposits of manganese nodules. Later, these were to provide a major economic benefit to the island when they were mined. The island, called Groote Eylandt, one of the largest islands in the Gulf of Carpentaria, possesses a Dutch name though likely discovered by the Portuguese. Its location is 138 degrees east longitude and 14 degrees south, some 50 km off the east mainland coast of Arnhem Land Aboriginal Reserve.

At the Universite' de Montreal in the late eighties I was engaged on a research project that attempted to unravel the intricacies of neurodegenerative disease, particularly Parkinson's disease (PD). Especially puzzling to our group was the severe deficiency of the neurotransmitter dopamine that occurred in the mid-brain of this disorder. The reason for the loss of dopamine producing cells in the corpus striatum region of brain was an enigma and we searched for clues that could aid in understanding this phenomenon. I was intrigued to learn from neurologist Dr Andre' Barbeau, that in the manganese mines of northern Chile some miners came down with symptoms quite similar to PD.

Of particular importance was the finding revealed at autopsy of a loss of dopamine cells in the same brain region as PD. Known among the villagers as "locura manganica," or manganese madness, and sometimes as the voodoo metal, the intoxication expressed itself by compulsive, bizarre, and aggressive acts in the early stages. Later, neurological symptoms similar to PD appeared. The possibility that manganese could be involved in PD was exciting to me and became a major focus for investigation in our laboratory. However, numerous attempts to uncover a rationale for the highly-selective neurotoxic insult of the metal on brain tissue under experimental conditions proved fruitless. The ability of a metal ion like manganese to induce a disorder of the brain similar to that of PD itself could provide a useful probe with which to uncover the underlying intricacies of metal-neuron interaction thus aiding in understanding the degenerative process in the central nervous system (CNS). More importantly to assist also in developing a rational drug therapy for the disorder.

An especially baffling aspect of our attempts to produce an experimental model of manganese intoxication, was the lack of a suitable animal species. Also, the effect of systemically-injected manganese salts depended not only on the type of animal, but also its age and the oxidation state of the metal. Later, we came to appreciate that an important aspect of the pathogenesis of manganism relates to the unique ability of the metal to undergo changes in oxidation state. Divalent manganese salts were relatively benign, whereas in the trivalent state they possessed potent neurotoxicity. A weird kind of Jekyll and Hyde phenomena. Toxic effects were greatly influenced by the route of injection. Aerosol inhalation with manganese dioxide dust of a particle size less than 10 microns was particularly effective. However, prolonged administration of the aerosol to monkeys required periods as long as 18 months to two years before lesions in the dopamine-rich corpus striatum were found. Primates are especially useful in manganese intoxication studies since unlike rodents they possess the brain pigment, neuromelanin, which undergoes degeneration in PD.

A strange twist to the manganese story occurred in 1986 when I was invited to present a paper on manganese neurointoxication at the University of New South Wales in Sydney, Australia. Following my presentation, Professor John Cawte, of the Department of Psychiatry discussed his research at Groote Eylandt in the Northern Territories. As a transcultural psychiatrist among the aboriginal population on the island he had been intrigued by the presence of a strange neurological disorder among the community. Known locally as "bird disease" because of the peculiar stance that afflicted individuals adopt, it has similar features to amyotrophic lateral sclerosis (ALS, or Lou Gehrig's disease). The clinical features include congenital malformations, psychiatric problems, and symptoms reminiscent of motor neurone disease. Professor Cawte terms the condition, "Groote Eylandt Syndromes."

The island is also the site of the largest manganese mine in the Pacific. I was delighted to receive an invitation to visit the island since it is a closed aboriginal community reserve and therefore off limits to outsiders. During my stay I had the opportunity to visit the manganese mine site run by the Groote Eylandt Mining Company, a subsidiary of BHP. Although manganese levels among white miners are normal (150-200 nmol/l), likely because of occupational safety measures, among aboriginal inhabitants the levels are considerably higher, (400-700 nm/l). Dr Mark Florence at CSIRO in Sydney has found that along with manganese dust from the mine being carried downwind to aboriginal community villages, additional sources of contamination are the soil and vegetables. Manganese concentration of soil ranged from 14,000 to over 100,000 ppm in contrast to a world average of 500 ppm. Fruits were also several thousand fold higher. Aboriginals are earth dwellers and eat "bush tucker," consequently their exposure to manganese is considerable. Calcium levels in drinking water obtained from the Angurugu river were extremely low. Calcium levels regulate manganese uptake. Experimentally we have found an enormous increase in uptake of manganese during calcium deficiency in rats. Iron deficiency also results in a greatly enhanced intake of manganese. Epidemiological studies in the western Pacific region have revealed clusters of neurological disorders like Parkinsonism, Alzheimer's disease, and motor neurone disease in diverse geographic areas. Their location in Guam, Kii Peninsula, Japan, and Western New Guinea suggest an environmental agent(s) is a likely contributor to their etiology. The foci of neurological disorders on New Guinea, is only 600 km north of Groote Eylandt. These apparently disparate regions can be connected to Groote Eylandt by a line running through approximately 140 degrees of longitude. Local engineers indicate a geologic anomaly exists in this area of the Western Pacific. Anecdotal geological accounts suggest these regions could lie on top of the same rock basin . Studies by NIH researcher, Frank Garrutto, among the Chamorro tribe, have revealed a high incidence of motor-neurone disorders in the Western Pacific correlated with regions having low concentrations of calcium and magnesium in soil and water. Excessive amounts of metals such as manganese, or aluminum, and deficiencies of an essential mineral such as calcium or iron can greatly impede critical absorptive processes resulting in essential minerals becoming toxic. Due to its unique electronic configuration calcium acts like a goalkeeper in a hockey match. By deflecting potentially damaging metallotoxins it plays a pivotal role in maintaining mineral homeostasis.

Although data on the psychiatric manifestations of the Groote Eylandt Syndrome among aboriginal inhabitants is limited, violence is common. According to social service records arrests and incarcerations of the native population on the island are the highest in the country. Personal experience of this was obtained during my visit to the medical clinic. One individual, apparently frustrated by the long line-up, in a fit of rage threw a spear at the nursing sister. Fortunately she ducked in time as it thudded into the wall behind her!

It has been known for some time that there is a link between brain chemistry and aggression. Evidence that manganese maybe involved in the neurobiology of aggression is accumulating. Researchers at the University of California have found significantly higher levels of manganese in the hair of criminals convicted of murder, rape and other violent crimes. Dr Louis Gottschalk, professor of psychiatry at UCI, said that " manganese appears to be a marker for violence." Francis Crinella, professor of pediatrics at UCI in related studies reports that nutritional deficiencies such as calcium are common among criminals and exacerbate elevated manganese levels. Crinella also found high manganese in learning disabled children. This is particularly relevant since learning disabilities have been known for years to be a strong risk factor for criminality. Children have a reduced ability to excrete manganese and their brain is selectively permeable to the metal ion making them particularly at risk. Serotonin, a key neurotransmitter, is reduced in violent individuals. The possibility that manganese could also be a physiological marker for detecting criminally aggressive individuals is exciting and supports a biological basis for violence. A pilot study is presently underway at California prisons to determine the effect of dietary intervention on violent prisoners. Preliminary data indicate that recidivism in younger inmates declined significantly following nutritional intervention using various neurotransmitter co-factors. In this regard, use of the manganese containing additive, MMT in North American gasolines has caused alarm among environmentalists who suggest chronic low level exposure of manganese from tailpipe emissions may constitute a serious public health risk. Whatever the eventual outcome of manganese role in the neurobiology of aggression, there is little doubt that unraveling its role in the geochemical environment and its relation to health will prove a stimulating challenge for the emerging field of medical geology.

MEDICAL GEOLOGY APPLICATIONS OF AN EAST AFRICA GEOCHEMICAL DATABASE

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Abstract

Presently available data concerning the geochemical composition of the surface environment of East Africa are incomplete and far from consistent. Many older data sets are deficient and do not meet basic requirements for establishing the range of natural geochemical background values.

A high quality geochemical database is advocated for the region. The applicability of such a database for addressing environmental issues will be of far greater significance for this region than for many other parts of the world, because most of the population still live close to the land, and because the distinctive nature of Earth processes in the region has carved out a unique geochemical landscape.

Compiling an East African geochemical database is the first step in understanding the hydrological, chemical and biological processes that determine the behaviour of chemical elements in this section of the Earth's surface in relation to how they may affect the life of man and animals.

Introduction

Complete geochemical databases do not exist for Kenya, Tanzania and Uganda, the countries collectively referred to as East Africa. Some form of conventional geochemical coverage (i.e., samples collected and analysed by various methods in a laboratory) exists for 97 percent of the surface area of Uganda, 68 percent for Tanzania and 9 percent for Kenya (Table 1). However, there is considerable variation between datasets in the various countries because sample media, methods of sample collection and preparation, extraction and analytical techniques, and levels of quality control were generally decided according to perceived mineral exploration targets of each country and a desire to minimise costs.

As a result of this diversity, numerical values can only be compared within areas where consistent methods and standards have been applied. Variation between datasets with respect to the assemblage of elements also makes it difficult to interact such datasets or use them as a basis for studying processes operating in the region's surficial environment. In addition, few elements of environmental importance have been determined in past survey work. To find ways of overcoming these problems, or at least to prevent their perpetuation into the future, was a major consideration underlying the present proposal.

Data obtained from an East African geochemical baseline study will have a range of environmental applications: to identify areas where deficiencies or potentially toxic levels of chemical elements may present a risk to human and animal health or to livestock or crops; to provide quantitative information on natural levels of the chemical elements over different geological environments in the region, which may be used to assess the effects of past, present and future human influence; and they will have an important contribution to make in land-use planning issues. The data will also have applications in mineral exploration, resource evaluation, geological mapping, and research into the fundamental processes of crustal evolution and ore formation (British Geological Survey, 1997). In addition, such a compilation will facilitate the modelling of environmental systems linked to issues of formulating environmental management and legislative control mechanisms.

By looking more deeply into just one of these applications, Medical Geology, this paper sets out to illustrate why a high quality geochemical baseline data is indispensable in monitoring the state of the East African environment and in identifying problem areas.

Methodology

The methodology for compiling such a database at the global scale has already been formulated and agreed upon internationally, within the context of the original "Global Geochemical Baselines Initiative" (GGB) and within the framework of the International Geological Correlation Programme, IGCP 259 (Darnley et al., 1995). Procedural guidelines have been set for all climatic regions, so that project implementation can proceed as soon as the requisite items of equipment are procured and the proposal endorsed by relevant national and international authorities and institutions, including commitment with respect to adequate funding. A summary of the principal recommendations is given in Table 2.

Medical Geology Applications

One of the most important applications of a geochemical database for East Africa would be in indicating areas where there is the potential for trace element deficiency or toxicity in man and animals. Diseases created by element deficiencies or excesses are most apparent in rural communities where water and food are locally derived and little exotic produce is consumed. Also, a unique distribution pattern of chemical elements is evident in the East African region as in many other tropical areas, the result of a combination of factors, including: (i) extreme tropical conditions of intense weathering, leaching and eluviation, which have led to pronounced separation of elements, though the extent depends on their chemical mobility and on the nature of the local environment (Trescases, 1992) and changes in the element distribution in the soil profile which affect uptake into plants and animals; (ii) volcanic activity associated with rift formation which has released a range of trace elements mostly above background levels into the environment, and, (iii) the region's diverse physiography, characterised by a range of altitudes, and with a peculiar hydrological network. It is therefore possible to delineate large areas containing element deficiencies or toxicities which are closely related to the local geology and/or geographical location.

The elements F and I have well documented deficiency-related health problems in the region, although disease also occurs if F is present above a certain threshold value (e.g., Ockerse, 1953; Nanyaro et al., 1984; Gaciri and Davies, 1993). Apart from these elements, however, very little is known about the behaviour of nutritional and toxic elements in the soil–water–foodcrops–human and animal continuum, let alone an understanding of the implications of their deficiencies and excesses in environmental health.

In Kenya, for instance, there are several health conditions including a variety of skin ailments which cannot yet be satisfactorily diagnosed. We have virtually no information on the variation in composition of the surface environment where the population lives, and there is an apparent lack of awareness by our medical practitioners of the great significance that changes in chemical parameters of the environment can mean in terms of disease causation. However, except in some specific cases such as iodine deficiency disorders, symptoms may be non-specific and diagnosis based on tissue or blood sampling, costly. The difficulties of diagnosing disease, and particularly subclinical conditions in animals and man related to trace element deficiencies or excesses are discussed by Mills (1996).

Creating a sense of awareness among medical practitioners of the influence that geochemical factors can have on disease causation will no doubt enlarge the diagnostic spectrum for environmental diseases and hence permit more precise identification of therapeutic targets.

A 'geochemical database' can be used for tracing exposure routes for toxicants in soils and groundwater. Such routes can include incidental ingestion of trace-element contaminated soil or ingestion of trace toxicants through crops which have been grown on contaminated soil. Soil contamination can occur through the long term irrigation of land with metal contaminated water. Other trace elements, when accumulated in (contaminated) soil can be phyto- and ecotoxic, causing a reduction in the capacity of food crops to ingest vital nutritional elements and hence, limiting crop production capacity.

The concentrations of certain trace elements (such as selenium) in crops (rice, corn, soybean) has been shown to correlate with the concentrations in the soil in which they are grown (Lavender, 1986); and, regionally, levels in fine fraction stream sediments give a good indication of likely soil concentrations (Appleton, 1992). High precision geochemical mapping can therefore be a cost-effective method of indirectly investigating the chemical composition of crops; and rural communities in East Africa will offer a particularly valuable opportunity for examining the relationship between geochemistry and health. Such mapping can also be used as a tool for targeting resources into areas worst affected by soil degradation as well as identifying factors limiting agricultural production. In order to benefit from these new approaches, more multi-element, multi-parameter baseline geochemical data are needed, coupled with specific research into the speciation of potentially harmful elements and essential nutrients in different geological and pedological terrains within the region.

Conclusion

Although some geochemical mapping is being undertaken by Geological Surveys of some African countries, few are using the internationally agreed standard methods as set forth in the GGB Initiative. Countries such as Kenya, Tanzania, and Uganda simply lack the analytical infrastructure and funding for such a high precision and systematic exercise. As such, earlier geochemical surveys show many possible intrinsic differences in datasets for any given element, which hinder or do not justify the assembly of most existing data into broader regional compilations.

This paper therefore advocates for complete geo-

Table 1. Some characteristics of the East African surface environment

	KENYA	TANZANIA	UGANDA
Location	Bordering the Indian Ocean, between Somalia and Tanzania	Bordering the Indian Ocean, between Kenya and Mozambique	West of Kenya
Geog. Coordinates	1 00 N, 38 00 E	6 00 S, 35 00 E	1 00 N, 32 00 E
Total land surface area	569,250 sq km	886,037 sq km (includes the islands of Mafia, Pemba and Zanzibar)	199,710 sq km
Climate	Varies from tropical along coast to arid in interior	Varies from tropical along coast to temperate in highlands	Tropical; generally rainy with two dry seasons (December to February, June to August); semi-arid in northeast
Terrain	Low plains rise to central highlands bisected by Great Rift Valley; fertile plateau in west	Plains along coast; central plateau; highlands in north, south	Mostly plateau with rim of mountains
Natural resources	Gold, limestone, soda ash, barites, rubies, fluorspar, garnets, wildlife, hydropower	Hydropower, tin, phosphates, iron ore, coal, diamonds, gemstones, gold, natural gas, nickel	Copper, cobalt, hydropower, limestone, salt, arable land
Land use	Arable land 7% Permanent crops 1% Permanent pastures 37% Forests and woodlands 30% Other (1993 est.) 25%	Arable land 3% Permanent crops 1% Permanent pastures 40% Forests and woodland 38% Other (1993 est.) 18%	Arable land 25% Permanent crops 9% Permanent pastures 9% Forests and woodland, 28% Other (1993 est.) 29 %
Irrigated land	660 sq km (1993 est.)	1,500 sq km (1993 est.)	90 sq km (1993 est.)
Percentage of surface area with some geochemical survey data	*AGRS - Conv. 9	AGRS 100 Conv. 68	AGRS - Conv. 97

*AGRS : Airborne gamma ray spectrometry Conv. : Conventional geochemistry
Source : 1. http://education.yahoo.com/reference/factbook/ke/geogra.html
2. Darnley et al., 1995

Table 2. Summary of principal recommendations from Darnley et al., 1995.

1. Commonly available representative sample media, collected in a standardized manner
2. Continuity of data across different types of landscape
3. Adequate quantities of the designed sample media for future reference and research requirements
4. Analytical data for all elements of environmental or economic significance
5. Lowest possible detection limits for all elements
6. Determination of the total amount of each element present
7. Tight quality control at every stage of the process

Source : Plant et al., 2000. Conv. : Conventional geochemistry chemical maps of East Africa for all non-gaseous elements and other chemical parameters in pertinent environmental media, based on the agreed guidelines. It is submitted that such a dataset would be invaluable for studies in Medical Geology, in addition to having an array of multi-purpose, multi-national environmental applications; it will also provide reference materials for future research requirements.

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THE 3RD INTERNATIONAL CONFERENCE OF THE DANUBE-KRIS-MURES-TISA (DKMT) EUROREGION: "ENVIRONMENT AND HEALTH"

On April 6-7 2001 the 3rd Conference of the Danube-Kris-Mures-Tisa Euroregion was held in Petrosani, Romania. The DKMT Euroregion is an economical division in Southeastern Europe, including four counties from Hungary, one from Serbia and four from Romania. The meeting was attended by over 50 participants, who discussed topics on medical geology, environmental pollution and environmental medicine, pertinent to the Euroregion. The first conference in the series was organized in November 1999 in Arad, Romania, followed in May 2000 by a meeting in Szeged, Hungary. Some of the environmental health and environmental pollution problems discussed in the meeting were revealed live to the participants during a field trip to an abandoned open pit coal mine (Valea lui Neag), where surface mining in the communist era led to a social and environmental disaster (see picture on the front cover), and to the underground coal mine of Petrila, one of the deepest in Romania and continuously active since 1859.

PAPER ENTITLED "MULTIPLE METAL CONTAMINATION FROM HOUSE PAINT: CONSEQUENCES OF POWER SANDING AND PAINT SCRAPING IN NEW ORLEANS" *by H. W. Mielke et al., Xavier University of Louisiana. Environmental Health*

Editors note. This is a summary of the original published paper, which should be referred to for details.

The changing geochemistry of cities is related to many actions. One activity is home repair and maintenance. Maintenance of old homes can release extremely hazardous materials if improperly done. For example, lead poisoning can arise from exposure to lead-based paint chips as well as dust produced during prep work for repainting. This research attempts to broaden the discussion by looking at a variety of metals existing in old paint besides lead, including cadmium, manganese, nickel, copper, cobalt, chromium, and vanadium. To get a full picture, he also compared the effect of two different paint renovation methods on accumulation of lead in interior and exterior environments. His findings illustrate the need for curtailing power sanding related hazards from metal dust while preparing for house painting and suggest a safer method of preparation.

The study was inspired by the experiences of a New Orleans family that had undertaken the renovation of their wood frame 1920s house (house 1). Old paint was removed by a professional painting company by power sanding. Consequent health hazards first showed up when the family dog died six weeks after power sanding began. The family was forced to vacate their house, and all three children were hospitalized with elevated blood lead concentrations. When advised by the hospital not to return to their house, the family consulted Mielke for advice on dealing with their lead-contaminated home.

The painting project at house 2 was begun later. After seeing the misfortune of their house 1 neighbors, the house 2 family chose to have their house dry-scraped in preparation for painting. Mielke and colleagues decided to conduct a case study on house 2 to determine whether scraping is a safer alternative for managing lead-based paint The researchers collected dust samples from the two houses and also paint samples from house 2 and 30 other houses in the city to determine the average content of lead and other metals.

By pulverizing old paint, power sanding can release many paint-bound metals that accumulate in the environment because they don't decompose. In addition to lead, power sanding can release enough cadmium, manganese, and nickel to not only place painters at risk of overexposure but also "contribute to exposure during a critical window of childhood that may contribute to chronic health problems later on in life." Elevated lead levels remained in house 1 even after repeated vacuuming with a HEPA-filter vacuum, mopping with a three-bucket procedure, and dusting with a tack cloth. Only after an intensive $70,000 remediation, including painting all interior surfaces, sealing all porous wood surfaces, and cleaning outdoor surfaces with lead-specific detergents, did levels improve.

House 2, on the other hand, demonstrated that scraping paint is a relatively safe method for preparation and that it doesn't contribute to lead dust accumulation in either the interior or exterior of a house. The amount of lead dust after scraping but before cleaning did not differ significantly from before the project started. To be effective, though, scraping must be accompanied by diligent cleaning practices; in fact, after a thorough post-scraping cleaning, the house had even less lead than before the project began.

The hazards from old paints aren't unique to New Orleans. All cities need to revise their codes to prevent poisoning from power sanding. The researchers make a number of recommendations to help protect the health of the workers and families from the problem. Paint should be tested for lead before any painting project is begun, and power sanding should be prohibited by city ordinance. The public, moreover, should be educated about the hazards of dusts created from sanding. The authors didn't study encapsulants (special liquid coverings to contain lead), but suggest that they may be helpful in curtailing metal dust contamination derived from house paint.

BOOK OF INTEREST

THE ATLAS OF PLAGUE AND ITS ENVIRONMENT IN THE PEOPLE'S REPUBLIC OF CHINA.
Chief Compilers: Liu Yun-peng, Tan Jian-an, Shen Er-li, Science Press, Beijing, 2000

The "Atlas of Plague and Its Environment in the People's Republic of China "was sponsored by the Office for Endemic Disease Prevention and Control, of the Ministry of Health, and the Bureau of Resources and Environment Science and Technology, of the Chinese Academy of Sciences (CAS), and it has been published officially. The Atlas' format is 787×1092 1/8 (hardcover), and it consists of 216 pages of text and 284 maps.

The Atlas reflects important achievements in China, and summarizes the epidemic history of plague in China in the past 200 and more years. It consists of ten parts (map groups): General Maps, Maps of Environmental Backgrounds, Maps of World Background of Plague Epidemics and Plague Foci, Maps of Plague Natural Foci and Their Environments, Maps of Plague Epidemics, Distribution Maps of the Reservoirs of Plague in China, Distribution Maps of the Principal Vectors of Plague in China, Ecotype Map of *Yersinia pestis* and Their Distribution, Maps of Plague Control and Management Organizations, Maps of Control Results.

It presents a comprehensive, systematic, synthesis of statistical charts, data, and results of investigations and researches concerning plague epidemics, prevention and control, monitoring, and focus distribution as well as their relationships with the environment. The Atlas also reveals the historic changes and the current situation of plague in China, the epidemic law and influential factors of plague, types of foci and their distribution patterns, as well as their relationship with environments; typology and characteristics of the spatial distribution of *Yersinia pestis* ecotypes and their relationships with insect vectors and reservoir animals; experiences, strategies and achievements in plague prevention and control accumulated over the years are also described. Moreover, the Atlas also summarily elucidates the geographical distribution law and epidemic characteristics of plague in the world and makes new classifications of plague foci for China and world. It is further found that the plague focus distribution is closely related to chemical geographic landscape, i.e., plague foci are distributed in Ca and Fe enriched landscape conditions.

MOUNTAIN GEOECOLOGY AND SUSTAINABLE DEVELOPMENT OF THE TIBETAN PLATEAU
edited by Du Zheng, Qingsong Zhang and Shaohong Wu
Kluwer Academic Publishers (2000) Dordrecht/Boston/London

CHAPTER 8 HUMAN HEALTH ASPECT IN GEOECOLOGY Tan Jian'an, Zhu Wenyu, Li Ribang, and Wang Wuyi, Institute of Geography, Chinese Academy of Sciences, Beijing, China. E-mail: tanja@igsnrr.ac.cn

This chapter includes: Influence of High Altitude and Health, Effects of Life Elements in Geo-ecosystem on Health (Iodine, Fluorine and Selenium), Impact of Landscape Factors on Health, and many references.

GEOENVIRONMENTAL MAPPING METHOD, THEORY AND PRACTICE
P. T. Bobrowsky. Swets and Zeitlinger (Balkema).

This book illustrates the wide variety of geoscience mapping undertaken throughout the world, with contributions from specialists in several countries. It includes papers on volcanic hazards, landslides, dolines, tsunamis, radon potential, medical geology, rainfall erosion, engineering geology, borehole stratigraphy, lake sediment geochemistry, aggregate resources, remote sensing, etc.