



# MEDICAL GEOLOGY NEWSLETTER

Cogeoenvironment Working Group on Medical Geology  
Newsletter No. 2

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## Main Articles

- IGCP Project 454 on Medical Geology
- Report on a Workshop on Geomedicine in Kenya
- Environmental Programme at Moi University
- Geology in Researching Links between Environment and Health



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### Special points of interest:

- *Geomedicine Course Syllabus (Page 14)*
- *Workshop in Uppsala this September (See Back Page)*
- *Request for Newsletter Articles*

Participants in the East and Southern African Regional Workshop in Geomedicine  
 From the left: Dr Barry Smith, BGS, UK , Dr Ron Fuge, Society for Environmental Geochemistry and Health, Prof Juergen Freers, Makerere University Medical School, Prof. K ole Karei, Moi University, Prof T C Davies, Moi University, Chairman, Dr Wilson Yabann, Dean, Moi University , Prof Charles Okidi, IUCN, Dr J N Kamara, UNEP. (See report inside)

## MESSAGE FROM THE CHAIRMAN

It has been a rather long time since the previous issue of the newsletter was distributed. The reason for this is that I have been very busy and that it has taken some time to approach, and make arrangements with, publishers for the planned book on medical geology.

As most of you know, at our workshop in Uppsala in June 1998, we decided to publish a book on medical geology, and planned the chapters and responsible authors. Now we have a publisher, Academic Press, in the USA. The book will actually be more extensive than we originally planned, with more authors and a couple of co-editors. I believe that the result will be very good.

One other piece of news is that a new IGCP project (under UNESCO and IUGS) was granted in February 2000: "Medical Geology". This project will be integrated in the Working Group on Medical Geology. The IGCP project will include some additional tasks and will also make it possible for members of the working group to finance travels etc., to meetings and workshops. Project leaders are Olle Selinus and Peter Bobrowsky. The estimated duration of this project is 5 years and more detailed information can be found below, and on the web page.

This autumn, in September, there will be a workshop in Uppsala, Sweden, September 4-10, 2000. Representatives from Academic Press will be present and the workshop will deal mainly with the book on medical geology. However, there will also be a two day seminar on medical geology with the title "The Geochemical Environment and Human Health". The conveners of this seminar will be Tony Berger, Canada and Catherine Skinner, USA. The Seminar will review current understanding and research needs concerning the effects of Geochemical cycles on human health, pathways to the human body, and geochemical influences at the bone, soft tissue and cellular levels. It is expected that this meeting will lead to the establishment of an on-going interdisciplinary network of medical and earth scientists carrying out research on the relationship between human health and the geological environment. The topics of the semi-

nar will be: Sources and External Pathways, Soils and Plants, Surface and Ground water, Effects and Internal Pathways, Hard Tissues (Bones and Teeth), The Cellular Level, Soft Tissues, Cancer and Cardiovascular diseases

I am now applying for money for the meeting and hope to be able to finance the stay in Sweden during this week for as many as possible attending and also money for the travel costs to Sweden for some people. Please make a note in your diary on this week and if you wish to attend, please send me a brief e-mail on this. Later this spring, I will send everyone in the working group detailed information.

As you all know we have a web page. I am regularly putting new information there and if you wish to have some information there, please tell me. Have a look at the web page regularly: <http://home.swipnet.se/medicalgeology> for new information.

I wish you a nice spring (or a nice autumn if you are living on the opposite side of earth).

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### REQUEST FOR CONTRIBUTIONS

This newsletter depends on contributions from those working in the field of medical geology. Please send contributions to the Editor, Dr. David C. Elliott, [delliott@cadvision.com](mailto:delliott@cadvision.com). Contributions may be of any length, from full articles (which may be edited to fit) to short items.

## IGCP PROJECT 454 MEDICAL GEOLOGY

by Ole Selinus

A new IGCP project was granted in February 2000: " Medical Geology". This project will be integrated in the Working Group on Medical Geology. The IGCP project will include some additional tasks and will also make it possible for members of the working group to finance travels etc., to meetings and workshops.

Project leaders: *Olle Selinus, Peter Bobrowsky,*

The International Geological Correlation Programme (IGCP) is a co-operative enterprise of UNESCO (United Nations Educational, Scientific and Cultural Organisation) and IUGS (International Union of Geological Sciences). It was launched in 1972, to facilitate geological co-operation across international borders, as geological processes and structures normally cut across such boundaries. The programme's major aim was to bring together scientists from East and West and to encourage the involvement of developing countries.

IGCP is interdisciplinary, covering all specialties of the Earth Sciences and establishing links with other UNESCO scientific programmes. It maintains active interfaces with disciplines related to these such as marine, atmospheric and biological sciences. Its purpose is to promote the wise use of the Earth as a human habitat and as a source of natural resources. IGCP operates world-wide with several thousand of scientists in about 150 countries.

Reflecting the contemporary needs of society, the four main objectives of IGCP are as follows:

- (1) **Increase** our understanding of the factors controlling the global environment in order that human living conditions may be improved.
- (2) **Develop** more effective ways to find and assess natural resources of energy and minerals.
- (3) **Increase** knowledge of geological processes and geological concepts through correlative studies of many locations around the globe.

(4) **Improve** standards of research, methods and techniques of carrying out research.

The International Geological Correlation Programme is carried out through individual projects, although it must be emphasized that IGCP is not a funding agency for research. Their number is not defined but is controlled by the available financial resources and by scientific peer review of project proposals and of annual reports of progress. Assessments of proposals for new IGCP projects, and of the annual reports of approved projects, are conducted annually by the IGCP Scientific Board. The established lifetime of an IGCP project is usually five years.

Additional information can be obtained from the IGCP Secretariat, at:

UNESCO, Division of Earth Sciences  
1, rue Miollis  
F-75732 Paris Cedex 15  
Tel.: 1-45 68 41 23 Fax: 1- 45 68 58 22

The IGCP project is likely to prove an efficient body in applying for project money, for example from the European Union, EERO, World Bank and ADB. Medical geology is a difficult topic to study in developed countries because of several confounding factors. One major difficulty in industrialised countries arises from the fact that the population eats food imported from other countries and continents and, in many cases, even the drinking water is derived from sources that are considerable distances away from where the consumers live. This makes it difficult to carry out research in the field of environmentally related diseases. Therefore, the developing countries are interesting for specific research and studies in this field. Also, Eastern Europe is an interesting region because of the intensive pollution in these countries. The European Union, as well as other international organizations finance research in these countries, and this new IGCP project will make every effort to tap such sources of funding.

**Brief outline of the project**

## IGCP PROJECT 454 *continued*

The primary aim of the project is to bring together, at the global scale, scientists in developing countries with their colleagues in other parts of the world, stressing the importance of geoscientific factors that affect the health of humans and animals.

The project will involve transfer of training as well as mutual exchange of information and experience. The developing world will provide considerable case study and research potential. For their part, the developed countries will offer their advanced techniques and research skills with appropriate transfer of medical knowledge and methodology. This initiative provides, for the first time, the opportunity for leading scientists from developing countries to come together in a truly international and inter-disciplinary way (involving geoscientists, medical doctors and veterinarians) to identify and tackle real problems of geoenvironment and health.

One of the main goals is to establish a dialogue between researchers in geographically separate and scientifically distinct but complementary areas. This will provide a forum for open discussion, foster scientific cooperation and lead to resolution of globally important issues.

We expect that short papers produced within the project will be published in regular refereed journals as well as other journals and magazines. Towards the end of the project a book on medical geology will be published, and flyers and other information material on the subject will be developed and distributed on an internationally.

The estimated duration of the project is five years, and it will be carried out in stages

Year 1: Advertising of project. Annual meeting of the group at the Geological Congress in Rio. Organisation of work. Contacts with complementary groups.

Year 2: Workshop in Sweden, planning bibli-

ographies, information material and book.

Year 3: 3<sup>rd</sup> World multi-country meeting, including workshop, possibly in China or Africa.

Year 4: Annual meeting.

Year 5: Final project meeting, preparation of final report publishing a book on Medical Geology.

Other main points of concern that the project will address are:

- Arranging joint interdisciplinary technical meetings to address issues of mutual concern amongst geoscientists and other disciplines concerned with medical geology.
- Producing and distributing a medical geology newsletter to disseminate information on medical geology to geoscientists, medical doctors, veterinarians, planners and industry.
- Arranging for the compilation of bibliographies concerned with medical geology problems.
- Encouraging geological surveys, universities and geological societies to take a more active role in providing useful information on geological conditions in medical geology.
- Encouraging the development of local working groups of multi-disciplinary medical geology experts.
- Encouraging research in the area of producing more effective methodologies for the study of geological factors in environmental medicine.
- Compiling methods distinguishing anthropogenic effects from natural effects caused by geology.
- Formulating recommendations for mitigation of effects of natural and man-induced hazardous geochemical conditions.

## IGCP PROJECT 454 *continued*

- Providing training lecture sessions at annual meetings by keynote speakers as a means of up-dating collaborators and providing up to the minute ideas and methodological approaches to younger developing countries' scientists.
- Regularly reviewing results of the collaborative activities of the project group with a view to selecting material of educational value for use at all levels, including schools, in developing countries.
- Appropriate interactive contact with other projects, ICSU-linked bodies and UNESCO intergovernmental programmes with a view to maximizing the utility of the products of the project, including advice on the optimisation of its social relevance and application.

### CURRENT STATUS OF RESEARCH IN GEOMEDICINE IN EAST AND SOUTHERN AFRICA

by T. C. Davies<sup>1</sup> and T. Schluter<sup>2</sup>

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*Editor's Note. Because of space limitations in the Newsletter, this is a shortened and edited version of the original paper, which can be found on the Working Group website*

The extent to which factors of the geological environment influence the occurrence and distribution of human and animal diseases is increasingly becoming apparent. Although some of these geologically related health problems express themselves in the developed world, they are more keenly felt in the developing countries due to the added stress of such factors as poverty and malnutrition. Again too, while most of the population of the developed world have diets which include food sources from geographically diverse regions, in African countries, most of the population live close to the land, relying on locally produced food and water. In these settings, therefore, the probability of detecting relationships between the geological environment and disease is greatly increased.

The 'East and Southern Africa Regional Workshop on Geomedicine' was organised by the School of Environmental Studies of Moi University under the auspices of UNESCO, UNEP and the Association of Geoscientists for International Development (AGID). The Workshop was held

at the Silver Springs Hotel in Nairobi, Kenya, from 23 to 27 June, 1999. The theme of the Workshop was 'Current Status of Research in Geomedicine'; this is the first time that a Workshop of this theme has been hosted by Africa.

The purpose of the Workshop was to serve as a forum for the exchange of ideas in Geomedicine (or Medical Geology), for learning about recent advances and for mapping out strategies for further research into areas of the subject where there is still a dearth of knowledge.

The Workshop attracted a group of over sixty interdisciplinary participants comprising geologists, geochemists, medical practitioners, biochemists, veterinarians, physicists, nutritionists, environmental lawyers, environmental economists and social scientists from Kenya, Tanzania, South Africa, Uganda, Zambia, Zimbabwe and the United Kingdom.

The Workshop presentations which included three keynote addresses and thirty thematic papers, reflected the breadth of the subject and inspired much

debate on what is arguably the most rapidly emerging and challenging of geological disciplines. The deliberations of the Workshop were covered in seven thematic sections.

### **I. Current status of research in Geomedicine**

A common concern in Session I was keynote lectures on 'Current Status of Medical Geology' (**Nyambok**), 'Current Status of Global Geomedical Research' (**Fuge**) and 'Exposure Pathways' (**Smith**) were given, was the question of being able to accurately determine the proportion of total trace element content that is bioavailable and bioaccessible in relation to uptake by food crops, as well as for their function in human and animal metabolic processes. The speakers reminded the audience of the importance of coupled effects or element-element interactions, such as I and Zn, and Mo and Co, and that the significance of these interactions need to be further elucidated. **Nyambok** explained that excess intake of Co can reduce the availability of I for production of the thyroid hormone. Also both Zn and Ca protect humans and animals against Cd poisoning and yet a Ca deficiency enhances Cd accumulation, thus exposing older people and pregnant women to great risk. The coupled effects can be synergistic, competitive or antagonistic. Hence, single element studies may be misleading and an organism may be suffering from the effects of deficiency or excess of an element even though the amount consumed is within the optimum range for normal health, because of the presence of another element.

In reply to the question of whether As has any metabolic function, **Fuge** noted that it has in the past been used for fattening livestock, but that this use was discontinued because of adverse effects produced when the element accumulates. He also mentioned the use of Se as an anti-aging element, a role that is better performed by vitamin E owing to its wider safety margin.

Responding to the question of the extent to which Se can be supplemented to reduce subclinical mastitis without compromising the bioavailability of vitamin E, **Fuge** envisaged no problem with supplementa-

tion of Se in relation to vitamin E because of their antagonistic relationship and because vitamin E has a wider safety margin; but this is still inconclusive.

**Smith** emphasised that high levels of various toxicants such as some heavy metals do not necessarily mean imminent risk, since there must be exposure for risk to occur. Moreover, risk occurs after exposure only when the toxicant is in a form that is bioavailable. To establish the risk involved, there exist risk assessment models (bioavailability models), but these are specific with respect to species, routes of exposure, physical form, etc. Because of the complexity of human risk assessment studies, various biomarkers have been used to help simplify the scenario, e.g. the analysis of teeth to indicate any exposure to say, Pb. Biomarkers give an integrated scenario of both exposure and bioavailability.

### **II. The geochemical circulation of nutritional and toxic trace elements (I, F, Se, Zn,**

#### **Cd, As, Pb, Hg, etc.) in relation to human and animal health**

Four presentations were given in Session II: The potential of geothermal systems for balneological use in Kenya was evaluated by **Tole**. He described the origin and location of the geothermal systems of Kenya, which are meteoric and mostly occurring around the Rift Valley region. He also examined the possible physical factors (e.g. heat), chemical factors (e.g. salinity, chemistry, trace element content), psychological and other factors that may lend to the balneological and hence commercial value of these waters.

**Odhiambo** reported anomalous concentrations of Cr in vegetation growing around an area of chromite mineralisation in the West Pokot District of Kenya. He noted that plants with anomalous levels of Cr content are usually browsed by domestic animals, especially sheep and goat, which are in turn eaten by humans. Moreover, Cr is found to be available in surface and groundwater which are consumed by the host population. The author therefore went on to propose that, since ingestion of Cr could have adverse health effects on the population, a detailed

analysis of its content in blood samples of both domestic and human populations should be undertaken in order to assess the concentration levels in the population living in this environment.

**Bühmann** explained how basalts and dolerites, with their very high trace element concentrations and richness in micronutrients, can be applied when crushed, to soils of a particular area to provide soil nutrient requirements for up to ten years. In contrast, regular fertilizers have to be applied every planting season and do not contain the full range of macro- and micro-nutrients. Crushed basalts and dolerites have been successfully applied to rejuvenate forests affected by acid rain in Europe and depleted agricultural land in South Africa. The main drawback in this application, however, is the cost of transportation to the site of application.

**Kaaya** observed that in East Africa, the geographical prevalence of cases of endemic Kaposi's sarcoma, classical Kaposi's sarcoma and epidemic Kaposi's sarcoma in and around the Rift Valley could apparently be the result of some geo-environmental factor. He however stressed that the aetiological factors underlying the occurrence are not fully understood and cannot surely be explained solely on the basis of a single environmental factor. The author also noted that Kaposi's sarcoma is associated with the HHV-8 (Herpes) virus, which suggests an aetiological role. He advocated for further research to evaluate the geo-chemical, physiological, pathogenic, dietary and other factors in better understanding the aetiology of Kaposi's sarcoma.

### **III. The impact of mining and mineral processing on human and animal health**

Six presentations were scheduled for Session III.

**Kahatano** gave a state-of-the-art overview of Au mining activities in Tanzania and concluded that mining and mineral processing operations at the Lake Victoria Goldfields, which contain the largest and richest mines in Tanzania, have created a potential health risk bomb and have already imposed severely adverse physical impacts (flooding and

deforestation), chemical impacts (including Hg contamination) and socio-economic impacts (poor sanitation, inadequate transportation) on the region's environment.

The second largest mine in Tanzania is the Lupa Goldfield where Au is presently won from small-scale quartz reefs and alluvial deposits. **Mnali** described several undesirable environmental impacts as a result of the release and accumulation of heavy metals from the mining operations. He traced the high concentrations of As observed in the tailings (with all its health implications) to mineral flotation reagents used, as well as to decomposition of accessory As minerals such as arsenopyrite, energite and tennantite. He explained that high concentrations of Hg in the stream sediments and mine tailings were a result of the use of this liquid metallic element to amalgamate the Au ore concentrate. Health effects resulting from the consumption of As contaminated water or inhalation of Hg vapour by miners cannot be promptly attended to, because the remoteness of the area precludes proper co-ordination between the miners and medical research personnel.

**Ndiweni** reviewed the effects of Se sufficiency/insufficiency on the major mammary gland defence strategy against mastitis. The author presented data from field surveys that investigated the effects of this micromineral on the incidence of mastitis in southern England and northern Zimbabwe. The author explained that management and feeding patterns are important factors to consider in Se supplementation exercise. She further noted that Se supplementation should preferably be given to cattle not affected by mastitis.

The consequences of I deficiency on reproductive health among the adolescent and young adult female population of Kenya were highlighted in a paper by **Carew**. The author made a strong case for the development of proactive curricula and public education programmes involving community health workers, teachers, journalists and other agencies of social change, to show the influence of shortage in micronutrients on human functioning and therefore exclusion from full community participation. She further advocated that monitoring of the iodisation policy in

Kenya be made a key issue.

The prevalence of ameloblastoma, a heterogeneous group of neoplasm in apparently geologically distinct areas of Tanzania gives prominence to the possibility that some geo-environmental factor may be involved in tracing out its aetiology. **Vu-hahula** listed other possible causes as hereditary, viral, tooth extraction, oral sepsis, nutritional disorders, etc., and stressed the need for collaborative, interdisciplinary research to establish the role of environmental factors or genetics in the histogenesis of this disease. It has also been suggested that trace element geochemical maps with overlays of epidemiological maps of ameloblastoma can help unravel its aetiology. **Kahatano** noted that such studies are already underway in Tanzania.

#### **IV. Geophagia, Kaposi's sarcoma and podocniosis**

Fluorine, I, Se and Pb, with their long recognized link to health, dominated the proceedings of Section IV with five papers, beginning with a consideration of the contribution of drinking water to dental fluorosis (**Nyaora et al.**). The authors showed that widespread consumption of highly fluoritic groundwater in boreholes and wells, as the most reliable source of drinking water, was responsible for the high prevalence rate of dental fluorosis among school children in the Njoro Division in Kenya. Correlations established between certain water quality parameters indicate that some of these parameters may be acting in concert with high fluoride either synergistically or antagonistically in the development of fluorosis.

The geochemistry of F and I was described by **Fuge**, followed by papers on the significance of variations in F content of fossil fish bones from the Lake Manyara area in Tanzania (**Schlüter**), the geochemical circulation of Se in relation to human and animal health (**Davies**), and the effects of Pb on human health (**Oladimeji**). Considering the important metabolic role of the halogens F and I in humans and animals, some apprehension was expressed (**Fuge**) on the belief that the other halogen, Br has no known metabolic function.

Depending on the concentration and chemical form, Se functions as an essential element or potent toxicant to humans, livestock, plants, waterfowl and certain bacteria. **Davies** cited several instances of the environmental consequences of this element's double-edged behaviour: chronic selenosis, hair and nail loss, nausea, vomiting, etc., as effects of toxicity and Keshan disease, Kashin-Beck disease, reduction of growth, productivity and reproduction, etc., as effects of deficiency. The author noted the need for research into the potential of Se to have a role in cancer prevention in humans.

Humans are exposed to Pb through their occupation, vehicular emissions, as a component of Pb acid battery, Pb contaminated house dust, soils, food and drinking water. These sources result in local and regional higher levels of Pb. Animals and humans are thus exposed to new health risks and their body tissues and fluids may contain more Pb than normal. **Oladimeji** presented overwhelming evidence that traces of Pb impair human health, and advocated for measures to reduce its level in the environment.

In the final paper of Session IV, depletion of both the quality and quantity of Lusaka's groundwater resources as a result of geogenic and anthropogenic pollution, but also because of over-extraction by an ever increasing city population, was discussed by **Nkhuwa**. The author showed how animal populations have been severely reduced over wide areas through the consumption of contaminated water by substances hitherto unknown to be present.

#### **V. Cardiovascular disease, cancer and the geochemical environment**

The population theme was continued in Session V with a consideration of the impacts of mining and mineral processing (**Ogola**) and malaria prevalence (**Uyanga**), on the western Kenya environment. Artisan Au mining in western Kenya is one of the most dangerous operations to human health as heavy metals and metalloids, especially Hg, Pb and As are discarded into the environment without any due consideration of their impacts on human health and the environment at large. **Ogola** reported recent mysterious deaths among

artisan miners in the Migori Au belt of western Kenya, the possible causes of which he attributed to metal poisoning. He further went on to call for renewed awareness and education on precautionary measures for communities involved in Au mining in the district.

**Uyanga's** preliminary results on the micro-epidemiology of malaria in western Kenya indicates that factors such as vegetation, soil structure, building structures, including spacing of buildings, were important in malaria distribution and prevalence in the study region. Other contributors however voiced the need to also look at other factors, such as the availability of medical facilities and financial status, before valid conclusions on the relationship between eco-neighbourhood and micro-epidemiology of malaria can be reached.

The geochemical circulation of As and Cd in relation to human and animal health was discussed by **Davies**. The adverse effects of exposure to As were stressed as well as the need for everyone dealing with groundwater supplies for human consumption to check their aquifers for As. **Davies** noted that geological and soil conditions and the extent to which these are modified by human activities such as the disposal of mine and other industrial or urban wastes, irrigation and agricultural practices, can have a significant influence on the Cd contents of foods of plant or animal origin. The author also reiterated the need for further research to establish the extent of bioavailability and bioaccessibility in evaluating toxicity.

The final two papers in this Session looked at two topics that are attracting renewed interest in the subject of Geomedicine. Geophagia, the involuntary or sometimes deliberate eating of clay or soils by members of the animal kingdom and in certain human communities, has been observed since ancient times. It has been attributed to lack of Fe in the diet as it was thought that the individual seeks to replace the missing element

by consuming the soil (**Moynahan, 1979**). **Gaciri and Maritim** described the geochemistry and mineralogy of rocks eaten by humans in Kenya. **Mustapha et al.** considered the distribution and health effects of Rn occurrences in Kenya. Though the highest Rn values were obtained from groundwater sources and from air in the basement of buildings, these authors do not think that the occurrences are geologically controlled.

### **VI. Health spas, mineral waters and volcanic gas chemistry**

All four scheduled papers in Session VI addressed the role of environmental perturbations on the distribution and prevalence of various diseases : Malaria (**Uyanga**), Endomyocardial fibrosis (EMF) (**Freers et al.**), Schistosomiasis (**Mhaka**) (not presented) and water-related diseases (**Okeyo-Owuor et al.**).

**Uyanga** attributed the high prevalence of malaria among subsistence farmers in the Funyula community in Busia District of western Kenya to the dynamics in eco-neighbours following landuse changes from the former high forest ecosystem. He held that house construction materials, malarial attacks within houses and proximity to shallow water bodies, as well as plantations or forests, to be the major determinants. It was also noted that eco-clustering enhances transmission in closely settled neighbourhoods and that attacks within certain houses lead to a vicious cycle, more or less. The presenter underscored the fact that eradication may be impossible since socio-economic conditions may not permit control measures to be put in place. He also noted that the use of bed nets is proving to be a successful intervention. Endomyocardial fibrosis is a restrictive heart disease in Uganda, Kerala in India, Brazil and parts of West Africa. In Kerala, an association has been shown between exposure to Ce, Mg deficiency and the development of EMF (**Yusuf and Flather, 1995; Kutty et al., 1996**). The clinical manifestations of EMF were illustrated by **Freers et al.**, who also described environmental risk factors of this tropical disease. The authors reported high cerium levels in soil, water and processed cassava flour in the Mukono District in Uganda, where EMF is endemic, as well as in other places in Uganda. However, since this does not seem to correlate with Ce levels in EMF cardiac tissues it was concluded

## GEOMEDICINE IN EAST AND SOUTHERN AFRICA *continued*

that the association between EMF and Ce may be a coincidental finding in people of low social status, rather than a cause and effect relationship. **Freers et al.** noted that their results were contrary to those from Kerala, which showed significantly higher levels of Ce in EMF hearts (**Kutty et al., 1996**). **Kardinaal et al., (1997)** have also drawn an association between toenail Se and the risk of acute myocardial infarction in European men.

In the final paper of Session VI, **Okeyo-Owuor et al.** reviewed the potential scientific rewards that geomedical research holds in the Homa Hills, a physiographically and ecologically diverse rural environment along the shores of Lake Victoria in western Kenya. The authors described direct relationships between the occurrence of anomalous trace element contents of the region's soils as well as surface and groundwaters, with the distribution and prevalence of various diseases. Disease prevalence in a number of cases (especially water-borne diseases) tended to increase towards the lake shore.

### **VII. Radiation and radon gas.**

In Session VII, **Elsenbroek** demonstrated an environmental application of regional geochemical mapping in understanding enzootic geophagia and hepatitis of calves and lambs in the Revilio area of South Africa, where a specific enzootic form of geophagia occurs in young cattle and sheep. An association between the disease and high concentrations of Mn in soils was suspected since all affected farms are situated on outcrops of high-magnesium dolomite rock. Regional geochemical maps of MnO %, Zn and Pb in the area show a general northeast-southwest anomalously high trend, visually correlating with the distribution of the affected farms.

The final paper (not presented) was a review of the status of research on Medical Geology in Cameroon (**Tchouankoue**). The author disclosed that much of the work done on Medical Geology in Cameroon relates mainly to the effects of volcanic activity along the Cameroon Volcanic Line (CVL). These have resulted in a peculiar pattern of element

distribution in soils that is in turn linked to the occurrence of various diseases, among which goitre is prominent. Frequent eruptions of Mount Cameroon release toxic gases and other polluting substances into the nearby lakes and thermal springs with which the surrounding population is in close contact, hence leading to loss of lives.

**Tchouankoue** noted that the major difficulties facing scientists trying to decipher the origin of the toxic volcanic gases as well as the mechanism of the Mount Cameroon eruptions are the complexity of the laboratory procedures used, and the non-multidisciplinary nature of the research teams. The author advocated the need for more members of the medical community, among others, to join geologists and geochemists in unravelling the mysteries of the Mount Cameroon eruptions.

The scientific sessions of the Workshop were concluded by attendance of participants at a full day's field excursion to Njoro on the outskirts of Nakuru, about 160 km NW of Nairobi, where incidences of fluorosis were observed as well as many other features of environmental interest.

In summary, the keynote speakers in this Workshop revealed much of what has been learned about Geomedicine since the pioneering days of Hippocrates, about the fifth century BC. The clear message is that we still do not know enough on the identification and quantification of the mineral and chemical forms of certain nutritional and toxic trace elements in the rocks, soils and sediments that constitute the natural sources of these elements entering water and the food chain. The elements needing urgent attention at the present time, according to the Workshop's findings are As, Cd, Hg, Se, Rn, Pb, Zn, F and I. The different chemical forms or species will have a marked influence on the solubility as well as bioavailability and bioaccessibility of these elements.

The Workshop also clearly brought out the great need for further collaborative and interdisciplinary studies to unravel the hitherto unclear relationships between the geo-environment and cardiovascular

## GEOMEDICINE IN EAST AND SOUTHERN AFRICA *continued*

disease, cancer, geophagy and certain endocrinal disorders.

In conclusion, reading through all the full papers which will appear in a forthcoming 'Special Issue' of the journal 'Environmental Geochemistry and Health' will yield much food for thought.

### **Key Points from the Workshop Resolutions / Recommendations**

Mission Statement / Preamble: 'To help the regional community optimise the health and productivity of the community, thereby saving on huge health costs'.

- A follow up meeting, involving political participation, should be held in Lusaka (Zambia), Harare (Zimbabwe) or Cape Town (South Africa), in June, 2001.
- African representation on the '**Working Group on Medical Geology**' within CO-GEOENVIRONMENT should be increased to

say 6 members.

- An '**East and Southern Africa Association on Medical Geology**' (ESAAMEG) be founded with representatives from each of the countries in the sub-region. The Association's main organ of scientific publications will be the journal '**Environmental Geochemistry and Health**' but will nevertheless have its own Newsletter as well as an internet home page.
- A comprehensive report of this Workshop should be published in the Bulletin of the International Union of Geological Sciences (IUGS), viz. '**Episodes**'.

Other recommendations involved: the promotion of collaborative, interdisciplinary efforts, the generation of baseline data on the flow of nutritional and toxic elements, research on speciation, bioaccessibility and bioavailability of the trace elements, and general raising of awareness on the issues involved. Sources of funding need to be identified.

## ENVIRONMENTAL STUDIES PROGRAMME: THE MOI UNIVERSITY EXPERIENCE

*E. K. Ucakuwun and T. C. Davies*

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*Editor's Note. This is an extract from a longer paper which can be read on the Working Group homepage. The syllabus in Geomedicine is of particular interest*

The establishment of the School of Environmental Studies (SES) at Moi University was a part of the national policy towards rational management of natural resources and the environment for sustainable development of Kenya. To that effect the concept of the School was built into the "Report of the Presidential Working Party on the Second University in Kenya" issued in 1981. The Working Party took note of the "increasing emphasis being laid on environmental management in the country ... which unfortunately had not been receiving sufficient in-

tellectual and scholarly backing".

The School endeavours to ensure that the blend of teaching, research and internship gives the student the theoretical rigour, thorough appreciation and understanding of the practical and real work problems of environmental and natural resources management. Ultimately, the programmes are designed to produce students who are professionally competent and marketable, by providing them with the depth of intellectual and analytical skills and schol-

arly background necessary to solve environmental problems.

As of the beginning of the 1999/2000 academic year, total enrolment in the Environmental Studies Programme at SES stood at 175 at the M.Phil. level and 33 at D.Phil. Out of this intake, 75 M.Phil. and one D.Phil. have graduated as of the end of the 1998/99 academic year. The majority of these graduates continue to be successful in gaining environmental-related employment.

The Masters degree lasts for two years: the first year is mainly for course work, while the second year is devoted largely to research and writing of a thesis. In between the two years there is usually an internship programme designed to give the students a practical familiarity with the national environmental problems either in the form of an intensive environmental impact assessment (EIA) seminar, or through practical attachments, for three months, in appropriate environmental or industrial institutions. There have been over 70 graduates of the M.Phil. programme.

Up until the end of 1998, approximately 40 - 50 percent of the graduates went on to work in various government ministries, parastatals and NGO's in the fields of planning and management, natural resources, education and law, whereas the others gained teaching positions in public and private universities countrywide. Today, we believe, the study of the environment at SES is on the forefront and is poised towards increasing academic excellence in the future.

The diploma programme lasts for one year and is intended for those people whose work takes them to the village and grassroots levels including leaders of NGO's and religious organisations, social workers and community and extension workers from government ministries.

In 1995, the school established a new programme in environmental impact assessment (EIA) techniques to complement the M.Phil. programmes and

open for participation by District Environment Officers and some personnel from the National Environment Secretariat as well as overseas students from Amsterdam and southern Africa.

Graduates of the School are increasingly found useful by agencies and organisations engaged in development-oriented activities and the environment. These include government ministries and departments which are expected to spearhead environmentally sound development programmes at both national and district levels, as well as private and parastatal companies engaged in activities that have a direct impact on the environment.

The School, by virtue of a standing invitation, is represented on the Municipal Council's Environmental Committee. The role of the representative from the School is to advise and contribute positively to discussions of the committee which involve sound policy formulations and decision making on issues of environment within the jurisdiction of the Municipality.

Study of the environment requires a tremendous breadth in terms of teaching specialties. The School's academic programmes are generally administered by the eight Divisions which comprise the School. Each Division organises programmes designed to develop expertise in a specific discipline, but within an interdisciplinary setting. The Divisions and their academic programmes are listed below.

- Environmental Biological
- Environmental
- Environmental Health
- Environmental Information
- Environmental Law
- Environmental Planning and Management
- Human Ecology
- Environmental Physical Sciences

The School emphasises the practically-oriented nature of its curriculum and its research agenda. To this end the School has established research labora-

tories and two field research stations. The first laboratory to be installed was the Environmental Information System Laboratory (EIS-Laboratory). The other four laboratories are for physical sciences, biology, biochemistry and a planning studio.

The research focus of the School is directed towards the broad fields identified at a “research priorities” seminar of the School in 1992.

These include : the sustainable use of land and water resources; biodiversity; environmental problems connected with urbanisation and human settlements; environmental hazards; technology and energy transfer; and environment and development.

Major ongoing research programmes of the School include : (i) Solid Waste Management in Nairobi and Hyderabad (in collaboration with the University of Amsterdam and the Centre for Economic and Social Studies in Hyderabad, India.) (ii) Economics of Arid and Semi-arid Lands (iii) The Interdisciplinary Research Project on the Homa Hills / Lake Victoria Interface Region and (iv) Tourism and Environment in Kenya.

The School has an excellent and up-to-date Documentation Centre, which is part of the Moi University library set-up. It has an impressive collection of books, journals and other miscellaneous publications related to environmental studies. It is already functioning as a regional focal point of environmental literature, judging from the number of requests and users of the facility.

The issue of the type of graduate becomes more urgent especially since environmental studies is a relatively new academic discipline which has yet to make its mark in the academic, business and employment sectors. The SES aims to produce graduates possessing an integral combination of knowledge, awareness, skills, problem-solving capabilities and commitment to act as :

A. Subject specialists in environmental biological sciences, economics, health, information systems, law, planning and management, physical sciences and human ecology.

B. Professionals well grounded in their areas of specialisation within an interdisciplinary framework, and who may be employed in various capacities such as teaching, research, environmental consultancy and management, where environmental issues are considered to be of importance.

C. Environmental managers

D. Environmental advocates and educators who are fully aware of, understand, and are committed to the concept that environment and development are two inseparable and interrelated aspects of sustainable development.

The School has established a wide range of funding linkages with central and local government departments, industry, international agencies and basic research support bodies. Financial and material support were provided by the UNEP and UNDP during the School’s formative stages. Cooperation has been maintained between the School and these bodies as well as several other organisations such as the FAO, for enhancing the School’s development through outreach and collaboration. The UNEP has in addition granted the School a number of scholarships for M.Phil. studies.

The School is presently involved in an upgrading programme financed by the Netherlands University Foundation for International Cooperation (NUFFIC). As part of this programme laboratory equipment is provided for. Eight junior research fellows have already undertaken Ph.D. studies at the University of Amsterdam as a part of the staff development programme of the School.

## GEOMEDICINE COURSE AT MOI UNIVERSITY

**(3 unit Course**, i.e. 2 one-hour lectures and 1 three-hour practical classes per week)

The health field concept; disease ecology; geography and disease. Principal chemical constituents of the human body; essential trace elements in life systems. Controls on elemental intake; antagonistic and synergistic effects. Dose-response curves. Investigation of causal links between specific diseases and the geological environment. Geochemical maps in geomedicine; health effects of excess / deficiency of selenium, lead, mercury, zinc, cadmium and arsenic. Dust emission in mining and mineral processing and the fate of inhaled particles; chronic bronchitis; allergic lung disease; coal workers' pneumoconiosis; asbestosis, berylliosis;

silicosis; talcosis. Geophagia; Kaposi's sarcoma and podoconiosis. Cancer and mutagens. Coronary heart disease; regional variation in heart disease. Ionising radiation and radon gas; geological aspects of waste disposal including radioactive waste. The epidemiology approach to environmental problems; environmental data sources; medical data sources. Data analysis using Pearson's correlation; stepwise multiple regression. Cause and effect. Hypothesis; implications for prevention and treatment. The changing nature of disease. Health spas and mineral waters. Balneology of peat deposits. Analytical techniques in environmental geochemistry. Geochemical data bases.

### GEOLOGY IN RESEARCHING LINKS BETWEEN THE ENVIRONMENT AND HEALTH.

A.R. Berger

COGEOENVIRONMENT has recently introduced geological and geochemical perspectives into a major project to set a research agenda on health and the environment. The recommendations of this project, initiated by the International Geographical Union (IGU) and the International Human Dimensions Programme on Global Change came from a series of workshops held last year. With financial support from IUGS, ICSU and UNESCO, the Commission brought five geoscientists and health researchers to the workshop on "Health and Resources" (Kingston, Jamaica, November 1999) to discuss issues related to water quality/quantity, land degradation, desertification, land control and deforestation, and their links to human health. Other participants included geographers, chemists, biologists, zoologists, epidemiologists and community health workers, sociologists and other social scientists.

Prof. Catherine Skinner (Yale University) introduced our session with a general overview of rock-

water interactions and the cycles of carbon, phosphate and iron, emphasizing both the positive and negative effects these have on human health. She dealt with the "silent health hazards", the pervasive but unsuspected elements in rocks soils and water that may over time cause health problems. The effect of F on osteoporosis and caries vs. fluorosis is one such example. The source and transport of the element and its effect on human health has been well documented, combining geological and medical/dental experience and knowledge.

Dr. Fiona Fordyce (British Geological Survey) reviewed BGS experience in detecting and monitoring Se, As, Rn and other elements in the UK, Africa and Asia. She illustrated the crossover to health effects by mentioning selenium deficiency and toxicities in China, the poisoning of thousands by arsenic in groundwater in Bangladesh, and the possible relationship of Ce in soils and cassava to heart disease in Uganda. She also described the

IUGS/IAGC project on Global Geochemical Baselines, and she invited wider participation in the efforts to characterize the natural geochemical background.

Dr. Kevin Teller (University of Victoria) showed that most of the mercury around placer gold mining operations in the Tapajos basin of Brazil does not come directly from the Hg used in gold recovery, but rather that it is bound to suspended sediments eroded from gold-bearing soils. This work demonstrates that a reduction of mercury pollution would only come through reduction of dredging, and not through reducing the use of Hg in recovering the gold: the importance of understanding the pathways taken by natural contaminants is clear.

In a departure from the geochemical perspectives, Prof. Irving Shapiro (University of Pennsylvania School of Dental Medicine) summarized one of the biochemical pathways for Hg in vertebrates and the need to understand the cellular reactions of potentially harmful elements after ingestion or inhalation. His perspective served to emphasize the importance of interdisciplinary research in physiology and biochemistry in understanding environmental hazards to human health.

Finally Dr. Antony Berger (Victoria, Canada) raised two broad issues related to environmental hazards: first the need to acknowledge in public policy and practice those places where natural background contents harm human health because of too low or too high levels of toxic components, and second the importance of distinguishing more fully between environmental chemicals of natural origin and those resulting from human actions such as industrialization and waste disposal.

The full papers can be found on the IGU web site (<http://post.queensu.ca/~jlj/healthandenvir>) for the project.

## MEMBERS OF THE WORKING GROUP

- Dr Olle Selinus Geological Survey of Sweden (Chairman)
- Prof Vasken Aposhian, University of Arizona, Tucson, USA
- Dr Don Appleton, British Geological Survey, UK
- Dr Peter Bobrowsky, BC Geol Survey Branch Canada
- Dr T. Charakupa-Chingono, ERSI-SIRDC, Harare, Zimbabwe
- Prof T.C. Davies, Moi University, Eldoret, Kenya
- Prof Edward Derbyshire, Royal Holloway, University of London, UK
- Dr D Dissanayake, University of Peradeniya, Sri Lanka
- Dr Dave Elliott, Canada (Newsletter Editor)
- Dr Robert B. Finkelman, US Geological Survey, Reston, USA
- Dr John Fortescue, Canada
- Prof Harold Foster, Dpt of Geography, Univ of Victoria, Canada
- Prof Adrian Frank, Centre for Metal Biology, Sweden
- Prof Ron Fuge, University of Wales, UK
- Dr Fiona Fordyce, British Geological Survey, Great Britain
- Dr Larry Gough, US Geological Survey, USA
- Dr George Guthrie, Western Michigan University, USA
- Dr Gerry Jacobson, Australian Geological Survey Organization, Australia
- Prof Tan Jianan, Inst of Geography, Beijing, China
- Dr Robyn Johnston, Australian Geological Survey Organization, Australia
- Dr Ephata Kaaya, Muhimbili University College of Health, Dar Es Salaam, Tanzania
- Dr Roman Kanivetsky, Minnesota Geol Survey, USA
- Prof Kazimierz Klimek, University of Sosnowiec, Poland
- Dr Jonas Lindgren, Geological Survey of Sweden, Sweden
- Prof Ulf Lindh, Uppsala University, Sweden
- Dr Owe Löfman, Centre for Public Health Sciences, Linköping, Sweden
- Dr Howard Mielke, Xavier University of Louisiana, New Orleans, USA
- Dr Ed de Mulder, Geological Survey, Netherlands
- Dr Maxwell Mwase, School of Veterinary Medicine, Zambia
- Dr Noma Ndiweni, Preclinical Veterinary Studies, Harare, Zimbabwe
- Dr Maria Nikkarinen, Geological Survey of Finland, Finland
- Dr Imasiku Nyambe, Geology Dpt, School of Mines, Zambia
- Dr Risto Piispanen, University of Oulu, Finland
- Dr Clemens Reimann, Geological Survey, Norway
- Dr William Shiels, Illinois State Geological Survey, USA
- Dr Steve Sibbick, British Columbia Geol Survey, Canada
- Dr Catherine Skinner, Yale University, USA
- Dr Ulrich Siewers, Geological Survey of Germany
- Dr Calin Tatu, Forslys Group, Arad, Romania
- Dr Jean Pierre Tchouankoue, University of Yaounde, Cameroon
- Prof Iain Thornton, Imperial College, UK
- Dr Todor Todorova, Sofia, Romania

**Cogeoenvironment Working Group  
on Medical Geology  
Newsletter No. 2**

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**TERMS OF REFERENCE**

Medical Geology involves the whole geosphere and can be considered dealing with ecosystem health. Medical geology is an interdisciplinary subject which involves not only geoscientists but also medical scientists and health professionals, veterinarians, biologists, etc.

- Improved communication amongst the various disciplines concerned with diseases caused by geological factors which influence the well being of humans and animals.
- Develop information material for the use of schools, public and private organisations interested in medical geology problems to show the impact of geologic factors on well being of humans and animals.
- Arrange joint technical meetings to address issues of mutual concern amongst geoscientists and other disciplines concerned with medical geology.
- Produce and distribute a medical geology newsletter to disseminate information on medical geology to geoscientists, medical scientists, veterinarians, planners and industry.
- Arrange for the compilation of bibliographies concerned with medical geology problems.
- Encourage geological surveys, universities and geological societies to take a more active role in providing useful information in medical geology.
- Encourage the development of local working groups of multi-disciplinary medical geology experts.
- Encourage research in the area of producing more effective methodologies for the study of geological factors in environmental medicine.

## WORKSHOP IN UPPSALA, SWEDEN THIS AUTUMN

This autumn, in, there will be a workshop from Monday 4th to Saturday 9th September, 2000. It will be in Uppsala, Sweden, at Sunnersta just south of the city centre with good bus connections to the city. The workshop will mainly deal with the book on medical geology but there will also be a two day symposium on medical geology with a probable title "The geochemical environment and human health". The organizers of this small symposium will be Tony Berger, Canada and Catherine Skinner, USA.

When the plans are more definite more information will be distributed, but the preliminary programme is:

Sunday 3 <sup>rd</sup>	Arrival
Monday 4 <sup>th</sup>	Start of meeting, presentations of the working group
Tuesday 5 <sup>th</sup> , Wednesday 6 <sup>th</sup>	Symposium
Thursday 7 <sup>th</sup> , Friday 8 <sup>th</sup> .	Discussions in smaller groups.
Saturday 9 <sup>th</sup>	Daytrip to Stockholm
Sunday 10 <sup>th</sup>	Departure