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MEDICAL GEOLOGY IN THE IMGA "RUSSIA— NIS" DIVISION

RUSSIA-NIS AUTHORS IN THIS NEWSLETTER

Left, Dr. Iosif Volfson
Chair, IMGA Russia-NIS Division

Below:
Left Alexander Gulynin,
Right, Alexey Strodubov

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FROM THE DIRECTORS

Interest in Medical Geology continues to expand worldwide at an increasingly rapid rate, creating numerous opportunities. Therefore, we launched the International Medical Geology Association (IMGA) in January 2005. This is the second regular newsletter of IMGA and our plans are to send you two newsletters like this every year. But we rely on your help and we hope that you will submit material for the newsletters in a timely manner.

Olle Selinus continues in his capacity as Director of this activity. Jose Centeno and Bob Finkelman are Co-Directors. Dave Elliott will continue his work as editor of the Newsletter

Secretary of IMGA is Kim Chisholm, University of Western Australia, Australia, Treasurer is Dave Slaney, New Zealand. We have also appointed six Councillors to represent the broad geographic distribution of Medical Geology and the wide range of disciplines that are embraced by this topic. The Councilors are:

Bernardino Ribeiro de Figueiredo (Geologist, Brazil)
Fiona Fordyce (Geochemist, UK)
Zheng Baoshan (Geochemist- China).
Calin Tatu (Medical researcher, Romania)
Nomathemba Ndiweni (Veterinary Biochemistry, Zimbabwe)
Philip Weinstein (Epidemiologist, Australia**)**
Also a webmaster, Gunnar Jarl, Sweden

We are very pleased that such experienced and competent people are willing to devote their time and efforts on behalf of the Association.

As part of the benefits of our membership at the IMGA, the Association can offer the book ***Essentials of Medical Geology*** with a 30% discount for those IMGA members in good standing. Please contact the secretary of IMGA, Kim Chisholm on this and she will arrange it.

What has happened recently?

- Human Health has a prominent place in the draft USGS Science Strategy as one of six new science directions.

- Bob Finkelman will be teaching a one credit course on Medical Geology at the University of Texas at Dallas beginning in January.

- Regional divisions of IMGA are now under development.. The following divisions are established: South America, Russia and NIS, Sub Sahara Africa. The following divisions are under planning: Caribbean and Central America, SE Asia including India, Sri Lanka etc, East Asia, Australia, Oceania, North America, Europe, Southern Mediterranean. Some of these are almost established.

- Education has started at universities in Australia, US and Sweden. Please send information on all new university courses for the website.

- 25-30th September 2006, The 7th International Symposium on Environmental Geochemistry (ISEG) took place in Beijing, China. About 500 participants attended. We gave one short course in medical geology, two plenary speeches and several other talks. Medical geology was very visible during the whole symposium.

Annual reward
We are in the process of establishing an annual international reward on medical geology in Monaco. More information will be in the next newsletter.

Publications
As you may recall the Royal Swedish Academy of Sciences had an international symposiuum on medical geology in May this year. The papers from this meeting will be published in the first issue of the prestigious journal of the Academy, Ambio, in a special issue in January 2007.

For new information, please look at the website.

Olle Selinus Bob Finkelman Jose Centeno

FROM THE DIRECTORS *Continued*

A NEW LISTSERVE

The IMGA now has its very own listserv! It is called 'medical-geology'. Medical-geology is administered through the UK JISCMAIL system and provides us with an email forum for the exchange of ideas, information and events. You can subscribe to this free facility by sending an email or through the web (www.jiscmail.ac.uk). To subscribe, please send an email to jiscmail@jiscmail.ac.uk with 'medical-geology' in the subject and 'join medical-geology YOUR_FIRSTNAME YOUR_LASTNAME' in the main body of the message. You will then be sent an email to confirm your registration and giving you details of how to send a message to the list, to suspend or to leave the list and some basic etiquette on what the list may and may not be used for. We can also post files on to the list's web page for us to download as we see fit. List archives can also be accessed through the JISCMAIL website (above).

This listserve will hopefully fill a need and if it becomes active soon, with the help from you, it will be an easy way to provide everyone with quick information and news.

2nd USGS EARTH SCIENCE AND PUBLIC HEALTH MEETING: NATIONAL CENTER IN RESTON. ORIGINALLY SEPTEMBER 2006

RESCHEDULED TO FEBRUARY 27, 28, AND MARCH 1, 2007.

This is a forum to foster collaboration between the Public Health and Earth Science Communities, leading to solutions to environmental health problems. The audience is organizations and individuals interested in environmental and earth science factors affecting human health. This meeting is designed to provide a broad forum for discussion, bringing together a variety of interested parties, including policy makers, scientists, resource managers, Congressional staffers, Federal and State government, and non-governmental organizations.

Overall, the meeting will be set up along six thematic areas: (1) exposure to toxic contaminants in air and dust; (2) chemical and pathogen contaminant exposure by drinking water; (3) human consumption of bioaccumulative contaminants; (4) pathogen exposure through recreational waters; (5) vector-borne and zoonotic diseases; and (6) animals as sentinels of human health, along which the USGS public health research is aligned.

The first day of the meeting - Tuesday, September 12 - is an overview day. Invited are a variety of people including DOI, Congressional staffers, and managers from public health organizations, as well as the scientists attending the entire meeting. During this day, we will have a poster session centered around the six topical sessions listed above. The following two days will consist of talks, posters, and break out sessions organized around the six topical sessions.

Registration (no cost), information on abstract submittal, agenda, and more at: http://health.usgs.gov/

MEDICAL GEOLOGY IN THE IMGA "RUSSIA— NIS" DIVISION

Dear Colleagues!

Almost five years have passed from that day, when **IGCP project 454** on Medical Geology became known in Russia. This wonderful event took place on a warm day, May 3, 2002, during the impressive introductory lecture of Dr. Robert Finkelman (IMGA Co-Chair for geoscience) on Medical Geology, at the Vernadsky State Geological Museum in Moscow. Dr. Finkelman was one of the leaders of the International Working Group on Medical Geology of the Commission on Geological Sciences for Environmental Planning. Two years and three months have passed from the date of the Workshop on Metals and Health held on September 6 – 7, 2003 in Edinburgh where only two representatives from N.I.S. (Kazakhstan and Russia) were present. Today, we are able to introduce the results of research carried out by scientists from the N.I.S. medical geology community within the framework of IMGA Regional Division Russia – NIS, which was established in July 2006.

The initiative of a special issue of Medical Geology Newsletter with contributions from scientists from N.I.S. has come out at the same time as the establishment of the IMGA Regional Division. This initiative was supported by IMGA headquarters, IMGA Chairman, Dr. Olle Selinus, and the editor of the bulletin, Dr. David Elliott. Today we are pleased to introduce some results of the studies carried out by the scientists from Russia and Ukraine to the international medical geology community.

It should not be a surprise that most of these papers are devoted to the problem of radiation safety. There is an underestimation of radon and radiation safety considerations in geological prospecting, the processing of uranium ores, civil engineering construction activity on radon prone territory, construction materials that containing radioactive substance usage, etc. This problem will be vitally important for many years, because of the enormous scale of environmental and health problems due to multiple nuclear tests and catastrophes.

One of the main targets of the IMGA Regional Division activity is to attract young scientists to conduct research in the field of medical geology. A pleasing fact is the active participation of young scientists from our countries in this bulletin. This allows us to express a hope for the expansion of medical geology in Russia and N.I.S. – and, of course in other member countries of IMGA. The paper "Isotopes of ^{234,238}U and ^{241}Am in the Environment, and Modeling Experiments" by Alexei Starodubov and Alexandr Gulynin, who graduated from the Moscow Skryabin Veterinary Academy, Chair of Radio Biology in 2001 and 2002 respectively (see photos on front page). They carried out their experiments around the city of Bryanck, which was contaminated with radionuclides in April and May 1986, after the Chernobyl catastrophy. A methodology for radiation safety assessments of underground water is presented by Dmitry M. Zuyev, Ph.D. (who defended his thesis in 2006, May) in the paper "A Methodology for the Radioecological Assessment of Underground Waters in the Moscow Region".

The distribution of Natural radon in the Moscow region is considered by Anastassia L. Dorozhko (who defends her thesis next year) in the paper "The Distribution Of Natural Radon In The Moscow Region".

Dr. Igor L. Komov (Ukraine) has revealed new factors in the field of radon safety in his paper "Risk Assessment Related To Minerals".

These publications reveal some directions and trends and demonstrate the level of development in the field of health problems related to radioactivity safety and medical geology of uranium, associated natural and technological radionuclides, which will be evaluated by you, Dear Readers.

However, many other scientists from N.I.S., are occupied in many other fields of medical geology. Some results of these studies have been introduced to the Internet users on the IMGA website (http://www.medicalgeology.org – IMGA Russia - NIS Division - Report from the Russia - NIS Division –

"Highlighting a Contribution to Urban Medical Geology and Mining Medical Geology from the Research Institute for Geochemistry and Crystal Chemistry of Rare Elements by Dr. Olga V. Menchinskaya, IMGRE, Moscow, Russia) and will be introduced to readers of the bulletin in the nearest future. Currently, the most important areas of study in the field of Medical Geology in Russia - NIS are:

- Geological and geochemical aspects of medical geology in term of mechanisms and scale of hydrogenic ore-forming processes and elements concentration as a base for the modelling and mapping of the spreading of endemic diseases, toxic elements such as uranium, fluoride, radon, arsenic, etc., in subsurface geospheres,and the atmosphere, and its effect on human health.
- Urban medical geology.
- Crystal chemistry and crystal genesis of biogenic minerals of different origin
- The therapeutic usage of minerals in terms of biological functions of the elements, metals in medicine and industry, and economic minerals in medicine.

The cooperative efforts of the geological and medical communities allows the identification of specific natural and technological sources of potential hazard, to increase both preventive measures and treatments for the main environmental, occupational, and associated diseases, and to have a significant influence in the decision-making process.

One of the most important recent advances of scientists from N.I.S. is a special chapter on medical geology "Medical geology today: purposes, problems and ways of their decision" (Written by Dr. Iosif Volfson, Dr. Igor Pechenkin, Dr. Yelena Kremkova) in the book **Bio-Inert Interactions. Life and Rock. (Publishers of Saint-Petersburg State University, Edited by Dr. Vladimir Gavrilenko, 2006).**

In conclusion we are pleased to congratulate all of the readers and their colleagues and relatives with upcoming winter holidays and invite you to participate in the **International Symposium**, which will take place in 2007 for the third time, in Saint-Petersburg, Russia. This highly successful conference series started in St. Petersburg in 2002 and was held in 2004 at St.-Petersburg University.

3RD INTERNATIONAL SYMPOSIUM:

BIO-INERT INTERACTIONS. LIFE AND ROCK.

An interdisciplinary conference dedicated to linking biosphere phenomena to physical & chemical reactions in the lithosphere.
Saint-Petersburg, Russia, 26-29 June, 2007

The **3d International Symposium** is dedicated to the exchange of recent advancements in biogeochemistry (b**io-inert interactions** in lithosphere, biogenic rock-and ore-forming processes, fossilisation of living organisms, stone in living organism, problems of environmental mineralogy and geochemistry). Special sections **Stone in living organism** and **Environmental mineralogy and geochemistry** are devoted to problems of medical geology. The conference provides a forum for professionals, regulators, and students to present their most recent findings and to discuss with colleagues from around the world state-of-the-art methodologies, analytical techniques, and process development.

Contact: Marina, spboe@mail.ru, for more information

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ISOTOPES ^{234,238}U and ^{241}Am IN THE ENVIRONMENT AND MODELING EXPERIMENTS

Alexander V. Gulynin & Alexei V. Starodubov, Fedorovsky Research Institute for Mineral Resources (Moscow) E-mail: vims@cnt.ru

The need to define the alpha-emitting nuclides for natural objects is a consequence of their extremely high radiotoxicity. Most of them are Class "A", the highest level of radiation hazard [4], and result in hazards because of internal irradiation. The group of scientists of the Fedorovsky All-Russian Research Institute for Mineral Resources and Moscow Veterinary Academy, Department of Radiation Biology carries out research on supertransuranic elements in the natural environment, living organisms, and in modeling experiments.

A comparison of the biological efficacy of isotopes of uranium and americium with other nuclides has shown that they are 20-100 times more toxic than ^{90}Sr [2]. Anthropogenic pollution of the biosphere by uranium results from the explosion of nuclear weapons, accidents at atomic power stations, leakages at radiochemical plants, and daily economic activities: the addition of phosphate fer-

Figure 1. Radioactive pollution in Europe.

tilizers into soil, burning of coal, mining of mineral resources, etc.

A huge contribution to radioactive pollution was made by the Chernobyl accident in April, 1986.

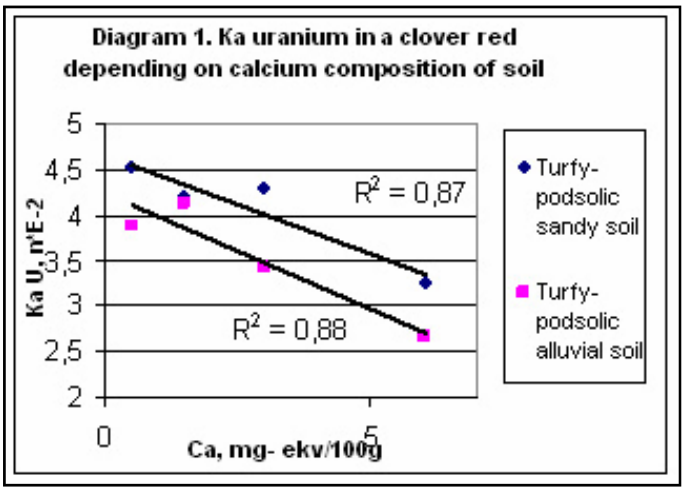
Isotopes of uranium and americium enter human and animal organisms via biological food chains. Thus it is necessary to determine their migration pathways in the biosphere, as well as the forms in which they are present in soils, inflows in plants, animal and humans.

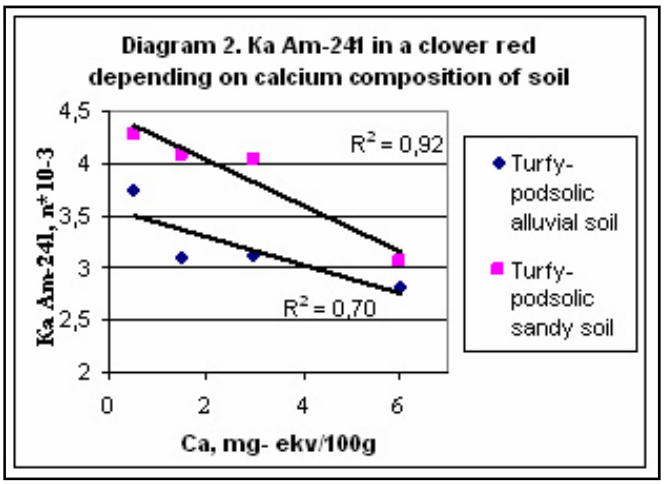
A series of experiments on the transfer of the natural isotopes of U (^{234}U, ^{235}U, ^{238}U). and ^{241}Am to plants, and their distribution in animal organism have been carried out by the authors by model experiments. A spectrometric method with radiochemical separation was used for the definition of the alpha-isotopes content. A strong dependence between the accumulation of isotopes of uranium and americium in vegetation from humus, and the content exchange Ca is shown on Diagrams 1 and 2.

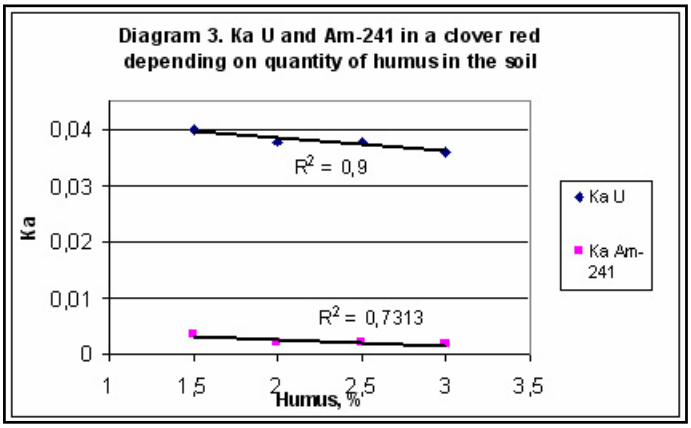
The greatest value of **Ка** (coefficient of accumulation) of uranium and americium had a standard value typical for the plants selected in soils characterized by low content exchange Ca (Diagrams 1, 2). The decrease of the transfer of uranium in plants with an increased content of Ca is insignificant, at 18%, while for americium this value decreases by a factor of 2.5 times.

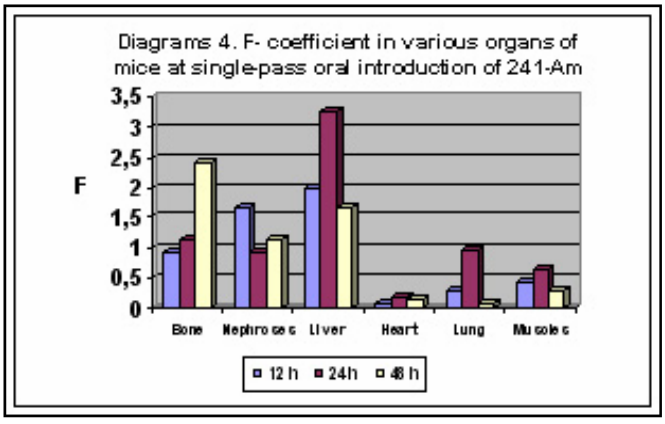
The values of **Ка** for isotopes from the humus content in soil have a negative correlation, they show considerable direct dependence between these values, (rAm = -0.86, rU = -0.95) (Diagram 3.).

It is found that lower pH values are present in soils with increasing transfers of isotopes of uranium and americium in plants. In neutral soils the value of **Ка** for uranium is approximately 0.045, and in acid soils









ISOTOPES ^{234,238}U and ^{241}Am IN THE ENVIRONMENT *Continued*

(Continued from page 8)

at a value pH=5.5, values of **Ka** are 1.4 times higher.

The toxicity of uranium and its compounds are a direct function of their solubility, a method of introduction and localization in an organism.

High values of the accumulation factor (F) of Uranium (U) in the organs of laboratory mice are noted in the first 24 hours in kidneys, 0.8E-3, the least in a muscular tissue and in the heart, 0.13E-3 and 0.10E-3 respectively. The deposition of uranium on the walls of a thin intestine (2% at 48 hours after the introduction of a tracer) was also observed.

A significant amount of americium at a single-pass oral introduction of ^{241}Am is noted in the kidneys and the liver (up to 3.3), and the least in the heart (Diagram 4)**.**

The radionuclides behave differently when introduced orally into animals of different ages. A decrease in the accumulation of radionuclides is observed in organs and tissues upon aging of the animals. One and a half month old mice are characterized by higher coefficients of accumulation of uranium isotopes than a 5-month (adult) animal.

Minor alteration of the ratio F_{young}/F_{adult} has been noted for the liver and for a muscular tissue (K = 1.13 - 1.25). The significant ratios of values for kidneys (3 times), to an osseous tissue (2.4 times) show a decrease in the transfer of isotopes of uranium from food to organism, in organs, with the age of animals.

The greatest F values of Americium for a chronic intake of small amounts of ^{241}Am over a long period of time are for bone and liver, - 7.7E-2 and 6.06E-2, respectively for adult animals, and 5.3E-2 and 1.39E-2, for young ones. The lowest values are for heart, lungs, and muscles, ranging from 0.63E-2 to 1.2E-2. It is shown that changes in the accumulation of ^{241}Am differs with animals of different age from 1.1 to 1.4 times.

The issue is the level of transuranium elements (^{241}Am, ^{241}Pu, ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{241}Pu) in nuclear fall-out at a great distance from the Chernobyl accident epicenter, because significant radioactive anomalies of Chernobyl origin ocurred over Belarus, the Russian Federation, Ukraine, and some other European states (Finland, Norway, France, etc.).

In the Russian Federation a group of researchers of the All-Russian Institute of Mineral Resources and “Bryanskgeology” (the state organization "Geotsentr Bryansk"), is engaged in this problem. Radioecological investigations of the soil, ground sedimentation, and vegetation have been carried out from 1991 to the present for this purpose in the Bryansk area, which is the most affected territory of the Russian Federation. The examinations were made using high resolution gamma-spectrometry, alpha-, and beta-spectrometry with radiochemical separation, beta-, gamma-, autoradiography, and alpha tracking autoradiography. Special attention is given to the determination of transuranium elements. **(**Figure 1)

The presence of submicronic radioactive particles in the upper soil stratum was shown, in the soils of the Bryansk area, in 1991. Up to 15-20% of the total amount of the particles contain the transuranium elements: ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{241}Pu, ^{241}Am. The rest of the radioactive particles are of condensation origin, mainly ^{137}Cs [1].

Transuranium elements have been detected in soils to a depth of up to 20 centimeters. The measured specific activities of soils are from 0.6 to 6 Bk/kg ^{241}Am and from 0.5 to 2,5 Bk/kg $^{239+240}$Pu in 2004 [3]. The peak activity of ^{241}Am in the polluted regions of the Bryansk area is expected in 2059 - 2060 due to the formation of ^{241}Am from ^{241}Pu ($T_{1/2}$=14.4). Consequently, the activity of ^{241}Am will exceed the total activity of the isotopes of Plutonium 238, 239, and 240 by approximately two times by 2060.

Despite small absolute values of activity of the transuranium elements in the soils of the Bryansk area, it is difficult to predict their effect on public health in the contaminated areas. The transuranium elements of the Chernobyl origin will affect human health for hundreds years due to exposure to the chronic radia-

tion.

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[5] Mechanisms in Radiobiology. Volume I, Volume II. Academic Press. New York and London. 1960.

IMGA WEBSITE

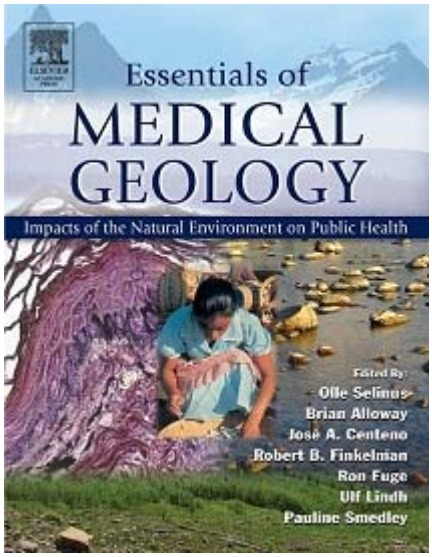
Check the IMGA website:

http://www.medicalgeology.org/

Contents include:

- How to join IMGA
- Information on IMGA (click on the IMGA icon):
  - Constitution and by-laws
  - Officers
  - Dues structure and how to pay dues
  - List of members
- Previous Newsletters
- Newsletter editorial policy and how to submit articles
- Information on and reviews of the book, Essentials of Medical Geology, including awards that it has earned.
- Courses and seminars
- Glossary of terms
- Links to other sites
- Short papers and referencelist

... And more



THE DISTRIBUTION OF NATURAL RADON IN THE MOSCOW REGION.

Anastassia L. Dorozhko, Vladimir I. Makarov, Institute of Environmental Geoscience (IEG RAS), Moscow, Russia, (a_dorozhko@mail.ru)

This exercise is a study of the relation between the lithology of overburden and secondary sediments, the structural geodynamic factors in the Moscow region, and the distribution of natural radon flux density (RFD) on the surface, in soils. Negative and positive (in small doses) impacts of natural radon on human and animal health and on plants have been studied all over the world. As a result of these studies, standards have been developed that are used in the construction industry, in particular, when considering the antiradon protection of buildings. However, the questions of sources, paths, and rates of migration, and the maximum depth from which radon can reach the surface in different geological conditions, have not been resolved. The difficulty of carrying out this task on the lands of large cities is increased because of a high content of natural radioactive substances in soils and groundwater, but even more significantly, because of the built-up nature of these areas.

In Moscow, four areas with different intensity and character of RFD anomalies were identified as a result of RFD studies on building sites in the last 8 years (about 400 objects). While studying the geological structure of these areas, the relation between the lithology of near-surface soils (and, accordingly, the content of natural radioactive substances - the presence of artificial radon was excluded at a sampling stage), and general high or low RFD background was confirmed, and there was no direct relation with the structure of secondary rocks. But this does not explain the existence of several point and linear anomalies with high RFD values on high or low homogeneous background lithological character. Consequently, the next stage was devoted to a study of the relation between radon distribution and structural, geomorphological, and geodynamic characteristics, of the area of investigation, in particular, the arrangement of high density of fractures and permeability zones - geodynamically active zones, which had been the direct subject of our research for many years. Borders between areas with various RFD values roughly coincide with the boundary zones between large blocks, which are interpreted as geodynamically active zones of different types. In other words, the identified areas and the regional neotectonic structures are similar to the RFD field structure. In three out of four areas, maxima of RFD values are in close proximity to or within the limits of borders between the regional geoblocks and mesoblocks. The orientation of the axes of anomalies in these areas coincides with some of the prevailing directions of these zones. Such a relation is not observed in the fourth area, where the most intensive RFD field was identified. Probably, this is due to the fact that quaternary and secondary layers have the maximum thickness there. Besides this, a probability of a relationship between the RFD distribution and ancient heterogeneity exists in this area. A good correlation between the maximum value of RFD field and the deepest part of Podmoskovny ancient rift trough, which is 800-1500 m deep, remains unexplained.

As a result, considering the two most credible factors, which can influence RFD distribution on the daylight surface, we can come to a conclusion that, along with the lithology of the near-surface soil, the structural factor, in particular the neotectonic division of the Earth's crust, also plays an important role in RFD distribution. This factor should be considered for forecasting radon danger for urban territories and for the geochemical mapping of soils in general.

The work was done with financial support from RFBR (Grant 03-05-64244a).

A METHODOLOGY FOR THE RADIOECOLOGICAL ASSESSMENT OF UNDERGROUND WATERS IN THE MOSCOW REGION

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The role of underground waters to the health of the population and facilities of the Moscow region is very important. The water-supply of the major towns in the Moscow region is based on artesian sources which are well surveyed and evaluated.

The sources of underground waters are protected from direct anthropogenic contamination and their use can play a major role in emergency situations. Thus, the problem of full-scale radioisotope studies of underground waters in the Moscow region, as well as the determination of natural and anthropogenic factors that influence a change in their radionuclide composition and, as a result, the quality, are of primary importance.

The object of research is the underground waters of water-bearing carbonate horizons with mineralization less than 1 g/dm^3. The analytical and methodical procedure for radioisotope studies that has been developed corresponds to the international system of radiation control, that allows monitoring of radioactive water contamination of natural and technological origin. The approach includes a number of highly sensitive methods for natural and technological radionuclide identification deposited in the underground waters.

The average levels of the total activity of alpha- and beta-radiation activity of the underground artesian water supplies of the majority of the large populated districts of the Moscow region have been determined from eight-years of radioisotope studies in the Moscow region. Data on the radionuclide composition of drinking water of exploited water-bearing horizon were obtained.

A database on the radioactivity of underground waters of the Moscow region was created. The organizational and safe-guard measures for the sanitary and hygienic aspects of artesian drinking water, and a system of radioisotope monitoring was also developed.

The new term "radiological type of water" has been proposed. Based on this term, the classification of underground waters in the Moscow region, in accordance with the radiological type, has been carried out.

The results have shown the absence of technological radionuclide contamination of underground water in the Moscow region. Anomalous values of radioactivity are of natural origin and are primarily connected with the composition of water bearing bed rocks, structural features, and tectonics of the region. The radiological character of the underground water of the Moscow region consists of: radium more than 50 %, radium-polonium 29%, radium-uranium 10 %, and uranium 4 %.

The criteria chosen as measures of safety are a combination of:

- The quality of underground waters of the particular bore holes, water supplies, etc. (the total alpha- and beta-activities, and the separately determined natural and technological radionuclide content);
- The dosage effects of water consumption on the population.

Proposed safety measures are:

- The reduction of the level of radioactivity in the water-supply source by the addition of water with low contents of radionuclide;
- The change of the water-supply source to an alternative source;
- Corrective technologies for water treatment; using filters, etc.

RISK ASSESSMENT RELATED TO MINERALS

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Summary

The risk assessment strategies discussed in this paper are concerned with the effects of minerals on human health, that is, medical mineralogy. Research into silicosis from hard rock formations has increasingly been redirected towards assessing lung cancer risk. In analysing risk assessment problems, it is important to realize that minerals are present in all parts of the environment, from both natural and technogenic sources. Many different groups of fibrous minerals have been recorded as containing chlorites, muscovite, biotite, talc, chrysolite, clay minerals, and asbestos. Many of the epidemiological studies cited by regulators as the basis for classifying minerals as carcinogens are either incomplete or failed to use a proper protocol. There is particular emphasis on the implications of mineral exposure to human health in the general area of ecotoxicity. Most of the radon in buildings comes from below, with only a small contribution from construction materials. The amount of radon emanated by small specimens is not enough to cause concern, but keen collectors who store large quantities of material indoors may be exposing themselves and their families to significantly increased radon levels.

Introduction

In analysing risk assessment problems, it is important to realize that minerals are present in all parts of the environment, from both natural and technogenic sources. The following factors can be distinguished as the most important in the risk assessment of minerals (Dixon 2000): minerals and health; mineralogical factors in ecology, and protection of the environment;

Many different groups of fibrous minerals have been recorded to contain chlorites, muscovite, biotite, talc, chrysolite, clay minerals, and asbestos. Many of the epidemiological studies cited by regulators as the basis for classifying minerals as carcinogens are either incomplete or failed to use a proper protocol. There is particular emphasis on the implications of minerals exposure to human health in the general area of ecotoxicity. The mining and downstream processing of mineral sands containing monazite or zircon presents radiation protection problems, due to the presence of uranium and thorium. Radiation hazards can exist from direct gamma-radiation from radioactive minerals, but also from inhalation of dust produced during the separation process.

The Collection of Minerals

Mineral collectors are well aware of the spectacular bright colors (e.g., Woelsendorfite), interesting crystallographic forms (e.g., Torbernite) or strong fluorescence (e.g., Autunite) displayed by the over 200 varieties of radioactive minerals (Dixon 2000). Minerals, which contain uranium or thorium, are radioactive. The idea of radioactivity sometimes evokes strongly negative feelings, but mineral collections containing such minerals can be quite beautiful as well as informative. Uranium and thorium are somewhat, but not extremely, rare elements. The average crustal concentrations of 2.7 and 8.5 ppm for uranium and thorium, respectively, are roughly similar to tin (3 ppm) but much higher than silver (0.06 ppm). Radiation hazards of minerals may be classified into three groups: those that emit strongly ionizing radiation, those that are strongly contaminating, and those that emit high levels of radon. Strongly ionizing Pitchblende is an example of a strongly ionizing mineral that emits high levels of gamma radiation due to the presence of radium, a degradation product of uranium.

Geologically older material contains correspondingly higher concentrations of radium and emits higher levels of gamma radiation. Geologically younger material, such as secondary uranium mineralization, emits lower levels of gamma radiation. Some minerals are strongly contaminating and readily leave mineral residue in the form of particulate matter. These are deemed potentially dangerous from the standpoint of particulate contamination (Komov, 2002). Careless handling is dangerous and should be avoided alto-

gether in order to avoid inhalation and incorporation into internal body parts. Ionizing radiation such as alpha or beta particles, which are comparatively harmless outside of the body, can cause significant mutagenisis if incorporated into the body via inhalation or ingestion. Torbnerite and autunite are examples of strongly contaminating material due to their strong cleavage, which produces small particles, that can be easily dispersed. The same can be said for many of the secondary uranium minerals, even if only present as thin coatings. Heavy mineral sands containing uranium or thorium minerals such as zircon or monazite or also problematic. Radon emitters: radioactive decomposition results in production of radon gas. Minerals containing radium, highly porous minerals and those with a high percentage of certain radioactive elements are potentially strong radon emitters.

Risk Assessment Strategies for Minerals Affecting Human Health.

The risk assessment strategies considered here are to do with the effect of minerals on human health, medical mineralogy, and mineral pharmacology. Research into silicosis in hard rock formation has increasingly been redirected towards assessing lung cancer risk. The past administration by inhalation of fine aluminum dust as a prophylactic agent in silicosis has provided the impetus for research into the evaluation of the potential for aluminum dust to produce fibrous or a neurobehavioral effect. The human organism has no recognised function for aluminum in normal biological systems. Mining and downstream processing of mineral sands includes monazite, zircon, and ilmenite. The mining and downstream processing of these minerals present radiation protection problems, due to the presence of uranium and thorium, particularly in monazite. Radiation hazards can exist from direct gamma-radiation from radioactive minerals, but also from the inhalation of dust produced during the separation process. Many different groups of fibrous minerals have been recorded as containing chlorites, muscovite, biotite, talc, chrysolite, clay minerals, and asbestos (Komov 2002).

Asbestos is a natural mineral fiber, which has been known and utilized commercially for about a century. Different types of asbestos fibre are associated with different level of risk (crocidolite-amosite-chrysotile). Studies have shown that there is a relation between the degree of crocidolite exposure and level of cancer risk in a population exposed to crocidolite deposits (Komov 2002). Research efforts employing animal model systems have as a goal, to identify and estimate the potential cause and effect relationships of specific minerals with various biologic responses. Different minerals are present in different forms with markedly contrasting ranges of solubility and mobility. Many of the epidemiological studies cited by regulators as the basis for classifying minerals, as carcinogens are either incomplete or failed to use a proper protocol. Many of the elements in minerals may be relatively insoluble, of low bioavailabity, and subject to very slow rates of migration. However, the properties of minerals may change over time. Sound risk assessment should be based on the best scientific data and evidence available, the behavior of minerals and their pathways and routes of exposure to plants, animals, and man. There is a particular emphasis on the implications of minerals and metals exposure to human health in the general area of toxicity. It has been shown that both input source uncertainties and corresponding values of risk assessment were influenced by the degree of spatial resolution used for collection of initial new information. Of special interest will be the competition between adsorption and precipitation for the control of heavy metal solubility. Platinum provides an example of the significance of speciation in metal toxicity. Pt group minerals appear to be biologically inert (Komov 2002). Platinum allergy, found in a number of mining workers is confined to a group of charged compounds that contain reactive ligand systems, the most effective of which are Cl ligands. Electromagnetic signals generated by minerals and rocks at phase transition of the first and second kind would be view as an informational mediator between organic and inorganic nature. Such minerals are used for treatment by the emission of electromagnetic impulses over the range of radio frequency and their influence upon peculiar points of the human body.

Crocidolite, one of the oldest asbestos minerals used by man, is today banned in many of its applications because of its toxicity. Coating the fibres with an iron complex can detoxify crocidolite, the major problem being to decrease or to neutralize some of the negative charge on the fibres. For example, this could involve the use of gamma-irradiation to induce changes in the iron ions from the ferrous state to the ferric state. Preliminary γ-irradiation experiments are being undertaken to test these assumptions. In view of the decrease in production of crocidolite, especially in Russia and Kazakhstan, where the production fell by a large volume, it seems worthwhile to pursue research into all possibilities of reducing the toxicity of crocidolite. This is particularly important as crocidolite has some very special properties such as a high tensile strength and an acid resistance that renders the fibres suitable for manufacturing special gaskets. Gamma-radiation should not affect those properties in the way that other treatments do. Treatment by addition of a coating increases the weight of crocidolite by more than 30%. In a coating process the major change is on the surface, which means that cutting or any mechanical transformation exposes new surfaces that are not coated, and are open to the production of airborne particles or to act as a catalyst for the production of the harmful OH^- group in a wet environment.

Radioactive Gemstones

Inevitably, we are all exposed to some radiation. The typical environmental radiation level is about 100 mrad (millirad) per year or 0.012 mrad per hour; which can be halved or doubled, depending on the location and altitude. Contributing to this exposure, are the radioactive components in our own bodies (over one million beta particles per minute, together with smaller amounts of alpha particles, etc.), as well as from soil, from cosmic rays, and from fall-out from nuclear testing. Additional exposure comes from medical and dental X-rays and from radiation treatments (Nassau 1984).

As mentioned above, zircon can contain radioactive elements, but the amount is usually so small in jewelry-grade material that this can be ignored. On several occasions, irradiated gemstones have been released into the trade (Nassau 1984). One example was a parcel of 100 blue topaz stones, where one 10 carat stone showed 0.2 mr (milliroentgens) per hour on a survey meter, compared to a 0.02 to 0.05 mr per hour background reading. Another example involved irradiated spodumene, where a 6-carat stone registered at 0.7 mr per hour. Much lower levels were found in some Maxixe-type blue beryl. Gemstones having a significant radioactivity represent a totally unnecessary exposure; although there are no appropriate standards, stones such as these should not be used for extended personal wear (Nassau 1984). A dealer working with a package of many such stones would be at a definite risk. Conscientious gemological laboratories now routinely check for radioactivity with a survey meter. Such radioactivity does decay with time, the rate of decay depending on the nature of the radioactive isotopes present. So far such occurrences appear to have been isolated incidents. This problem may lessen, since it is reported that the Brazilian authorities have been confiscating radioactive gemstones and investigating the unauthorized use of nuclear reactors. Radioactivity is also seen in some old, radium-exposed, diamonds (Nassau 1984). These stones may be colored or they may have had their color, but not their radioactivity, removed by a heat treatment. Although usually not too highly radioactive, at least one such stone was found to be exceptionally so, darkening film in as little as 15 minutes and giving the very high reading of 40 mr per hour on a survey meter. When located, highly radioactive stones should be kept in a thick-walled lead container, equipped with the customary magenta-on-yellow radiation-hazard warning label.

Highly radioactive minerals containing uranium and/or thorium elements in high concentrations emit alpha, beta, and gamma radiation. The principal hazard to mineral collectors is the radon gas released into the atmosphere in a closed cabinet. Systematic examination of native samples and a review of the literature have shown that all native zircons are radioactive with a level from 10 to 280 micro roentgen per hour per carat, which is caused by the thorium and uranium content in these gems. In charoite the radioac-

tivity is insignificant, about background level, and caused by potassium-40; but sometimes it is more intensive as a result of micro-inclusions of thorium-bearing minerals, ekanite and steatite. Some camellias, onyxes, and agates are characterized by weak radioactivity, about the background level, but sometimes these stones from Central Asian and Mongolian deposits have radioactivity 2 to-3 times higher than the background level, induced by fine micro-plates of uranium mineralization. A slightly higher than background radioactivity of gems is considered to be beneficial by some doctors, its action on the human organism being comparable to that of very weak radon baths. Abnormally high radioactivity of zircons and ekanite-bearing charoite is undoubtedly dangerous. There are serious reasons to consider that the unfortunate diamonds of Tuilier, King Alfons XII, and others known as "Ceilon diamonds" were, in fact, burnt natural zircons with high radioactivity (Nassau 1984). The radioactivity of each piece of jewelry can be tested in domestic conditions by putting it wrapped up in a light-tight paper on a photo film for a week (Nassau 1984). Grey, or even black, spots will appear on the developed film under the dangerous article as a result of the radioactive effect, to which light-tight paper is not an obstacle. Heat treatment and irradiation are well-known procedures for improving the color and quality of nature gem-stones (Nassau 1984). Before these treatments it is necessary to know the composition of minerals and to group them by their dependence on different chromospheric elements. Neutron activation analysis is a very sensitive method to check the composition of stones to be treated. The concentrations of some main elements (in ppm) were found in five typical samples of investigated groups of samples

Emerald. There is no detectable by NAA quantity in these samples (Trower 1993). The pale green color is caused mainly by Fe^{59} (6800 ppm ± 9 %), the presence of Cs^{134} (3800 ppm ± 17 %) is the reason for the long lasting radioactivity of samples after neutron irradiation (Trower 1993).

Corundum (1) Pale pink with violet due to a combination of Cr^{51} (1300 ppm ± 20%) and Fe^{59} (120 ppm ± 10%);

Corundum (2)] Pale green Combination of Fe^{59} (310 ppm ± 9%) and Cr^{51} (83 ppm ± 20%);

Corundum (3) Pale raspberry brown Fe^{59} (10,000 ± 17 %) and Cr^{51} (3800 ppm ± 20%).

Forsterite. Pale green yellow, combination of Fe (mainly), Ni, Cr, and Co, produces this color. After neutron irradiation there are new colours That in forsterite is an interesting, smoky-swampy.

By mass, minerals comprise the greatest part of the aerosol particles in the troposphere, the part of the atmosphere that we inhabit. They have, with prominent exceptions, been largely overlooked by atmospheric scientists, although increasing attention has been devoted to them recently. They are important as absorbers and scatterers of radiation and thus can have important effects on climate, most especially on local and regional scales because of their relatively localized spatial and temporal distributions. Because aerosol particles are small in dimension and large in number, most analyses have been on large numbers of particles, with averaged bulk compositions and properties. Such bulk measurements have important limitations (Trower 1993). The radiative, health, and visibility effects of aerosol particles are caused by the cumulation of individual rather than averaged particles, and therefore there is much reason for studying particles individually. Transmission electron microscopy is well suited to the study of individual aerosol particles. Many widely used assumptions in global climate models are seen to be of limited validity when individual particles are examined. Thus, spherical shapes, extent of mixing of phases, and particle speciation are all problematic but can be resolved through individual-particle TEM studies. A difficulty is that deliquesced species lose their water in the vacuum of the electron microscope, and these important aerosol types dehydrate and change their character. With this important limitation, aerosol particles can be studied on an individual basis, their most detailed

properties can be determined through TEM, and they represent a far richer and more complex world than is commonly assumed (Nassau 1984). Radioactive Minerals contain uranium and/or thorium elements in moderate to low concentrations that emit alpha, beta, and gamma radiation.

Conclusions

The following factors can be distinguished as the most important in the risk assessment of minerals: minerals and health, mineralogical factors in ecology, and the protection of the environment. Mining and downstream processing of mineral sands containing monazite, zircon presents radiation protection problems, due to the presence of uranium and thorium. Radiation hazards can exist from direct gamma-radiation from radioactive minerals, but also from inhalation of dust produced during the separation process. Three sources of hazard might be present: direct radiation (gamma rays and alpha particles), ingestion of minerals and emission of radon. Much higher levels of activity can occur in rocks in veins or deposits. A dealer working with a package of many such stones would be at a definite risk. So far such occurrences appear to have been isolated incidents. The ultimate source of radon indoors is the small amount of uranium that is present in all rocks and soils.

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GEOLOGY AND HEALTH SESSION AT NORTHEAST GSA MEETING

DURHAM, NEW HAMPSHIRE, 12—14 MARCH 2007

The Northeast Section meeting of the Geological Society of America will be held in Durham, New Hampshire, from March 12 to March 14, 2007. A special session on *Health and Geology in the Northeast* is being organized for this meeting. This session will focus on the relationship between geological factors (both natural and anthropogenic) and disease, pathology and death in modern and fossil humans, animals and plants. This is an eclectic field and the intent of the session is to bring together researchers with various backgrounds and interests in order to facilitate discussion of the interrelationships between geology and health.

We encourage all of you interested in the interaction between geology and health to submit an abstract to this meeting. The abstract deadline for the meeting is December 5, 2006. Abstracts can be submitted electronically at http://gsa.confex.com/gsa/2007NE/index.epl

For further information contact Catherine Skinner at "catherine.skinner@yale.edu" or Nelson Eby at "Nelson_Eby@uml.edu".

THE CORRELATION OF POTENTIAL FIELDS WITH PSYCHIC DISORDERS AND SOMATIC DISEASES IN LITHUANIA: WHAT IS BEHIND IT?

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Introduction

Systematic studies of human health and the natural environment that have been initiated in recent years have revealed a rather close correlation between the geographical variations of the different diseases rates and geological factors in Lithuania (Šliaupa et al., 2004a,b; Zukauskas et al., 2005). These studies considered geofactors, such as (1) gravity and magnetic fields, (2) sub-soil lithologies, (3) concentrations of geochemical elements in the soil, (4) relief and other landscape features, (5) drinking water chemistry. The analysed medical parameters are i) psychic diseases and human behaviour such as schizophrenia, alcoholic psychosis, suicides, homicides and (ii) somatic diseases such as tuberculosis, cancer, infections, cardiac-vascular, and respiratory diseases. A rather strong correlation between human health and the earth's potential fields was identified using formal statistical approaches. Nevertheless, a strong statistical correlation does not necessarily imply the direct effect of gravity and magnetic fields on human health, as this linkage can be via some other geofactors, directly (or indirectly) related to potential fields. In this paper, the nature of the correlations is discussed.

Data and Methods

Statistical data on the distribution of schizophrenia, alcoholic psychosis, suicides, tuberculosis, cancer, infection, cardiac-vascular, and respiratory diseases were collected from 45 administrative regions of Lithuania that were analysed with respect to different geofactors. The persistence of trends recognised by comparing medical data for different years from 1999 to 2003 (Fig. 1) persuade one that certain geographical parameters are involved. These have different formats and, therefore, a special technique was applied to unify geofactors for individual administrative regions (Fig. 2). This study is based on the application of statistical methods and geographic information system (GIS) tools. Data were processed and interpreted in MapInfo Professional environment. For the automation of tasks, study-specific programs were written in the MapBasic language. The statistical correlations between regions-scaled environmental and health parameters were identified using the STATGRAPHICS Plus program. Only correlations with a confidence level 0.95 and correlation coefficient higher than ±0.30 were considered to be meaningful.

The digital models of the gravity and magnetic fields (and their variability) were converted to average values for each administrative region. The relief height, slope gradients, and dissection were derived from the digital terrain model of Lithuania. The other analysed landscape factors are the percentage of the forests, lakes, rivers, and wetlands that were derived from the CORINE Land Cover model. The density of the neotectonic faults and occurrence of the hydrogeochemical anomalies, related to active faults, were incorporated. The sub-soil lithologies were derived from the digital Quaternary Map of Lithuania. They show different geochemical enrichment of the soil. Twenty eight trace elements were analysed. The ground water is mainly exploited for drinking water supply in Lithuania. Data on the chemical composition of the drinking water were collected from more than 12,000 boreholes stored in the GEOLIS database of the Lithuanian Geological Survey.

Geographic Trends of Diseases Rates in Lithuania

The psychic disorder and human health parameters show some distinct trends across Lithuania, implying involvement of geographic-dependent factors. In particular, the north-eastern part of Lithuania is characterised by a higher schizophrenia rate. In the west, distinct NW-SE tends are identified, whereas

the eastern half of the country is dominated by a NE-SW anomaly pattern. The highest disease rate of alcoholic psychosis is registered in the west, and it is the lowest in central Lithuania. Central Lithuania is marked by an increased suicide rate, and it. should be noted that Lithuania has the highest suicide rate in Europe. Also, the rate of tuberculosis is quite dramatic, averaging 280 events per 100,000. The highest rates are reported from west Lithuania and there is a distinct trend, crossing the whole country from NW to SE. In general the eastern part of Lithuania is characterised by a lower tuberculosis rate. Cancer shows a different pattern. The highest disease rate is registered in southwest Lithuania, while the lowest is in some regions of east Lithuania. The rate of cardiac-vascular diseases is generally higher in the eastern part of Lithuania. East Lithuania is characterised by a risk of higher respiratory diseases and is especially high in the south. Increased infection rates are reported from central and southwest Lithuania.

Potential fields and human health

The gravitational and especially the magnetic fields are discussed as important factors for living organisms. Gravitational and magnetic fields show considerable variations across the country. The maximum intensity of the gravity field, +35 mGal to +42 mGal, is reported from southeast, south central and north Lithuania, whereas minimum values, –15 mGal to –21 mGal, have been documented in west and central Lithuania. A high-intensity magnetic field dominates east and southwest Lithuania (+5nT to +20nT), whereas minimum values (-7 nT to –10 nT) are identified in central and west Lithuania. There is no discernable correlation between the gravitational and magnetic fields. Analysed medical parameters have consistent statistical correlation with the

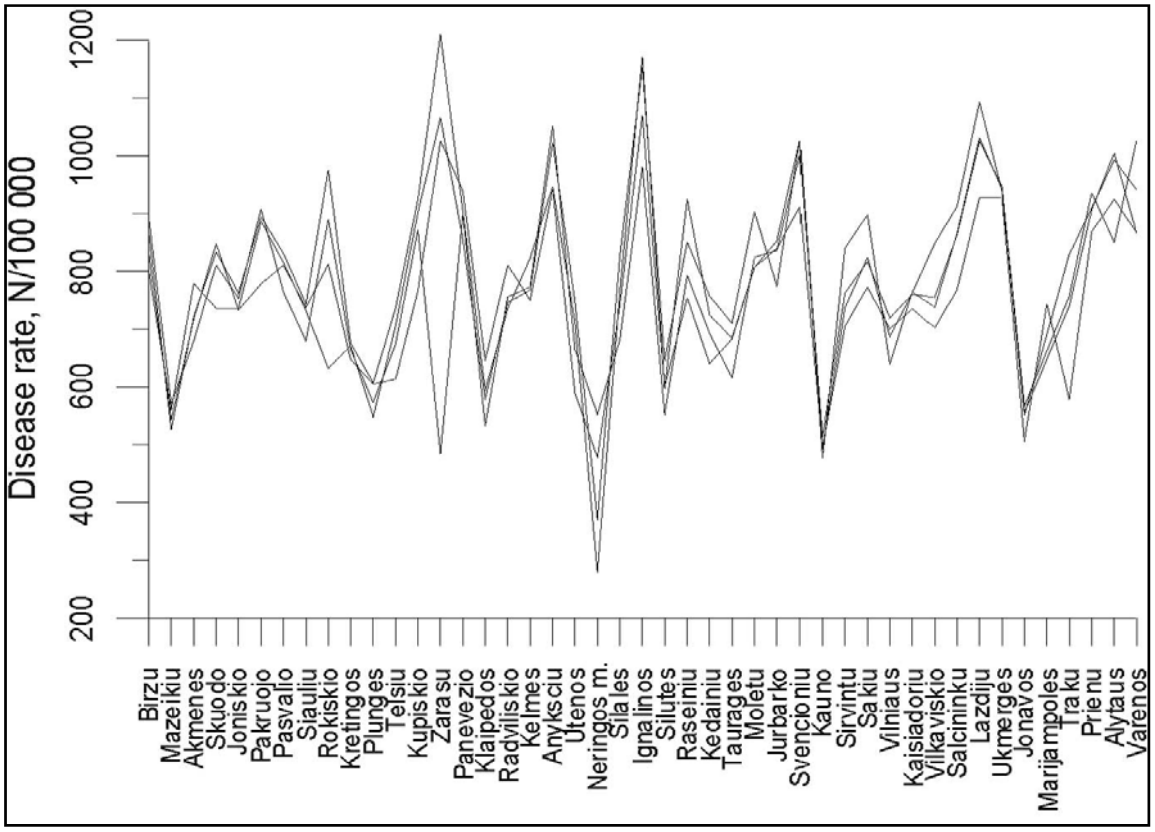

Figure 1. Cardiac-vascular disease rates (lethal events per 100,000 population) in different regions of Lithuania, year 1999, 2001, 2002, 2003. Note consistent trends for different regions.

intensity of the magnetic and gravity fields, whereas the variability of the earth's fields has a less distinct statistical correlations. Schizophrenia positively correlates with the magnetic field, the coefficient of correlation is as high as +0.30. The gravity field intensity correlates negatively with the crime distribution. The most distinct positive crime anomalies in southwest of west Lithuania and in central Lithuania are confined to distinct gravity minimums. The cardiac-vascular diseases correlate with the magnetic field (+0.37). The infectious diseases also correlate with the gravity and magnetic fields, the correlation coefficients are respectively +0.31 and -0.33. Tuberculosis negatively correlates with the gravitational and magnetic fields (-0.33 and -0.35). Cancer has a consistent correlation with the magnetic field, essentially with its variability (correlation coefficient +0.45).

The statistical methods fail to reveal existing relationships in some cases, as evidenced by comparison of the homicide distribution with the magnetic field map. A very distinct NE-SW trending anomaly marks the first-order fault zone (Taurage-Ogre) in west Lithuania. Similarly, the NW-SE oriented maximum marks the other large-scale tectonic zone (Vilnius-Mazeikiai). The maximum in northeast Lithuania is confined to large Daugavpils tectonic block.

Disease rates and other geofactors

Apart from the potential fields, consistent statistical correlations were identified for the other geological parameters. Cancer correlates with some geochemical elements of the soil, i.e. titanium and zircon (+0,32), with a weaker relationship to Y, Yb, and Nb (+0.22 to +0.29). Drinking water containing an increased amount of Ca, $HCO_3$and a higher pH, statistically has a remedial effect on tuberculosis. A close relationship to respiratory diseases is identified for the differentiation of the relief (+0.44), essentially in the areas that show a less dense river network (correlation is -0.32). Of the analyzed soil chemical elements, Rb and Sr have a consistent negative loading on the respiratory disease rate, as well as the drinking water salinity and SO_4 content (-0,38). The infectious diseases correlate with the soil pH. The low rate of cardiac-vascular diseases spatially correlates to higher concentrations of Na and K, and a higher pH. Schizophrenia negatively correlates with soil trace elements P, Pb, and Sn (-0.40, -0.38, -0.40). Alcoholic psychosis shows a strong relationship with the drinking water chemistry. There is an especially strong negative relationship of Mg, Ca to alcoholic psychosis. The water chemistry also correlates with the suicide level, i.e. Na, K, high pH showing "remedying" effect.

Discussion

Human health is shown to correlate with natural environmental factors, including gravitational and magnetic fields. However, an observed statistical correlation does not necessarily imply a genetic relationship, as environmental parameters are intimately interrelated. Rather, they reflect some particular environmental systems with a specific set of factors, such as the soil lithology and chemical composition, drinking water chemistry, etc.

The statistical cross-correlation of the environmental parameters reveals two large groups that can be conventionally called the gravity and magnetic field groups. The present relief and sub-soil lihtologies were formed by the Quaternary glaciation and deglaciation processes. In turn, these processes were strongly controlled by the deep structure of the earth's crust that is sensitively reflected by the magnetic and gravity fields. The former reveals the distribution of the shallow geological bodies, whereas the latter one is influenced mainly by deeper geological sources. Accordingly, the gravitational and magnetic fields relate inversely in terms of statistical correlation. It was determined that the intensity and variability of the magnetic field has a direct statistical correlation with the present relief (height, dissection), whereas the gravitational field has a inverse statistical effect on the relief. Furthermore, sandy sub-soil lithologies are more common for high magnetic field areas, whereas the high gravity field directly correlates with clayey lithologies. The relief and related lithologies are the

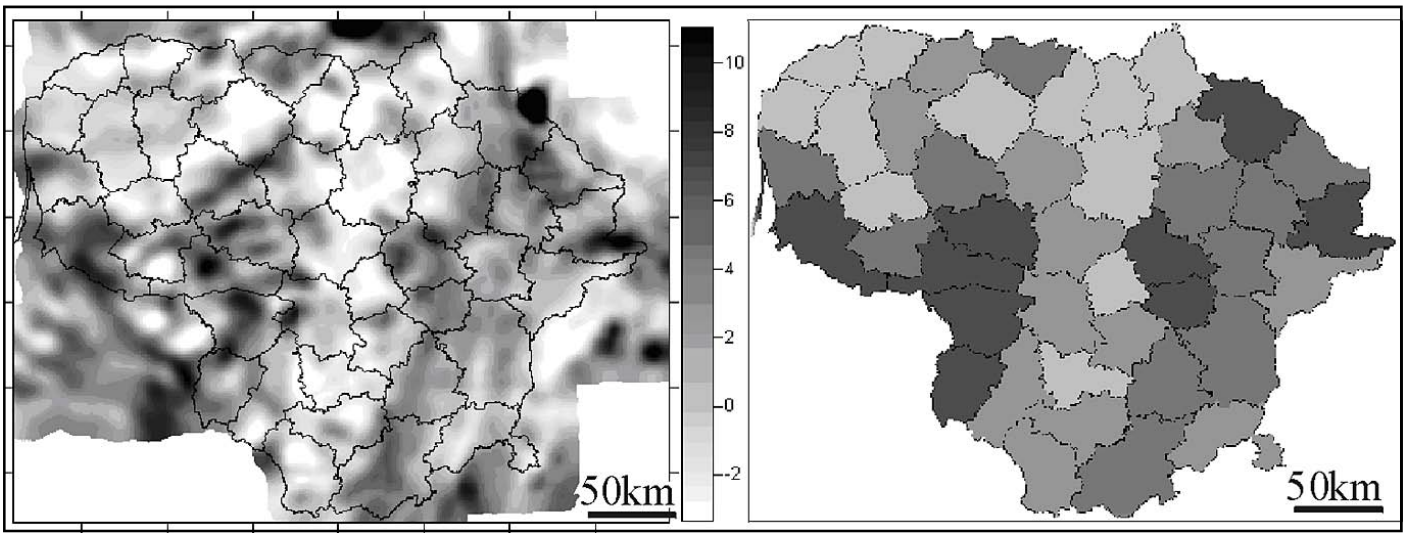

Figure 2. Conventional magnetic field map (left figure) scaled to 45 administrative regions of Lithuania (right figure).

Figure 1. Cardiac-vascular disease rates (lethal events per 100,000 population) in different regions of Lithuania, year 1999, 2001, 2002, 2003. Note consistent trends for different regions.

major factors controlling the other landscape parameters (drainage network, land cover, etc.). Accordingly, the higher magnetic field (in turn, the higher and more dissected relief) directly correlates with the lake, wetland, and forest percentages, while inversely correlating with the river and neotectonic fault network densities. These factors show opposite trends from the gravitational field. The relief intimately relates to the sub-soil lithologies that have different geochemical compositions.

This statistical cross-correlation between different environmental factors provides some explanation for the obtained statistical relationships with different diseases. Cancer is shown to correlate with the magnetic field and some trace elements (Ti, Zr, Y, Yb). These elements are typical representatives of the clastic (allochtonous) association showing increased amounts in sandy lithologies. This particular lithotype set is believed to be the environmental factor directly controlling the spatial distribution of the disease rate in a country scale.

As for the respiratory diseases, the relief seems to be of primary importance. The atmospheric currents and related chemical enrichment are strongly dependent on the relief that can explain the observed relationship. As for the potential fields, they have a direct influence on a relief via relationship ”crustal structure – relief forming processes”.

The infections are ”gravity”-group controlled (a direct correlation). They primarily correlate with soil pH, and the more acid soil seems to have a remedial effect via the food chain.

Cardiao-vascular diseases directly correlate with the ”magnetic” group factors, but the most essential parameter seems to be the drinking water chemistry, the lower disease rate being associated with high concentrations of Na and K. These two elements, especially potassium, are well recognised to prevent cardiac-vascular diseases.

Schizophrenia is ”magnetic”-group controlled. The major parameter is likely the sandy lithologies that are typically enriched in phosphorus which is known to have strong impact on brain function.

The suicide level shows a surprisingly strong geographical control. A likely explanation is an impact of the landscape on the economic-social framework. On the other hand, direct involvement of the geofactors should not be neglected, as is hinted by the strong correlation of the disease rate with the drinking water chemistry, in particular the remedial (in terms of statistics) effect of potassium. It is known that when potassium starvation becomes chronic, suicide is often contemplated and sometimes attempted.

The homicide rate does not show any correlation with environmental factors, as it is primarily a social-dependent parameter. Still, some interesting direct correlation of the fault density with the homicide rate should be mentioned. It is often discussed to what extent tectonics may have an impact on crime rate.

Conclusions

Environmental conditions show rather minor changes across the country. However, even minor changes in the living environment have a certain impact on human health. We fully acknowledge that the human health depends on interaction of very different factors, and the environment is one (and maybe not the most important) of those factors.

The presented results indicate that one has to be rather careful when interpreting observed correlations of human behaviour and health with low-intensity earth's fields, as we are living in a highly complex environment where different parameters are very closely interrelated. The authors of the presented study do not neglect the possible influence of potential fields on a human organism, but one has to be careful when identifying factors having direct and indirect impacts.

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We can now offer the book, Essentials of Medical Geology, with a 30% discount to members of IMGA. Contact IMGA Secretary, Kim Chisholm, for details.

HEALTH OF CATTLE AND WILDLIFE DOWNWIND FROM GAS FACILITIES: THE WESTERN CANADA STUDY

Tee L. Guidotti, MD, MPH; Co-chair, Scientific Advisory Panel, Western Interprovincial Scientific Studies Association, Calgary, Alberta (Canada) and GWUMC SPHHS Department of Environmental and Occupational Health, 2100 M St., NW, Ste. 203, Washington DC 20052, tel. 202 994-1734, fax 202 994-0011, eohtlg@gwumc.edu.

The Western Canada Study of Animal Health Effects Associated with Exposure to Emissions from Oil and Natural Gas Field Facilities was begun in 2000 to answer specific questions related to alleged exposure-related averse outcomes in cattle downwind of gas facilities, mostly related to reproduction, calf production and mortality. The study was designed to answer primary hypotheses with sufficient power to resolve the issues and secondary hypothesis with enough power to provide a reasonably authoritative answer. Ultimately, 33,000 cows (which in turn produced 28,000 calves) were followed through two calving cycles in four western Canadian provinces, each individually tracked with herd-level exposure assessment based on passive dosimetry and, for a subset, supplemental fine particulate monitoring. A nested wildlife study was conducted at the same locations using European starlings as an indicator species. With specific anomalies and exceptions noted in the report, there was no overall pattern to suggest substantial adverse effects on cattle reproduction or wildlife. Air contaminant levels were relatively low compared to urban air pollution. The Study was professionally managed by an independent corporate entity created for the purpose, Western Interprovincial Scientific Studies Association, with oversight by a Scientific Advisory Panel. The principal investigator for the Study was Dr. Cheryl Waldner, veterinary epidemiologist at the University of Saskatchewan. Further information is available at: http://wissa.hillandknowlton.ca.

2ND HEMISPHERICAL CONFERENCE IN MEDICAL GEOLOGY

OCTOBER 21-26, 2007, SAO PAOLO, BRAZIL

On behalf of the International Medical Geology Association (IMGA) and the Organizers of the Brazilian Geochemistry Congress, we invite you to participate in the **2nd Hemispherical Conference on Medical Geology**, October 21-26, 2007 in Sao Paulo, Brazil. The aim of this conference is to bring together scientists from South America, Central and North America, Canada, and the Caribbean Basin to share the most recent advances and latest information on Medical Geology research with particular emphasis on this part of the globe. The 1st Hemispherical Conference on Medical Geology was organized in Puerto Rico with participation from over 50 delegates and with representation from each of the regions.. The 2nd HCMG is expected to bring together a wide range of disciplines in geosciences and biomedical research with particular interest on Medical Geology. Among the general topics of this international meeting will include:

1. Soils, water, air and public health
2. Environmental surveillance and public health
3. Emerging and re-Emerging Diseases and Medical geology
4. Geochemical and Human Health Databases
5. Tools of the Trade in Geosciences and Public Health

For more information please contact the IMGA at olle.selinus@home.se or Jose Centeno at Centeno@afip.osd.mil or tonycent@comcast.net.

MEDICAL GEOLOGY IN BRAZIL: EFFECTS OF GEOLOGIC MATERIALS AND FACTORS ON HUMAN HEALTH AND ENVIRONMENT. 2005 INTERNATIONAL WORKSHOP OF MEDICAL GEOLOGY RIO DE JANEIRO, BRAZIL

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RIO DE JANEIRO, BRAZIL, 2006

Medical Geology, the science dealing with the study of the impacts of geologic materials and processes (that is the natural environment) on animal and human health, is a rapidly growing discipline that has the potential of helping the medical community all over the world in addressing a wide range of environmental and human health issues and improve public health. This book addresses specific issues regarding the development and integration of medical geology in Brazil. It was prepared with the objective of describing the state of medical geology research in Brazil, with particular emphasis on the geological considerations, methodologies and results of current investigations conducted by Brazilian geoscientists and biomedical/public health professionals.

The book is arranged in 30 chapters which were presented as research articles at the recent 2005 International Workshop of Medical Geology (IWMG-2005). The IWMG-2005 was organized in June 2005 in Rio de Janeiro, under the auspices of the Geological Survey of Brazil - CPRM. On the first chapter, Dr. Olle Selinus provides a detailed description and historical evolution of Medical Geology as a globally emerging discipline, and gives the reader an insight into how exposure (or lack of exposure) to trace elements can affect our quality of life. The second chapter by da Silva et al. details the historical progression of medical geology in Brazil, which is follow by a chapter on the importance of integrating epidemiological studies on the evaluation of public health within the context of Medical Geology.

The others chapters provide detailed and precise information on results obtained from a number of regional and national research studies in Brazil, approaching themes related to the concept of Medical Geology. In many cases, data obtained from geochemical studies have been correlated with human health data from populations affected by these prob-

lems, providing a forum that will encourage interactions and communication between the geoscience and biomedical/public health communities to seek novel solutions to better protect human health from the damaging effects of physical, chemical and biological agents in the natural environment.

Our aim in preparing "*Medical Geology in Brazil*" has been to provide the first compilation of references illustrating the development and implementation of Medical Geology inn Brazil. This collection of chapters is not a complete review of our understanding of issues acting at the interface of Geosciences and Health, and the focus of chapters on specific issues indicates the main areas of research within Brazil. Nevertheless, we hope that by compiling these works of our Brazilian peers and colleagues, we may initiate a further drive for reference regional books of this nature.

We would like to thank all the authors for the valuable contribution, in special to Foundation of Assistance the Research of the State of Rio de Janeiro (FAPERJ), for the financial support, to Geological Survey of Brazil (CPRM), to Brazilian Society of Geochemistry (SBGq), and the International Medical Geology Associations (IMGA) for the incentive and logistical support, we are sure that together we are contributing for the dissemination and development of Medical Geology in Brazil, consequently, to improve the quality of life of our population.

Cassio Roberto da Silva, CPRM
Bernardino Ribeiro Figueiredo (UNICAMP)
Eduardo Mello De Capitani (UNICAMP)
Fernanda Goncalves Cunha (CPRM)

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EDITORIAL POLICY AND DIRECTIONS TO AUTHORS, MEDICAL GEOLOGY NEWSLETTER

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- Articles should typically be about two pages long, of single spaced Times Roman 12 point text, including figures and tables. Longer articles may be included subject to space availability.
- Submissions may be edited to fit into the space available in the Newsletter or for clarity.
- A submitted item may be delayed to a subsequent newsletter, usually be because of space limitations.
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The Newsletter will be prepared in MS Publisher and distributed on a CD.

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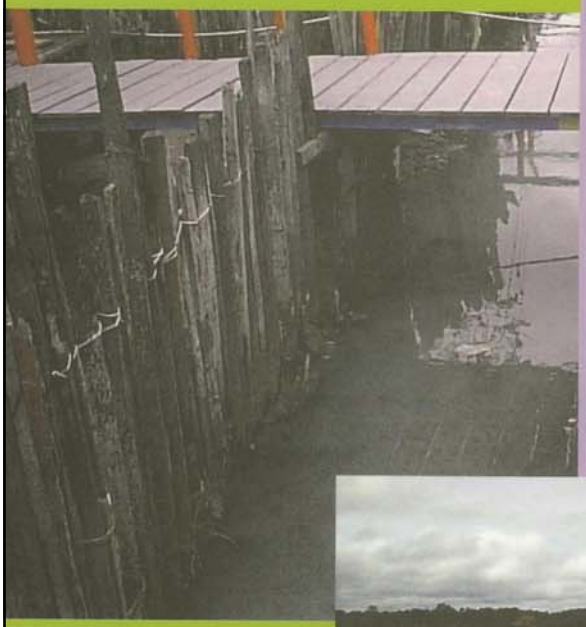
2005 WORKSHOP INTERNACIONAL DE GEOLOGIA MÉDICA

RIO DE JANEIRO, BRASIL

GEOLOGIA MÉDICA NO BRASIL

EFEITOS DOS MATERIAIS E FATORES GEOLÓGICOS NA SAÚDE HUMANA E MEIO AMBIENTE



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Cover of the book MEDICAL GEOLOGY IN BRAZIL
See page 25 for information on the English version