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MEDICAL GEOLOGY NEWSLETTER

International Medical Geology Association

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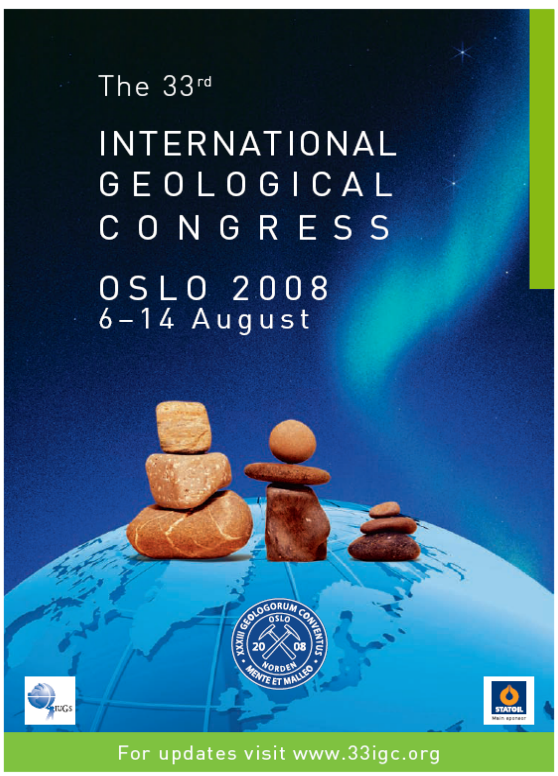
MEDICAL GEOLOGY AT THE INTERNATIONAL GEOLOGICAL CONGRESS,OLSO , AUGUST 2008

Medical geology will be highlighted at the International Geological Congress in Oslo in August 2008. About 6000 participants are expected. Participate in the Medical Geology programme!



CONFERENCE THEME, Monday 11 August:
Water, human health and the environment

SYMPOSIA
- Earth and health/medical geology
- Groundwater – geopollution, contamination and health aspects
- Emerging issues in geotoxicology –other aspects of geology and health
- Occupational and geohazard applications of medical geology
- Quantitative aspects of medical mineralogy

HALF DAY SYMPOSIUM
To set out the key questions posed by the IYPE's Theme Earth and Health

SHORT COURSES
- Medical Geology
- Quantitative aspects of Medical Mineralogy

IMGA Business Meeting

Inside this issue:

FROM THE DIRECTORS: THE FUTURE

What is the future of medical geology and the IMGA? It is generally risky to predict what the future holds, especially for an emerging intellectual pursuit that can be buffeted by economics, politics, business trends, and other factors. Nevertheless, there may be certain trends emerging and some logic that may allow us to forecast what medical geology would look like 10 years from now. We envision that it will be an accepted field of endeavor with people identifying themselves as practitioners. The field will continue to grow. Certainly the increasing concerns about climate change and its potential health impacts will help foster interest in medical geology.

But where will medical geology be flourishing? The level of interest and the enthusiastic response from students is a function of the prevalence and severity of medical geology issues. In many developing countries mining activities are leaving, or have left, a legacy of environmental degradation and concomitant health problems due to poor water and air quality. Simply experiencing these problems does not appear to be a sufficient stimulus to medical geology activities. The country must have a robust geoscience community, a conscientious public health community, a political atmosphere tolerant to environmental issues, and a reasonably sound economy. Finally, the most critical and unpredictable aspect is the need for a catalyst, an individual or group willing to take on the mantle of leadership.

In the developed countries medical geology will largely be of academic interest. Credit courses will be offered. Organizations and individuals will seek to apply knowledge, skills, tools, and databases in collaboration with researchers from developing countries. In the future, representatives from developing countries will lead the International Medical Geology Association – perhaps the current leaders of the Regional Divisions. A journal dedicated to medical geology will be published regularly and a conference dedicated to medical geology will be held on a regular basis. Modest funding for medical geology research could be available from the European Union, the World Health Organization, the U.S. National Science Foundation, multinational banks, and philanthropic organizations. Geoscientists will still dominate the field but there will be greater networking and collaboration with public health and biomedical scientists. Finally, government agencies, universities, and mining companies will begin to advertise for medical geologists.

Saying this we wish to point out some concrete matters for the near future:

In October we will organise the Second Hemisperic Conference in Medical Geology in Brazil. The first was in Puerto Rico. Detailed information can be found on the website. In connection with this, we will also have a short course in medical geology.

We are also planning for a sponsored conference in Monaco next spring. In the next newsletter we will hopefully have necessary details. Another important conference in the future is the 33rd International Geological Congress in Oslo in August next year. There will be much medical geology there and more information can be found in this newsletter. (see front page) September 1 the final program was launched on the website (www.33igc.org) and registration started. There is also a possibility for scientists from developing countries to apply for money to attend the Congress. See the website for more details under Geohost Applications.

When we have the resources necessary, we intend to fund IMGA member travels to conferences and short courses. The funding will be based on need and potential for meaningful benefits and contributions. This will be an important matter for the association. IMGA wants to support young scientists who are interested in bringing this interdisciplinary science forward. It is also important to support scientists from developing countries where many studies in medical geology are carried out.

When funding permits we would also like to sponsor specific research in medical geology. One first step is the Expressions of Interest on Earth and Health in the International Year of Planet Earth.

FROM THE DIRECTORS: THE FUTURE (Cont.)

An important step in education will also be the web based course in medical geology we are working on. See this newsletter for more details.

We will also contact all regional divisions of IMGA to involve them in all that is going on.

Finally we are also working on making it possible for all members to pay their dues by creditcard by just pressing a button on our website. This is actually quite complicated to arrange with several external banks and companies involved. But we are almost there!

Please look at the website regularly for information on when we are ready in the very near future.

Next newsletter will be ready in December. We urge everyone to send material for the newsletter, including reports from all regional divisions to the editor Dave Elliott not later than the end of November.

Olle Selinus, Bob Finkelman, Jose Centeno

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The main year of International Year of Planet Earth is approaching. Medical geology is one of the topics of this event, and we will, therefore, report on certain activities and provide an update on pending events.

National/Regional Committees

Since the onset of 2007, fifteen more nations have established a National Committee, nine of them (**in bold**) in the last three months alone, bringing the total to forty six. These include: Albania, **Argentina**, Australia, Austria, **Belgium**, Brazil, Bulgaria, Canada, Cyprus, Czech Republic, **Denmark**, Estonia, France, **Georgia**, Germany, **Hungary**, India, Iran, Iraq, Ireland, Italy, Japan, Korea, Lithuania, Malaysia, **Mexico**, Mongolia, Morocco, **Mozambique**, Namibia, Netherlands, New Zealand, Norway, Peru, Poland, **Portugal**, Romania, Slovak Republic, Spain, Sweden, Switzerland, Tanzania, Turkey, UK, **USA** and Yemen. In addition, there is one Regional Committee for IYPE, for East and Southeast Asia.

BOARD OF PLANET EARTH

Launch Events

The triennium of the International Year of Planet Earth (2007-2009) was launched in three continents (Asia, Europe and South America) within less than a month of New Year's Day 2007. Geoscientists from all corners of the Earth converged on London on 9th January for the inaugural meeting of the Board of the International Year of Planet Earth Corporation (familiarly known these days as the IYPE). Fifteen Board Members came, together with some twelve IYPE national Committee representatives, 3 International and Associate Partners, two observers, and one of the IYPE's Goodwill Ambassadors, Professor Aubrey Manning.

All gathered at 9 a.m. on 9th January in the august Council Room of the Geological Society of London (GSL) to deliberate on the status of the IYPE at the moment when the long-serving Management Team yielded up its governance role to the new Board. The heavy work over, the delegates 'shape-shifted' into celebratory mode on 10th January at the prospect of the formal joint launch of the International Year of Planet Earth and the Bicentenary of the Geological Society of London (2007), recognized by all as a very happy coincidence. Board members, GSL Fellows and schoolchildren all trooped out into the rain-threatened courtyard of Burlington House to hear Professor Richard Fortey, FRS, President of the GSL, and invited speaker, Professor Aubrey Manning. Professor Manning congratulated the world's oldest geological society on reaching its bicentenary and welcomed the International Year of Planet Earth prior to the launching of 4567 balloons, half of which bore the GSL logo and the other half that of the IYPE, each balloon representing 1 million years of Earth history! He spoke passionately on the need to nurture the Earth and for geology and its cognate sciences to play an increasingly vital role in ensuring that both the riches and the vulnerabilities of the planet are respected so that our dependence on the Earth may be tempered by long-term awareness of the principles of sustainability.

As the rain fell heavier, the ropes restraining the large canvas mass behind the speakers was suddenly loosened, releasing the mass of blue and white biodegradable balloons that rose above the twin greys made up of London's buildings and clouds ,and veered away into what is usually part of the flight path of the innumerable passenger airliners that descend upon Heathrow airport. Scurrying back into Burlington House and into the old library of the GSL, several tables were laid out with geological samples and exhibits.

Preparations for the Global IYPE Launch Event at the UNESCO Headquarters in Paris, on 12th and 13th February, are in full swing. About 700 guests are expected, including some 350 students from all corners of the world. Heads of State, leading scientists and CEOs of major international companies will address four key issues dealing with Earth Sciences for Society. A second continent-wide IYPE Launch event will take place on 22 and 23 May, 2008 in Arusha, Tanzania, and preparations are in hand for a comparable event in Latin America later in 2008.

Science Programme Committee

Guidelines for Science Project Proposals are being developed. The Science Programme Committee is evaluating more than thirty Expressions of Interest, some of these on Earth and Health or Medical Geology, of which about two-thirds are considered capable of further development. It is expected that some modest funding for the Science programme will be available in the course of 2007. A meeting of the SIT leaders is scheduled for September or October 2007.

Outreach Programme Committee

Guidelines for Outreach Project Proposals are being produced. The Outreach Programme Committee are evaluating over 30 Expressions of Interest. A Vice-Chair of the OPC was appointed, Dr. Phil Manning (UK). A group has been created to secure the corporate identity of the IYPE. Work on transforming the IYPE website into a web portal is expected to start

soon. Ten thousand copies of a new, eight page flyer were produced and preparations are being made to reprint 5000 copies of the very first IYPE Brochure, 'Planet Earth in Our Hands'. In addition, the IYPE brochures are in the process of being translated into a variety of languages. Some 10,000 copies of the Soil brochure will be printed in French. On June 22nd a contract was signed between the IYPE Corporation and the Boston & Hannah Company for the production of the IYPE book, with a target completion date of February 2008.

Board

On May 4th, the Board of IYPE Officers (a subset of the IYPE Board) met in London. An outline strategy for addressing the question of filling the remaining vacancies on the IYPE Board was drafted. This was taken further, among other issues, during the full Board meeting on 20th and 21st June in Paris. A list of nominees was produced which will result in the final appointment of a Chairperson before mid September

2007. Dr. Larry Woodfork agreed to stay on as the Acting Chair of the Board in the interim. Procedures were also developed for the appointment of a Vice Chair, the Chair of the Development Committee, and for final appointments of the shared positions of the representatives of the Associate Partners, the International Partners, major sponsors, and of the Regional Representatives. In addition, some well-known and respected, non-geoscientist VIPs will be approached as Honorary Co-Chairs, adding to the status of the IYPE.

The International Geographical Union (IGU) and the American Geological Institute (AGI), both of which are Founding Partners of the IYPE, appointed their former President Prof. Anne Buttimer and its Executive Director Dr. Pat Leahy, respectively, as members of the Board.

Secretariat

The IYPE Secretariat has been operational since January 2007, and a first evaluation of it took place at the end of March. An electronic archive has been put in place and the Expressions of Interest for both the science and outreach programmes are now being processed through the Secretariat. The Secretariat took responsibility for production of the Minutes of the Second Board meeting that took place in June.

FURTHER INFORMATION ON IYPE AT:
www.yearofplanetearth.org

WHY EATING DIRT CAN BE GOOD FOR YOU...UNLESS IT CONTAINS LEAD

Heather Gingerich

Pain in the pocketbook

Does little Jonny suffer from NDD (nature deficit disorder) on top of his ADHD and childhood obesity? Does he know where the ingredients for his Coco Puffs came from before the grocery store? Is there a T-shirt with the slogan "If it can't be grown, it must be mined" anywhere in his closet?

These may all be signals that the "disconnect" between urban populations and the natural environment is as wide as it has ever been. Curiously, this situation has developed at a time when North Americans are having to dig ever-deeper into their collective pockets to pay for health care. According to the *Economist*, increased health spending is outpacing economic growth, with per capita expenditures from both public and private sources growing at twice the rate of gross domestic product (GDP). The biggest spenders appear to live in the United States, with 15.3% of the national income going towards health, followed by Canada at about 9.5% and Mexico at 6.5%.

This is bad news for governments and citizenry alike, as remedial measures include raising taxes, reducing other spending (i.e. education, infrastructure, environment, social programs) or requiring the electorate to pay themselves, which are all bitter pills to swallow. However, Medical Geology may offer another, more palatable, option – reducing health care spending through prevention.

The worth of an ounce of prevention

The Big Three (cardiopulmonary disease, cancer, diabetes) currently account for the bulk of the nearly $2.2 trillion USD in health spending in North America, and most analysts only see that number rising with the increased pressures of an ageing population and globalization. Of course, we'd be remiss to ignore all the new pathologies that are cropping up thanks to the clear and present dangers associated with climate change.

When you think about it logically and statistically, some proportion of disease incidence *must* be linked to natural geological and ordinary environmental factors – it can't all be caused by lifestyle choices and heredity. Consider then (possibly while nibbling on a doughnut), the vast fortunes that might be saved if the incidence of say, cancer, could be reduced by the health expenditure equivalent of 1%. For the mathematically disinclined, the impressive sum involved in that maneuver would be just shy of $22 billion USD – more than the GDP of the Dominican Republic or the state of Vermont.

And what if the geographical distribution of such health problems could be accurately defined for targeted relatively inexpensive preventative strategies like public awareness and education? The judicious use of gamma-ray surveys that reduces the incidence of some bone and lung cancers by cutting off human exposure routes to naturally-occurring radionucleotides via drinking water and radon gas-laden air in basements is but one example of the many cost-saving scenarios that are based on the principles of Medical Geology.

Here there be monsters

Still, the notion of geoscientists as front-line health care workers may be a bit of a stretch for the masses, those that make up the budgets, and most doctors. Members of the latter group are relatively abundant in North America, although there is arguably always room for more, especially in sickening communities. In Canada, the United States and Mexico there is one physician for every 476, 182, and 667 people, respectively. However, medical school curricula are jam-packed as it is, and so there is little room to explore the relationship between rocks, dirt, and water and grandpa's rheumatism.

Fortunately, exploration is *terra cognita* for geoscientists, who have been collecting data and systematically mapping North America for over 150 years in the form of geological surveys. As a result, there is now a treasure trove of health related information available in the public domain, not to mention the gems of proprietary data that are being hoarded by private industry.

The dawning of the Computer Age has made Medical Geology a very cost-effective option for reducing health spending. Take all of the *existing* geological information available for a given area and couple it with the epidemiological data that has been gathered in the past 60 years by institutions like the World Health Organization, the Center for Disease Control, and Statistics Canada (who performs detailed Canadian Community Health and National Public Health Surveys that are geo-referenced by postal code). Put it all into the hands of a GIS-whiz, and watch previously obscured patterns emerge like a scene out of *A Beautiful Mind*.

If a geologist falls in the forest, does anybody hear?

The recipe is simple, and best of all, it calls for ingredients that we already have on hand. So why do most North Americans still think that Medical Geology pertains to the care and treatment of sick pet rocks? Perhaps because so many in our technology-loving society have forgotten the fact that humans are part (and not apart) of the natural world.

It turns out that ignorance of some things (like the lead in your drinking water) is not bliss, and that we are the apparent victims of our own success in an over-specialized and insular North American society. Thus, health care practitioners and policy-makers are not likely to recognize the answer to run-away spending that's lying right beneath their noses…or feet.

This was not always the case, as Hippocrates and Chinese medical practitioners, who were arguably superior general scientists as compared with their modern counterparts, had established as early as the third century BC that health (or lack thereof) is often related to the air, water and soil of a "place" – they just didn't know exactly how.

Precise figures are hard to come by, but geoscientists and physicians appear to be more or less equally numerous in North America – about 870,000 versus 650,000, respectively, in the United States, for example, but the latter has the access to both the public whose health we're trying to save and, perhaps more importantly, the halls of legislative power.

Therefore, the remedy for the "earth-health disconnect" probably isn't about training more earth scientists or more doctors, or even training them differ-

WHY EATING DIRT CAN BE GOOD FOR YOU (Cont.)

ently for that matter. The most likely solution involves a) recognising the foundational contribution of the earth science community, especially within the community itself, b) restructuring the existing body of geoscientific knowledge so as to allow for a multiplicity of uses, including public health and c) effectively *marketing* this information to practitioners of health care and policy-making.

The Great One once said

Although the road back to earth-health integration is being made in concurrent and not consecutive steps, the fact that the International Medical Geology Association has only 13 members in Canada, 35 from the United States and 6 in Mexico, indicates that we are closer to the beginning of the journey than its end. After all, that's one card-carrying medical geologist for every 8.8 million people or 16,000 physicians. However, we're not starting from scratch either.

For instance, in terms of making quality geoscientific information available and intelligible for non-geoscientists, you don't have to dig very far into the USGS Health web-site (http://health.usgs.gov/) to find little goodies like a dataset of chemical water quality parameters for 18,659 domestic wells. And the goal of Natural Resources Canada's Environment and Health Program (http://ess.nrcan.gc.ca/eh-esh/index_e.php) is to construct a "stable and predictable framework" of geoscience information intended for use in health policy-making.

The Geology and Health division of the Geological Society of America (GSA) already boasts 200+ members a mere two years after its inception. This impressive number yet only represents 1% of the total membership, and so there is ample room for growth.

Furthermore, there are eight Medical Geology-related topical sessions offered at this year's GSA Annual General meeting October 28-31 in Denver, Colorado, and they include everything from *Malice and Medical Geology: From Arsenic to Polonium—An Examination of Geological Agents as Poisons* to *Positive and Beneficial Aspects of Earth Sciences in Public Health*. The deadline for submissions was July 10 but it's not too late to visit http://www.geosociety.org/meetings/2007 for a complete listing of topical sessions and information about attending this meeting.

Which is what this IMGA regional co-director intends to do. I figure that not only is setting up a booth and waving the Medical Geology flag in Denver worth the investment, but it is in keeping with the sage's advice - if you want to score the goal, you've got to "skate to where the puck is going to be" (Wayne Gretzky).

Editor's Cultural Note for non-canadians.

Wayne Gretzky was an ice hockey player of superlative talent. It pains the editor to admit this, since he reached his peak when playing for the Edmonton Oilers, the great rivals to the editor's home town Calgary Flames. He was often referred to (by Edmontonians) as "The Great One" When requested, Ms. Gingerich refused to change this reference!

A FORUM ON MEDICAL GEOLOGY: IMPACTS OF NATURAL ENVIRONMENT ON HUMAN HEALTH—CASE STUDIES FROM ASIA

The forum was held on 23rd May, 2007 at the Institut Geologi Malaysia, Kuala Lumpur, Malaysia
Organised by :
Insitute for Environmental and Development (LESTARI, UKM) ,
Institute of Geology, Malaysia
The Geological Society of Malaysia
International Medical Geology Association

See Article on Page 12, Medical Geology: Impacts of Natural Environments

GEOGENIC DISEASE IN PARTS OF THE GANGETIC PLAIN AND ITS RELATION TO THE GEOCHEMICAL ENVIRONMENT

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The Gangetic Plain, India, is underlain primarily by Quaternary alluvial deposit of the Pleistocene and Holocene period. The thick pile of the Quaternary alluvial sediment column, ranging in thickness from 200m to 1000m (Kar *et al* 1996; Prasad and Kar 2005) is, in places, associated with volcanogenic sediments. Geomedical studies indicate the presence of naturally occurring excessive arsenic and fluoride in groundwater from various states, namely Punjab, Uttar Pradesh, Bihar, West Bengal, and Jharkhand. Selenium concentrations in parts of Punjab (Prasad and Kar, 2004), and boron and manganese in higher concentrations are recorded in the alluvial soils.

The detailed study carried out in parts of eastern Uttar Pradesh and Bihar was aimed at identifying the causative factors for the health problems in the area. The study involves the geomorphic disposition of the Quaternary sediments, their mineralogical composition, and chemical constituents. The area is highly populous and agriculture is the main occupation. The local populace suffers from lower limb deformity for unknown reasons. The major part of the area is occupied by black soil deposited in a lacustrine environment (Figure 1). These soils shows swelling and shrinkage properties, developing surface cracks during dry period and becoming slippery and sticky in the rainy season.

Fig.1. Palaeolake surface under active cultivation.

Geologically, the area exposes the Pleistocene sediments designated as Older Alluvium and Newer Alluvium of Holocene age, developed along the flood plain of the Ganga River system. The alluvial units comprises both fluvial and lacustrine sediments. The Pleistocene units of the fluvial regime are represented by yellowish silty clay and sand, a multicyclic sequence recorded up to a depth of 700+ m. The lacustrine unit is represented by black clay in isolated areas. The areas under palaeolakes presently occupy a cumulative area of 380 km^2, exposed on either side of Ganga River in and around the Ghazipur - Buxar area. The thickness of the black clay unit varies from 1.5 m near the periphery to 10m at the deepest part of the palaeolake. The black clay areas are highly productive and are under intense seasonal cultivations. The agricultural produce is widely consumed by the local populace.

The black clay was sampled at 10-15 cm vertical intervals (Figure 2) to determine elemental concentrations. These samples were subjected to laboratory analysis by various methods, such as EDX, XRD, and ICP AAS, and Marc Kit. The EDX studies indicate an elemental presence of Na(0.9-5.32%), Mg (1.44-10.81%), Al (8.20-22.03%), Si (18.61-55.01%), K (1.26-5.27%), Ca (0.51-1.98%), Ti (0.24-0.64%), Mn (0.01%-0.36%), Fe (1.75-8.93%), Cu

Fig. 2. Vertical section of palaeolake clay being sampled for analysis.

(0.03-0.19%), Ga (0.07-12.93%), As (0.16-6.43%), Se 0.17 – 5.05 %), and Zr (0.2-0.51%). Of the trace elements, Ga (0.07 to 12.93 %) and Se (0.17 – 5.05 %) are of higher concentration than the others. The ICP AAS indicate average concentrations of CaO, MgO, K_2O, SiO_2, Al_2O_3 and TiO_2 are 1.9%, 2.1%, 2.2%, 60%, 15%, and 60% respectively. The 25 elements analyzed were B (50 ppm), V (71-120 ppm), Cr(70-150 ppm), Co (17-78 ppm), Ni (40-66 ppm), Zn (59-86 ppm), Sr (66-111 ppm), Y (20-25 ppm), Nb (21-24 ppm), Mo (<5 ppm), Ag (<1 ppm), Cd (<2 ppm), Sn (20 ppm), Sb (10 ppm) Ba (205-538 ppm), La (20-34 ppm), Ce (10-56 ppm), W(10- 55 ppm), Pb (10-31 ppm), Bi (10 ppm), Zr (46-220 ppm), Cu (28-54 ppm). Arsenic values were analyzed at < 20 ppm. The XRD analysis indicates the major clay mineral assemblage as montmorillonite. The other clay mineral assemblages identified are: vermiculite $(MgFeAl)_3\ (AlSi)_4O_{10}(OH)_2 .4H_2\ O$; illite ($KH_3OAl_2\ Si_3\ AlO_{10}OH_2$); nontronite $Na_{0.3}Fe_2^{3+}(Si_3Al)_4O_{10}(OH)_2 .nH_2O$; lessingite $(CeLiPO_4)(CeCa_5)(SiO_4)_3(F,OH)$ and Faujasite $(CaNa_2Mg)_{3.5}(Al_7Si_{17}O_{48}).3H_2O$. The soils are rich in P_2O_5, with values ranging from 425-1338 ppm.

Regionally the alluvial soils, represented by yellowish silty clay, are rich in K_2O, NaO, CaO, MgO, and Fe_2O_3. The common clay minerals are kaolinite, illite and there is an absence of rare earths. In contrast, the chemical composition of black clay of palaeolakes in the area shows characteristically low values of K_2O, Na_2O and CaO and a higher presence of rare earth elements and the presence of clay minerals such as montmorillonite, nontronite vermiculite, faujasite-Ca points towards volcanic ash derivatives supplemented during time of sedimentation. These volcanogenic supplements increase the toxicity of the soil manifold.

The health problems due to presence of these toxic element in soil and water resulted in diseases such as (i) cracking of the sole and oozing of blood from people working bare footed in black clay areas during the rainy season for paddy cultivation, (ii) Deformity of lower limbs- a paraplegic condition (Figures 3 & 4, below). The popular belief is that these diseases are due to the high consumption of locally grown pulses known as khesari/latri dal (*Lathyrus sativus L*). These diseases were also suspected to be due to a

Fig. 3

Fig. 4

high manganese and arsenic concentration in soil, water, and pulses (Wilner and Low 1993).

The manganese concentration of potable water and pulses were also analysed. Water samples were collected from different depths, viz. surface water, dug wells (3.5 to 5m bgl), shallow hand pumps (10-15m, bgl), most producing wells (Indian Merk-II) at depths of (30-40m bgl) and deeper tubewells (200-240m, bgl) and analyzed. The manganese concentrations vary from 0 to 0.3 ppm in dug wells to 0.3 to 0.7 ppm in shallow hand pumps against the desirable limit of 0.1 ppm and the permissible limit of 0.5 ppm (BIS). The surface water and deeper tubewells do not show the presence of manganese. It appears that the manganese concentrations in both dug well and shallow hand pumps are derived from the black clayey soil.

Paraplegic-like conditions, amongst children and adults have been observed in these areas. The data indicate a low manganese concentration in soil water and pulses. As such the deleterious effect of manganese attributed to lower limb deformity in the area is not consistent. The author suspects the cause of disease, such as the cracking and oozing of blood and the deformity of the lower limbs, is probably due to the toxic effects of rare earth elements either as one, or in combination. The lower limb deformity in infants in some cases may be attributed to juvenile arthritis is not well diagnosed.

It is important to understand the linkage between geological material and health hazards in such areas. Massive research in collaboration with medical practitioners, soil scientist, geologists, agronomists, and scientists of related field under the domain of medical geology will play an important role in understanding and ameliorating such problems.

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MEDICAL GEOLOGY: IMPACTS OF NATURAL ENVIRONMENT ON HUMAN HEALTH-CASE STUDIES FROM ASIA.

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Humans are an integral component of the biosphere, and the geosphere is the basis for all biogeochemical processes. Interactions between humans and other living organisms and their surroundings are inevitable parts of biogeochemical cycles, but humans are the only organisms with the technology and skill to control and influence the surface environment beyond the compensating capacity of natural geochemical processes in the Earth System.

In the last couple of decades, human invasion has been severe enough to perturb biogeochemical cycles significantly, leading to increased public awareness on topical issues such as "global climate change". Therefore, it is not surprising that until recently, anthropogenic activities and their adverse effects on environmental and human health were the focal points of interactions between human and the surface environment. There are, however, ever-rising inter-

SPATIAL DISTRIBUTION OF DISSOLVED LITHIUM IN GROUNDWATER AND SUICIDE MORTALITY IN TEXAS

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Lithium (Li) is the lightest of the alkali metals and is found in trace amounts in nearly all rocks (Schrauzer, 2002). In previous studies, lithium has been found to be a factor influencing suicide behavior and mortality rates. Although this relationship is not fully understood, Lithium has become known for its beneficial psychosomatic effects. The first legitimate medical application of lithium was introduced in 1949, when lithium carbonate was found to be beneficial in manic-depressive illness, and today, lithium carbonate is one of the most widely prescribed psychiatric drugs. Kessing et al. (2005, p. 860) found that "continued lithium treatment was associated with reduced suicide risk regardless of sex and age." Lithium has been associated with volcanism, a fact that may account for its common occurrence in the water of many aquifers, which are often composed of reworked and highly weathered igneous sediments (Schrauzer, 2002; Texas Water Development Board, 2005). Many counties and cities in Texas rely heavily, if not exclusively, on groundwater for their water needs. Groundwater may also have a direct influence in the natural nutritional uptake of lithium through many of the common foods and vegetables eaten daily because many of these foods contain trace amounts of lithium (Schrauzer, 2002). It is possible that the uptake of lithium through groundwater may provide a protective function on suicide behavior and mortality.

This study examined the spatial distribution of suicide mortality rates in Texas counties, from 1980 to 1998. Using the conceptual framework of disease ecology, this study provides insight into selected risk factors associated with suicide mortality. In particular, dissolved lithium concentrations in the groundwater (Figure 1) and the correlation to suicide mortality rates (Figure 2) were tested. Spearman's rank correlations and the Wilcoxon test are used to examine race, gender, and dissolved lithium concentrations as risk predictors of suicide mortality. The results suggest that Texas counties with lower dissolved lithium concentrations in their groundwater had significantly higher suicide mortality rates ($r = -.150$, $p < .025$). Counties with higher populations of Whites had significantly higher suicide mortality rates ($r=.315$, $p=.000$), but counties with higher populations of Hispanics had significantly lower suicide mortality rates ($r= -.250$, $p=.000$). Males had higher suicide mortality rates than females ($Z=-13.706$, $p=.000$). Further research into the relationship between lithium concentrations and suicide is warranted.

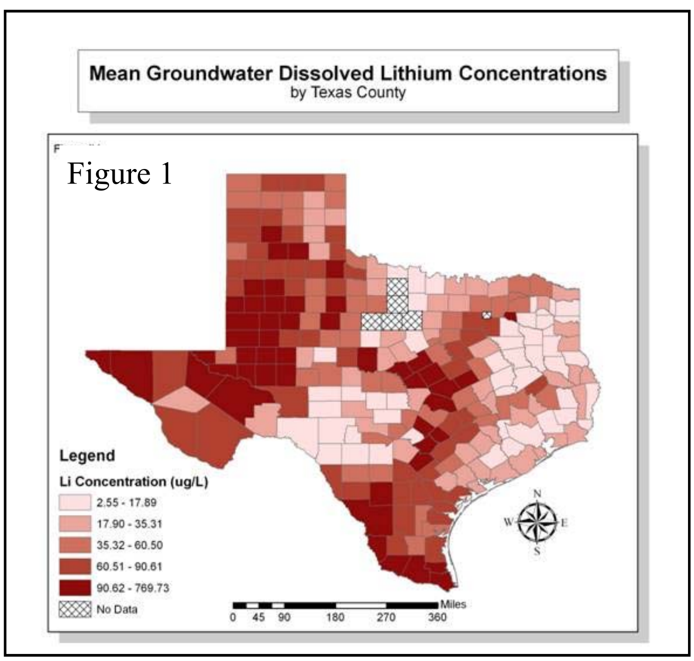

Figure 1

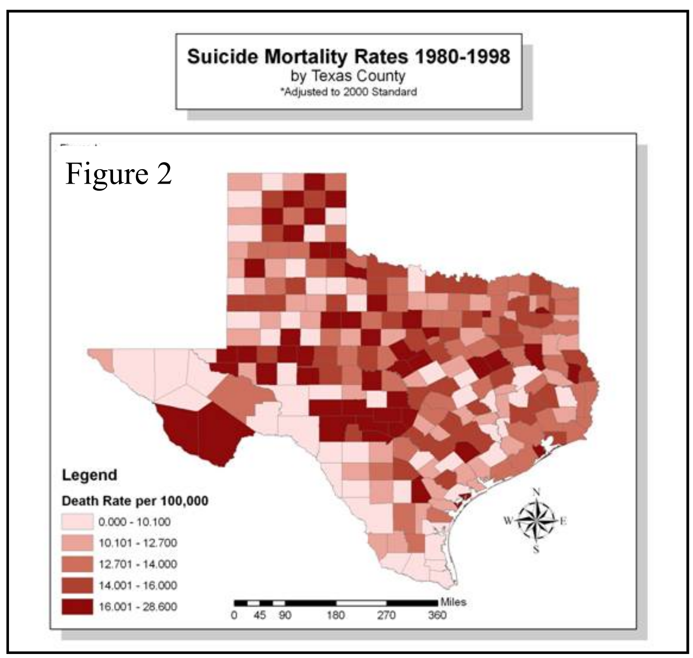

Figure 2

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MALIGNANCIES IN SWEDEN AFTER THE CHERNOBYL ACCIDENT IN 1986

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On 26 April 1986, an accident occurred in the Chernobyl nuclear power plant resulting in the release of large amount of radionuclides. Almost five percent of the total released caesium-137 was deposited in Sweden. The incidence of malignancies in Northern Sweden has been studied by Martin Tondel, MD at Division of Occupational and Environmental Medicine, presented in his thesis and defended at Linköping University June 4, 2007.

In two studies, 1.1 million inhabitants in Northern Sweden were included. In the first study the population was classified according to the deposition of caesium-137 in the parishes with help of an analogue map provided by the Swedish Radiation Protection Authority. In the second study a more advanced method was used, ignoring the exposure classification for parishes, and instead matching the dwelling coordinate and its inhabitants to a digital map of the deposition of caesium-137. In spite of a more valid exposure classification the risk estimates were similar in both studies. An increased risk by exposure in six categories, i.e. a dose response, was seen. An increased risk was statistically significant and could be expressed as 10 % per 100 kBq/m^2. No obvious excess for leukaemia or thyroid cancer was recognised in any of the studies. The estimated number of exposure related cases was calculated to be 3% of the total number of cases of malignancies. In a methodological study the two different ways of classifying the exposure was compared. Out of the 450 parishes, 111 got a different classification (25%). Two explanations were identified: skewed distributions between population and caesium, and higher resolutions in data, respectively. The similar risk estimates in both studies could probably be explained by relatively homogenous exposure in the parishes making the intra-parish difference less influential, especially when included in categories.

However, could the increase in the incidence of malignancies be explained by, e.g., confounding factors? In the analyses, adjustments have been done for several such factors with a remaining increased risk for caesium-137. Using the same methodology with dwelling coordinates and a digital map of the terrestrial gamma radiation, provided by The Geological Survey of Sweden, this radiation was also a risk factor for total malignancies. However, it indicated only weak confounding, not affecting the overall results. Applying the Hill criteria for causality there is support for a causal inference between the fallout of caesium-137 from the Chernobyl accident and the increased incidence in total malignancies in Northern Sweden.

Future Perspectives

To gain a better knowledge on the effects of ionising radiation it is important to study the exposed groups after the Chernobyl accident. This is a challenge, because of the low dose, hence requires a large study base. Sweden has the advantage of holding valid registries on both the population and health outcomes and together with the unique data on radiation exposure makes Sweden suitable for these studies. A next step needs to be a more thorough individual dose as-

Martin Tondel at Chernobyl

sessment taking internal dose into account, before calculating the risks. Our studies point to the importance of focusing on latency periods, time trends and specific sites of malignancies.

Also other outcomes, e.g. cardiovascular diseases and malformations, should be studied in relation to the radioactive fallout after the Chernobyl accident. The influence of age on the sensitivity to develop different diseases should be addressed in future studies. Finally, of great importance for future radiation protection is to evaluate the effectiveness of food restrictions, and other recommendations by the authorities, in relation to health in the affected regions.

For additional information: http://urn.kb.se/resolve?urn=urn:nbn:se:liu:diva-8886

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ECOLOGICAL AND MEDICAL HABITAT QUALITY ASSESSMENT

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EDITOR'S NOTE: This article is a further example of research in medical geology that was reported on in several articles in the last Medical Geology Newsletter. Please contact the authors for further information.

Current methodical developments in, and approaches to, technological pollution-level assessments do not allow in-corpore toxicity assessments. Usually only one factor (but sometimes several) is considered, such as chemical pollution, radioactive and ultraviolet radiation, noise level, etc. Combining many pollution parameters is not, by itself, a sufficient condition for comprehensive toxicity assessments because the list of environmental dangers (ozone holes, mobile telephones radiation, etc…) continues to enlarge dramatically. Assessing the effect of technological pollution on human health by considering the individual parameters of every affected organism is similar to an equation containing an infinite number of unknown parameters. Any efforts of assessment can only asymptotically approach existing reality.

In our opinion, any method of assessing the levels of environmental health threats must make it possible to make a preliminary assessment of toxicity levels with speed and confidence. This allows a rapid response when undertaking preventive measures, even within the sphere of medical-ecological rehabilitation of a population, or when continuing existing programmes.

ECOSCAN-technology was developed by IMGRE for such projects, which made it possible to assess with sufficient rapidity, the population of any given terrain. The environmental hazard with the greatest adverse effect on human health is then selected.

Ecological and medical research requires a staged approach. In the first stage, an examination of medical-demographic data and population morbidity is carried out and those territories that greatly differ from each other in environmental hazard levels and health indexes are selected. Territories are then compared across different levels of environmental hazard, controlled by the levels of health and social care.

In the second stage, a detailed analysis of general morbidity is carried out using the annual report data of pediatric clinics in the "background" and "experimental" territories. The analysis is supplemented with the study of the individual documentation of children suffering from chronic diseases that are registered in the dispensary books. This choice is determined by the fact that children are more sensitive to various exogenous effects, they are not addicted to any pernicious habits, and are not in occupational contact with technological pollutants, etc.

In the third stage, generalization and differentiation of the environmental, geochemical, and medical data, is carried out. Those pathologies and defects which are manifestly connected with the harmful effect of the pollutants are excluded. The specific character of technological pollutants and their potential to cause negative effects are also taken into consideration.

Research work carried out in Vladicaucasus (the North Osetya, the Caucasus Region, the Russian Federation) in 1999-2000, could serve as an example of the aforesaid. The soil pollution that currently exists in the city of Vladicaucasus has a technological origin and is closely connected with the industrial enterprises. A high concentration is typical for such elements as cadmium, lead, zinc, tungsten, stibnium (antimony), copper, silver, indium, arsenic, tin, and bismuth. In the Central district of Vladicaucasus, there is a complex zonal halo around non-ferrous industry metallurgy enterprises that produce lead and zinc, and tungsten and molybdenum concentrates. In summary, the elements in the halos of technological pollution can be differentiated into stable groups of elements of technological origin. (see box on next page).

A wide spectrum of pollutants is a typical feature of the geochemical rows, which are named after the first

Cadmic (type I)
Cd → Ag → W → Pb → Sb → Zn → Cu → Bi → In → Sn → Mo → As;
Tungsten (type II) *W → Pb → Ag → Cd → Zn → Sb → Cu;*
Silver- polymetallic (type III)
Ag → Pb → Zn → W → Sb → Bi;

element in the row, with the highest range index. The majority of soil pollutants relate to the first (Pb, Zn, Cd, As) group of potential hazard, fewer to the second group of potential hazards (Cu, Sb, Ni), and to the third group of (W, Sn). Extremely high concentrations and considerable fluctuations in the types are characteristic of the elements comprising the basic pollution types. Table 1 shows the parameters of the basic pollution types in comparison with *Maximum Concentration Limit (MCL)*.

For the elements forming the basic pollution types, an excess of the *MCL* concentration is noted. The excess of the existing normative indexes is:

I type: Cd –208 times, Pb –56 times, Zn –80 times, Cu –23 times, As –23 times, Sb –12 times, Sn – by 8 times; there are also high concentrations of In (100g\t) and Tl (40 g\t);
II type: Pb and Zn –37 times, Cd –34 times, As – 12,5 times, Cu –10 times, Sb –4 times;
III type: Zn –42 times, Cd –37 times, Pb –32 times, Cu –7 times, As –6 times, Sn –4 times, Sn –2 times;
IV type: Zn –23 times, Pb –18 times, Cd –13 times, Cu –4 times, Sn –2 times;
V type: Zn –40 times, Cd –22 times, Pb –15 times, Cu –6 times.

Within the framework of environmental and medical research, a comparative analysis of the medical data was carried out. The territories for which data was collected are comparable in geochemical pollution spectrum but are different in pollutants concentration.

There are two administrative districts in Vladicaucasus (the Industrial and the Over-Terek), different in

Elements	MCL. Hazard groups.	*I type*		*II type*		*III type*		*IV type*		*V type*	
		Av.	**Max**	**Av.**	**Max**	**Av.**	**Max**	**Av.**	**Max**	**Av.**	**Max**
Pb	32-1	1790	10000	1170	15000	1010	10000	567	3000	489	1000
Zn	55-1	4420	15000	2020	15000	2280	15000	1250	5000	2150	8000
Cd	0.5-1	104	1500	17	200	18.4	200	6.7	60	11	80
Cu	33-2	756	10000	318	6000	241	4000	123	500	186	1000
W	-	69	200	58.5	1000	18.5	200	10	60	12	30
Ag	-	6.3	50	2.4	40	2.8	30	0.7	4	1,1	6
Sb	4.5-2	51.7	500	18	400	8.7	200	0.8	40	2.3	30
As	2-1	30	500	25	600	12.6	600	-	-	-	-
In	-	49.5	300	1.8	50	0.6	10	0.2	3	0.1	3
Sn	4.5-3	34	150	20	300	16.5	100	11	30	12	30
Bi	-	11.6	80	6	100	5	30	2.3	10	2.5	6
Ni	20-2	50	300	42	100	43	150	43	300	46	60
Mn	1500	803	6000	631	2000	698	4000	646	5000	735	3000

Table 1 ***Parameters of the basic technological types and Maximum Concentration Limit (MCL) , g/t***
Note: On the territory of Vladicaucasus, the soil composition is related, in the urban and industrial zones, to clay sands, loam sands and loams in the forest park zones. As the textures of soil differ drastically and soil acidity hasn't been defined, research work (Golovin and others.., 2000) is recommended to be carried out by simpler standards. For further calculations, a Supposed Concentration Limit (SCL) of sand soils or MCL of soils was used.

geochemical characteristics, medical and demographic indices, and morbidity rates. Geochemical and medical data were obtained from issues of the State Medical Statistics and from official results of epidemiological researches. The Industrial district is characterized by a maximum level of technological pollution represented by all measured geochemical types. In the Over-Terek district, elemental pollution was shown, but with lesser concentrations of pollutants. The most auspicious medical and demographic situation with a low sickness rate was discovered there, so. the district was determined to be "background" territory. In the Industrial district, the medical and demographic situation was distinguished by negative tendencies with a predominance of indices of ecological problems (rising rate of spontaneous abortions, high indexes of perinatal and infant mortality, congenital malformations and oncology diseases).

The results of the statistical treatment of geochemical sampling into two city districts enables us to reveal a qualitative and quantitative difference in the geochemical spectrum. The geochemical parameters of the technological pollution in two districts of Vladicaucasus are shown in Table 2. There are no data on arsenic in the Over-Terek district as there is little analytic data. It is only possible to remark on a high concentration of this element in the soil of Industrial district – up to 600 g/t. Comparison with epidemiological health markers permits a metric characterisation of the cause-and-effect dependence (how the health indexes depends on the intensity of technological pollution of the habitat).

The geochemical parameters and health indexes on the "background" and "experimental" territories indicate definite regularities. In the Industrial district element-pollutants (1st hazard group, Pb 3.5 times, Cd 6 times, and if there are high concentrations of As, up to 600 g/t) in high average concentrations were identified. These can cause increasing rates of congenital malformations and tumors. These elements have mutagenic, teratogenic and carcinogenic toxicity. As for the excess of other elements represented in Table 2, information about their effect on the human health is extremely poor and incomplete, often conflicting.

	Cd			*Pb*			*Zn*			*Ag*		
	I	***O***	***R***	***I***	***O***	***R***	***I***	***O***	***R***	***I***	***O***	***R***
C_{av}	26.1	4.4	**5.9**	1195	343	**3.5**	2756	851	**3.24**	3.05	0.4	**7.6**
C_{min}	1.5	1.5	1	50	40	1.3	100	100	1,00	0,1	0.05	2
C_{max}	300	20	**15**	15000	15000	**10**	15000	3000	**5**	40	4	**10**
Σ	12.9	2.9		167	220		285,8	496		2.39	0.3	

	W			*Bi*			*Sb*			*Cu*		
	I	***O***	***R***	***I***	***O***	***R***	***I***	***O***	***R***	***I***	***O***	***R***
C_{av}	35.8	7.2	**5**	6.2	1.6	**3.88**	28,98	15	1.93	319.8	125	2.6
C_{min}	1.5	1.5	1	1	1	1,0	15	15	1	40	60	0,7
C_{max}	1000	30	**33**	100	8	**12.5**	300	15	**20**	6000	800	**7.5**
Σ	24.8	4.4		8.78	1.06		38.62	0		43.8	120	

CM	23.5	10.4
Tumors	2.2	0.6

Table 2 ***Comparative analysis of geochemical parameters and health indexes in the Industrial (I) and the Over-Terek (O) districts***

*Note: R – ratio of the concentrations in Industrial district to the concentrations in Overterek district (g/t); **σ** – standard deviation. Data about CM (congenital malformations) and tumors are represented in relative values, calculated for 1000 children in the age of 0-14.

US NATIONAL RESEARCH COUNCIL (NRC) REPORT "EARTH MATERIALS AND HEALTH: RESEARCH PRIORITIES FOR EARTH SCIENCE AND PUBLIC HEALTH

The National Research Council (NRC) recently published the report "Earth Materials and Health: Research Priorities for Earth Science and Public Health." (see covers on back page) *"This report presents a broad update describing our understanding of the interactions between earth materials and public health, provides an introduction to successful past cooperative scientific activities at the interface of the earth and health sciences, and suggests future avenues for crossover and integration of research for the common good of humankind"* (from page 10). The report also identifies research priorities at the intersection of earth materials and human health- by focusing on four basic human exposure pathways—air, drinking water, food, and exposure though natural and human changes to the environment.

The NRC produced the report at the request of the National Science Foundation (NSF), U.S. Geological Survey (USGS), and the National Aeronautics and Space Administration (NASA). The NRC was charged to investigate ways that interdisciplinary research could enhance the knowledge base at the intersection between earth and health science disciplines. The NRC's Committee on Research Priorities for Earth Science and Public Health produced the report under the auspices of the NRC's Board on Earth Sciences and Resources and Board on Health Sciences Policy.

THE REPORT

Committee on Research Priorities for Earth Science and Public Health, National Research Counsel, 2007, Earth materials and health—Research priorities for earth science and public health: Washington, D.C., The National Academies Press, 188 p., ISBN:10: 0-309-10470-X.

SUMMARY

Interactions between earth materials and processes and human health are pervasive and complex. In some instances, the association between earth materials and disease is clear—certain fibrous (asbestos) minerals and mesothelioma, radon gas and lung cancer, dissolved arsenic and a range of cancers, earthquakes and physical trauma, fluoride and dental health,but these instances are overshadowed by many cases where individual earth components, or more commonly mixtures of earth materials, are suspected to have deleterious or beneficial health impacts. Unraveling these more subtle associations will require substantial and creative collaboration between earth and health scientists.

The surge of interest and research activity into relationships between public health and earth's environment that commenced in the 1960s has not been sustained. Today, few researchers span the interdisciplinary divide between the earth and public health sciences, and "stove-pipe" funding from agencies provides little incentive for researchers to reach across that divide. The limited extent of interdisciplinary cooperation has restricted the ability of scientists and public health workers to solve a range of complex environmental health problems, with the result that the considerable potential for increased knowledge at the interface of earth science and public health has been only partially realized and opportunities for improved population health have been threatened.

In response to this situation, the National Science Foundation, U.S. Geological Survey, and National Aeronautics and Space Administration requested that the National Research Council undertake a study to explore avenues for interdisciplinary research that would further knowledge at the interface between the earth science and public health disciplines. The study committee was charged to advise on the high-priority research activities that should be undertaken for optimum societal benefit, to describe the most profitable areas for communication and collaboration between the earth science and public health communities, and to respond to specific tasks:

- Describe the present state of knowledge in the emerging medical geology field.
- Describe the connections between earth science and public health, addressing both positive and negative societal impacts over the full range from large-scale interactions to microscale bio-

geochemical processes.

- Evaluate the need for specific support for medical geology research and identify any basic research needs in bioscience and geoscience required to support medical geology research.
- Identify mechanisms for enhanced collaboration between the earth science and medical/public health communities.
- Suggest how future efforts should be directed to anticipate and respond to public health needs and threats, particularly as a consequence of environmental change.

Research Priorities

The committee addressed this charge by focusing analysis on human exposure pathways—what we breathe, what we drink, what we eat, and our interactions with earth materials through natural and anthropogenic earth perturbations (e.g., natural disasters, land cover modifications, natural resource use). Specific examples for each exposure pathway are presented to highlight the state of existing knowledge, before listing priority collaborative research activities for each exposure pathway. These research activities are grouped into three broad crosscutting themes: (1) improved understanding of the source, fate, transport, bioavailability, and impact of potentially hazardous or beneficial earth materials; (2) improved risk-based hazard mitigation, based on improved understanding of the public health effects of natural hazards under existing and future climatic regimes; and (3) research to understand the health risks arising from disturbance of terrestrial systems as the basis for prevention of new exposures. The committee received suggestions for broad research initiatives and specific research activities from national and international participants from the earth science, public health, and government funding communities at an open workshop, which formed the basis for deliberations to identify the research themes considered to have the highest priority. In compiling these recommendations the committee required that the research proposed must involve collaboration between researchers from both the earth science and the public health communities and did not consider the abundant examples of valuable research that could be undertaken primarily within the disciplines.

Earth Material Exposure Assessments—Understanding Fate and Transport

Assessment of human exposure to hazards in the environment is often the weakest link in most human health risk assessments. The physical, chemical, and biological processes that create, modify, or alter the transport and bioavailability of natural or anthropogenically generated earth materials remain difficult to quantify, and a vastly improved understanding of the spatial and geochemical attributes of potentially deleterious earth materials is a critical requirement for effective and efficient mitigation of the risk posed by such materials. An improved understanding of the source, fate, rate, and transport, and bioavailability of potentially hazardous earth materials is an important research priority.

Collaborative research should include:

- Addressing the range of issues associated with airborne *mixtures* of pathogens and physical and chemical irritants. The anticipation and prevention of health effects caused by earth-sourced air pollution prior to the onset of illness requires quantitative knowledge of the geospatial context of earth materials and related disease vectors.
- Determining the influence of biogeochemical cycling of trace elements in water and soils as it relates to low-dose chronic exposure via toxic elements in foods and ultimately its influence on human health.
- Determining the distribution, survival, and transfer of plant and human pathogens through soil with respect to the geological framework.
- Improving our understanding of the relationship between disease and both metal speciation and metal-metal interaction.
- Identifying and quantifying the health risks posed by "emerging" contaminants, including newly discovered pathogens and pharmaceutical chemicals that are transported by earth processes.

Improved Risk-Based Hazard Mitigation

Natural earth processes—including earthquakes, landslides, tsunamis, and volcanoes—continue to cause numerous deaths and immense suffering worldwide. As climates change, the nature and distribution of such natural disasters will undoubtedly also change. Improved risk-based hazard mitigation, based on improved understanding of the public health effects of natural hazards under existing and future climatic regimes, is an important research priority. Such collaborative research should include:

- Determining processes and techniques to integrate the wealth of information provided by the diverse earth science, engineering, emergency response, and public health disciplines so that more sophisticated scenarios can be developed to ultimately form the basis for improved natural hazard mitigation strategies.

Assessment of Health Risks Resulting from Human Modification of Terrestrial Systems

Human disturbances of natural terrestrial systems—for example, by activities as diverse as underground resource extraction, waste disposal, or landcover and habitat change—are creating new types of health risks. Research to understand and document the health risks arising from disturbance of terrestrial systems is a critical requirement for alleviating existing health threats and preventing new exposures. Such collaborative research should include:

- Analysis of the effect of geomorphic and hydrological landsurface alteration on disease ecology, including emergence/resurgence and transmission of disease.
- Determining the health effects associated with water quality changes induced by novel technologies and other strategies currently being implemented, or planned, for extending groundwater and surface water supplies to meet increasing demands for water by a growing world population.

Promoting Collaboration

Geospatial information—geological maps for earth scientists and epidemiological data for public health professionals—is an essential integrative tool that is fundamental to the activities of both communities. The application of modern complex spatial analytical techniques has the potential to provide a rigorous base for integrated earth science and public health research by facilitating the analysis of spatial relationships between public health effects and natural earth materials and processes. Research activity should be focused on the development of high-resolution, spatially and temporally accurate models for predicting disease distribution that incorporate layers of geological, geographic, and socioeconomic data. This will require development of improved technologies for high-resolution data generation and display.

Before it will be possible to take advantage of the considerable power of modern spatial analysis techniques, a number of issues associated with data access will need to be addressed. Improved coordination between agencies that collect health data will be required, and health data from the different agencies and offices will need to be merged and made available in formats that are compatible with GIScience analysis. Existing restrictions on obtaining geographically specific health data, while important for maintaining privacy, severely inhibit effective predictive and causal analysis. To address this, it will be necessary for all data collected by federal, state, and county agencies to be geocoded and geographically referenced to the finest scale possible, and artificial barriers to spatial analysis resulting from privacy concerns need to be modified to ensure that the enormous power of modern spatial analysis techniques can be applied to public health issues without affecting privacy.

Although important gains have been made *within* individual funding agencies toward support for interdisciplinary research, a dearth of collaboration and funding *between* agencies has restricted significant scientific discovery at the interface of public health and earth science. The committee suggests that, for there to be substantial and systemic advances in interdisciplinary interaction, a formal multiagency collaboration support system needs to replace the existing ad hoc nature of collaborations and funding support. Despite wariness about proposing yet another bureaucratic structure, the committee believes that a multitiered hierarchical management and coordination mechanism could provide a structure by which the relevant funding agencies would be encouraged to interact for improved communication and collaboration.

The synergies from interdisciplinary interactions provide the basis for innovative and exciting research that can lead to new discoveries and greater knowledge. As both the researchers, and the agencies that fund their research, seek to increase support for interdisciplinary research, the time is right for the earth science and public health communities to take advantage of the opportunity to promote true collaboration—there is no doubt that society will ultimately derive significant health benefits from the increased knowledge that will derive from research alliances.

The interface between the earth sciences and public health is pervasive and enormously complex. Collaborative research at this interface is in its infancy, with great potential to ameliorate the adverse health effects and enhance the beneficial health effects from earth materials and earth processes. The earth science and public health research communities share a responsibility and obligation to work together to realize the considerable potential for both short-term and long-term positive health impacts.

THE IMGA AND THE GEOLOGICAL SOCIETY OF AMERICA, GEOLOGY AND HEALTH DIVISION

The **IMGA** and the Geological Society of America's **Geology and Health Division** both formed at about the same time and have very similar goals and objectives. Clearly, it would be mutually beneficial if we were to develop a positive working relationship. To this end, we are in the process of developing a permanent liaison-type position between the IMGA and the G&H Division and will explore how we can effectively work together to achieve mutual goals. We encourage you to check out their website:
Geology and Health Division website: http://rock.geosociety.org/GeoHealth/index.html.

The G&H Division is sponsoring a number of sessions at the upcoming **2007 GSA Annual Meeting Oct. 27-31, to be held in Denver, CO.**

T8. **Role of Geology in Planning and Mitigation of Natural Hazards -** Syed E. Hasan
The session aims at gathering experts from a diverse field comprising geoscience, engineering, public policy, emergency planning and management, health, pollution control, and hazard forecasting to discuss lessons learned from major hazards and their mitigation. Oral.

T124 **Medical Geology** – Stephen York
This session considers anthropogenic-health-related activities that cause redistributions of naturally occurring substances. Oral.

T125. **Climate Change and Human Health: From Subtle Changes to Potential Disasters, Past, Present, and Future -** Mathew Huber, Gabriel Filippelli
This session will include studies of past climatic impacts on societies, the current state of climate modeling and risk analysis, and the variety of future scenarios, prioritized from the standpoint of risk potential. Oral.

T126. **Malice and Medical Geology: From Arsenic to Polonium—An Examination of Geological Agents as Poisons -** Gabriel Filippelli, Geoffrey Plumlee
This session will include techniques and case studies involving the identification and use of geological agents as human poisons in the past, and current efforts to quickly identify and treat toxicity cases. Oral.

T127. **Positive and Beneficial Aspects of Earth Sciences in Public Health -** Ulli Limpitlaw, Lynda Williams

We are seeking to bring together researchers of various disciplines including but not limited to geology, mineralogy, geomicrobiology, hydrology, medicine, dentistry, and geochemistry, who investigate Earth materials that benefit humans and animals. Oral.

T129. **Teaching Climate Change and Energy Issues in the Classroom: An Imperative for Educated Citizens and Geoscientists -** George T. Stone, Andrew M. Buddington

Presentations will provide geoscience educators essential knowledge and methodologies for effectively communicating salient conclusions and predictions of climate change science and energy policy analysis in the classroom and the public arena. Oral.

T130. **Forensic Geoscience: Research and Case Studies -** Elisa Bergslien, C.E. Nehru

Applications of geoscience research to the law. A forum to share research projects or present case studies. Use of analytical techniques, geophysical tools, database development, provenance, remote sensing, disturbed stratigraphy, and other investigative techniques. Oral.

T7. **The Environmental Geology and Geochemistry of Mineral Deposits: Best Practices for Effective Prediction, Mitigation, Closure, and Remediation -** Geoffrey S. Plumlee, William X. Chávez Jr, Mark Logsdon

This session presents expert perspectives on best practical application of geological and geochemical information throughout all phases of mineral development (exploration through closure), so that adverse environmental and health impacts can be anticipated and prevented. Oral.

T29. **Arsenic: From Nature to Human -** Prosun Bhattacharya, Abhijit Mukherjee, Jochen Bundschuh, Alan H. Welch

Arsenic of geogenic origin contaminates drinking water resources, soils and plants and that calls for global approaches through exchange of information and experiences among different regions of the world. Oral.

HEALTH-CASE STUDIES FROM ASIA. (Cont. from P. 12)

ests on other aspects of interactions between human and the surface environment primarily focusing on impacts of natural environment on human health. This apparently cryptic link is a re-emerging, rapidly growing discipline known as "Medical Geology".

Medical Geology studies the influences of natural environmental factors and geological processes on human/animal health, and their geographical distribution. In this context, earth's materials such as atmospheric dusts, found in the surface environment either in the form of solution, gas, bio-molecules or minerals, can contribute to the etiology of endemic diseases. Despite the significance of geology in human health, there is only limited understanding of the mechanism of toxicity and relative roles of other cofounder factors (e.g., genetic, geographic and demographic) triggering diseases. It is, nevertheless, ironic that the fundamental principles controlling the complex interactions between the human body and earth's materials also regulate the distribution and dispersion of elements in geochemical processes. Therefore, improving our understanding about the factors governing bioavailability, stability, solubility and reactivity of chemical elements in the surface environment as well as in the human body are equally important to assess the consequences of interactions between human and the surface environment in general.

Many people living in developing countries in Asia rely on coal for their domestic energy. Several toxic trace elements released into the atmosphere can be inhaled and/or ingested by humans leading to severe health problems, and even to death. The health impacts of indoor coal combustion, and the geochemical and toxicological characteristics of As, Se and Fe have been studied

2ND HEMISPHERIC CONFERENCE ON MEDICAL GEOLOGY, BRAZIL

On behalf of the International Medical Geology Association (IMGA) and the Organizers of the XI Brazilian Geochemistry Congress, we invite you to participate in the **2nd Hemispheric Conference on Medical Geology**, October 21-26, 2007 in ATIBAIA, State of Sao Paulo, Brazil. The aim 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 Hemispheric Conference on Medical Geology was held 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 you will find:

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
6. Risk analysis and risk communication

SHORT COURSE ON MEDICAL GEOLOGY, Monday, October 21, 2007, Atibaia Bourbon Resort

An one-day short course will also be held in conjunction with the XI Brazilian Geochemical Congress in Atibaia, Brazil. The leaders will be Olle Selinus, Robert Finkelman, José Centeno and Geophrey Plumlee. Additional information on short courses programs can be found at http://www.medicalgeology.org

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

The Bourbon Atibaia Resort , Atibaia

More information at http://www.bourbon.com.br/galeria_fotos_atibaia.php

NEW DISTANCE EDUCATION COURSE IN MEDICAL GEOLOGY

Since their commencement ten years ago, short courses in Medical Geology have been held in more than 40 countries across every continent. The courses have been attended by thousands of students and professionals with diverse backgrounds in medical, environmental and geological disciplines. In order to meet the growing interest in Medical Geology, the International Medical Geology Association (IMGA) is now coordinating a distance education course enabling a broader global audience to learn about this emerging discipline

The distance education course covers the different aspects of Medical Geology, ranging from the occurrence and exposure pathways of natural elements to their beneficial as well as toxic effects on health. It will explore the origin, distribution and fate of geological agents in the environment and their impact on human health so as to offer an integrated view of the entire field of Medical Geology. The course will also provide an analytical framework by which to assess and develop interventions relevant to the field.

The distance education course is relevant to any person interested in health or environmental issues. Intended course participants include graduates in any field concerned with health issues and the natural environment, individuals whose work directly or indirectly relates to health science/earth science issues, managers in earth science or health science fields, environmental health workers as well as food scientists and nutritionists. The course assumes basic knowledge of science, but participants are not expected to be familiar with advanced topics in either health sciences or earth sciences.

A multidisciplinary team is involved in the course, including Dr José Centeno from the U.S. Armed Forces Institute of Pathology (AFIP) in Washington, Dr Robert Finkelman from the U.S. Geological Survey, Dr Olle Selinus from the Geological Survey of Sweden, and Phil Weinstein, Professor from the School of Population Health at the University of Western Australia. Many other earth scientists, health researchers and doctors have contributed to the course development. The two principal coordinators are environmental epidemiologist Dr Angus Cook and geochemist Dr Karin Ljung, both based at the School of Population Health at the University of Western Australia.

We will be formally opening for enrolments from November 2007.

For more information or to apply, please contact the course coordinators:

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COURSE TOPICS **(Continued on Back Page)**

1. **Principles of Medical Geology**
   - Introduction
   - Current and historical perspectives
2. **Defining the intersections between health and earth sciences I**
   - Principles of geology, geo-chemistry and earth science
   - Mineral classification and speciation
3. **Defining the intersections between health and earth sciences II**
   - The role of toxicology and pathology in medical geology
   - Environmental medicine and epidemiology
4. **Exposure pathways in medical geology**
   - Natural and anthropogenic processes
   - Contaminants of soil and water
   - Mineral and fuel extraction

DISTANCE EDUCATION COURSE CONTENTS (Cont.)

5 **Nutrition and trace elements I.**
- Geochemical processes and nutrition
- Principles of essentiality, deficiency and toxicity
- Halogens in health and disease: Iodine; Fluoride

6. **Nutrition and trace elements II.**
- The role of mineral elements (iron, selenium, copper, zinc)
- Medical geology and impacts on food sources, including crops and animals

7. **The role of metals in toxicity I.**
- The body's reaction to toxic metals
- Arsenic
- Cadmium

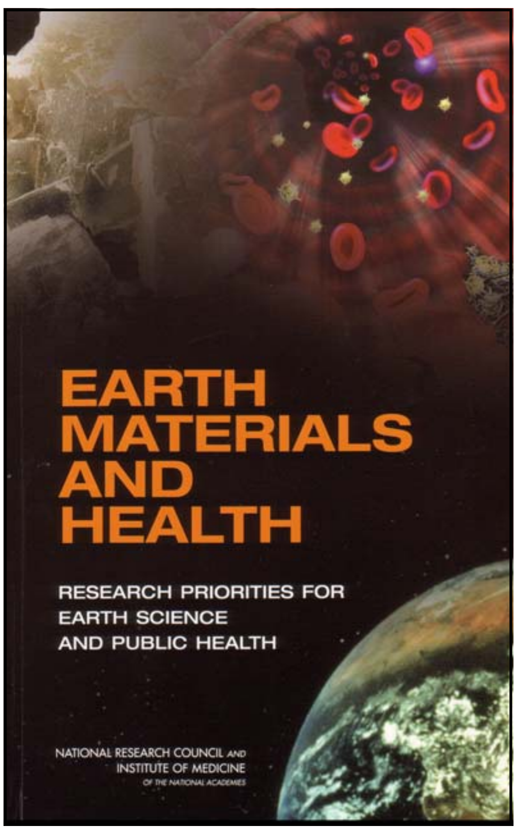
8. **The role of metals in toxicity II.**
- Lead
- Mercury
- Other metals (aluminium)

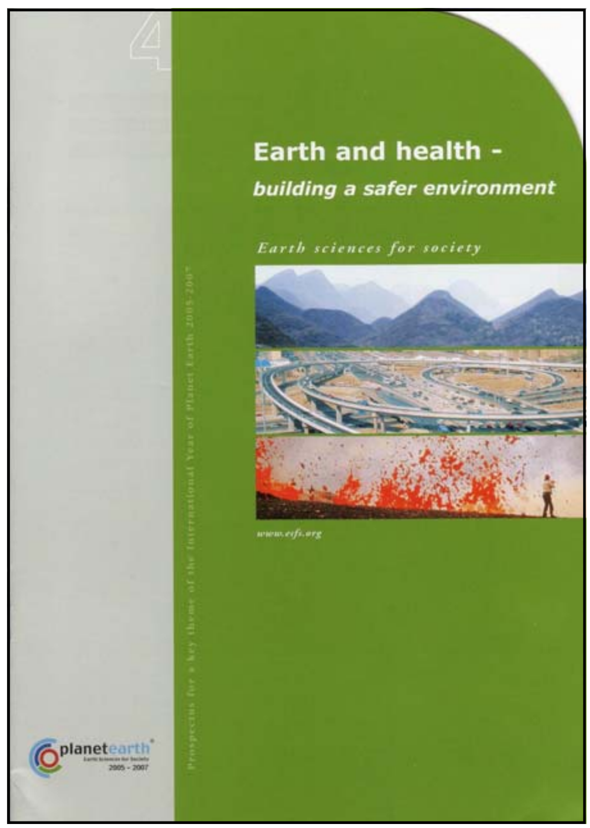
9. **The impact of geogenic dusts on human health I.**
- Silicates; mineral dusts

10. **The impact of geogenic dusts on human health II.**
- Asbesitiform minerals

11. **Natural radioactive processes and health**
- Radon and uranium in air and water sources

12. **Integration and review/ Case study**
- Overview
- Case study: Medical geology in a changing planet (including reference to climate change)





US NRC Report Covers: EARTH MATERIAL S AND HEALTH: RESEARCH PRIORITIES FOR EARTH SCIENCE AND PUBLIC HEALTH