

# Health Benefits of Geologic Materials and Geologic Processes

Dr. Robert B. Finkelman  
U.S. Geological Survey  
Reston, VA 20192  
[rbf@usgs.gov](mailto:rbf@usgs.gov)

## Historic Use of Rocks and Minerals as Drugs

<u>When</u>	<u>Where</u>	<u>What</u>	<u>Why</u>
3000-2400 BC	Mesopotamia	salt, saltpeter	?
~3000 BC	India	asphalt, salt	diabetes
~2000 BC	China	HgO, arsenolite, pearl, cinnabar	various
~1600 BC	Egypt	antimony sulfide, copper acetate, sodium carbonate	eye disease
	Tibet	pearl, coral, calcite, turquoise	various illnesses
	Africa	soil	various illnesses
	Greece & Rome	terra sigillata, metals	antidote for poison
~ 800 AD	Central America	Mayan Codex – minerals	medical prescriptions
~1000 AD	Islam	mercury compounds	
~1200 AD	Europe	gold	

# Potential Health Benefits of Geologic Materials

- Essential Nutrients
- Pharmaceuticals
- Talismans and Amulets
- Hot Springs
- Geophagia (?)

# PATTERNS OF INFLUENCE OF THE ELEMENTS

assimilation increase →

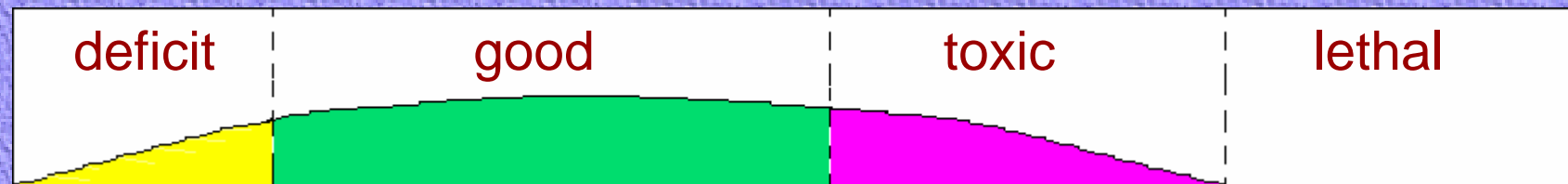
## MACRONUTRIENTS

(C, Ca, Cl, P, Mg, K, Na, S, O, H)



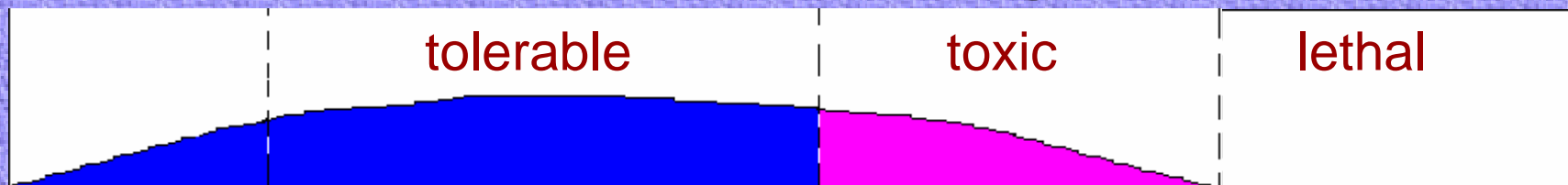
## ESSENTIAL MICRONUTRIENTS

(As, Co, Cr, Cu, Fe, Mn, Mo, Se, V, Zn, F, I, Si)



## NON ESSENTIALS

(Be, Cd, Hg, Ni, Pb, Sb, Sn, Ti etc.)



“Everything is poisonous, nothing is poisonous. It is just a question of dosage.”

# ESSENTIAL ELEMENTS TO ANIMALS AND VEGETATION

TO ALL	TO SEVERAL CLASSES	TO SOME CLASSES	TO SOME SPECIES	POSSIBLY ESSENTIAL
H, C, N	Si, V, Co	B, F, Cr	Li, Al, Ni	Rb, Sn
O, Na, Mg	Mo, I	Br	Sr, Ba	
P, S, Cl				
K, Ca, Mn				
Fe, Cu, Zn, Se				

**MAJOR ELEMENTS**

**TRACE ELEMENTS**

# **ACTION OF MACRONUTRIENTS**

<b>Ca</b>	<b>Strengthening of bones and teeth; muscular activity; blood coagulation; cellular permeability. Excess may originate liver and bladder stones and renal insufficiency.</b>
<b>Cl</b>	<b>Maintenance of blood pressure; vital as acid constituent during digestion.</b>
<b>K</b>	<b>Maintenance of corporeal fluids; muscular contractions and nervous impulses.</b>
<b>Mg</b>	<b>In bones, together with Ca; activation of muscular contractions; body temperature control; component of several enzymes.</b>
<b>Na</b>	<b>Active in hydrosaline equilibrium; transmission of nervous impulses and transport of metabolites.</b>
<b>P</b>	<b>Bone constituent as apatite; participates in most body chemical reactions. Excess turns hair and bones brittle.</b>

G.Cortecci – “Geologia e Salute” and others  
F.R. Siegel – “Environmental Geochemistry”  
O.Selinus e A.Frank – “Medical Geology”

# ACTION OF MICRONUTRIENTS

<b>Co</b>	<b>Active in vitamin B<sub>12</sub> and in chemical reactions. Deficiency causes anemia. Excess causes hearth failures.</b>
<b>Cr</b>	<b>Needed for metabolism of sugar. Deficiency may cause diabetes, intolerance to glyucose etc. Excess may result in renal failures. Excess of Cr<sup>6</sup> is carcinogenic.</b>
<b>Cu</b>	<b>Component of oxidizing enzymes during metabolism of energy sources; active in the synthesis of hemoglobin, in keratization and in skin and hair pigments. Deficiency leads to osteoporosis and low number of white blood cells.</b>
<b>F</b>	<b>Give strength to teeth and bones, avoiding dental caries and osteoporosis. Excess causes fluorosis of teeth and bones.</b>
<b>I</b>	<b>Required by thyroidal hormones, temperature control, body growth, reproduction etc. Deficiency causes abnormal growth of the thyroid.</b>

G.Cortecci – “Geologia e Salute” and others  
F.R. Siegel – “Environmental Geochemistry”  
O.Selinus e A.Frank – “Medical Geology”

# **FUNCTION OF MICRONUTRIENTS**

<b>Fe</b>	<b>Essential component of hemoglobin and enzymatic complexes required for energy generation and immunological system.</b>
<b>Mn</b>	<b>Promotion of growth and development; cellular functions; in bones and cartilages; takes part in metabolic reactions. Excess leads to excess of blood. May cause neurological diseases if inhaled into the lungs.</b>
<b>Se</b>	<b>Prevention of vascular and other diseases; neutralizes cells oxidation and aging action of free radicals. Excess turns nails and hair brittle.</b>
<b>Zn</b>	<b>Occurs in all tissues, mostly in bones, muscles and skin; active in the immunological system; regulates body growth; protects the liver. Deficiency reduces body growth.</b>

G.Cortecci – “Geologia e Salute” and others  
F.R. Siegel – “Environmental Geochemistry”  
O.Selinus e A.Frank – “Medical Geology”

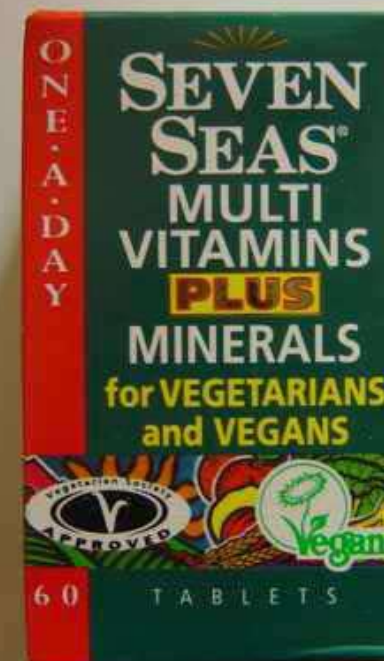
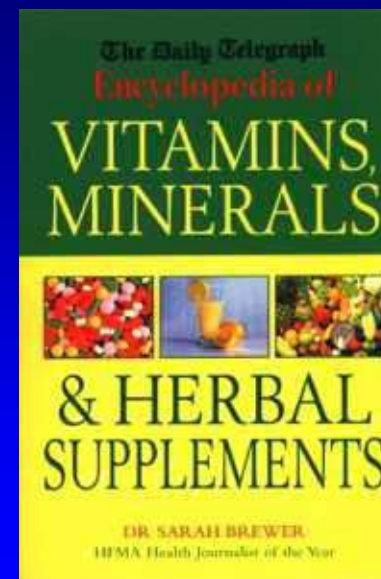


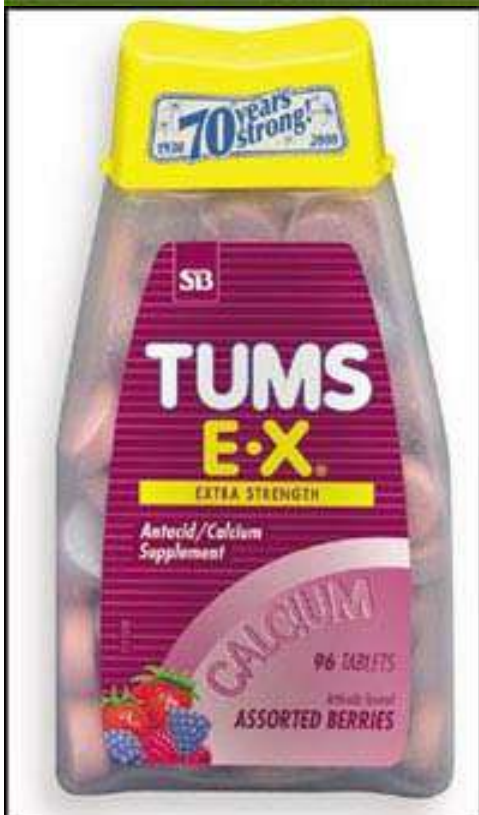
# Pharmaceuticals



This pharmaceutical, Trisenox, is composed mainly of Arsenic Trioxide. A controversial compound, used to treat Acute-Promyelocytic Leukemia (APL) in relapse patients. In several reports from China, this compound has been shown to induce complete remission in all APL victims studied.

# Mineral Content





## Elements, Minerals, and Rocks Used in Pharmaceuticals and Health Care Products

- Arsenic - pharmaceuticals
- Mercury – mercurochrome, dental amalgam
- Calcium – antacids
- Various Elements – in vitamin supplements
- Boron – Boric Acid
- Selenium – Skin Treatment
- Sulfur – Sulfur Drugs

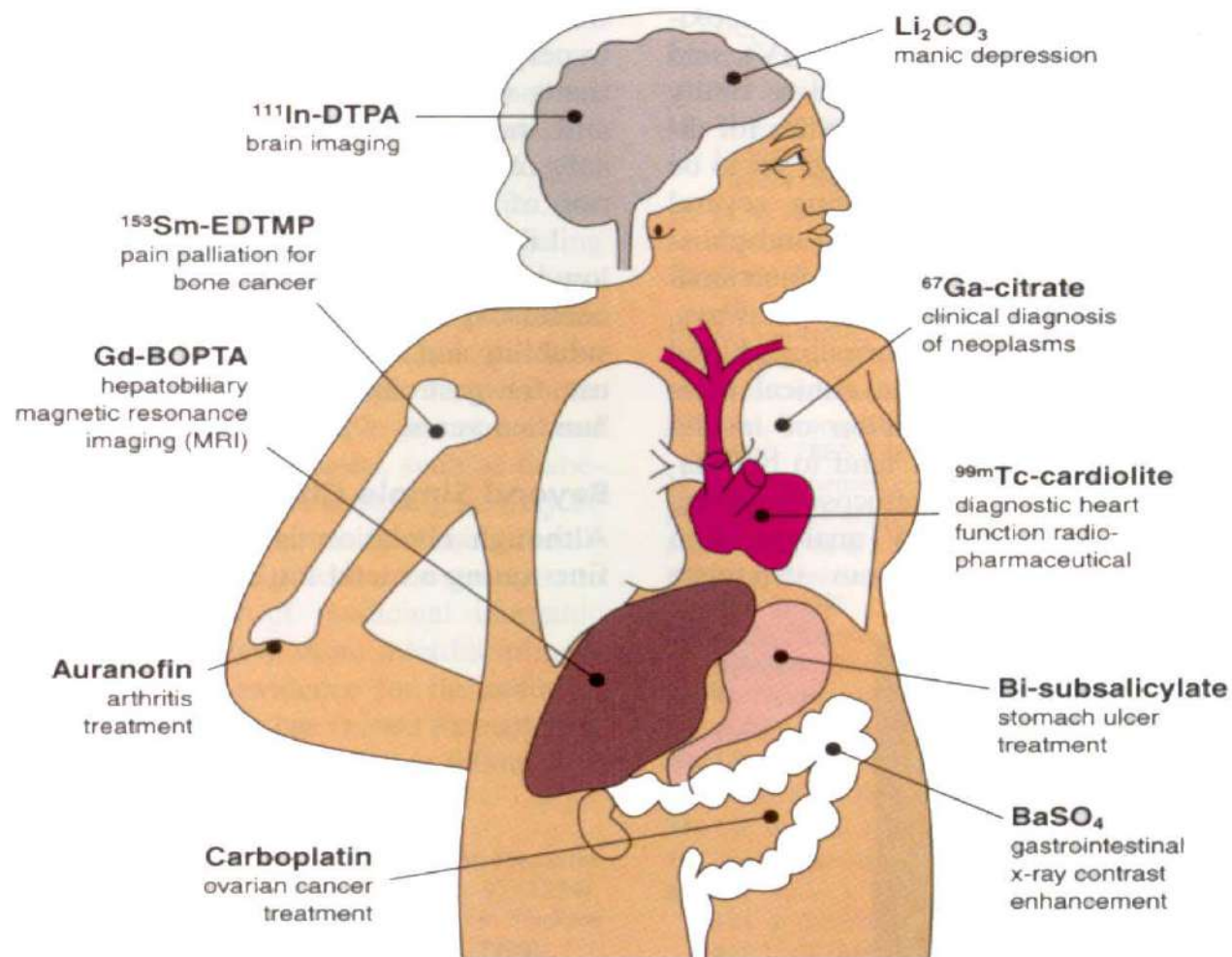
## Elements and Minerals Used in Pharmaceuticals and Health Care Products

- Magnesite – Milk of Magnesia
- Barium – Enemas and in X-radiography
- Bismuth – settles upset stomachs
- Calcite – Tums
- Rutile – toothpaste
- Gypsum – Plaster of Paris
- Talc – Talcum powder

## Elements, Minerals, and Rocks Used in Pharmaceuticals and Health Care Products

- Kaolin – koapectate
- Coal Tar – skin products
- Pumice – Lava soap
- Bauxite (Al) – Anti perspirtant, toothpaste
- Fluorite – fluoridation
- Halite - Preservative
- Zinc oxide – skin ointments





**Fig. 1.** Metal ions are important in diagnosis and therapy of a host of different human pathologies. Gd,  $^{111}\text{In}$ , and  $^{99\text{m}}\text{Tc}$  are used in medical imaging;  $^{153}\text{Sm}$  and Au to relieve pain in bone cancer and arthritis, respectively; Bi to soothe upset stomach; and Li to calm bipolar psychosis.  $^{67}\text{Ga}$ -citrate is used in clinical diagnosis of neoplasms (by SPECT imaging), and Pt is used for cancer treatment.

# Adsorbing clay tablets (*Terra sigillata*) from ancient Greece

From Lemmos, Melos and  
Samos islands



*Terra sigillata* with  
turkish seals  
(designing its  
origin)







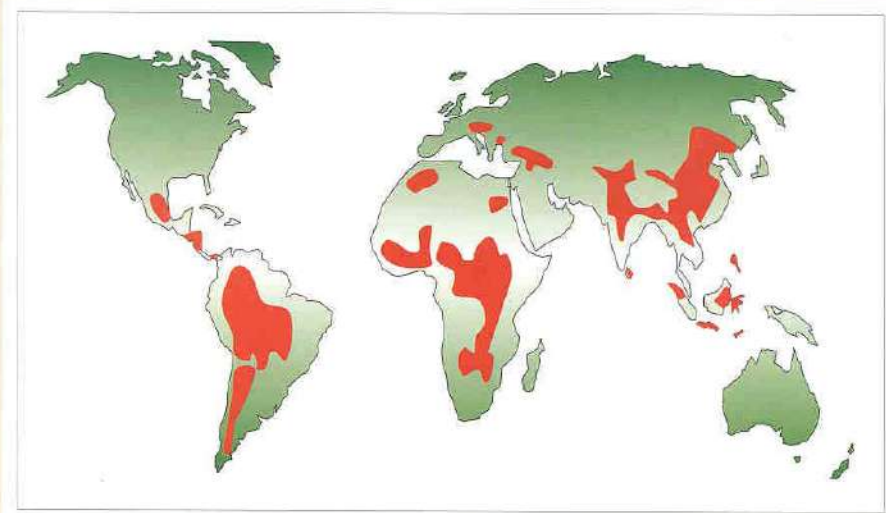
# Goiter



*AFIP/USGS Study: Urumqi, China*



**Element deficiency - Iodine**



# Talismans and Amulets

Can religion improve health? While the debate rages in journals and med schools, more Americans ask for doctors' prayers.

# FAITH & HEALING

BY CLAUDIA KALB

**O**N A QUIET SATURDAY afternoon, Ming He, a fourth-year medical student in Dallas, came across a man dying in the VA Hospital. Suffering from a rare cancer and hooked up to an oxygen tank, the man, an Orthodox Jew, could barely breathe, let alone speak. There were no friends or relatives by his bed to comfort him. When the young student walked into his room, the man looked at her and said, "Now that I'm dying, I realize that I never really learned how to live." Ming He, 26, had no idea how to respond.

"I thought, 'My God, the chaplain doesn't work on weekends, what do I do?'" She held the man's hand for a few minutes in silence; two days later, he died. And as soon as she could, she signed up for "Spirituality and Medicine" at the University of Texas



**DEVOTED:** Jimmy O'Shaughnessy, 23, is fighting cancer; with the Rev. Kelly Childress at UCLA

Southwestern Medical School, a course that teaches students how to talk to patients about faith and illness.

More than half of the med schools in the country now offer such courses—up from just three a decade ago—largely because patients are demanding more spiritual care. According to a NEWSWEEK Poll,





# Talismans and Amulets

Unlike the rock-derived Pharmaceuticals, Talismans and Amulets do not have a known physical effects, but do have a certain psychological effects. Talismans have been used for thousands of years, more common then then now, and were believed to ward off evil and heal certain medical conditions. These Talismans were composed of various rocks and minerals, with each crystal having its own unique healing powers.



Hematite: A stone commonly used in the healing of cardiovascular and circulatory diseases, and detoxification.

Quartz: Along with Rose and Smokey Quartz, this crystal is used in mood related diseases such as depression.



[http://www.imaginarious.ca/Healing\\_stones.htm](http://www.imaginarious.ca/Healing_stones.htm)

**Talismans and Crystal Amulets, such as these, are composed of a great variety of rocks and minerals. A selection of these are shown on the chart, along with a list of the conditions each treats.**



	Arthritis/Joints	Bleeding/Blood	Circulatory System	Depression	Detoxification	Eyesight	Headache	Heart
Amethyst				X	X	X	X	
Aquamarine							X	
Aventurine				X			X	
Black Tourmaline	X			X	X			
Bloodstone		X						
Carnelian	X	X						
Chalcedony								
Citrine								
Flourite	X					X		
Hematite		X	X		X			
Lapis Lazuli								X
Moonstone								
Quartz								
Rose Quartz				X				
Smoky Quartz				X				
Green Tourmaline								X
Turquoise								





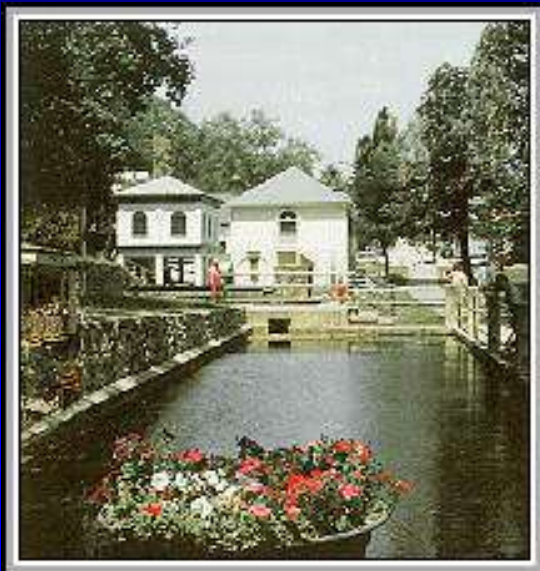
# Hot Springs



Hot springs and other naturally occurring mineral baths, have been used for centuries all across the globe. They were known to have been quite popular in Ancient Greece and Rome, as well as Ancient Japan and among the Native Americans in North America. Hot springs are still very popular today, especially in North America. Over 200 commercial springs exist in the US alone, along with countless Native American and smaller springs in Virginia, Pennsylvania and New York. The springs were believed to have treated a myriad of medical conditions, including venereal diseases. As well, many Government sponsored studies began around the springs, and lasted until the 20<sup>th</sup> century. Enthusiasm and use of springs and medicinal baths have been declining ever since in both North America and Great Britain.

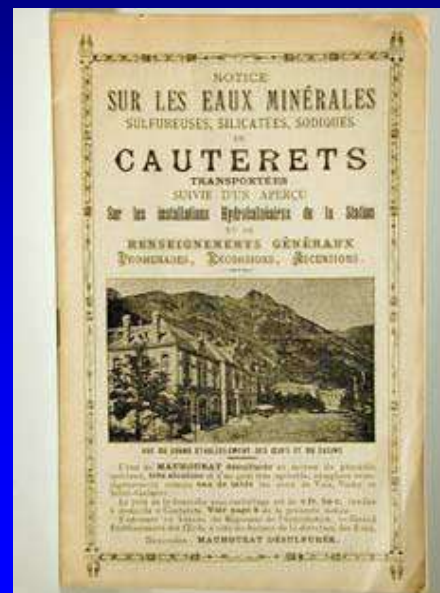


An American treasure at Pagosa Springs, and a British landmark at the Roman Baths.



Berkeley Springs was a frequent favorite of many American notables.

<http://www.sacredsites.com/final40/180.html>



This is a Poster from 1892 about a French mineral spring. Cauterets, in Central France offered relief in their baths from: Asthma, Bronchitis, Rheumatism, Laryngitis, and many other conditions.



Thomas Jefferson, Theodore Roosevelt, Davy Crockett, Henry Clay, Edgar Allan Poe, and Robert Louis Stevenson, along with many other American presidents and notables were all hot springs regulars. Saratoga Springs in New York, and Berkeley Springs in West Virginia were amongst their favorites. They swore by their healing powers as well as the entertainment and relaxation they provided.

*Balneotherapy,*  
medical use of hot spring, ONSEN,  
in Japan



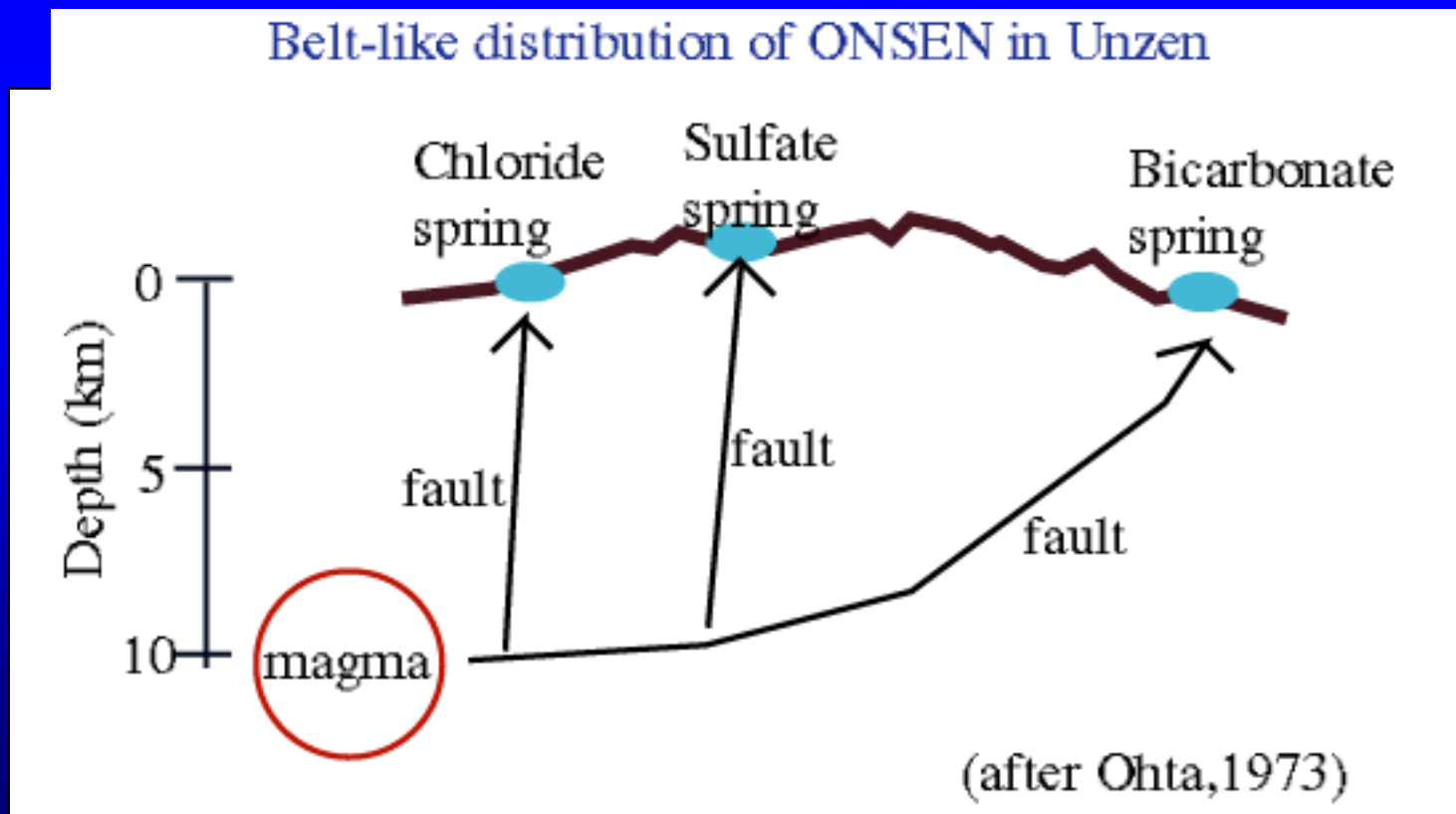
Mio TAKEUCHI

National Institute for Advanced  
Industrial Science and Technology



## Classification of ONSSEN

Simple hot spring	Chloride spring	Hydrogen carbonate spring	Sulfate spring	Carbon dioxide spring	Iron spring	Sulfur spring	Acid spring	Radioactive spring
-------------------	-----------------	---------------------------	----------------	-----------------------	-------------	---------------	-------------	--------------------







# Rock-bath for medical treatment



## Bath-tub of Tamagawa onsen



50%

100%





Figure 4- Sand-bathing facilities in Hotel Portro Santo Geomedicine Centre

# Geophagia

- Geophagia – A noun: eating earth, clay or chalk; occurs in some primitive tribes or sometimes in cases of nutritional deficiency. Also known as 'Pica.'



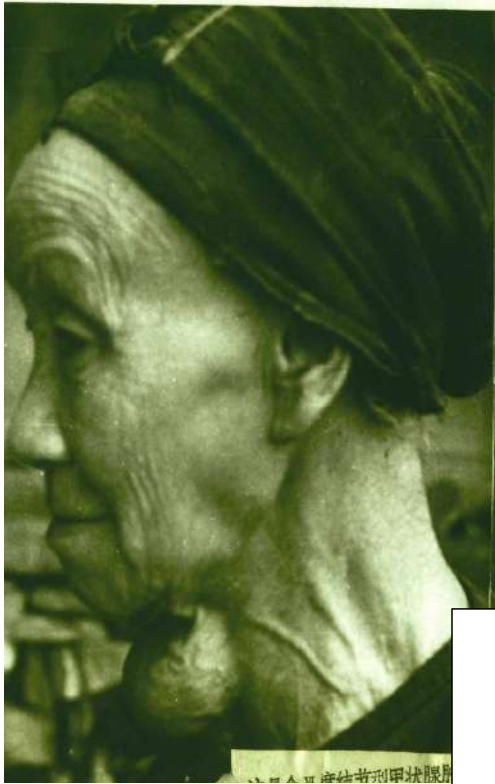
The “dirt” [shown] is *kaolin*, a white clay mined in Georgia and South Carolina that is used for everything from making ceramics and textiles to diarrhea medicine.

[http://www.augustachronicle.com/stories/031899/fea\\_clay.shtml](http://www.augustachronicle.com/stories/031899/fea_clay.shtml)

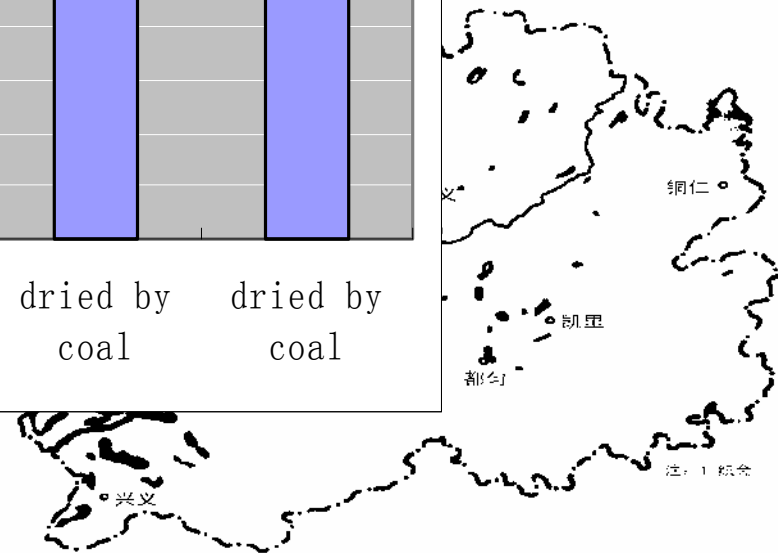
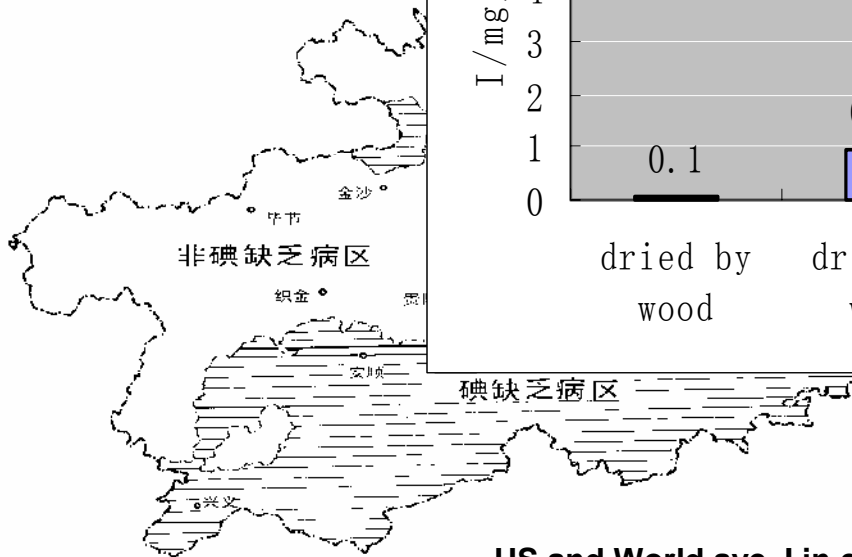
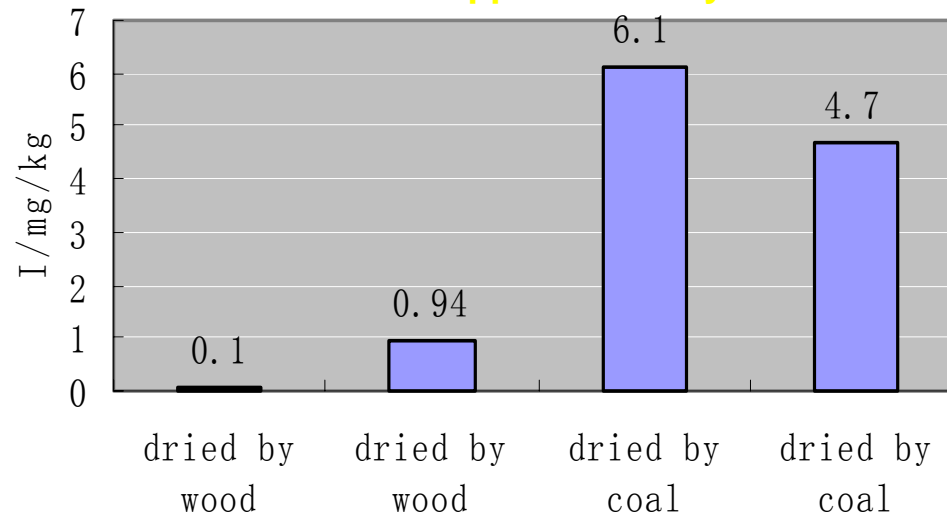
In this particular case, many pregnant women in rural southern Georgia, eat *kaolin* or a grayish native clay to Georgia commonly sold in Grocery stores. They crave the “dirt” and claim that it helps quite their pregnancy sickness and makes them feel better.







**Iodine content of Chili Peppers dried by different fuels**



**US and World ave. I in coal = 1ppm, Guizhou coal = 8 ppm**