Colorado Scientific Society

The objective of the Society is to promote
The knowledge and understanding of Earth science,
And its application to human needs

Vermiculite deposits and asbestos—Examples from Colorado and elsewhere

By
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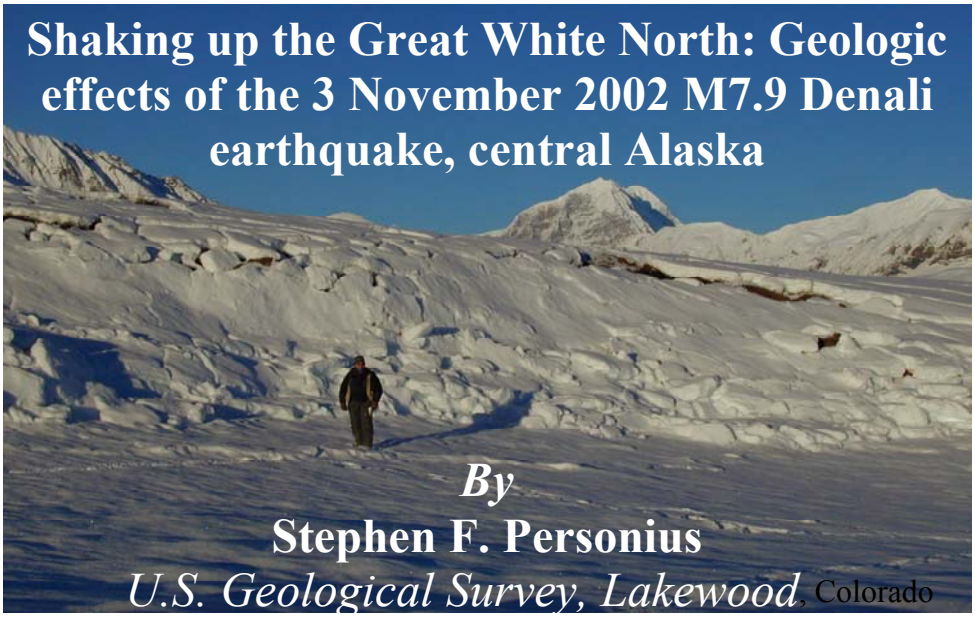
U.S. Geological Survey, Lakewood, Colorado

Shaking up the Great White North: Geologic effects of the 3 November 2002 M7.9 Denali earthquake, central Alaska



By
Stephen F. Personius
U.S. Geological Survey, Lakewood, Colorado

Thursday, February 20, 2003

American Mountaineering Center
710 10th St. (NE corner with Washington), Golden
Social half-hour – 7:00 pm. Meeting time – 7:30 pm.

Abstracts

Vermiculite deposits and asbestos—Examples from Colorado and elsewhere

By **Bradley S. Van Gosen** and **Heather A. Lowers** U.S. Geological Survey, Lakewood, Colorado

Vermiculite, used in many commercial applications, is a water-rich, platy mineral formed by the weathering of mica minerals. When heated to 800°C or higher, the water contained within the vermiculite is converted to steam, which pushes apart the mineral's plates; this expands the mineral accordion-like by six times or more its original thickness. Heat-expanded vermiculite is very light weight, has fire- and sound-proofing properties, and is thus well suited for many uses, such as in low weight insulating building materials. Unfortunately, health hazards are now known to be associated with some vermiculite materials.

Vermiculite was mined and milled from 1923 to 1990 near the small town of Libby in northwestern Montana. The Libby ("Zonolite") mine was the world's largest producer of vermiculite during its operation. Unusually high rates of respiratory ailments and mortality due to asbestosis within Libby mine and mill workers and residents have been recognized in recent years; these respiratory diseases have been linked directly to occupational and environmental exposure to amphibole asbestos particles intergrown within the Libby vermiculite deposit. As a result, the U.S.Geological Survey began a study to determine if amphibole asbestos minerals are common as accessories in other vermiculite deposits.

The study of U.S. vermiculite has involved the mineralogical analyses of vermiculite-rich samples collected previously from 62 vermiculite mines and deposits in 10 States. These samples were collected during the 1940s, 1960s, and 1970s as part of a reconnaissance survey of the Nation's vermiculite resources. The mineralogy of these samples was compared with those of a representative suite of 30 samples collected recently from the former mining operations at Libby. In our study, the Libby and U.S. reconnaissance samples were analyzed by X-ray diffraction, scanning electron microscopy, energy-dispersive spectroscopy, and electron probe microscopy.

Despite the reconnaissance nature of the sampling, the mineralogic characterization of the vermiculite samples revealed consistent results. Our analyses indicate that (1) fibrous (asbestiform) amphiboles are not common in all types of vermiculite deposits, but they also showed that (2) the geology and asbestos mineralogy of the Libby deposit is not unique. "Type 1" vermiculite deposits are those that formed in geologic environments similar to the Libby deposit—that is, relatively quartz-deficient, potassium-sodium-calcium–rich igneous intrusions that are usually zoned. We found that all the type 1 deposits sampled consistently contain fibrous amphiboles (asbestos). "Type 2" vermiculite deposits are those that formed where masses of ultramafic rock were intruded by granite and (or) felsic pegmatite; these types of deposits also often contain fibrous amphibole. Both type 1 and type 2 vermiculite deposits occur in Colorado. Two "type 1" deposits are known in southern Colorado; one abandoned vermiculite mine site is being considered for asbestos abatement and reclamation, whereas another site is being sampled and evaluated. Asbestos-rich deposits of "type 2" have been recently identified in a remote area of north-central Colorado.

Shaking up the Great White North: Geologic effects of the 3 November 2002 M7.9 Denali earthquake, central Alaska

By **Stephen F. Personius** U.S. Geological Survey, Lakewood, Colorado

On November 3, 2002, a **M**7.9 earthquake generated about 330 km of surface rupture on parts of three faults in central Alaska. These surface ruptures rank among the largest strike-slip ruptures in the past two centuries, and their length and amount of offset are comparable to those of the great California earthquakes of 1857 and 1906. The earthquake epicenter was located in the central Alaska Range about 150 km south of Fairbanks, Alaska. Seismological data indicate that the earthquake initially began as a reverse-slip rupture that, 15 seconds later, became a right-lateral strike-slip rupture. The reverse-slip motion produced thrust faulting along 45 km of the newly discovered Susitna Glacier fault. Some scarps on the Susitna Glacier fault are more than 6 m high, but average dip-slip displacements are about 3 m. The northeastern end of ruptures on the Susitna Glacier fault intersect the Denali fault, where right-lateral strike-slip ruptures extend eastward for more than 210 km along the Denali fault. Lateral offsets average about 5 m on the Denali fault, and we measured a maximum offset of 8.8 m about 170 km east of the epicenter. Much of the rupture on the Denali fault occurred in glacier-filled valleys, which produced spectacular surface expressions of lateral-slip faulting in glacial ice. Eastward, the slip transferred from the Denali fault onto the southeast-trending Totschunda fault, where lateral offsets averaged about 1.5 m and the ruptures continued an additional 75 km to the southeast.

Strong ground motion from the earthquake generated major landslides and avalanches throughout the Alaska Range, but it did little damage to manmade structures in the sparsely populated region. Surface manifestations of earthquake-induced liquefaction included lateral-spread failures and sand blows in saturated sediments along many streams and lakes in the region. The mapped trace of the Denali fault crossed the Trans-Alaska Pipeline and thus poses a serious environmental and economic threat to central Alaska. The 2002 fault rupture underwent 3.9 m of dextral slip beneath the pipeline, and we measured as much as 6 m of lateral slip at nearby sites. Fortunately, the pipeline had been designed to accommodate 6.1 meters of dextral slip and 1.5 m of vertical slip at the fault crossing and withstood the earthquake without failure. The “design” rupture was based on preconstruction geologic studies that clearly demonstrate the value of earthquake science in engineering design and risk mitigation.

Colorado Scientific Society, January 2003 President’s Note

By **Jim Cappa**

On January 28th, the American Institute of Professional Geologists held its annual Legislative Reception for our state senators and representatives. The Colorado Geological Survey and other local geological institutions such as the Colorado School of Mines, the Colorado Oil and Gas Conservation Commission, and the Association of Engineering Geologists were represented. All of our state legislators were invited to the reception. The purpose is to let the legislators know, at least in a superficial way, the kinds of programs and projects that various geological agencies are working on in Colorado and the importance of these the projects to the citizens of Colorado.

Some of our state legislators have a strong interest in geological issues and how they affect their constituency. Some of the most important issues are landslides and swelling soils, mineral resources (especially sand and gravel resources) and urban development, suburban residential development over abandoned coal mines, oil and gas development especially in residential areas, coal bed methane and water, the drought and its effect on ground water aquifers. All are important issues here in Colorado that command a great deal of our attention at the Colorado Geological Survey and also the attention of citizens and their representatives. It is critically important that scientific data, whether they are geological maps, ground water quality data, or maps of mineral resource areas, be used in making policy decisions. That is our job as scientists.

Sometimes even the best-intentioned persons are not aware of the role geology plays in their daily lives. A week ago I was talking with an intelligent, well-educated person and mentioned to her my involvement with some of Colorado's vermiculite deposits and their associated asbestos minerals, the topic of Brad Van Gosen's talks during the upcoming Colorado Scientific Society meeting on February 20th. This person, who uses vermiculite in her plants, was surprised to find that vermiculite is a natural product of the earth and that somewhere it is mined.

All of us who work for public agencies are feeling the budget pinch this year. Funding for higher education is being cut back. Private industry firms are cutting back on expenses. However, it still is vitally important for us to step out of our role as scientists and become spokesmen for our own good work. The need to sell the value of our science to the citizens of this state and the country is growing more important as budget dollars get tighter. We need to be more assertive in letting the public know the importance of the work we do, whether that is in government service, education, or private industry. We need organized outreach on a large scale that reaches thousands of people, and we need to do outreach on an individual level when the opportunity arises. Keep spreading the word.

Memorial to Bill Braddock

By **Jim Cole** U.S. Geological Survey, Lakewood, Colorado

Bill Braddock passed away at home January 1, 2003, at age 73 of cancer. His professional career spanned more than 40 years and combined his life-long interests in the study of geologic structures, teaching and training students in the challenging area of field investigations, and hiking in the high country of Colorado's Front Range. Bill's research contributions to the geological sciences included important papers on landslide complexes near Fort Collins; origin and deformation of the complex crystalline rocks in the northern Front Range; formation of slaty cleavage in low-grade metamorphic rocks; laboratory studies of mechanical properties of the Pierre Shale; and numerous detailed geologic maps in the region, including the Geologic Map of Rocky Mountain National Park.

Bill earned his Doctorate from Princeton University in 1959 shortly after joining the Geological Sciences faculty at the University of Colorado in Boulder. During his 36 years there, Bill taught significant parts of the core curriculum for geology majors and other innovative courses in structural geology, petrology, rock mechanics, and computer applications.

He held a career-long seasonal appointment with the U.S. Geological Survey to conduct research in the Front Range. The high productivity of his U.S.G.S. project allowed him to support many graduate students who advanced the knowledge of Colorado geology while beginning their own careers. Scores of professionals around the country and abroad owe much to the quality of his mentorship.

He was especially devoted to wide-ranging geologic studies and mapping in Rocky Mountain National Park. He volunteered countless hours to provide geology training for seasonal naturalists, to lead field trips, to conduct geology seminars for the Rocky Mountain Nature Association, and to counsel Park resource managers on geologic matters. He provided similar training and guidance for the City of Boulder Parks and Recreation Department and compiled geologic maps of open-space areas to educate visitors about local Earth history.

He is survived by his wife, Carol Gerlitz, and by their sons and stepsons. Contributions in his name may be made to Hospice of Boulder County, 2594 Trailridge Drive East, Suite A, Lafayette, Colorado 80026. Condolences may be sent to 4271 Plum Court, Boulder, Colorado 80301.

More Minerals Named for (or by) Coloradoans

(Richard M. Pearl recorded the following tidbits of Colorado mineralogical history in an article *Minerals Named for Colorado Men*, March, 1941, Colorado Magazine, v. 18, no. 2, p. 48-53. The information was updated in the new volume, *Minerals of Colorado* by Eckel et al. and the Friends of Mineralogy.)

Cahnite was named for an outstanding crystallographer and mineralogist, Lazard Cahn, who served as vice-president of the Mineralogical Society of America in 1928. He died at Colorado Springs on May 22, 1940. Cahnite is a white hydrous boro-arsenate of calcium, an entirely new type of natural chemical compound when it was first observed about 1913 in crystalline form at the zinc deposits at Franklin, New Jersey. Cahn sketched the crystals and gave them to Harvard University, where Professor Charles Palache believed them to be a new mineral, though there was not enough material to analyze. Palache proposed the name to recognize Cahn's "indefatigable efforts to preserve and make known to science the rare Franklin minerals." The name appeared in 1921 and later in 1926. Cahnite does not occur in Colorado.

Hillebrandite was named in 1908 by Fred E. Wright "as a token of appreciation of the fundamental researches of Dr. W.F. Hillebrand of the USGS in mineralogical chemistry." Hillebrand was a charter member of the Colorado Scientific Society. Hillebrandite comes from Durango, Mexico, in the Termeras mine at Valedeño. It is a hydrous calcium silicate, forming white radiating masses in the contact zone between limestone and diorite.

Guitermanite and its associate mineral, **Zunyite,** were named by Hillebrand in 1884, in the Proceedings of the Colorado Scientific Society. Crystal-clear tetrahedral crystals of Zunyite, named for the Zuñi mine, occur throughout the San Juans. Hillebrand described another mineral, guitermanite, a sufide of lead and arsenic. He named it for Franklin Guiterman, the metallurgist and chemist of Silverton and Denver who discovered it on zunyite in the Zuñi mine on Anvil Mountain near Silverton. The mineral later proved to be Jordanite, a lead/arsenic/antimony sulfide.

A View Through the Brown Cloud

by Lisa Ramirez Rukstales

The brown cloud is tinged with baby blue these days.

Lisa and Ken Rukstales are pleased, albeit a bit surprised, to announce the (early) arrival of Scott Diego Rukstales. He was born at 8:55 pm on Saturday, February 1, and came in at 5 lb 7 oz. Mom and baby are doing fine; they were planning to come home Tuesday, February 4.

Judges Needed for Denver Metro Regional Science Fair

Judges are needed for the Denver Metropolitan Regional Science and Engineering Fair, to be held Monday, Feb. 24, at the Denver Museum of Nature & Science. Judging will be in the afternoon, 1–5 p.m. (plus orientation and free lunch [!] beginning at 11 a.m.). Nonscientist volunteers are also needed to help with logistic operations at the fair. If you wish to volunteer you can add your name and address to the list of judges online at http://www2.uchsc.edu/ahec/science/judges or you may contact Fair Director Jim Stevens at science.fair@uchsc.edu or 303-724-0346.

CSM 2002 Faculty Senate Distinguished Lecture

Murray W. Hitzman will deliver a talk entitled **"**An Earth Scientist Views Earth Systems Engineering" on February 26, 2003, at 4 p.m., in Metals Hall, Green Center, Colorado School of Mines campus. Dr. Hitzman is Head of the Department of Geology and Geological Engineering and is also the Charles Franklin Fogarty Professor of Economic Geology. The public is invited to attend the lecture and a preceding reception.

Earth Science Meetings and Talks

*Newsletter items must be received by the 4th of each mont*h. Items may include special events, open houses, etc...thanks!

Colorado Scientific Society's regular meetings are held the 3rd Thursday of the month at the American Mountaineering Center in Golden (unless otherwise advertised). Social time begins at 7:00 p.m. and talks start at 7:30 p.m. For information, contact Jim Cappa at (303) 866-3393, jim.cappa@state.co.us

Denver Mining Club meets every Monday (except when noted) at Country Buffet near Bowles and Wadsworth (at 8100 W. Crestline Ave.) 11:30 a.m.-1:00 p.m. For additional information contact Dick Beach, (303) 986-6535 .

Denver International Petroleum Society meets the 2nd Friday of each month at the Wynkoop Brewing Co., 18th and Wynkoop Streets. Reception begins at 11:30 a.m., luncheon at 12 p.m., program at 12:30 p.m. Make reservations (required) by leaving message at (303) 623-5396. Reservations accepted after 8 a.m. on Friday until 10:30 a.m. on Wednesday prior to the meeting. Cancellations accepted until 11:00 am Wednesday prior to the meeting. Cost: $15 for lunches; talk only is available for $2 (make checks payable to "D.I.P.S."). Contact Keith Murray at (303) 986-8554 for information.

Denver Region Exploration Geologists' Society (DREGS) meets in the Mutual Consolidated Water Building, 12700 West 27th Avenue, Lakewood. Social hour 6:00-7:00 p.m. Technical presentation at 7:00 p.m. Meetings are normally scheduled for the first Monday of each month. **Building Exploration Models, Where geology and Geophysics Come Together**, Feb. 3- Ken Witherly, president of Condor Consulting, Inc. For information contact Jim Piper, (303) 932-0137, or http://www.dregs.org.

Denver Well Logging Society (DWLS) meets on the third Tuesday of each month, Sept. through May. Lunch and a technical talk at the Wynkoop Brewery begins at 11:30 a.m., 18th and Wynkoop Sts. in Denver. Subject matter usually deals with the application of well logs to oil and gas exploration. **A New Micro-Resistivity Imaging Device for use in Wells Drilled with Oil-Base Mud,** Feb. 18- Mitch D. Pavlovic, Baker Atlas, Houston, Texas. Call Elice Wickham at 303-573-2781 for reservations. Web page: http://dwls.spwla.org.

Rocky Mountain Association of Geologists (RMAG) Reception, 11:30 a.m.; lunch at noon; talk, 12:30 p.m. Reservations taken by recording at 303-623-5396 until 10:30 a.m. Wed. before the luncheon; cancellations taken until 11:00 a.m. on Wed. at 303-573-8621. Luncheon costs $20 payable to RMAG at the door. Reservations are not required for talk only—cost is $3. Meeting location: Denver Petroleum Club, Anaconda Tower, 555-17th St, 37th floor. Web page: http://www.rmag.org.

University of Colorado at Boulder, Geological Sciences Colloquium Wednesdays, 4:00–5:30 p.m., Rm. 180. Refreshments at 3:30 p.m on the 3rd floor. For info., call 303-492-8141. Web page: http://www.colorado.edu/GeolSci. February talk titles have not yet been announced.

Friends of Dinosaur Ridge; 7:00 pm at Red Rocks Elem. School, in Morrison. Join now. **Hunting Meteorites in Bolivia**, Feb. 25 - Bob Raynolds. **Paleoenvironments of the Morrison Formation,** March 11 - C. Turner. Web page: http://www.dinoridge.org.

Colorado School of Mines, Van Tuyl Lectures Fridays from 3:00–4:00 p.m. in Berthoud Hall room 108: **The Engineering Design Team Process: Does Gender Matter?** Feb 7- Barb Moskal, CSM; **A fluid mixing Model for Konkola North, Zambian Copperbelt**, Feb. 14 - Sally Sutton, Colorado State University; **The Paleocene/ Eocene Thermal Maximum: Effects on Alluvial Soils and Continental,** Feb. 21- Mary Kraus, University of Colorado; **Thinking Outside the Box – The Role of the Geologists in Keeping Up With Energy Demand,** Feb. 28- Robbi Gries, Priority Oil & Gas, LLC. Web page: http://www.mines.edu/academic/geology/ca lendar/vantuyl.html

USGS Central Region Colloquium Series Lectures held weekly, 1:30-2:30 p.m., Foord Conference Room, Bldg. 20 (entrance W-3), Denver Federal Center, Lakewood, CO. For more information call Pete Modreski, 303-202-4766, pmodreski@usgs.gov or see http://geology.cr.usgs.gov/crg/colloquia.htm. Feb. 6-to be announced; **Assessment of Global Oil, Gas, and Natural Gas Liquid Resources Using the Total Petroleum System Concept**, Feb. 13-T. S. Ahlbrandt; Feb. 20-to be announced; **Introduction to the National Institute of Invasive Species Science,** Feb. 27-Tom Stohlgren.

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