

CMS News

A Publication of The Clay Minerals Society

Summer 1995

Wayne Hudnall named new editor

Wayne Hudnall has agreed to take the place of Ray Ferrell as Editor-in-Chief of Clays and Clay Minerals. The transition will take place in January, 1996.

The Society is grateful to Ray Ferrell for his dedication and innovations over the past four years, and to Wayne Hudnall for volunteering to take on such an important responsibility.

Starting in January, correspondence regarding manuscripts should be sent to Dr. Wayne H. Hudnall, Agronomy Department, MB Sturgis Hall, Louisiana State University, Baton Rouge, LA 70803 USA. Phone: 504-388-1344; fax: 504-388-1403; e-mail: whudnall@lsuvm.sncc.lsu.edu

CMS joins AGI

The American Geological Institute welcomed the Clay Minerals Society to its membership at AGI's Member Society Council meeting, held March 6, 1995. "The Clay Minerals Society has a distinguished history," said AGI President Samuel S. Adams. "We are pleased that CMS has chosen to affiliate with AGI and to strengthen our efforts to address issues of concern to the geoscience community." With the affiliation of the CMS, the

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CMS goes on-line with home page and list server

The Electronic Communications Committee spent this year searching for a CMS member or members to take on the task of running a CMS list server and starting a CMS World-Wide Web home page. After discussions with several members, Cliff Johnston of Purdue University agreed to set up both, and they are now up and running.

Members will "subscribe" to the list server, and the server will serve as a focal point for internet discussions among all subscribed members. For example, if a subscriber has a question about where to find a really great beidellite sample, he/she would send the question to the list server. The server would then transmit the question to all subscribers. The subscriber, by sending the question to the server, has, in effect, contacted all other subscribers. We could have discussions amongst our society members on any subject. Obviously, the more members subscribed, the better. It costs nothing to "subscribe," and I would like to see CMS try to get as many members subscribed as

possible.

The World-Wide Web home page is something different. It allows the society to set up a focal point of communication, with text and illustrations

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Cliff Johnston, who has set up the CMS home page and list server at Purdue, with Carrie Babcock (holding a hunk of Otay bentonite) and Prakash Malla on a San Diego field trip, 1993. Simeon Tsipursky and Steve Rice talk in the background.

Dave Pevear

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The Clay Minerals Society



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CMS News welcomes advertising. Inquire about rates to the Society Office. Articles and other contributions submitted to *CMS News* are subject to editing and are published on a space available basis. All opinions expressed herein are the opinions of individual contributors, and not of The Clay Minerals Society.

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The Clay Minerals Society
P. O. Box 4416
Boulder, Colorado 80306 USA
(303) 444-6405
FAX (303) 444-2260
peberl@clays.org

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This newsletter printed on recycled paper.

Letters

Contacts with American clay scientists sought
Editor:

I would like to receive articles and to have contacts with universities and research centers of the United States which have programs on technology of clay materials.

My laboratories in the High School of Mines, Industry, and Geology in Niamey, Niger, and in the University of Ouagadougou in Burkina Faso do research on physics and chemistry of clay materials.

At this time, we have begun technological studies notably to promote our local materials in the area of tiles, bricks, and pottery.

My activities are mentioned on page 10 of *CMS News*, February 1993.

If anyone can help us with the documentation and contacts we need, we would very much appreciate it.

Prof. T. S. Kabre
Directeur de la Recherche et de la Production
Ecole des Mines et de la Géologie
B. P. 732 Niamey, Niger

High school needs help
Editor:

I am writing for information on any source who may be able to donate equipment, supplies, or funds to use in earth science classes and laboratories. Laboratory exposure is essential to understanding and appreciating the sciences. However, earth science is a new course at Plymouth High School and funds are not available to supply the equipment and materials to allow for hands-on work.

I would like to thank you in advance for your help.

Jeannie Shannon, Plymouth High School
PO Box 827, Plymouth, NC 27962

CMS dues are raised

In order to meet the cost of a full-time assistant for the Editor of *Clays and Clay Minerals*, the CMS Council has reluctantly found it necessary to make a number of budget cuts and to raise costs of subscriptions and memberships. Neither the present nor future Editor feels it is feasible to run the editorial office with a half-time assistant any longer.

In 1996, membership dues will be raised to \$60 for subscribing members and \$30 for non-subscribing members. Student memberships will remain the same (\$15). Library subscriptions will be raised to \$165 (\$180 outside North America).

Directory changes

Please let the CMS Office know any directory changes as soon as possible. We would especially appreciate e-mail addresses.

CMS office e-mail address

The e-mail address of the CMS office in Boulder is now peberl@clays.org. The old one should still work, but just to be sure, please use the new one.

Archives contributions

Many thanks for contributions to the Archives by G. Kacandes, W. Keller, and D. Pevear.

Meeting article next time

The article discussing the CMS Baltimore meeting will be published in the next issue of *CMS News*.

Thanks...

To the following people who contributed to this issue:

Scott Argast
Adrian Beserra
Dave Bish
Rebecca Cohen
Ginny Colten-Bradley
Pat Costanzo
Dennis Eberl
Karuna Eberl
Emmanuel Giannelis
Ross Giese
Steve Guggenheim
Michele Hluchy
Warren Huff
Chrystie Jackson
Marion Jackson
Cliff Johnston
George Kacandes
Hani Khoury
M. J. Nash
Dave Pevear
Rich Pollastro
Marion Reed
Brij Sawhney
Don Scafe
Ken Towe

Downsizing squeezes basic research at the USGS

The following article, written by Richard A. Kerr, is reprinted with permission from *Science*, Volume 268, 30 June 1995, pages 1840-41. Copyright 1995 American Association for the Advancement of Science.

The U. S. Geological Survey (USGS) has faced oblivion and survived, but for scientists at the agency the aftermath isn't going to be easy either. The call for abolishing the USGS in the Republicans' Contract with America has so far proved to be an empty threat. But researchers in the Geologic Division, where most of the agency's basic earth science research is done, are still facing an uncertain future: Agency officials, anticipating a congressional funding reduction in next year's budget, are preparing to eliminate hundreds of jobs. The eventual size of the layoff will depend on the agency's fate in Congress, but basic research won't be spared another source of pressure: a reorganization plan being pushed by the USGS's director, Gordon Eaton, who came on board a year ago.

The effect of Eaton's plan, as explained in a division document, will be to move the Geologic Division "from a position of 'patron of the sciences' to a mission-oriented organization that focuses more on program activities and meeting customer requirements and less on generic disciplinary issues within the earth sciences." Many fear the reorganization combined with layoffs will deliver a disastrous blow to the agency's stature as a key source of data and basic research on topics from earthquakes to geologic dating.

Indeed, senior researchers who see the writing on the wall have already started an exodus. Last year, after 31 years of service, geochronologist and National Academy of Sciences member Brent Dalrymple left the USGS. The agency "was getting to be an almost impossible place to do decent

research," he says. And others shared that frustration, he says, noting that "there was a time when the survey had 10 or 12 people in the National Academy. I think they'd be down to zero next month if Mary Lou Zoback (a geophysicist in the Menlo Park office) hadn't just been elected." In the Geologic Division, says Dalrymple, now dean of oceanography at Oregon State University, research "just isn't a priority anymore."

Eaton, himself a one-time academic and USGS researcher, agrees with critics that basic research "is an essential part of what we have to offer the nation." But observers note that Eaton inherited an agency under strain and is working to mollify a results-oriented Congress as best he can. And his remedy, many USGS observers tell *Science*, has been to accelerate a trend of squeezing basic research that began more than a decade ago.

In 1982, after some good years in the 1970s and early '80s, the Geologic Division had 3800 "full-time equivalents," or FTEs (funding equal to salaries for 3800 full-time employees), to do its work: map rock types, monitor volcanoes, understand how earthquakes damage buildings, assess how much oil and gas remain to be found, and explore the continental shelves, among other jobs. Then a period of slow funding growth accompanied by inflation set in. The USGS enjoyed some real increases in the 1980s, but they went largely to the customer-oriented divisions: the National Mapping Division, which used them to acquire state-of-the-art mapmaking technology, and the Water Resources Division, which applied them to assessing the nation's water quality. The Geologic Division was getting along on much the same \$230 million per year or so. By 1987, attrition had reduced staffing from 3800

to 2700 FTEs, and two buyouts in the past year dropped it to about 2200. Meanwhile money for field work was dwindling, so even the people who remained felt squeezed.

Now officials at the USGS's national headquarters in Reston, Virginia, are taking aim at the Geologic Division again. They are poised to slash several hundred more scientific positions to bring total Geologic Division employment to about half what it was in 1982. They are assuming as a worst-case scenario that Congress will cut total agency funding by 20% in the 1996 budget. Although the eventual size of the layoff will depend on congressional action that began only last week, notices that particular positions are being abolished will be served on 1 August, effective 1 October unless the layoffs are rolled back because of a less-than-disastrous outcome in Congress. (*Editor's note: Since this article was written, the dates have been moved to August 15 and October 15 respectively, and there will be an addback of 100 positions to the original RIF list.*)

While Geologic Division researchers wait for the ax to fall, they are watching their division be remade in the image of the Water Resources Division, or "waterized," as some say. The looming reorganization, which will be formalized shortly, will shift the responsibilities for specific projects from the head offices in Reston to team leaders in the field offices, reporting to one of three regional geologists. This regional orientation has long been in place in Water Resources, where it allows for close coordination of more than 1000 cooperative arrangements between the USGS and state and local agencies.

The move toward that model accelerated last April when Eaton appointed Patrick Leahy—a 20-year veteran of Water Resources who has

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Interviews with the clay scientists

Marion L. Jackson

M. L. Jackson is an emeritus professor at the University of Wisconsin-Madison, where he taught for over 40 years. He is a Distinguished Member of The Clay Minerals Society, as well as a past President, Brindley Lecturer, and Pioneer Lecturer. In fact, the only CMS award he has not received is the Marion L. & Chrystie M. Jackson Mid-Career Clay Scientist Award, which was funded and established by Jackson and his wife, Chrystie. The interview was conducted in Saskatoon in August, 1994, by Brij Sawhney, a former student of Jackson and a past President of the CMS, and Dennis Eberl, CMS President at the time, with Chrystie Jackson in attendance.



Drawing by M. J. Nash

CMS: Okay, Prof, I'd like to ask the first question. When I nominated you a few years ago for honorary membership to the Agronomy Society and Soil Science Society of America, my letter said that you can rightly be called the father of the soil clay mineralogy in this country, and I still hold that view.

JACKSON: Thank you very much. You're embarrassing me.

CMS: In that context, can I ask you what made you start in this particular field of soil science so early in your life, and what are the various factors that were responsible for your continued enthusiastic interest all these years, four decades or more?

JACKSON: That is an interesting question. I can answer it. After I finished my Ph.D. degree in Wisconsin, they asked me if I'd like to stay on as a staff member. I said, "That sounds good." They said, "We'd like to have you make your career in clay mineralogy of soils and elsewhere." So that was a clear assignment. I went to the conference at Missouri in 1953, and by that time I'd

bought an X-ray diffraction machine and started studying the key factors in clay diffraction.

The first thing I noticed was that a given clay would give a highly variable diffraction intensity, depending on its preparation. I learned that calcium or magnesium saturation followed by some kind of a polar solvent (I used benzene) made the most consistent, high-intensity pattern. Later on, following some advice from the literature, we tried using glycerol for solvation. That made the patterns even more consistent and reliable, and diagnostic

for montmorillonite, vermiculite, and various other minerals in which we were interested. We learned that clays are sensitive and very responsive to preparation.

After that, I think I generally pursued this interest, but during World War II, there were several practical problems that bothered our state. Our alfalfa was failing in central Wisconsin, and they didn't seem able to do something to fix it. I took a war-time leave from my regular work and tackled that problem. It turned out that, like so many problems, there were two factors responsible for the alfalfa failure. One was that the soils weren't adequately limed, but lime didn't do any good by itself. And secondly, they tried various fertilizer treatments, and none of those worked by themselves. But lime and potassium together solved the problem, and the alfalfa came back. So the college appreciated that very much, and some of my colleagues slapped me on the back and said, "Well, you don't have to do anything else the rest of your life; you've already earned a career in this department!" Of course, they forgot about this later.

CMS: How did you solve that problem? Just by trial and error, or did you analyze the soil?

Jackson, *continued*

JACKSON: We had soil tests, and it was a case of paying attention. We had acid soils and low potassium. It wasn't very difficult actually. In hindsight, it looks very simple, but the experimental station had failed, as had several other workers. The farmers were even disgusted with the University because, as they said, "I tried lime, and it didn't work." I said, "Show me where you put it." You couldn't tell where they put it, because they didn't add the potash. Other farmers put on only potash, and nothing spectacular happened. Every night I shipped soil samples to the university for diagnostic tests. The next morning they got the sample by express, and by the middle of the day, I was receiving an answer. We published, and educated the county agents.

So it became a very prosperous area again. We've gone back up there to see, after 20 or 30 years, how did our program take hold? What we found was that two-thirds of the land was under new management. A few older farmers were still there. The farms are larger, as everywhere. Gradually as people retire, their farms are swept up into larger holdings.

CMS: So success made you do more and more?

JACKSON: I went back and attended the clay mineral conferences and published a series of papers with my students. At first, I started out having a dozen graduate students, but I found that was too much, so I cut it back to five or six and tried to stick to that. I thought I was not doing justice to the individual student by having too many. I remember one year, I had five Ph.D.s graduate, and I didn't replace any of them. That was an experience one has to learn.

CMS: Bob Garrels was asked, "What do you consider to be the ideal number of graduate students?" He said, "One."

JACKSON: That is true, but they help each other, and I thought the optimum number was about six. We had a research conference every week at the same hour, 4:00 until 5:30. Each week one of the students would be prepared in advance. We'd go over his report. He had to put out a written report of one page, no more than one page, and he had to state the broad general objective, a more specific objective, and, finally, just what he was going to show by this approach. You remember that, Brij?

CMS: Oh, yes.

JACKSON: By having a limited report, and these three

levels of focus, I think the students learned that you can only do so much at any one time. If you get too many things going, nothing gets the right attention. I thought those research reports were successful. I had many students say when they came to write their theses, "Thank goodness for those research reports!" They'd have to focus about every six weeks.

CMS: Did any particular problems early on, when you were first studying soil science, really make an impression on you, make you take this subject up as your study in life?

JACKSON: When I made the commitment to go to Wisconsin, I had been in Nebraska through a bachelor's degree and a master's degree. My master's thesis was on land use planning, a very general topic and a very thick thesis. When I went to Wisconsin, I wanted to get down to brass tacks, carve out an area of research. Professor Truog became my advisor, and he encouraged me to find an area. He kind of defined it as being clay. He had had several graduate students, and he had tried to do X-ray diffraction. They had some old machinery. It was very poor. It didn't give good results, and they didn't go into detail in sample preparation or anything, so that was lost effort. But he still had in mind, "I've got this young fellow. I'm going to point him to that problem, and maybe he can solve it." The first thing I did was go to the General Elec-

Some of my colleagues slapped me on the back and said, "Well, you don't have to do anything else the rest of your life..." Of course, they forgot about this later.

tric Company to study X-ray diffraction at their factory. They had made a drastic improvement on the equipment.

CMS: About what year was this?

JACKSON: About 1941. Before that, the leading equipment was from the midwest. The leading institution was Illinois, and they built their own X-ray machines. Dr. Clarke was in charge, and there were some people in soils using it. So after I went to the factory, I went down to Illinois to see where some work was being done. Their equipment was vastly inferior to the new equipment from General Electric. I had quite a campus struggle about ordering it, not that it was very much money involved, probably \$2400, but it was conventional on campus, especially in the physics department, to build your own equipment. I said, "Can you people build it and guarantee it will get the same results?" Well, they just backed away,

continued on next page

Jackson, continued

so we got the appropriation. It sounds like a modest sum, but you have to multiply by 20 to see what kind of money it was in those days. So I got the money for the equipment. That wasn't the only one. I got a replacement, and a third one before the end of my career. After the second one, the leading X-ray person in the physics department then quit his old route, and bought the same equipment I had. They admitted they couldn't quite match industrial technology. Industry is best in building good equipment. They work at it six days a week.

CMS: If you want to do science, you can't be building equipment.

JACKSON: You have to get good equipment. It's been illustrated many times—infrared, X-ray, or any number of things. Look at what's here in Saskatoon: a floor full of expensive equipment. Obviously one can do nice research with it. P. M. Huang, when he came to Saskatoon, didn't have any equipment, so he requested equipment funds. To say something for the Canadian system, after he'd done a certain amount of work, the federal Canadian Research Council gave him a five-year grant with enough money for every year—\$87,000 a year—besides salary, so he didn't have to ask for money every year. It was a good research grant. There's nothing like this in the United States that I know of. Nobody has that kind of money. Now he says, "The only thing is, it's up to me to make use of it. Otherwise, when I want to renew, I won't get anything." But they have a system of funding promising young scientists who have had a few years experience, and they're ready to relieve them of the tedium of writing proposals. I never got rid of that problem. I had NSF support and AEC support, but I was writing a proposal every year.

CMS: Prof, going back to research, you have been at the forefront of many fields in soil science, not just the clay part, but many of the special fields, including mineral analysis, chemical analysis, mineralogical weathering, phosphate reactions, aluminum interlayers, even atmospheric dust. What is it that made you take on so many things, and so early on?

JACKSON: I learned that even if you can get your equipment and your grant, if you don't do anything with it, you're sunk. So the next thing was to get a good idea. I remember fairly early in my career, there was a question about the nature of soil acidity. There was a dilemma. Some of the famous characters believed that it was hydrogen causing acid soils, and there was another group that thought, no, it's aluminum. They had their data, and they

could prove it. I found by reasoning carefully through the data and doing some observation, that it was both. The aluminum formed hexahydrate, with water, releasing hydrogen ions by hydrolysis. So yes, it was exchangeable aluminum. Yes, it was hydrogen ion. It was a combination, and there was no way to study soil acidity except by facing up to this problem of aluminum in soil acidity. There'd always been something that one of our famous people called the soil acidity merry-go-round. He gave a paper by that title. I got up and made a comment, and the president of the Society said, "Will you give a paper on that subject next year?" So I wrote a paper, and showed that this dilemma was just understanding hydrolysis. This argument had been going on for 20 or 30 years.

Very early on, to answer your other question, we got X-ray going. Now what were we going to do with it? There was evidence sprinkled through the literature that the more you weathered, the more you'd go from one mineral to another until finally you wound up with aluminum hydroxide, gibbsite, even boehmite. That had been observed in Australia, and various places where they'd had extreme weathering. So looking at the world literature, I decided to write my first paper in that series on weathering sequence. We had good data. We had a Canadian bringing in rock flour, the earliest and least weathered of anything the glacier would leave, ground primary minerals from Ontario. We went clear up to Hudson's Bay, got some till that was pretty fresh, with ground-up feldspars, and even

If you get too many things going, nothing gets the right attention.

amphiboles, that came out of the rocks and never weathered at all. Then we went through micas that have been around for quite a while, in Illinois or Indiana, and vermiculite became a reality. Mica went to vermiculite, and vermiculite weathered either directly or indirectly, lost some of its charge, and became montmorillonite, as we called it in those days, but now it is called smectite. Our pioneers in mineralogy, montmorillonite people at the USGS, didn't ever convert, but like MacArthur, just faded away. Finally smectite took hold.

CMS: How did your phosphate work come about?

JACKSON: If you have aluminum in a mine, it reacts with phosphate to form compounds. At first, people put a small amount of phosphate on the soil, and it got lost in the soil by absorption. They didn't know exactly what identities held on to the phosphate. But if you took a larger treatment and used X-ray diffraction, you could actually identify aluminum phosphate and calcium phos-

Jackson, continued

phate. If you know the products of weathering, then you wonder what each one does with fertilizer. We found that potash pretty much went into mica interstices, as described by Dr. Bray. He called it the frayed edge. We thought that was an excellent idea, and we found it really was true that micas frayed like that, and potassium would be fixed, but was still more available than the native potassium in unweathered minerals. We paid attention to adsorption characteristics of potassium and phosphate. These are two of the major elements. The third one is nitrogen. We studied nitrogen use in the midwest. Some pioneers in the southern states—Mississippi, and so on—were using large applications and getting enormous yields of corn. After World War II, there were enormous nitrogen fixing plants that came out with ammonium, and they would convert it to nitrate or whatnot, but anhydrous ammonia under pressure is what we used.

I always had to get permission to do a study from Professor Truog, and he'd say, "Well, we studied that, but you're young, and I'd like to have you go ahead with a study of the use of nitrogen." Problems are never simple, and it turned out in Wisconsin, they'd go out and try nitrogen on the standard population of corn plants, and there was a poor response. But if you put a higher stand density together with anhydrous ammonia, the plants took off. The yield was tremendous. Our state average was 44 bushels of corn per acre, and in two or three years it went up to over 100, and finally 130 was standard. Of course, you had to use a large amount of seed to get this high population, and then you could use various forms of nitrogen. It became more economical to use nitrate, which became available as solutions under low pressure. When we used anhydrous ammonia, we used high-pressure tanks, and injected it in the soil. We had to make a study of whether anhydrous ammonia would be lost to evaporation. They were worried about that.

We found that the soil had a strong affinity for ammonia. Just put the nitrogen in the soil and cover up a little. That high adsorption of anhydrous ammonia was a surprise to everybody. First they used anhydrous ammonia, then they found that if they used a low pressure in a barrel and put the ammonium nitrate in with some water, they could get up to 40% N in solution without having to deal with the high pressure. That became very popular in the midwest, and it went from people shaking their heads, saying, "No, it isn't going to work in Iowa, no, it isn't going to work in Nebraska," till everybody was using it,



Brij Sawhney interviews Marion Jackson in Saskatoon, 1994.

High Iron Photos

and they are still using it today. It was an age for turnover. With all those wartime investments in making ammonium nitrate for explosives, they thought they were going to be standing stark and unused. With the demand for nitrogen fertilizer, they never had to stand idle. The method was incorporated in most of the states, and where they have irrigation in the west, they still use it. It takes over 100 pounds of N for 100 bushels of corn. We toured around the plains, just to have a better grasp of these enormous plants and how they were fixing nitrogen with natural gas as a source of power. The nitrogen companies would give us a research grant, enough to support a graduate student or two, and that's how we managed to finance that research.

CMS: What do you think of the current trend toward organic farming?

JACKSON: There's nothing wrong about the importance of organic matter, but that isn't sufficient. If a farmer is

There was evidence... that the more you weathered, the more you'd go from one mineral to another until finally you wound up with aluminum hydroxide, gibbsite, even boehmite.

content with a low yield, he can go ahead and do what we did before the great revolution of using mineral fertilizer. Most organic farmers have changed to taking care of the soil. But we're going to use what makes the soil pay. If we can invest a dollar and get two dollars back, we're going to do it. I think there's just a few unrealistic people

continued on next page

Jackson, continued

who still stick to "organics only."

CMS: Tropospheric dust. How did you get involved in that?

JACKSON: Well, dust gets in your eyes, you know.

CMS: Ha, ha, ha. That's true, that's true.

JACKSON: Well, I grew up on loess plains of Nebraska where the dust was 100 feet thick.

CMS: Is it that thick in Wisconsin?

JACKSON: It wasn't that thick in Wisconsin, but in Nebraska it was, so I was used to thinking in terms of large increments. And the second thing that happened, we found a colleague at the University of Chicago, who was extremely capable at isotopic analysis, but he hadn't published very much. So I invited him to come up to Wisconsin, and I explained to him what we had in mind about dust. The place it came into focus was Hawaii. I went out there to look for dust, and sure enough they had these meter-thick deposits, here and there. Even on the mountain tops, they had dust. There were some hypotheses from others who were geochemists, who had discovered dust deposits in the ocean in their drilling projects. It was ob-

We followed dust as it came across the Pacific Ocean. Some went on Japan, some went in the ocean, some landed in Hawaii, some landed in North America.

vious dust ought to be on the islands of Hawaii, too. That was kind of an ideal place because they didn't have any parent material that had the minerals in it the dust had. We traced certain minerals, like weathered mica and so on. We used quartz for the tracer by the quartz isotopic ratio. It was unique in sediments, but when you got dust, it had a different source coming from Asia. The first thing I had to do was figure out a chemical method to isolate quartz by itself. We found if we fused the soil with certain reagents, they would decompose the layer silicates and we'd get that quartz out, monomineralic. You could X-ray it, and all we had was quartz. When we had it monomineralic, then we had a simple system that was ideal for oxygen isotopic ratios.

We followed dust as it came across the Pacific Ocean.

Some went on Japan, some went in the ocean, some landed in Hawaii, some landed in North America. So the dust is circulating all the way around the globe, especially in the northern hemisphere. That's a lot of land.

CMS: This is a continual fall-out ?

JACKSON: Yes, it comes in every rain. You know there's always a little dust you have to wash off your windshield.

CMS: There was always an international flavor in your lab.

JACKSON: One of my early graduate students was Dr. Hseung, from China. When things had quieted down from the war, they started sending people. We kept corresponding. Eventually he was a member of the National Academy of China. He wrote a letter inviting Chrystie and me to come over to the Chinese Academy. He came to Wisconsin as a young man, and he lived to be 85 or so. It was nearly at the end of his term that I actually went to China. We had people coming, bringing soil from China and from various other places. We did that work long before I saw it first hand.

CMS: Then people came from India and from Australia and New Zealand...?

JACKSON: They came from these and many other countries. We published a couple of papers. People read the papers and would think, "I've got to send a student over there." I had a professor visiting from Scotland, and he just stayed a few days. We asked him to stay longer and give us more lectures, but he only had so many days in his itinerary, so then he went home. We wrote him asking, "When are you coming back and staying longer?" He sent a mature young man who came over for a year. That man is now a citizen of the United States. He went back home, but he immigrated finally and has a job with the federal government. So your human resources go with your scientific growth and publication. We had a slogan in Wisconsin—publish or perish. If you didn't publish something, you were certainly going to perish in Wisconsin. As soon as we got some data, we tried to round it out, make a good paper, and give it at the clay conferences and soil conferences. As far as getting human resources, it's like Topsy, it grew naturally.

CMS: Do you have any questions you'd like to ask Marion, Chrystie?

C. JACKSON: Well, I hadn't thought of that.

Jackson, continued

CMS: Now's your chance!

JACKSON: She's been taking notes over there.

CMS: I've got one more question I want to ask while we are on this scientific stuff. A few years ago you got interested in the health aspect of these metals, aluminum and silicon and selenium.

JACKSON: Especially selenium.

CMS: Selenium, yes.

JACKSON: I grew into that as I reflected on the necessary elements for good health. I was thinking, "What can we do that is anti-aging?" The literature is there, and Wisconsin had done some early work. We had heart trouble with our cattle. They'd come up with a bad heart and die, or be very crippled, in a certain region of Wisconsin. Our biochemists, being as efficient as they are, learned that these cattle required selenium. They gave them selenium in their feed, and that turned around the heart trouble.

The question of anti-aging came up, and I read in some of the journals that selenium was an anti-aging mineral. It's complimentary to vitamin E, but they weren't fully replaceable for each other. About ten percent you had to get from selenium or ten percent you had to get from vitamin E. But they overlap each other as anti-aging agents, which was interesting. So I went back over to biochem and said, "I'm interested in selenium that you have the lead on. They said, "We have methods, but we don't work on it any more." I said, "Well, I'm interested in studying it for humans because I have some literature from China where people were dying of heart deaths and were having



Joe White and Marion Jackson at the barbecue, Houston, 1991.

Jo Eberl

their one acre. So they had drainage from the rivers, and then it would evaporate over the flood plains. The guy that was out on that acre or two would eat his own wheat and rice and get selenosis from excess. We had it in California and Idaho and Washington. In certain areas they'd had selenosis in cattle, and they had it in the same states that they had deficiencies elsewhere.

CMS: Do you think people should be taking selenium?

JACKSON: Yes, I learned what the daily requirement is, and it is, for good health, 150 micrograms per day, and it isn't stored, so you have to take it every day.

CMS: Another human aspect of your great success—someone has said that behind every great man there's a great woman.

JACKSON: Yes, behind every successful man is a successful woman.

CMS: Right. I have known Mrs. Jackson for more than four decades now, how kind and affectionate and understanding she is. Would you like to say a few words about her role in your career?

JACKSON: I'll give you a parable. A man was taking a walk with Jesus, and they had two tracks. Once in a while, there would just be one track, and the fellow said, "What happened to the other one?" Well, Jesus said, "That's when I carried you."

CMS: All right, great. I like that.

JACKSON: I did something right, early. I decided when

continued on next page

The daily requirement [of selenium] is... 150 micrograms per day.

trouble from age 10, in certain regions of China." This caught the attention of our medical community nationwide. So they republished the Chinese in English. Here was human selenium deficiency, and within a couple years I was going over there to see it. They also had in the literature areas of selenium toxicity. I'd already read the American literature, and they never show a single example, even when they took an extreme case out in South Dakota, where some guy who had lived in a pocket of high selenium was not sick from the excess. But in China they have more one-acre farms, and they eat the food off

Jackson, *continued*

I was a farm boy that there must be a better life than living on the farm, with all those privations we had in the early days. I decided, "I'm going to get a good academic record so I can finance my education." I had no money. But I turned out to be a ranking number one scholar in my high school. I had my fees paid for the first year in the university. After that I had to earn them. Now they give you four years, but then they just gave you one year to give you a start. I went to Lincoln and the University of Nebraska, and I decided, "There's no use doing this job half way. I'll try to be the top scholar in the University of Nebraska, which I did. Meantime I was living and learning, and getting acquainted. Chrystie's brother, Rodney Bertramson, and I lived in the same boarding house, and we got to chatting.

CMS: He was an agronomist, wasn't he?

JACKSON: He was president of ASA at one time. Chrystie was in western Nebraska teaching school. She came down to visit Rodney. The landlady had a room she rented out to temporary tenants, so Chrystie and I had a chance to get acquainted. The landlady was very wise. Chrystie always helps with the dishes, you know, so the landlady disappeared. I wasn't going to pass up that. I was working on my car, and I thought, "Let that wait till tomorrow." I went in and dried the dishes, and I asked her

So we established our first home in Wisconsin. And Chrystie has won her way among everyone.

a question. "I suppose a young lady like you is already spoken for." She said, "No, not at all." So I thought, "Well, that's frank." I had the opportunity, and it was a stroke of serendipity that I got one summer's work at the soil survey in her county. During the course of the summer, we improved our acquaintance. She, her brother, and I went to South Dakota to the Black Hills in my old model A Ford. Then she came down to the university. Two years later, it was time for me to go to Wisconsin. I thought I'd go up and get started, and come back and get Chrystie. Then I thought, "That's a very poor idea." I decided I'd ask her to go with me. So we established our first home in Wisconsin. And she's won her way among everyone.

CMS: She won the heart of so many young students, all of whom are so grateful.

JACKSON: It was a good solid romance, but we didn't leave any pebbles unturned either. Another interesting story which I think is worth telling: the head of the soil survey led the field trip every year, and Chrystie's brother (when we were both on the trip) said, "You know, my sister and our parents live out here in the country where we're going." He spoke to the director of the soil survey and said, "Couldn't we stop there and have a dish of ice cream?" The group was about 20 students. In the meantime, Rodney called her. Her father went out and milked the cow, Chrystie went to town to get some ice. So we had ice cream together.

Dr. Condra, the head of the soil survey and of the field trip, had been tipped off about our engagement. He decided to reveal it. He said, "Well, I understand that you've had some activities we didn't know about. I think you should go up there and tell that young lady good-bye in a suitable manner, and we'll go on and finish this trip." So we did.

Condra would usually take the boys up in some pine grove someplace near the end of the day, and he'd get every one of those fellows to make a little speech. That was good training for bashful boys. It could be about anything they wished.

CMS: That's a great idea. Where did the idea arise for the Marion and Chrystie Jackson Award. Did you have some input on that, Chrystie?

C. JACKSON: It was really my idea. Marion had been recognized many times. I was always terribly excited when he would come home and tell me about some award. And I thought, "How meaningful it would be to young people to have an award!" It isn't a monetary thing so much as that they are acknowledged as doing something very superior within their own field.

JACKSON: We talked it over after some meetings where they'd given awards in the Soil Science Society. They'd give the award to some 80-year-old, who had already retired. We decided, "What they really need is a mid-career award." We gave that award to the Soil Science Society one year, and to the Clay Minerals Society the next year. Chrystie has her own funds, and she wrote a check for ten thousand, and I wrote a check for ten thousand.

CMS: So how many more of Marion's ideas are yours?

C. JACKSON: Oh, I'll never tell!

CMS: We'd like to know that! That's a good one!

JACKSON: When we sent that check, I sent a letter along. I said, "If in any event you can't use this, then you

Jackson, *continued*

send the check back." But nobody sent it back! Now I have heard from Dennis that the \$20,000 had grown into \$37,000. They kept it as an endowment, and used the income from it to pay the awards.

C. JACKSON: It's been rewarding. We've met such wonderful young people.

JACKSON: Well, that was a nice thing. The CMS has a systematic way of finding some mid-career person. Every year, we'd go to the meeting, and this young person would come and thank us. In that way, instead of knowing just the Walter Kellers and all the older fellows, we got acquainted with the mid-career people in both societies, people whom we wouldn't have necessarily met before.

C. JACKSON: It adds a new dimension to our lives to meet the young people, and to see the wonderful things they've done. The only problem is there are so many of them who have done so well. The CMS has done a great job of choosing each awardee.

CMS: Excellent.

JACKSON: It made a little more trouble because the Society has to say, "Now, who are some of our new young comers?" That's the proper focus. You get a committee of five, and next time another committee, and they're starting to look at the young people who are emerging. I think they've done a very good job of selecting.

C. JACKSON: We've met some outstanding young people.

JACKSON: Some of these young fellows have made tremendous contributions by midcareer.

C. JACKSON: We'd enjoy seeing former grad students recognized... they are outstanding.

JACKSON: The CMS specified the age bracket right to the year of age. They said, "If we don't specify that, we'll always be having trouble." So they wisely stated the age bracket.

CMS: Speaking of your former graduate students, how would you rate Brij as a graduate student?

JACKSON: Well, he's made an excellent record, as is al-



Marion and Chrystie Jackson at the CMS meeting in Houston, 1991. *High Iron Photos*

ready known.

CMS: What did you think of him when he was a graduate student?

JACKSON: I thought enough of him to work with him, and to make sure that he had a good thesis. He did.

C. JACKSON: He won our hearts as well.

CMS: I was lucky.

JACKSON: We picked several students, not too many but

In that way, instead of knowing just the Walter Kellers and all the older fellows, we got acquainted with mid-career people in both societies, people whom we wouldn't have necessarily met before.

maybe a half a dozen, from India, one at a time, and we made an American out of each.

CMS: The first year I spent there, you said, "You know what I'm going to do, I'm going to have an Indian student every year. And you're the first one."

JACKSON: You know Sridhar Komarneni is here, and he's one of those former Indians. On the record, he was the number one student at everything, from grade school all the way through, and got gold medals and so forth.

CMS: Other than Brij, of course, who do you think was your brightest student?

continued on next page

Jackson, continued

JACKSON: I couldn't name just one. Or I'm sure I wouldn't think of the right one. But what I have in mind is that there were many very talented young people that came from various countries and many states of the United States.

CMS: Where do you think soil clay mineralogy is going now in these hard times?

JACKSON: I have faith that good people are entering the field. When I read the abstracts and go to the meetings, I'm happy with what I see. You have very good abstracts, and they're coming internationally to this conference—from France and various other countries. I believe you said, Dennis, our Society is getting to be international. And it is. You know we have some societies that meet every four years, and they have a proceedings, but that doesn't take the place of a journal that's capturing these current articles from all over the world every other month.

CMS: The thought occurs to me that none of your children followed the tradition of being in science. Did you let them do what they wanted to do, or how did you help them make career decisions?

JACKSON: We had four children. They each chose their own field. Whatever they chose, we supported them. We counceled with them in general; they each made the decision.

I have faith that good people are entering the field.

C. JACKSON: One of the reasons is that they're a combination of Marion and myself, and I'm not as science-oriented, so that made their choice even harder.

CMS: Where do your interests lie?

C. JACKSON: I taught. I love working with little children.

CMS: What grade did you teach?

C. JACKSON: I taught in the country school at age 17 first, very successfully. It brought together a whole com-



The first four Jackson Awardees with the Jacksons in Baltimore, 1995: Jan Srodon, Joe Stucki, Marion and Chrystie Jackson, Steve Guggenheim, Dave Bish. High Iron Photos

munity that was having problems getting along. The kids did very well on state exams and all. I was only four years older than some of the pupils, I realize now. I thought I was grown up.

JACKSON: She was grown up. She had to get started in the work-day world.

C. JACKSON: I've always worked with young children, in Headstart, Montessorri and preschool. It's my first love. I adored working with my family, and all the children—you know when you have a family, you often have all the other children coming in. We had parties at our house with 30-60 kids, and the neighbors would say, "You know, you're going to get into trouble with their drinking beer and things." I never thought of such things. Nobody ever brought a can of beer. We were just there, and enjoyed them.

JACKSON: We had a big rec room. Chrystie would really entertain.

C. JACKSON: The kids were fine young people. We often chaperoned at the university. We didn't have any problems. They'd say, "We're going to have this party. Will you chaperone?" because they didn't trust some chaperones. It was interesting. I loved it.

CMS: You were inducted into the National Academy of Sciences. What do you think of that?

JACKSON: This was eight or so years ago. It's really a great honor, and I appreciate the fact that I scarcely knew some of my sponsors. They ask you to write your record in five or six lines. They also give you a page of other

Jackson, continued

things. And your nominator has to be able to boil it down to that. That's a very severe test because you've got to focus on something.

CMS: What do you think were your best accomplishments, in five lines?

JACKSON: Well, I have a hint because those five lines are what the president uses at your induction. I learned that what counted was the books. I had two books out, an

elementary course in soil analysis and an advanced course. And that was mentioned in the five lines. It's hard to sort it out and say, "Well, this was his most significant thing."

C. JACKSON: To me, it was wonderful being a part of Marion's life in his scientific world. People like you came to us, from throughout the world, who have been like our own family. You're all a part of our lives. It's been so wonderful for us to have had that opportunity to call them "our family."

USGS, continued from page 3

never supervised research—as Chief Geologist in charge of the division. And while some staffers welcome the shift of management responsibilities toward regional offices, others told *Science* that they are less enthusiastic about Water Resources as a model. Some of the skepticism stems from the fact that the water unit specializes in what geologist David Scholl, who is retiring to emeritus status from the Menlo Park office, calls "storefront science," in which "customers" such as cities and counties walk out the door with a specified "product," such as an evaluation of ground-water quality. Only about 10% of Water Resources' work can be called basic research, everyone agrees, while Geologic Division work may involve something closer to 50%.

And given the layoffs and reorganization in the offing, many observers presume that 10% basic research is the level USGS managers, who aren't talking publicly, are shooting for. That would be a "blueprint for bean-counting oblivion," according to economic geologist Paul Barton in Reston, another academy member who will soon be leaving the USGS. He and Dalrymple cite numerous cases in which basic USGS research

turned out to be just the ticket for "customers," who may not have even realized they had a problem. In the early 1970s, for example, USGS geophysicist Arthur Lachenbruch, who has recently retired, was studying how heat moves around in Earth's crust, just because he thought it was interesting. Over lunch one day, he heard from colleagues that engineers were planning to bury the Alaska oil pipeline in permafrost. Lachenbruch realized, when no one else seemed to, that the heat from the fluid friction within the pipe would surely melt the permafrost and wreak disasters on Alaska. The seemingly irrelevant researcher quickly convinced the engineers, and the pipeline was elevated above the permafrost.

People like Lachenbruch "see problems in ways other people can't," says Dalrymple, and are thus a crucial component of an organization like the USGS. "Even though you're downsizing, there has to be some critical mass (of basic research) you maintain. I don't know what it ought to be, but it probably has to be larger than 5 or 10%."

Eaton disagrees. In a reply to concerns expressed in a letter from Barton, Eaton argued that "the 10 to 12%

of [Water Resources Division] staff who do basic research (as opposed to data-gathering and analysis) strike a balance that, if applied to [the Geologic Division], would provide more than ample room for" work like Lachenbruch's. And some staffers see the paring of research in many parts of the Geologic Division as inevitable. One scientist who has shuttled between research and management at headquarters argues that it is proper for the Geologic Division to focus more on understanding local processes, such as volcanic eruptions or landslides, and less on basic research and the broad geologic mapping that some traditionalists still view as the core of the division.

"We're not a basic research organization," says the staffer. "We have to show more impact on society, policy, or economics. Some have come to feel they can do science for science's sake and have lost touch with the underlying rationale of why the tax-payers should pay their salary." Applied science and gathering fundamental knowledge "are not separate," he notes; "it's a matter of balance." Finding the right balance, and retaining the right people to make it work, will be the challenge.

Teaching Clay

Welcome to a new (hopefully regular) column in the CMS newsletter! The Continuing Education Committee is sponsoring this feature which will address numerous aspects of teaching clay science. The intent of the column is for members to share their expertise, interests, and tips for teaching clay science to students at every level—from grade school to graduate school and everything in between! In order for the feature to succeed, though, we need your help—we are soliciting input from any and all members who have something to share. If you would like to submit a short description of something that works well with your students—an exercise, a demonstration, a particular way that you explain some aspect of clays, your teaching strategies, etc., please send it to Michele Hluchy, Geology & Environmental Studies Program, Alfred University, Alfred, NY 14802; e-mail: FHLUCHY@BIGVAX.ALFRED.EDU.

The first column in our series has been submitted by Steve Guggenheim who teaches about clays at the University of Illinois at Chicago. Steve has a particular way of explaining the Bragg Equation to his students that he has graciously agreed to share with us.

*Michele Hluchy, Chair, Continuing Education Committee
Alfred, New York*

The Bragg Equation: What to do with "n" and Other Comments

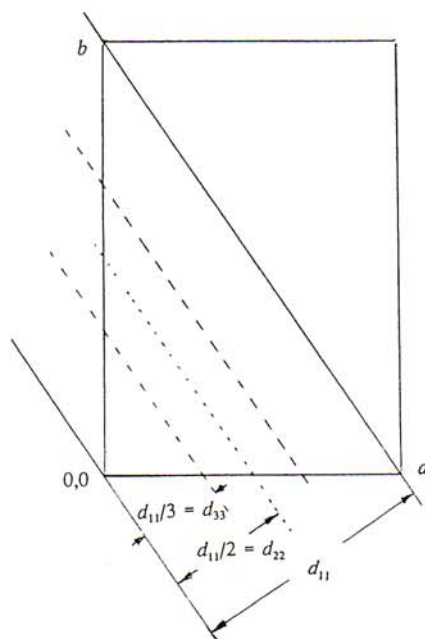


Figure 1. A unit cell is defined, along with d_{11} and related planes.

The Bragg equation, $n\lambda = 2d\sin\theta$, is well known to clay mineralogists and diffractionists. However, the Bragg equation is rarely used in this form; instead, a revised form is used which has the "n" (the order of diffraction) incorporated in the Miller indices, hkl , as $\lambda = 2d_{hkl}\sin\theta$. This revised Bragg equation includes a subscript, which is often (incorrectly) omitted when writing the equation. When teaching the use of the revised equation, the concepts behind "n" and " d_{hkl} " and their relationship to the physics of diffraction are frequently overlooked or misstated. The purpose of this short comment is to illustrate the inter-relationship of "n" and " d_{hkl} " and to give a correct derivation of the revised Bragg equation. We start with the Bragg equation, thereby assuming that the equation was derived previously and that Miller indices are understood.

The aim of this exercise is to eliminate n (an integer specifying the number of wavelengths involved in the phase difference between successive planes in the direction of the diffracted beam), by manipulating d , the interplanar spacing.

This change is desirable because (a) n is implied by designating a *specific* plane, hkl , (b) d_{hkl} has a clear crystallographic meaning whereas n does not, and (c) the revised equation is simpler to use. To illustrate (a) and (b), consider a simple case of a two-dimensional plane with $h = 1$ and $k = 1$ for the unit cell shown in Figure 1. Let us also re-arrange terms and separate constants following the form of $\theta = [\text{Sin}^{-1}(\lambda/2) (n/d_{hk})]$, where λ is fixed for the experiment and is thus considered a constant here. We will then examine the effect of varying n incrementally:

$$\theta' = \text{Sin}^{-1}(\lambda/2) (1/d_{11}) \text{ for } n = 1 \quad \text{(a)}$$

$$\theta'' = \text{Sin}^{-1}(\lambda/2) (2/d_{11}) \text{ for } n = 2 \quad \text{(b)}$$

$$\theta''' = \text{Sin}^{-1}(\lambda/2) (3/d_{11}) \text{ for } n = 3 \quad \text{(c)}$$

and so on.

Note that only the fraction involving d_{hk} varies in the formulations above. By simple algebraic manipulation, rewrite equation (b) and (c) so that the numerator of the variable part of these equations is always 1, by multiplying by the appropriate fraction:

$$\left(\frac{2}{d_{11}}\right) \cdot \left(\frac{1/2}{1/2}\right)$$

so that $\theta'' = \text{Sin}^{-1}(\lambda/2) \left(\frac{1}{d_{11}/2}\right)$ (b')

and

$$\left(\frac{3}{d_{11}}\right) \cdot \left(\frac{1/3}{1/3}\right)$$

so that $\theta''' = \text{Sin}^{-1}(\lambda/2) \left(\frac{1}{d_{11}/3}\right)$ (c')

and so on.

Note that as we increment n and maintain the numerator of the variable part of the expression equal to 1, the effect on d is clear. For example, for equation (b), the effect of $n = 2$ is that the d spacing becomes $d_{11}/2$ (in equation b'), which is equivalent to d_{22} (Fig. 1). For equation (c), the effect of $n = 3$ is that the interplanar spacing is $d_{11}/3$, which is equivalent to d_{33} (Fig. 1). Generally, when $n = m$, d becomes d_{hk}/m or $d_{h/m,k/m}$. Thus, the values of n and d are clearly and directly related, and we can properly write the Bragg equation as $\lambda = 2d_{hkl} \text{Sin}\theta$. For the modified Bragg equation, when n does not appear in the equation, it is *required* to include the subscript!

Several additional comments are in order. First, the definition of d is not related to atoms. It is improper to draw atoms on the planes used in the derivation of the Bragg equation, since the equation works equally well for planes not containing atoms. The drawing of atoms on the planes implies that the planes are related to these atoms, and they are not. Also, note that the equation involves reflection and not diffraction. Although the results may be similar for the two concepts, the process of diffraction is quite different than the process of reflection, and this should be emphasized to the student. Finally, we often describe the reflection process in terms of "mirrors," since it is natural to try to relate abstract concepts to familiar things. However, the analogy does not hold because successive planes reflect also (a "semi-transparent mirror?").

Steve Guggenheim
University of Illinois at Chicago

Student Profile

George Kacandes

Nationality: U.S.A.

Place of Study: Ph.D: Department of Geosciences, Penn State University

Thesis Advisor(s): H.L. Barnes and L.R. Kump

Thesis Topic: The effect of fluid chemistry on the reaction of smectite to illite under flow-through conditions. This is a laboratory experimental study, and much of my initial work involved designing a hydrothermal system (150 -300 °C) capable of handling clay suspensions. It was also critical that this system permit sampling of solids as well as fluids during a single experimental run. The sequence of illitic products

formed during these experiments is much like that observed in sedimentary basins, passing from precursor smectite (SWy-1) to end member illite, through a progression of mixed-layered smectite/illite intermediates. Two solution parameters I have investigated are aqueous silica activity and pH. Aqueous silica affects the extent of illitization which increases with decreasing silica activity. pH affects the mode of illitization: micaceous illites form at near neutral pHs and celadonic illites at higher pHs. These results suggest that illitization is controlled by the relative solubility of smectitic components as represented by SiO_2 , $\text{Al}(\text{OH})_3$, and

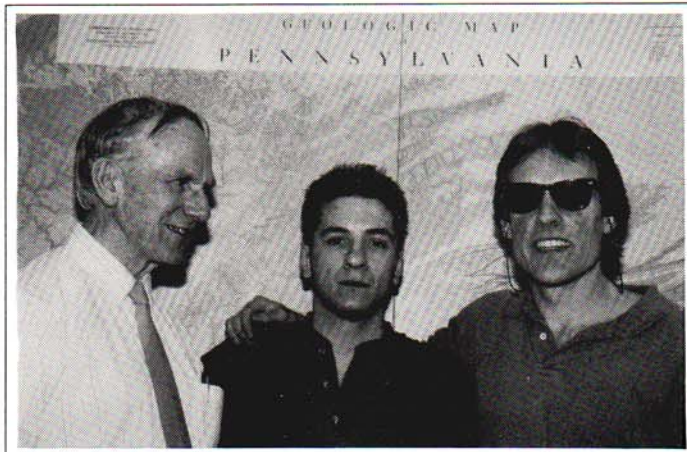


George Kacandes rock climbing in Colorado.
Dennis Eberl

$\text{Mg}(\text{OH})_2$. The results of these experiments also indicate that there is something special about smectite in smectite/illite: The smectite component in all mixed

layered clays examined is highly charged and displays vermiculitic characteristics, expanding on Ca-saturation, but collapsing upon K-saturation. A cursory examination of natural samples from the Gulf Coast indicates that this behavior may be more common than not. During my dissertation, I was fortunate to have received funding from DOE, NSF, and the Clay Minerals Society. I have completed my experimental work and am presently writing my dissertation.

Interest in Clay: I first became interested in clays as an undergraduate. I had a course in X-ray diffraction where we were to analyze a series of unknown powders. Most of these were easy to identify. I thought it would be neat to analyze some "dirt." I spent hours trying to identify the



George Kacandes flanked by advisors Hu Barnes and Lee Kump. G. Kacandes

material. I think it turned out to be a mixture of quartz, kaolinite, and mica. From then on I was hooked! I was formally introduced to clay mineralogy through an excellent course taught here at Penn State by Sridhar Komarneni. A year later, I attended my first Clay Minerals Society Meeting. The Clay Minerals Society consists of a very diverse group of scientists, and I feel lucky to be a part of it. I am inspired by members like Ken Towe, who do work ranging from clay mineralogy to paleoecology. I also like the fact that the CMS has a strong industrial connection.

Favorite Literature: I like history and comparative mythology. In the latter area, Robert Graves is my favorite author.

Favorite Sports: Olympic-style wrestling and soccer.

Favorite Music: Latin music, especially Cuban *són* and *charanga*.

Favorite Clay: High-charge smectite.

Editor's note: George is a past CMS grant recipient and has helped organize the Goldschmidt Conference for several years.

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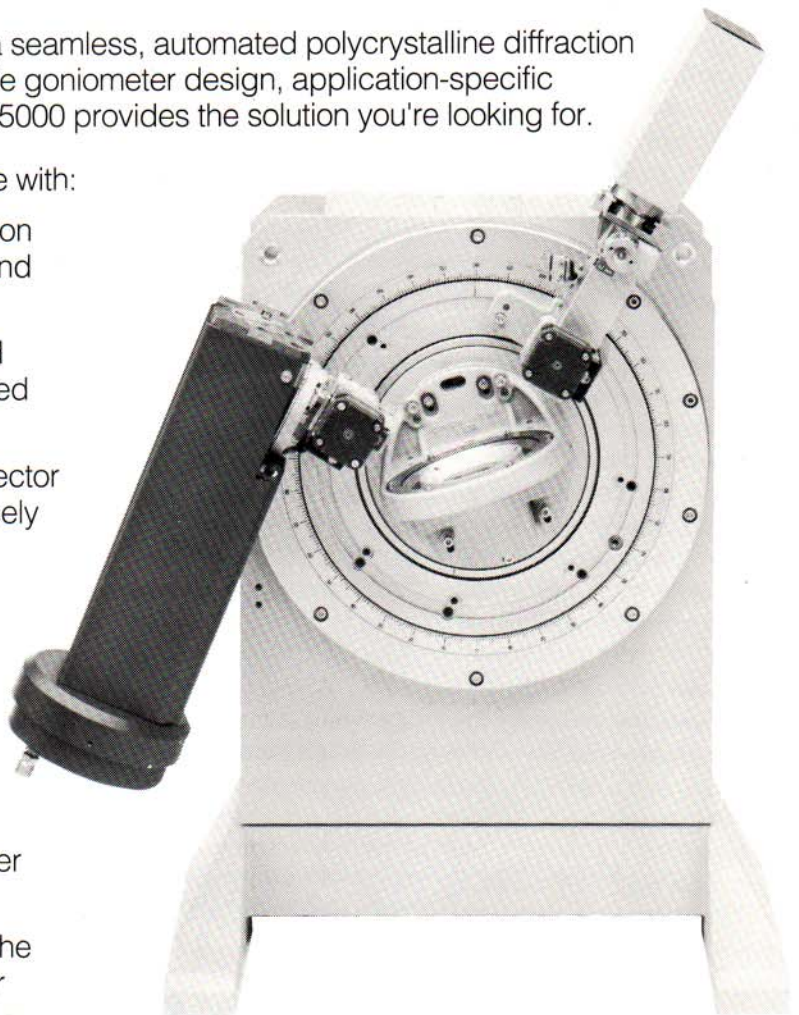
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Clays In & For The Environment

Workshop (Saturday, June 15)

Isotope Geology of Clay Minerals From Isotope Crystal Chemistry to Petrogenesis
organized by T. K. Kyser and F. L. Longstaffe (Tel: 519-661-3177; fax: 519-661-3198)

Symposia

Clay Sciences for Environmental Remediation and Waste Management
Chet Francis and Mark Elless (tel: 615-576-8192; fax: 615-574-7420)

Isotope Geochemistry and Environmental Research
Claudia Mora (Tel: 615-974-6010; fax: 615-974-2368)

Colloid Characteristics and Transport
Paul Bertsch (Tel: 803-725-2472; fax: 803-725-3309) and John McCarthy (Tel: 615-576-6606; fax: 615-576-8643)

Application of Clays for Nanocomposite (Clay-Polymers) Material Development
Gary Beall and Simeon Tsipursky (Tel: 708-392-4600; fax: 708-506-6199)

Clay/Biology/Health
George Guthrie (Tel: 505-665-6340; fax: 505-665-3285) and John Naim

Field Trip

Soils and Geomorphology of Valley and Ridge Province
organized by Dave Lietzke, John Foss, and Michael Clarke

Technical Program Chairs

Claudia Mora, Department of Geology Sciences
The University of Tennessee, Knoxville, TN 37996
Tel: 615-974-6010 Fax: 615-974-2368

Paul Bertsch, Savannah River Ecology Laboratory
University of Georgia, Aiken, SC 29801
Tel: 803-725-2472 Fax: 803-725-3309

General Chair

S. Y. Lee, Environmental Sciences Division
Oak Ridge National Laboratory, Oak Ridge, TN 37831-6038
Tel: 615-574-6316/7359 Fax: 615-576-8646 E-mail: SYL@ORNL.GOV

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The Clay Minerals Society

33rd Annual Meeting

June 15-20, 1996

Park Vista Hotel
Great Smoky Mountains National Park
Gatlinburg, Tennessee, USA

Ask the Clay Doctor

(Not a real doctor)

Dear Clay Doctor: I would like to correct a small error in your response to "spaced in Strasbourg," who wanted to know what kind of clay is found on the Moon (*CMS News*, Winter 1995). Your identification of *moonmorillonite* is close, but not quite on the mark. The only known lunar clay is *beidellite*, the more stable smectite in a highly aluminous environment where troctolitic waves once washed onto an anorthositic shore.

Many scientists today are not aware that, long before the Apollo and Luna sample returns, the spaced scientists of the 19th century knew of the occurrence of this clay on the Moon! Their keen multispectral vision—even with the naked eye—allowed this determination (our modern, degenerate, fully-clothed vision is but a sorry vestige of our ancestors' powers). Indeed, this knowledge was so widespread at the time that it was enshrined in the words of a then-popular song:

"Beidellite...

... beidellite...

... beidellite, of the silvery Moon"

Modern misinterpretations have corrupted the original wording, but our distant relatives surely knew that beidellite formed in the tidal mudflats of the primordial lunar magma ocean.

Der Lunar Terminator, from Hadley Delta, Palus Putredinis

Dear Clay Doctor: My son just turned 20 months old. According to the child-rearing books, he should be speaking several dozen words by now, but so far his only utterances are "illite," "sepiolite," and "hydroxy-aluminum vermiculite." Am I failure as a father?

Worried in Fort Wayne

P.S. At least he doesn't say stegosaurus yet.

Dear Worried: On the contrary, it sounds as though your child may have a talent in clay science. Now that he has learned the names of clays, the next most important thing to learn about is funding. I suggest that he be made to come up with an original experiment involving clay before being fed.

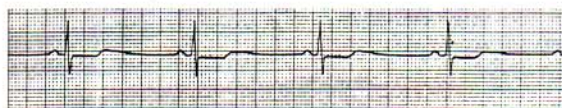
Dear Clay Doctor: I have a lot of clay in my back yard you can study.

Some YoYo, Albuquerque

Dear YoYo: Thanks for your offer of clay to study. As you may know, clay is a diminishing resource, because it

is continually lost in subduction zones and down the sinks of careless clay mineralogists. When I run out of clay to study, I'll be down to your place with my truck. I will call you first.

Dear Clay Doctor: Recently, a former student sent me a sample of a peculiar-looking clay material from a waste disposal site and asked for an identification of the minerals present. When I submitted the sample to my aging but still adequate X-ray diffractometer, it produced the following pattern:



I must confess I am completely stumped by this tracing. Either a new mineral has been discovered or my diffractometer is preparing to bid this blessed orb farewell. Would you be so kind as to interpret it for me?

Mystified in Mystic

Dear Mystified: Please sit down before reading this, and have a trusted friend close by. Now, it is quite clear to me that no new mineral has been discovered. Rather, your machine has suffered what we in the trade refer to as a peak or wave inversion. It arises from an exceedingly rare reversal of Bragg diffraction effects, or what some have called the uncertainty principal. In short, your sine theta is now cosine theta. I speak, of course, of the subject of wave mechanics, and you clearly need a good one. With luck, a skilled mechanic can put it right in no time, but the problem is to find a person with the requisite talent. Most of the better known wave mechanics have either been frightened away by the high cost of malpractice insurance, or have been seductively lured into hosting radio talk shows. Modesty and the threat of legal action prevent me from naming names, but I am confident that with diligence and a recent edition of your local yellow pages, you will find the necessary help.

Dear Clay Doctor: What is the smallest clay particle?
Bertha, TINYTOWN

Dear Bertha: The smallest particle of clay, discovered by the eminent clay mineralogist B. F. Wadley in 1968, was found clinging to an ordinary household dust ball (common var. *ghost turd*). Wadley donated his discovery to the Clay Mineralogy Hall of Fame in Fithian, Illinois, where it resided until 1976, when it was stolen. It was days before the guards noticed it was missing. The dust ball is still on display.

Feats of Clay

Rich Pollastro has been playing bass in a classic rock 'n roll band. Twenty-three years ago he supported himself in graduate school playing the guitar.

There's a new baby in **Darrell Schulze's** house.

The results of the 1995 CMS elections are as follows:
Vice-President Elect: **Joseph W. Stucki**;
Councilors: **James E. Amonette**, **Jillian F. Banfield**,
Michele M. Hluchy, and **Paul A. Schroeder**.

Plenary speakers at the Gatlinburg meeting will be **Victor Drits**—Distinguished Member, **Sam Savin**—Brindley Lecturer, **Darrell Schulze**—Jackson Lecturer, and **Max Mortland**—Pioneer Lecturer.

Wally Parham is now a Research Associate at the Bishop Museum in Honolulu and Project Director of the China Tropical Lands Project. He has recently edited a volume for the Bishop Museum titled *Improving Degraded Lands: Promising Experiences from China*.

Sridhar Komarneni was honored with an award for his research on "Ceramic Nanocomposites Via the Sol-gel Route" by the National Association for Science, Technology and Society with the cooperation of the Federation of Materials Societies. His work was recognized as "one of two dozen exemplars of 'real' materials research in the last decade which will or has affected technology and thence society." He is also a co-author of a new book called *Advances in Porous Materials*, published by the Materials Research Society, and has recently received a patent entitled, "Dealumination and Selective Removal of Organic Material from Zeolites."

Congratulations to **Max Mortland** on his marriage last summer.



Ginny Colten-Bradley, keynote speaker at DePauw University's first Women in Science reunion.
Courtesy G.V. Colten-Bradley



Dave Pevear, far right, receives the Excellence of Poster Award from SEPM President Noel James. Co-awardees were W. S. Clendenen, C. R. Tapscott, W. R. James, C-S kim.
D. Pevear

Dave Pevear was awarded the 1994 Excellence of Poster Award at the 1995 SEPM annual meeting, for "Paleothermometry: Reconstructing the Thermal History of Sedimentary Basins."

Ginny Colten-Bradley was the keynote speaker at DePauw University's first Women in Science reunion, held in October 1994. "She was really inspiring..." said one of the organizers of the meeting. Her message was that "you never know what life is going to bring..." Another attendee appreciated Ginny's description of "how some women integrate their personal and private lives more than we hear about men doing." She showed not only that working parents must find a balance between career and family, but also that "having it all" is possible over the course of one's life, although not always simultaneously.

Charles Roth is spending a six-month sabbatical with **George Bailey** in Athens, Georgia.

Rolf Nueesch and **Carl Bowser** are spending sabbaticals in Boulder, Colorado, with **Dennis Eberl**.

The CMS notes with sorrow the death of **Ivan Rosenqvist**.

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For more information, contact:

ASA, CSSA, SSSA Headquarters Office, 677 S. Segoe Road, Madison, WI 53711-1086
Phone: (608) 273-8080 Fax: (608) 273-2021

Meeting Calendar

August 13-28, 1995, Vladivostok, Russia: 8th International Symposium on Water-Rock Interaction. Numerous topics; field trips to Baikal Lake and Kamchatka Peninsula. Contact: Dr. Oleg Chudaev, Secretary General WRI-8, Far East Geological Institute, 690022 Vladivostok, Russia. Phone: 7-4232-317567; int'l fax: 7-50985-12430; domestic fax: 4232-317840; e-mail: fegi@visenet.iasnet.com

August 19-25, 1995, Leuven, Belgium. European Clay Groups Association - Euroclay '95. Contact: Prof. P. Grobert, Secretary Euroclay '95, Centrum voor Oppervlaktechemie EN Katalyse, KU Leuven, K Mercierlaan 92, B-3001 Heverlee, Belgium. Tel: (32) 16 220931; fax: (32) 16 295126.

October 1995, St. Petersburg: International Symposium on the History of Mineralogy, Mineralogical Museums, Gemology, Crystal Chemistry, and Classification of Minerals. Contact: Prof. Vladimir G. Krivovichev, Fac. of Geology, St. Petersburg Univ., Universitetskaya Emb., 7/9, St. Petersburg 199034, Russia; phone: 812-218-94-81; fax: 812-218-13-46; e-mail: Anna@dean.geol.lgu.spb.su

October 1-4, 1995, Dallas, Texas: Society of Petroleum Engineers. Box 83386, Richardson, TX. Tel: 214-952-9393. Fax: 214-952-9435.

November 6-9, 1995, New Orleans, Louisiana: Geological Society of America, Mineralogical Society of America. GSA, PO Box 9140, Boulder, CO 80301. Tel: 303-447-2020.

June 15-20, 1996, Gatlinburg, Tennessee: The Clay Minerals Society Annual Meeting. Contact: S. Y. Lee, Environmental Sciences Division, Oak Ridge National Laboratory, P.O. Box 2008, Bldg. 1505, MS-6038, Oak Ridge, TN 37831-6038, USA. Tel: 615-574-6316; fax: 615-576-8646; e-mail: syl@ornl.gov

August 4-14, 1996, Beijing, China: 30th International Geological Congress. Abstract deadline: Nov. 1, 1995. Contact: Prof. Zhao Xun, Deputy Secy. General, 30th I.G.C., P.O. Box 823, Beijing 100037, P.R. China. Tel: 86-1-8327772. Fax: 86-1-8328928.

October 6-9, 1996, Denver, Colorado: Society of Petroleum Engineers. Box 83386, Richardson, TX. Tel: 214-952-9393. Fax: 214-952-9435.

October 28-31, 1996, Denver, Colorado: Geological Society of America, Mineralogical Society of America. GSA, PO Box 9140, Boulder, CO 80301. Tel: 303-447-2020.

June 15-June 21, 1997, Ottawa, Ontario, Canada - Joint AIPEA/CMS Meeting. Contact: Jeanne B. Percival, Geological Survey of Canada, 601 Booth St., Ottawa, ON K1A 0E8, Canada. Tel: 613-992-4496; fax: 613-943-1286; e-mail: percival@gsc.emr.ca

October 5-8, 1997, San Antonio, Texas: Society of Petroleum Engineers. Box 83386, Richardson, TX. Tel: 214-952-9393. Fax: 214-952-9435.

October 20-23, 1997, Salt Lake City, Utah: Geological Society of America, Mineralogical Society of America. GSA, PO Box 9140, Boulder, CO 80301. Tel: 303-447-2020.

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Hidden Lives of Clay Scientists

Clay comes alive

The following is an excerpt from an article written by Doris Millholland, published in the Summer/Fall issue of Epoch, the newsletter of the Geology Department at SUNY-Buffalo.

Clay play started when Pat Costanzo persuaded her mother to attend a ceramics class with her at UB's

studied sculpture with Paul Lucassi at the Parsons School of Design in New York City. Clay tiles and drums with Frank Giorgianni, who teaches at the New School in New York City, came

next, then clays and color at the

Greenwich House in Greenwich Village. Her last instructor was Catherine Mühlbauer, a UB graduate who now teaches at Mt. St. Mary's school in Kenmore.

Pat's clay creations are more likely to take the form of sculpted heads. This has prompted Ross to enroll in a bronze casting course at UB. He will use his new skill to transform Pat's sculpted heads into bronze casts.

A basement workshop holds the equipment needed for creating with clay: a slab roller to make uniform slabs of clay; an extruder to form different shapes from the clay, such as rods or coils; a potter's wheel to shape the clay objects; and a 4-foot kiln for

firing the clay pieces. Plans for the future include wind chimes, lawn ornaments, and urns.

How do clay by day and clay by night interact? By studying clays, we can learn how the minerals interact with each other. "Glazing is a Black Art," says Pat. "There is no way to really know the principles that decide the behavior of glazing. Even if you follow a glaze 'recipe,' you are always taking a chance. You never know what you're going to get. Knowing more about the basic fundamentals of the interactions of these things can help predict behavior."

They would like to further combine their clay interests by visiting the island of Santorini in Greece to collect volcanic ash deposits and to study Greek sculpture.



Pat Costanzo and Ross Giese in the studio.

John Spierre



Ross Giese and Pat Costanzo in the lab.

John Spierre

Creative Crafts Center. Soon Ross Giese was coming along to watch, and shortly afterwards he was hooked on the potential of clay as an expressive medium.

Ross enrolled in more courses emphasizing use of the potter's wheel, and now there are numerous mugs, dishes, bowls, casseroles with lids, vases, and flower pots to attest to his craft.

Pat, after learning the basics in hand-building and sculpture classes,

Heck's Angels

Marion Reed, former CMS President, and his wife Betty regularly ramp a motorcycle onto their airplane and take off for extended trips, sometimes with other like-minded friends in their own airplanes, land at remote airports, then take their bikes out, and "terrorize the natives for a few days before loading the bikes and moving to the next area. We have flown the plane through much of North America, from southern Mexico to the northern-most reaches of Alaska, and from California to eastern Massachusetts."



Marion and Betty Reed with their airplane.

Courtesy Marion Reed

New Members

We welcome the following people who have recently joined The Clay Minerals Society.

Mr. Sven J. Abend
Niemannsweg 96
D-24105 Kiel
GERMANY

Mr. Andrew Barron
104 Madison Sturgis
LSU, Agronomy Dept.
Baton Rouge, LA 70803

Henrik Bengston
Dept. of Geology
Earth Science Centre
S-41381 Gothenburg
SWEDEN

Mr. Barry R. Bickmore
Dept. of Geological Sciences
Virginia Tech
Blacksburg, VA 24060

Adrian Biron
Geological Institute
Slovak Academy of Sciences
Banska Bystrica, Severna 5
974 01 Bratislava
SLOVAKIA

Dr. Alex E. Blum
U.S.G.S.
3215 Marine St.
Boulder, CO 80303

Mr. Matthew M. Bonus
13 Nutting Ave.
Amherst, MA 01002

Dr. Robert S. Bowman
Dept. of Geoscience
New Mexico Tech
Socorro, NM 87801

Mr. Michael R. Brister
100 Livingston Place
Metairie, LA 70005

Ms. Susan E. Burns
325 Olde Bridge Way
Alpharetta, GA 30202

Dr. William M. Carty
40 South Main, #2
Alfred, NY 14802

Dr. Xiaobing Chen
2000 Logston Blvd.
Richland, WA 99352

Catherine Chisholm-Brause
VIMS
Gloucester Point, VA 23062

Dr. Jon D. Chorover
Dept. of Agronomy
116 ASI Building
Penn State University
University Park, PA 16802

Dr. Gordon J. Churchman
CSIRO Division of Soils
Private Bag No. 2, Glen Osmond
South Australia 5064
AUSTRALIA

Dr. Mark E. Conrad
MS 70A-3363
Lawrence Berkeley Laboratory
Berkeley, CA 94720

Ms. B. Lea Cox
1018 Euclid Avenue
Berkeley, CA 94708

Dr. Maria Fernanda Cravero
Departamento de Geologia
Universidad Nacional del Sur
San Juan 670, 8000 Bahia Blanca
ARGENTINA

Mr. Donald B. Cross
Cross & Associates, Ltd.
472 Berkley Crescent N.W.
Calgary, Alberta T3K 1A8
CANADA

Mr. Cecil L. Dharmasri
Dept. of Agronomy
Louisiana State University
Baton Rouge, LA 70803

Mr. Joseph E. Dove
3993 St. Clair Ct.
Atlanta, GA 30319

Dr. Drummond Earley, III
Twin Cities Research Center
U.S. Bureau of Mines
5629 Minneapolis Ave. S.
Minneapolis, MN 55417

Mr. Paul Eberly
University of New Mexico
Dept. of Earth & Planetary Sci.
Albuquerque, NM 87104

Mr. Dr. Frantisek Eichler
Jachymovska 282
460 10 Liberec 10
CZECH REPUBLIC

Dr. Wm. Timothy Elam
Code 6685
Naval Research Lab
Washington, D.C. 20375-5345

Mr. Owen E. Etheridge
Thiele Kaolin Company
PO Box 1056
Sandersville, GA 31082

Mr. George Fiederling
Buechtingstrasse 5
D-56470 Bad Marienberg
GERMANY

Andrea L. Foster
Rm 130 Mitchell Building
Stanford University
Stanford, CA 94305-2115

Amir Frez
DOGEF - Ames Hall
Johns Hopkins University
Baltimore, MD 21218

Dr. Susanne Gier
Institute of Petrology
University of Vienna
Dr. Karl Lueger Ring 1
1010 Vienna
AUSTRIA

Dwight Glover
Evans Clay Company
PO Box 595
McIntyre, GA 31054

Mr. Arnold F. Griffin
Micron Research (WA)
7/14 King Edward Rd.
Osborne Park 6017, Western Aus-
tralia
AUSTRALIA

Bernard H. Grobety
Dept. of Mineral Sciences
Smithsonian Institution
NHR 19
Washington, DC 20560

Mr. Christopher A. Guest
Dept. of Agronomy
Purdue University
1150 Lilly Hall
West Lafayette, IN 47907-1150

Mrs. Frauke Hagelberg
Boistrasse 2
D-24114 Kiel
GERMANY

Victoria C. Hover
University of Michigan
Dept. of Geological Sciences
425 E. University
Ann Arbor, MI 48109-1063

Ms. Dongfang Huo
1102 S. Goodwin Ave.
W-315 Turner Hall
Dept. of Agronomy
University of Illinois
Urbana, IL 61801

Ms. Srimathie P. Indraratne
Dept. of Soil Science
University of Manitoba
362 Ellis Bldg.
Winnipeg, MB R3T 2N2
CANADA

Mr. Andreas D. Jazdanian
University of Illinois
Dept. of Geological Sciences
845 West Taylor St.
Chicago, IL 60607

Ms. Jodi L. Johnson-Maynard
PO Box 9921
Moscow, ID 83843

Ms. Maureen D. Johnston
Sherritt, Inc., Information Services
10101-114th Street
Fort Saskatchewan, AB T8L 3W4
CANADA

Mr. Michael J. Kelton
K/T GeoServices, Inc.
661 N. Plano Rd., Suite 317
Richardson, TX 75081

Miss Fiona M. Kennedy
Dept. of Soil Science
The University of Reading
Whiteknights, PO Box 233
Reading RG6 10W
ENGLAND

Mr. Jae Gon Kim
Dept. of Geology
University of Georgia
Athens, GA 30602

Dr. Youn Joong Kim
Korea Basic Science Center
Yusung P.O. Box 41
Taejon 305-600
REPUBLIC OF KOREA

Mr. Konstantinos P. Kitsopoulos
Geology Dept.
Leicester University
Leicester LE 1 7RH
UNITED KINGDOM

Mr. Steffen Kloppenburg
Bauernweg 25
D-25541 Brunsbüttel
GERMANY

Dr. Suz-chung Ko
Tonmineralogisches Labor
Sonneggstr. 5, NO F151
ETH-Zentrum
CH-8092 Zürich
SWITZERLAND

Dr. Takashi Kosaki
Lab. of Soil Science, Fac. of Agr.
Kyoto University
Kyoto 606-01
JAPAN

Joel Kostka
Center for Great Lake Studies
Univ. of Wisconsin-Milwaukee
600 E. Greenfield
Milwaukee, WI 53204

Mr. Mark P. S. Krekeler
Room 500, Dept. of Geology
University of Cincinnati
Cincinnati, OH 45221-0031

Ms. Kara J. Linna
New Mexico State University
Dept. of Chem. and Biochemistry
PO Box 30001, Dept. 3C
Las Cruces, NM 88003

Kenneth J. T. Livi
Dept. of Earth & Planetary Sci.
Johns Hopkins University
Baltimore, MD 21218

Mr. Kalumbu Malekani
Chemistry Department
South Dakota State University
Box 2202
Brookings, SD 57007

Mr. Kenneth R. Mars
Texas Tech University
Dept. of Geosciences
Science Bldg., Room 125
Lubbock, TX 79409-1053

Dr. Katsumi Marumo
Geological Survey of Japan
Higashi 1-1-3,
Tsukuba Ibaraki
JAPAN

Garald Matisoff
Dept. of Geological Sciences
Case Western Reserve University
Cleveland, OH 44106

Ms. Heather G. McElroy
Department of Geology
Bryn Mawr College
101 N. McCrion Ave.
Bryn Mawr, PA 19010-2899

Mr. James C. W. Meleton, Jr.
Nord Kaolin Company
PO Box 297
Jeffersonville, GA 31044

Allen Norris
Thiele Kaolin Company
PO Box 1056
Sandersville, GA 31082

Miss Clara Olabisi Oyegoke
Soils Division
Macaulay Land Use Research Inst
Craigiebuckler
Aberdeen AB9 2QJ
SCOTLAND

Ms. Menegatti A. Philipp Paolo
Tonmineralogisches Labor
Institut für Geotechnik
Sonneggstrasse 5, 8092 Zurich
SWITZERLAND

Mr. Dirk Penner
Eichofstrasse 21
D-24116 Kiel
GERMANY

Mr. Jesper C. J. A. P. Petersson
Geologiska Institutionen
Geovetarcentrum
Göteborgs Universitet
41381 Göteborg
SWEDEN

Mr. Buford Boyd Pollett
Rt. 3, Box 110
Wrightsville, GA 31096

Mr. Victor J. Polyak
5702 50th, #95
Lubbock, TX 79414

Dr. Hugh Powell
University of Adelaide
Department of Chemistry
South Australia 5005
AUSTRALIA

Dr. Silvério Prates
Rua Artilharia UM, 40-2
1200 Lisbon A
PORTUGAL

Mr. John F. Rakovan
Dept. of Earth & Space Sciences
State University of New York
Stony Brook, NY 11794-2100

Mr. Luis Antonio Rodriguez
c/ Alejandro Casona, 11, 4°
Apdo 126, 33420 Lugones
Asturias
SPAIN

Mr. John D. Rogie
P.O. Box 402
Golden, CO 80402-402

Roth, Mr. John R.
McCrone Associates
850 Pasquinelli Drive
Westmont, IL 60559

Mr. David L. Ruff
Floridin Company
1101 N. Madison St.
Quincy, FL 32351

Dr. Edward J. Sare
Dry Branch Kaolin
Rt. 1, Box 468D
Dry Branch, GA 31020

Mr. Karl F. Schiller
1928 Sageway Drive
Tallahassee, FL 32303

Mr. Brian K. Schroth
ESPM Dept, 108 Hilgard Hall
University of California
Berkeley, CA 94720-3110

Mr. Marcus Schwertfeger
Weissenburgstrasse 37
D-24116 Kiel
GERMANY

Dennis Sekutowski
Engelhard Corporation
101 Wood Ave.
Iselin, NJ 08830-0770

Guanayao Sheng
Dept. of Crop and Soil Science
Michigan State University
East Lansing, MI 48824

Mr. Les Sluggett
Western Industrial Clay Prod., Inc.
714 East Sarcee Street
Kamloops, BC V2H 1E7
CANADA

Mr. Louis P. Solebello
McCrone Associates, Inc.
850 Pasquinelli Drive
Westmont, IL 60559

Dr. Graeme A. Spiers
Plains Innovative Lab. Services
107-11 Research Drive
Saskatoon, SK S7N 3R2
CANADA

Dr. Ramanathan Sriranjana
Dept. of Agricultural Engineering
University of Manitoba
Winnipeg, MB R3T 5V6
CANADA

Mr. Scott R. Stewart
2426 NW 9th St.
Corvallis, OR 97330

Mr. Heping Sun
Dept. of Geology
University of Cincinnati
Cincinnati, OH 45221-0013

Mr. Peter Heinrich Thiesen
Heischberg 2
D-24119 Kronshagen
GERMANY

Mr. Theofilos Toulkeridis
Ctr. de Géochimie de la Surface
CNRS
1, rue Blessig
F-67084 Strasbourg - Cedex
FRANCE

Dr. M. P. Turpault
INRA
Centre de Recherches de Nancy
54280 Champenoux
FRANCE

Dr. Roger R. Townend
PO Box 120
Bentley, WA 6102
AUSTRALIA

Dr. Godfrey A. Uzochukwu
North Carolina A & T University
Waste Management Institute
Greensboro, NC 27411

Mr. Ardeschiv Vahedi-Faridi
2719 N. Francisco
Chicago, IL 60647

Warr, Dr. Laurence N.
Geol.-Paläontologisches Institut
Ruprecht-Karls-Universität
Im Neuenheimer Feld 234
69120 Heidelberg
GERMANY

Mr. Forrest J. Weesner
601 Briar Hill Road
Madison, WI 53711

Jun Wu
Dept. of Agronomy
University of Illinois
W-315 Turner Hall
1102 S. Goodwin Ave.
Urbana, IL 61801

Dr. Ernest K. Yanful
Geotechnical Research Centre
Dept. of Civil Engineering
The Univ. of Western Ontario
London, ON N6A 5B9
CANADA

Zhidong Zhang
Dept. of Geosciences
Texas Tech University
Lubbock, TX 79409

Mr. Huitang Zhou
Dept. of Geological Sciences
Indiana University
Bloomington, IN 47405

What about clay research in Jordan?

Clay research has started in Jordan in the beginning of 1980. Myself, together with many graduate students at the University of Jordan and geologists from the Natural Resources Authority are involved in characterizing the clay deposits in Jordan.

Jordan is considered a unique country from geographical and geological point of views.

The type and origin of mineralization and distribution of mineral deposits and occurrences in space and time are closely related to the geological structures created during a long period of geological development of the Arabian Platform in general and the Red Sea—the Dead Sea rift system in particular.

Regional uplifting of blocks, their relative movements, and ancient volcanism resulted in the concentration of certain mineralization in some localities that demand geologic exploration. Phosphate rocks and bituminous marls are widely distributed, and the most important salt and potassium

deposits in the world are located in the Dead Sea area. Zeolites associated with volcanic tuff are newly discovered in northeastern Jordan. Zeolitization process is a regional one and needs further investigation, since fujasite is the essential mineral, followed by phillipsite and chabazite.

Clay minerals are widely distributed and are of economic value. Fluvial kaolinite beds are associated with the lower Cretaceous sandstones. Huge and unlimited lower Silurian kaolinite and illite deposits occur to the south-southeast of Jordan. The most interesting clay minerals association in northeastern Jordan is the Pleistocene high expandable mixed-layer illite-smectite and palygorskite, which occurs together with diatomite. The neof ormation-transformation processes are debatable in a volcanic magnesium-rich closed system.

Volkonskoite filling cavities, voids, fractures... is widely distrib-



Hani Khoury and his wife Mai. Courtesy H. Khoury

uted in central Jordan and is associated with varicolored marbles and travertines. The presence of Cr together with other high levels of many elements make the volkonskoite distribution an extremely realistic analogue of cementitious L/ILW repositories.

Hani N. Khoury
Amman, Jordan

Hani Khoury earned his Ph.D. in Geology at the University of Illinois. He is Chairman of the Geology Department at the University of Jordan.

New books edited by CMS members

Several recently-published books edited by CMS members are of interest.

Quantitative Methods in Soil Mineralogy, edited by J. E. Amonette, J. W. Stucki. Provides the reader with a solid understanding of current and emerging analytical techniques and how they are best applied to the quantitative characterization of soil minerals. Authors include R.W. Sanders, B. L. Sawhney, D. E. Stilwell, F. A. Khan, A. D. Scott, B. Cicel, P. Komadel, L. R. Drees, M. D. Ransom, R. J. Gilkes, D. L. Cocke, R. K. Vempati, R. H. Loeppert, D. A. Laird, R. H. Dowdy, D. L. Bish, R. C. Jones, H. U. Malik, R. E. Hughes, D. M. Moore, H. D. Glass, A. D. Karathanasis, W. G. Harris, D. G. Schulze, R. A. Dahlgren, as well as Amonette and Stucki. 1994. \$39.00. Order from the SSSA, 677 South Segoe Rd.,

Madison, WI 53711-1086 USA.

Soil Science Education: Philosophy and Perspectives, edited by Philippe Baveye, Walter J. Farmer, Terry J. Logan. Examines the issues, challenges, and opportunities for new trends in educational environments under new soil science paradigms. Explores new facets in the field of soil science and maps out new territory. 1994. \$18.00 from the SSSA (address above).

A Reference Slide Collection for Soil Micromorphology, put together by M. L. Thompson, A. R. Mermut, W. D. Nettleton, L. D. Norton, S. Pawluk. Designed for those who want to learn more about the organization of soil components at the microscopic scale. Features four categories—biological features, coatings, microstructure and porosity, and related distribution patterns. Each group comprises a class of micromorphological features

that is important to soil behavior, management, or genetic interpretations. 115 slides, 135-page narrative manual. 1993. \$50.00 Order from SSSA, address above.

Isotopic Signatures and Sedimentary Records, edited by N. Clauer, S. Chaudhuri. An overview of the most recent findings of isotope research in the sedimentary environment. Can be used as a tool for the understanding of mineral-water interactions in the supra-crustal level. 1992. DM 164. Order from Springer-Verlag, Postfach 31 13 40, D-10643 Berlin, Germany.

Clays in Crustal Environments, edited by N. Clauer, S. Chaudhuri. Provides information about the dynamics of isotope systems in clays, and helps us understand the physical and chemical parameters in the transfer of masses within the crustal domain. 1994. DM 128. Order from Springer-Verlag, address above.

The Clay Minerals Society Organization and Committee Personnel 1995-1996

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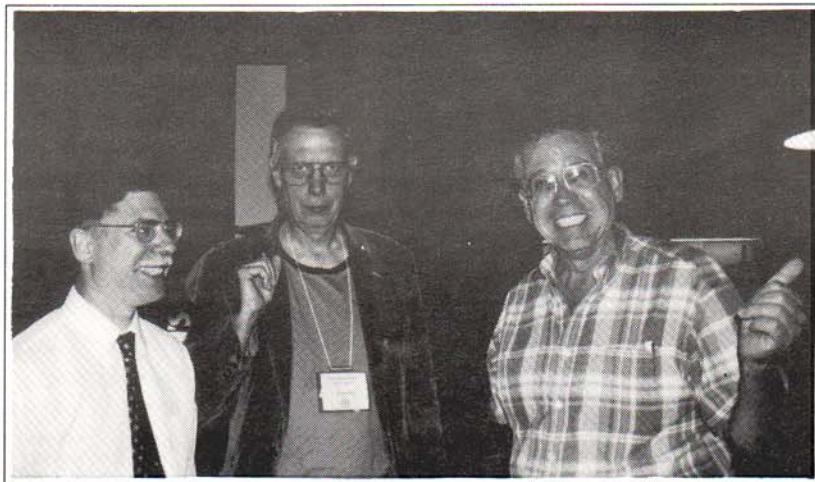
President's Report, June 1995

The following is 1994-1995 CMS President Rossman Giese's report to the Council.

Lots of things are changing. Some of these changes are internal and are normal to a complex organization such as ours. Others arrive from the outside and are driven by changes in the economy and society. To continue to be successful, we must adapt and profit from these changes. I will highlight some items that seem to me to be of general interest.

Our journal is of primary importance to our scientific role, and we cannot overlook its economic contribution to the Society. Ray Ferrell has worked hard for us. It is not easy to find a person who has a solid scientific background, the skills necessary to edit manuscripts well, and a person who can deal with authors and reviewers in a patient yet determined manner. At the end of this year, our new editor, Wayne Hudnall, will take over these duties. Good luck! We still have problems with Allen Press in terms of the service we get and what it costs us. I feel we should move as rapidly as possible to a situation where we can do ourselves what Allen Press should be doing for us. We will benefit in two ways: better service and (likely) lower costs. We are also going to have a new secretary. After many years (decades? millenia?) of service, Don Scafe is going on to other things. This job is one of those very important functions which is largely invisible to the members and therefore underappreciated.

The Society is now a member of AGI. There is the hope that this will give us more exposure in the earth sciences community and allow us to influence science policy at the federal level. The Society is considering joining AIPEA for much the same reasons. We continue to do what we can for Eastern European colleagues by sending back issues; 12 members have donated 1995 subscriptions to libraries and individuals, and I hope that other CMS members will



At the time this photo was taken (1994), it is obvious that only Ross Giese (center) was President of the Clay Minerals Society. Steve Guggenheim (CMS Pres. 1996-97) and Ken Towe (CMS Pres. 1995-1996) are blissfully unaware of the grim realities that lie ahead. Jo Eberl

join in this effort.

The clay community is now online thanks to the efforts of Cliff Johnston. I urge all members to list their e-mail addresses with the Society office so these can be included in the directory. All this will allow us to communicate more easily and more rapidly.

Financially, we are in better shape than last year, even though we are still running a (small) GOF deficit; our net worth continues to increase as the result of income from the endowment. Much thought has gone into reducing our expenses and increasing our income. Thanks to Dave Pevear and Jo Eberl for working on this, Herman Roberson for taking on the job of treasurer just as we were changing our fiscal year, and Blair Jones for being our AGI representative and attending the National Research Council Meeting.

I see longer term problems and opportunities. Traditionally, clay science was largely taught in universities in either geology or agronomy departments. The geological people and many of those in soil science departments naturally looked upon our society as

their home base. In turn, their students joined our group and continued the relationship, often as faculty members in their own right. The problem is that as clay mineralogists leave universities, through retirement or death, they are unlikely these days to be replaced by another clay mineralogist. The reason is simple: the common perception (and it is largely true) is that clay research is unlikely to receive outside research funding. Without such external funding, new faculty rarely get hired or receive tenure. If we lose the clay mineralogists in universities, where will new clay scientists come from? If clay science is really important, and I think it is, someone will continue to teach the subject. But, and here is where the problem lies, the science will be taught by people who do not look upon our society as their home base. They may be chemists or physicists or engineers—and there is nothing wrong with that. What worries me is that these new people and their students will not have the same attachment to our society that we have.

There are two possible solutions. The obvious one is to enhance the opportunity for clay mineralogists to

continued on page 30

Message from the President...

According to the by-laws, your president assumes office immediately following the adjournment of the annual meeting. In fact, of course, the duties of the office require that much work be started well before the official installation. Accordingly, like all previous presidents, I was busy at our annual meeting in discussion with many of you, and in arranging for the numerous changes that are necessary in the composition of our committees that are so important for the efficient operation of the Society. The composition of the new Council and the complete committee rosters are listed elsewhere in the newsletter.

Ross Giese will be telling you about some of the activities that took place in the past year in his report, but I would like to tell you about what to expect in the coming year. Over the next eleven months, your society will be making several changes and exploring several avenues, a few of which I would like to outline for you now. Firstly, and most importantly, Ray Ferrell will be relinquishing the reins as Editor-in-Chief of *Clays and Clay Minerals*. The office of Editor will not be moving from Baton Rouge, however, as Joe Dixon's search committee has "fingered" Wayne Hudnall to take over in 1996. The Council has approved this selection. We are fortunate to have Wayne's services because of his past experience as an Associate Editor, and his proximity to Ray at LSU should make the transition a smooth one. I would like to thank Joe Dixon and his committee for their efforts in locating an individual to assume this very important position. The editorial-assistant job under Wayne's direction will be expanded from a part-time to a full-time position, so that we can expect prompt and efficient handling of the increasing load of manuscripts. This expansion will, of course, add to the

already increasing costs associated with publishing our journal. As a direct result, your Council had to wrestle at some length with the overall budget in Baltimore to achieve some reasonable balance between income and expenses. Because the Society has been running an operating deficit for the past several years, these increased expenses will mean not only a cut in some of our services in the next year, but also increases in dues to cover these added costs. Like many other scientific societies, ours has been experiencing the fall-out from the "downsizing" that has taken place throughout the country, seemingly in all quarters. This has translated most dramatically into a loss of subscribers to our journal as libraries themselves face cutbacks in their budgets and drop some journals. Each of you should endeavor to ask your respective libraries to be sure to keep *Clays and Clay Minerals* on their shelves!

Secondly, there will be several actions taken by the various committees in the next year. I am asking the Policy and Administration Committee, on behalf of the Council, to present a change to the by-laws that would make several of our *ad hoc* committees permanent parts of our committee structure. In particular, the Continuing Education, Research Grants, Nomenclature, and Source Clays committees will be affected. The Council has also requested that the Nominations Committee give consideration to recruiting foreign members and adding their names to our slate of Council nominees. We are an increasingly international organization, and the make-up of our Council should reflect this, if possible. The Publications and the Finance and Budget Committees, together with Jo Eberl, will be exploring the possibility of our taking over some of the subscription management and fulfillment duties from the Allen Press,

where the costs have become increasingly expensive and the services provided have deteriorated. The Program Development Committee will be exploring the feasibility of holding a joint meeting with the Denver X-ray Conference some time in the future, and Dave Bish will pursue our joint participation in an environmental mineralogy symposium with the Mineralogical Society of America at the 1996 meeting of the Geological Society of America. Finally, Jan Srodon's Eastern European Liaison Committee will be arranging for us to send out back issues of our journal, as well as issues of our newsletter, in an outreach to clay scientists at the appropriate Ukrainian, Bulgarian, and Moldavan research institutes.

On another issue that potentially affects all of us, the Executive Committee has been faced with the perennial question of how to handle requests from various organizations to obtain mailing labels representing our membership list. None of us wants to have a "blizzard" of advertising brochures in our mailboxes, but many of us would like to keep abreast of new advances in technical equipment or services that could be useful to our research. Accordingly, we are considering the sale of our membership list to *selected* companies whose products, services, and promotional materials are such that a serious intent to address the needs of our members is evident. The details of this program have yet to be worked out, but your individual views are of interest to your elected officers. If you have any thoughts or ideas about this question, I encourage you to pass them along to me, and I will see that they reach the others who will be making recommendations. The judicious sale of our membership labels could be an added source of income to our operations as well as a useful source of information about new products to each

continued on page 30

Towe, *continued from page 29*

of you.

Finally, as emphasized by Dave Pevear in his message two years ago, the smooth operation of your society takes place because of the volunteer efforts on the part of a great many members, combined with the cheerful and efficient work of our Manager, Jo Eberl. I would like to express thanks to all of those persons on all of the various committees, and we should all thank Jo for her devotion. When you call into the office in Boulder, remind her that we appreciate her fine work! It is always dangerous to do so for fear of leaving someone out, but several other persons need to be singled out for their work in making the Baltimore meeting in June a success. General Chair, Del Fanning, and his "sharp-pencil" management executive, Deborah Starobin Armstrong from the University of Maryland, both worked long and hard to bring things together. Sarkis Ampian did a magnificent job in helping us garner the corporate as well as personal financial support necessary for many activities, while Ginny Colten-Bradley's efforts in putting together a stimulating program and making many other behind-the-scenes arrangements were extraordinary. Each of these volunteers gave freely of their time to help the Clay Minerals Society prosper. I urge any of you, whether a new member or a retired member of long standing, to let us know if you want to make a difference, and help us out. Don't be bashful! Call or write—to me, or to anyone on the Council or any committee chair. One more thing... don't forget to check your calendar and make your plans to attend the meeting being arranged by S. Y. Lee in Gatlinburg, Tennessee next June. See you there!

*Kenneth M. Towe
Washington, D. C.*

Giese, *continued from page 28*

obtain outside funding. This is a daunting challenge given the enormous demands on the funds of, for example, the National Science Foundation. Still, it is essential that we make ourselves more visible to funding agencies and to other geoscientists, many of whom still do not understand the importance of clay minerals. Our joining AGI is a step in this direction.

We should also be actively working to attract other scientists who are studying clay minerals to join our society and attend and participate in our meetings. We should also ensure that our view of clay science is readily available. (The Continuing Education Committee, under Michele Hluchy's direction, has taken on this project.) We have much to offer other people, and in turn, we will benefit from the presence of non-traditional clay mineralogists. There are several ways we can do this. One is to schedule symposia at our meetings and invite the participants to publish in our journal. We can participate with other societies in joint meetings or symposia; the colloid group of the American Chemical Society is an obvious possibility. As a side benefit to these activities, we may find that as the number of interdisciplinary articles increases, more libraries will subscribe to the Journal. Thus, we will ensure the continuance of our society both financially and intellectu-

To join the CMS listserver, send an e-mail message to: listserv@vm.cc.purdue.edu, and write a message as follows: SUB CLYMIN-L Susie Q. Clay (replace name with your own).

To see the CMS home page, open a browser such as Netscape, and use the following address or location:
<http://ctjrs.agry.purdue.edu/claymin/clayminsoc.html>

ally. We can't ask for more than that.

It has been an interesting year being President. This job exposes one to all sorts of curious situations and personalities. The Society succeeds or doesn't, depending on the efforts made by a small subset of the membership. We are blessed in having a very generous supply of talented and hard working people. I thank them for all they have done and continue to do, and I strongly urge others to let us know that they would like to participate in the running of the Society.

*Rossmann F. Giese
Buffalo, New York*

AGI, *continued from page 1*

American Geological Institute now serves 27 earth-science organizations, representing more than 80,000 geoscientists, geophysicists, and other earth and environmental scientists.

Founded in 1948, the AGI provides information services to a worldwide geoscience community. AGI coordinates improvements in earth-science education, offers scholarships to minority students, and works to increase public awareness of the vital role geology plays in our society. In keeping with these goals, AGI founded and directs GeoRef, an online bibliographic database of more than 1.8 million geological references from 1785 to the present; and publishes a variety of books and publications, including *Geotimes*, a monthly earth-science news magazine.

Internet, *continued from page 1*

possible. We can put our newsletter on the web, and we can put any announcement we like, etc., on it. The possibilities are just about endless.

The society owes Cliff Johnston and Purdue a debt of gratitude. I anticipate that these two services will prove invaluable to our society in the coming years.

*David L. Bish, bish@lanl.gov
Report to CMS Council, 1995*

Best student paper and poster awardees

At this year's annual CMS meeting, 29 student papers were presented. The presentations were of outstanding quality, and the large number of students participating is a good sign for our society! Thirteen CMS members graciously agreed to help with the evaluations of these presentations, and the Awards Committee thanks them for their help. The highest rated presentations are outlined below. Congratulations to these students, and to all the students who gave presentations, for a job well done!

*Michele M. Hluchy
Alfred, New York*



Best Student Paper: Jean M. Hemzacek-Laukant, for "Source Clays and Regulatory Requirements: Material Safety Data Sheets." Advisor: Haydn Murray, Indiana University. Other: Jean is Chair of the Contributions & Membership Committee and the Regulatory Issues Committee. She is also the mother of two beautiful young children.

High Iron Photos



Best Student Poster: Susan M. Gill (left), for "Role of Organic Matter in the Alteration of Kaolinite to Illite in a Lower Pennsylvanian Paleosol." Advisor: Heddy Yemane (right), University of Pennsylvania. Other: Susan was a 1994 CMS Student Grant Recipient.

High Iron Photos



Best Student Poster Runner-up: Victor J. Polyak (left), for "Dickite in Caves of the Guadalupe Mountains in New Mexico." Advisor: Necip Güven, Texas Tech University. Del Fanning, Chair of the Baltimore meeting, on right. Other: Victor is an active caver, or spelunker, and is interested in the little-studied clays in caves.

High Iron Photos



Best Student Paper Runner-up: Enid J. Sullivan, for "Topological and Thermal Properties of Surfactant-Modified High Resolution Thermogravimetric Analysis. Advisor: Robert Bowman, New Mexico Tech. Other: Jeri was a 1994 CMS Student Research Grant Recipient.

Courtesy J. Sullivan

Chemical Weathering Rates of Silicate Minerals

A Mineralogical Society of America Short Course

November 4-5, 1995

Bourbon Orlean Hotel

French Quarter

New Orleans, Louisiana, USA

The principal purpose of the Course is to present a broad interdisciplinary review of silicate weathering processes and to identify avenues of future research. The Short Course will coincide with the release of Volume 31 of the Reviews in Mineralogy Series and will feature a series of presentations by world-renowned experts presenting theoretical, experimental, and field aspects of chemical weathering, with an emphasis upon the quantification of rates of weathering. Discussion sessions involving all participants will focus on aspects of integration between theoretical approaches and experimental measurements, between laboratory rates and field estimates, and between chemical and physical weathering at the soil, watershed, and continental scales. The interdisciplinary nature of the course should benefit both established researchers in the field as well as workers in related studies such as watershed processes, nutrient cycling, soil sciences, and global change issues. Students are especially encouraged to attend.

Speakers will be Antonio Lasaga, William Casey, Patricia Dove, Alex Blum, Lisa Stillings, Susan L. Brantley, Kathy Nagy, Michael Hochella, Jillian Banfield, Harald Sverdrup, Art White, James Drever, Robert Stallard, and Robert Berner.

Registration fee for the Short Course will be \$300 (\$50 extra after July 12) for researchers and \$250 (\$50 extra after July 12) for students. This fee will include the nights of Friday and Saturday, November 3-4, 1995, at the Bourbon Orleans Hotel (double occupancy, some single rooms may be available at additional cost), continental breakfasts on Saturday and Sunday, a banquet on Saturday, admission to all short course events, and one copy of the MSA Short Course Handbook.

For more information and to register, please contact the MSA, 1015 18th St. NE, Suite 601, Washington, DC 20036; phone: 202-775-4344.

Wanted: 1962 Photographs

The 11th National Conference on Clays and Clay Minerals (Predecessor of Annual Meetings of the Clay Minerals Society) was held August 13-17, 1962 in Ottawa, Canada. After 35 years, its 34th Annual Meeting will be back in Ottawa to join the 11th International Clay Conference (ICC) in 1997.

On this occasion, the Organizing Committee plans to commemorate the anniversary by exhibiting photographs, documents, and other related records during the 11th ICC. Donations or loans of photographs taken in the 1962 meeting would be greatly appreciated.

Please contact: Hideomi Kodama, Chair of the 11th ICC, Centre for Land & Biological Resources Research, Agriculture Canada, 960 Carling Ave., Ottawa, ON K1A 0C6, Canada. Tel: 613-759-1913; fax: 613-759-1926.

Eastern European donations

Thanks to the following people who donated subscriptions to Eastern European libraries or individuals: P. Costanzo, D. Eberl, J. Elzea, R. Giese, R. Hamada, R. Hughes, W. Johns, R. Martin, D. Pevear, U. Schwertmann, Y. Shinohara, and J. White.

ICDD Crystallography Scholarships

Applicant should be a graduate student seeking a degree with major interest in crystallography, e.g., crystal structure analysis, crystal morphology, modulated structures, correlation of atomic structure with physical properties, systematic classification of crystal structures, phase identification, and materials characterization.

Application deadline is 31 October 1995. More information can be obtained from the Secretary, International Centre for Diffraction Data, 12 Campus Boulevard, Newtown Square, PA 19073-3273 USA. Phone: 610-325-9810; fax: 610-325-9823.

Society Management

The CMS is considering taking over some of the duties associated with maintaining our data base, handling dues and subscriptions, and so on. Our publisher, Allen Press, currently handles these responsibilities. Anyone interested in making a proposal to do this for the Society should contact Jo Eberl at the Society Office in Boulder.

Missing e-mail pages

At the CMS meeting, someone accidentally walked off with the e-mail list of members whose names start with A-H. If you made a correction to your name on one of those pages, please send it to the CMS office.

Commentary

Polymer-Clay Nanocomposites

Composites are already widely used in such diverse areas as transportation, construction, electronics, and consumer products. They offer unusual combinations of stiffness, strength, weight and corrosion resistance that cannot be attained alone from the individual components. Typical examples include glass- and carbon-fiber reinforced polymers.

Nanocomposites are a relatively new class of materials with ultrafine phase dimensions, typically in the order of a few nanometers. This new

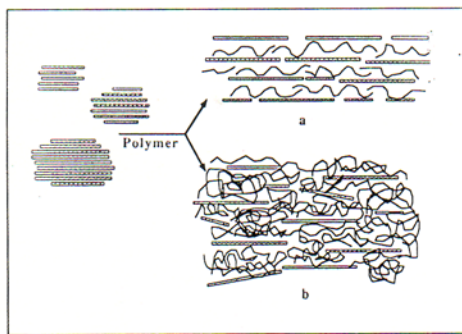


Figure 1. Schematic of composite structures obtained using smectite clays. The rectangular bars represent the clay layers. (a) single polymer layers are intercalated in the clay galleries (intercalated hybrids); (b) composites obtained by clay delamination and dispersion (delaminated hybrids).

design leads to materials with new and improved properties, cost, and ease of manufacturing, and therefore offers new business opportunities.

At Cornell we have focused on the design and synthesis of polymer nanocomposites using layered ceramics and, in particular, smectite clays (Fig. 1). This approach exploits the ability of smectite or swelling clays to intercalate a wide variety of solvent molecules, monomers, and polymers. A particularly attractive design involves individual clay layers (1 nm thick) homogeneously dispersed in a continuous polymer matrix (Figure 1b). In order to attain a particular degree of stiffness, strength, and barrier

properties in these hybrids, a far less ceramic content than in comparable glass- or mineral-reinforced polymers is required, as such polymer-silicate nanocomposites are far lighter in weight than conventionally reinforced polymers. In addition, they exhibit stiffness, strength, and dimensional stability in two rather than in one dimension.

Synthesis of nanocomposites typically involves either intercalation of a suitable monomer followed by polymerization or polymer intercalation from solution. Shown in

Figure 2 is a schematic of nanocomposite formation by monomer intercalation. Various mono- or multifunctional monomers can be used, yielding linear or crosslinked polymer nanocomposites. Alternatively, a polymer solution can be used. The role of the solvent is primarily to assist with clay dispersion and delamination.

For most technologically important polymers, both approaches are limited since neither a suitable monomer nor a compatible polymer-silicate solvent system is always available. We have recently discovered (patent application pending) a more versatile approach based on direct polymer melt intercalation. The process involves heating the polymer-silicate mixture either statically or under shear in an extruder above the melting or glass transition temperature for crystalline and amorphous



Emmanuel Giannelis

polymers, respectively. Depending on the polymer, pristine or alkyl ammonium-exchanged clays can be used. Polyethylene oxide, for example, can be easily intercalated in Na⁺- or Li⁺-exchanged clays; for less

polar polymers (i.e. most engineering polymers), different organoclays can be used.

Due to space limitations, let us only say that while polymer intercalation from solution is entropically driven, enthalpic interactions drive melt intercalation. Furthermore, while one expects the process to be rather sluggish, we have found that intercalation of high molecular weight polymers can be completed in a matter of minutes. As a result, the hybrids can be processed in a simple extruder.

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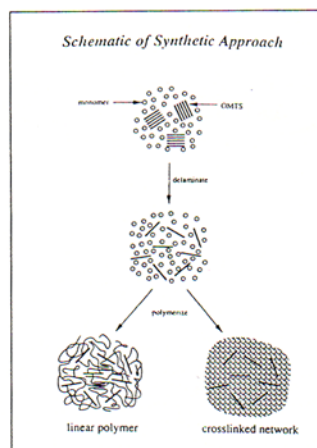


Figure 2. Schematic diagram for nanocomposite synthesis by monomer intercalation/delamination. OMTS refers to organo clay particles.

That delaminated hybrids can be obtained with clay layers embedded in a polymer matrix is confirmed by transmission electron microscopy (TEM) and X-ray diffraction. A TEM micrograph of a clay hybrid clearly shows the individual clay layers with a thickness of 1 nm in a continuous polymer matrix. Furthermore, the X-ray diffraction patterns of the hybrids lack the characteristic 001 reflections due to the periodic stacking of the clay layers.

The advantages of hybrids containing single clay layers uniformly dispersed in a polymer matrix were first demonstrated by a group at the Toyota research center in Japan. Table 1 summarizes and contrasts the properties of a clay-nylon nanocomposite containing 4.2 wt.% clay to those of pure nylon.

Clay-epoxy nanocomposites prepared in our group also show a similar improvement in the mechanical properties. Figure 3 shows the temperature dependence of the tensile storage modulus, E' , and $\tan\delta$ of an epoxy nanocomposite containing 4 vol.% of clay. The nanocomposite shows a 60% increase in storage modulus in the glassy region compared to the unfilled epoxy. The equivalent increase in the rubbery region is 450%. This increase in modulus is quite remarkable, since to achieve the same stiffness in particulate reinforced composites, filler loadings of up to 40 vol.% are required. In addition to an increase in modulus accompanied by a decrease in the coefficient of thermal expansion, nanocomposites exhibit significant increases in heat resistance, thermal stability and barrier properties. For example, the permeability of wa-

ter in a nanocomposite containing 5 vol.% silicate is reduced by nearly an order of magnitude compared to the unfilled polymer as shown in Figure 4. Note how the decrease in permeability is much more pronounced in the nanocomposites compared to conventionally filled polymers containing much higher clay loadings.

In summary, clay-polymer nanocomposites can be synthesized by intercalation

of monomers or polymers in smectite clays. The properties of the nanocomposites are considerably better than conventionally filled polymers with comparable filler loadings. As such, the nanocomposites exhibit properties typically associated with the more difficult to process and, therefore,

more expensive fiber-reinforced polymers, yet they can be processed by techniques normally used for unfilled polymers (i.e., extrusion, injection molding, spin casting, etc.). In addition, they are far lighter in weight than fiber-reinforced polymers. This combination of enhanced properties, weight reduction, and low cost has al-

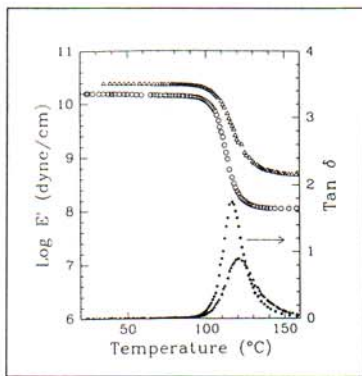


Figure 3. Temperature dependence of E' (open symbols) and $\tan\delta$ (shaded symbols) for pure epoxy and clay-epoxy nanocomposite.

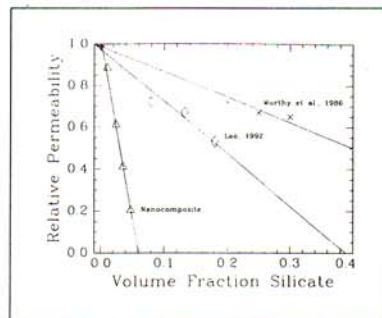


Figure 4. Relative permeability versus clay volume fraction for clay-nanocomposites and conventionally clay-filled polymers.

TABLE I
Properties of Nylon and Clay-Nylon Nanocomposites

Property	Clay Nanocomposite	Nylon-6
Tensile Modulus (GPa)	2.1	1.1
Tensile Strength (MPa)	107	69
Heat Distortion Temp (°C)	145	65
Impact Strength (kJ/m ²)	2.8	2.3
Water Adsorption (%)	0.51	0.87
Coefficient Thermal Expansion (x,y)	6.3x10 ⁻⁵	13x10 ⁻⁵

Table 1

ready led to a few commercial applications. Toyota Motor Company has introduced an automotive timing-belt cover made from clay-nylon nanocomposites. Ube Industries, in collaboration with Toyota, is also producing nanocomposite barrier films for food packaging and other applications. Similar R&D efforts focusing on clay-nanocomposites are already underway in several US companies, ranging from automotive to electronic appliances.

*Emmanuel P. Giannelis
Ithaca, New York*

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