CMS News

A Publication of The Clay Minerals Society

June 1990

Show-em Missouri!

An originally karstic landscape about 300 million years old

Photo supplied by Walter D. Keller

This is in north central Missouri (Mexico, MO) where the Cheltenham refractory clay was strip-mined to the "bottom-rock" conglomerate that covers its contact with the underlying karstically dissolved Mississippian Burlington Limestone. The Cheltenham swamps, in which that "fire clay" was deposited and formed, filled these depressions back in early Pennsylvanian time, hence the exhumed surface topography is that of an authentic natural karst surface. The water-filled deep pit is about 65 feet deep; the other topography relief can be estimated by comparing with the mine equipment.

This area has been reclaimed, of course, i. e., "beautified" in clay-miner's lingo, by partial refill and a recreational lake.

Walter D. Keller
Columbia, Missouri

CMS publishes first workshop volume

Quantitative Mineral Analysis of Clays, the first volume of the CMS Workshop Lecture Series, has been published by The Clay Minerals Society this spring. Based on the 1985 workshop conducted during the joint CMS and International Clay Conference in Denver, the volume is edited by D. R. Pevear and F. A. Mumpton. It is appropriate for both students and professionals.

Contents include Principles and Techniques of Quantitative Analysis of Clay Minerals by X-ray Powder Diffraction (R. C. Reynolds, Jr.); A Computer Program for Semiquantitative Mineral Analysis by X-ray Powder Diffraction (J. W. Hosterman and F. T. Dulong); A Computer Tech-

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Come to Columbia
The Clay Minerals Society
Annual Meeting
October 6-11, 1990
Columbia, Missouri

Ballot addendum required

The offices of secretary and treasurer were inadvertently left off the 1990 ballot. Although the positions are uncontested, in order to remain in accordance with our by-laws, we need to take the vote. Please take the time to read the information on page 18 and to send in the ballot card.

Inside ...

The Clay Minerals Society

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CMS News is published quarterly by The Clay Minerals Society. Contributions of articles, letters, commentary, photographs, and drawings are welcome.

The newsletter is distributed to all CMS members. Membership rates are as follows: full membership, including a subscription to *Clays and Clay Minerals*, \$35.00/year; student membership, \$17.00/year; nonsubscribing membership, \$10.00/year. Institutional subscriptions to *Clays and Clay Minerals*, \$120.00/yr (\$135.00 overseas). Please contact the Society Office for information regarding membership and subscriptions, and for a copy of our publications list.

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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Many thanks to our advertisers this month, **Nature's Own, Radix Instruments,** and **Jim Stauver,** for helping make the newsletter possible.

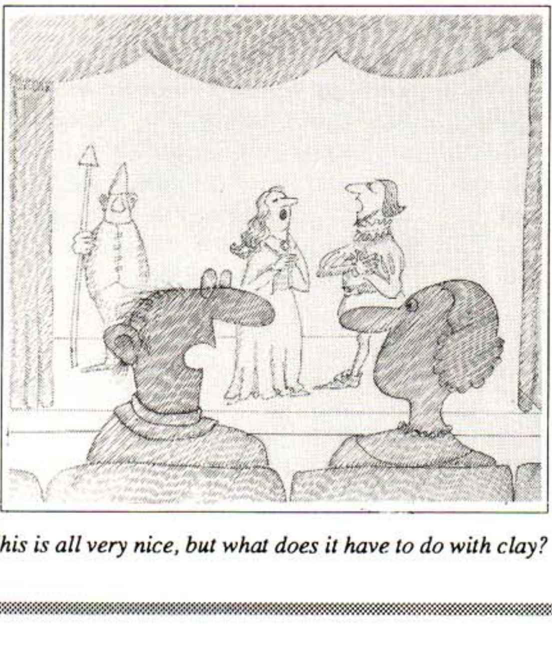
New CMS volume, *continued from page 1*

nique for X-ray Diffraction Curve Fitting/Peak Decomposition (R. C. Jones); Quantitative Mineral Analysis by X-ray Transmission and X-ray Diffraction (B. L. Davis and L. R. Johnson); Quantitative Determination of Clays and Other Minerals in Rocks (Maynard Slaughter); A Combined X-ray Powder Diffraction and Chemical Method for the Quantitative Mineral Analysis of Geologic Samples (C. S. Calvert, D. A. Palkowsky, and D. R. Pevear); and Computer-Generated Templates to Convert Degrees 2θ to Interplanar Spacings (L. J. Poppe and J. E. Dodd).

Quantitative Mineral Analysis of Clays is available from the CMS Office for \$16.00, including postage. 171 pages. Future volumes in the series will be *Electron-Optical Methods in Clay Sciences, Thermal Analysis of Clay Materials,* and *Rheological Properties of Clay Minerals.* The workshops have all been sponsored by the Continuing Education Committee of the CMS.

Clays, Muds, Shales, and Weaver

Clays, Muds, and Shales by Charles E. Weaver provides a comprehensive and critical summary of clay mineral literature that relates to geology and geologic processes, making it useful both as a reference book for geologists and as a text for the specialist. Contents include Background, Structure and Composition, Soils and Weathering, Continental Transport and Deposition, Marine Transport and Deposition, "Authigenic Marine" Physils, Diagenesis Metamorphism, Physils in Sandstones, Evolution of Physils and Continents, Lithification and Petrology. It is available from Elsevier Science Publishers, P. O. Box 211, 1000AE Amsterdam, The Netherlands. The cost is US \$136.50. 820 pages.



This is all very nice, but what does it have to do with clay?

Peter Hall recognized

Lelia Coyne regrets that her interview, in the last issue of *CMS News*, neglected to acknowledge the valuable help and cooperation she received from Peter L. Hall at Schlumberger Cambridge Research.

Thanks...

To the following people who contributed to this issue:

Graham Cairns-Smith
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F. A. Mumpton
Haydn H. Murray
Walter E. Parham
Sam H. Patterson, Jr.
Herman E. Roberson
Leonard G. Schultz
Rodney T. Tettenhorst
Kenneth M. Towe
W. Arthur White

Letters

Kaolinite and the diagenetic fence

Editor:

I have just read with much interest Dr. Walter D. Keller's letter to the editor in the March issue of *CMS News*. If I understand Dr. Keller's statements correctly, he accepts the age distribution of kaolinite in the sedimentary record as a primary feature of the record. In other words, the presence or absence of kaolinite in sedimentary rocks depends only on the conditions of the pedogenic environment. This may be the case for the distribution of commercial-size deposits of surficially weathered kaolinite. However, the lack of kaolinite as a clay mineral component of pre-Mesozoic sedimentary rocks is to some degree a secondary feature of the record, a result of diagenesis.

Freshly-deposited, muddy sediments on a global scale initially contain many phases, most of which are incompatible in a system at chemical equilibrium. With time, excess phases are eliminated, and internal equilibrium is approached in the rocks. The rate of diagenetic change increases with burial depth and the accompanying increased pressures and temperatures. With rapid burial, diagentic change can occur in a few millions of years; slower burial or little burial can result in the persistence of metastable (unstable) phases for hundreds of millions of years. On the average, most diagenetic change is accomplished in about 200-250 million years. Smectites are converted to illite-rich, mixed-layer clays, and eventually to mica plus quartz. Kaolinite reacts to chlorite. The original metastable assemblage of muddy sediments with increasing age and/or diagenesis is converted to an assemblage of illite (mica)-chlorite-quartz ± K-feldspar. Thus, the mass-age distribution of kaolinite in sedimentary rocks does not simply reflect surficial environmental conditions of formation but also diagenesis/metamorphism.

To the extent the data base is sufficient and interpretations correct, the distribution of kaolinite in the geologic record appears to bear little relationship, with one possible exception, to the inferred O_2 or CO_2 content of the atmosphere (Figure 1). In general, the evolution of the Earth's surface environment has followed a path of decreasing acidity and increasing redox conditions, as atmospheric CO_2 levels have fallen and O_2 levels risen since the Archean. Superimposed on these trends, particularly as documented for the Phanerozoic, have been cyclic variations in these atmospheric gas concentrations. It is possible that the observed higher kaolinite content of Mesozoic muddy sediments reflects the higher atmospheric CO_2 levels at this time which led to

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Interviews with the clay scientists

Rollin C. Jones

Rolly Jones has been a soil mineralogist in the Department of Agronomy and Soil Science at the University of Hawaii at Manoa since 1968. Easily spotted at CMS conferences in his wild Hawaiian sports jackets, he has had a number of Ph.D. and M.S. students, many of them from countries other than the U. S. "My most famous foreign student (from a country called Texas) is Dr. Wayne Hudnall." The interview was conducted at the Sacramento meeting, and Dr. Jones responded to additional questions by mail.

Drawing by M. J. Nash

CMS: What is happening with clay science in Hawaii?

JONES: I'm spending most of my time right now working with my student, Hameed Malik, on kaolinitic Vertisols: in other words shrink-swell soils that have nearly the same swelling percentage and pressure as normal Vertisols; yet a cursory XRD pattern shows only a 7 Å peak. TEM shows the 7 Å peak to be primarily dehydrated halloysite. After removal of free iron, oriented XRD slides reveal a prominent illite peak along with two broad peaks at about 11 and 12 Å. There is only a slight indication of expansion with ethylene glycol. All this brings up our friend — tropospheric dust. In Hawaiian soils, mineral potassium is generally lost to plant uptake. There are no K-feldspars to supply potassium for illite formation. Illite in Hawaii is much older than the islands, and blows here as dust from the Gobi Desert. The smectite that we apparently are observing with our shrink/swell tests is illite/smectite formed from the weathering of tropospheric illite. The Vertisols that Hameed is studying on the islands of Lanai and Molokai have parent materials that have been transported to the sample sites by wind from other parts of the islands. During eolian transport, tropospheric dust has been added to the native dusts to form a nearly uniform layer at least three meters thick. Hameed's study is proving to be very enlightening in view of the work done on illite/smectite by Hower, Reynolds, and others. I never thought we would ever be seeing illite/smectite high and dry on a tropical island. I thought it was only something that was dug up in the Gulf of Mexico.

CMS: Hawaii is so isolated. It is amazing that you get that much dust. Is Hawaiian agriculture dependent on it?

JONES: Yes. Most of the illite comes down in the higher rainfall areas. And a lot of agricultural land needs to have potash applied — good stiff doses of N, P and K are required all the time. And then, of course, there is the continual recycling of organic matter that falls to the ground, decays, and is recycled.

When I moved into my house, all the organic matter, all the top soil, had been bulldozed out. No matter how much I watered it, weeds didn't even grow. I took some of this "soil" to the lab and had it analyzed; it turned out to be virtually a sterile medium, like sand, although of course there is no quartz in it. So I started buying treble superphosphate by the fifty pound bag, and just throwing it on. Normally this application rate would have burned the plants, but at last things started to grow.

CMS: What do you think of Amazonian agriculture?

JONES: I think it is a disaster, a complete disaster, in that they have essentially the same problem that I had in my backyard, plus the problem of irreversible drying of the soil.

CMS: What happens when this soil dries irreversibly?

JONES: If it is dried irreversibly, it isn't the same soil. It loses its cation exchange capacity, which wasn't very large to begin with, and it loses almost all of its surface area as it dries, to make sand- and gravel-sized aggregates. It loses its ability to hold nutrients.

CMS: In Great Britain, and also in New Zealand, soil scientists are being fired. One of the comments in England was that even though agronomists have been studying soils for fifty years, they haven't helped agriculture one bit. Is this true?

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Jones, *continued*

JONES: I don't think that it's true at all. One of the big problems is that the population is growing exponentially. This population increase is happening mostly where people are the poorest and can least afford to use high tech agriculture. They have to use hand labor, and they don't have the N, P, K, and minor elements to put on the soil. The type of agriculture they are familar with, the way their forefathers did agriculture, is no longer adequate to feed the population. What we are trying to do at Hawaii (we are in the College of Tropical Agriculture, which means that we are interested in anything from the Tropic of Cancer to the Tropic of Capricorn all the way around, including Africa, South America, the Phillipines, Indonesia, and so on) is to introduce entirely new practices. In other words, how can we farm a land that is very poor in fertility with minimum inputs to get maximum outputs? Sustainability is the big buzz word, especially in view of impending climate changes, if climates are changing. What we are looking into is not necessarily the high tech way, even though high tech enters into it in the form of computer models. For example, we are studying manure crops, green manures of different varieties, specifically nitrogen-fixing varieties, to be used in intercropping.

CMS: What does a clay mineralogist have to do with this sort of study? Can a knowledge of clay mineralogy help grow food in the Third World?

JONES: Well, you kind of wonder about that, *but* everybody and his brother come to me to find out what the mineralogy is. I'm kept so busy doing other people's work along those lines that I hardly have time to do my own. They want to know, for example, the minerals that are going to fix phosphorous; if there are any minerals present that are going to fix potassium; what are the organic-mineral interactions that might have some play on nitrogen balance; what is the percentage of clay-sized particles versus, say, organic matter. These are important factors because, in a lot of these areas, organic matter and clay contents are very poor. It is like trying to raise food in a sand culture. We want to be able to give estimates for expert systems. One of the reasons I'm pushing so hard on curve-fitting XRD patterns is to be more quantitative, to be able to do quantitative XRD.

In order to be quantitative, we are interested in measuring integrated XRD peak intensities. One of the first big problems that we found is reproducibility of specimen preparation. We try as hard as we can to make uniform slides, but we may get as much as 50 percent deviation in peak areas. Sometimes we measure five or six replications just to get decent statistics. I never dreamed that specimen preparation was that much of a problem until we actually started getting quantitative about it. Holding up an XRD pattern, you take a look at it and say, well this is about the same as that; but the eye is not very good at integrating a peak.

CMS: What are the patterns of clay mineral occurrences in the Hawaiian Islands?

JONES: There are soils in Hawaii that contain *no* clay minerals. The soils may be so young that clay minerals have not had time to form as is the case, for example, on the big island of Hawaii, and there are soils that are so highly weathered that they have lost almost all of their silica, and hence contain no phyllosilicates. Areas of silica depletion occur in the high rainfall areas on the islands of Maui, Oahu, and, in particular, on Kauai. In fact, a few of the soils on Kauai contain only the silica that is continually added via tropospheric dust. Between the two extremes one finds the clay minerals halloysite, which often occurs in low pH environments, kaolinite, which occurs in moderately acid soils, and smectite, which occurs in dry, moderately basic soils and in pockets between lava flows where silica and bases have accumulated.

Illite in Hawaii is much older than the islands, and blows here as dust from the Gobi Desert.

CMS: I was struck by the difference in weathering intensity among the islands as you go northwest from Hawaii, where the hot spot is, to Maui, Molokai, Oahu, and Kauai, in order of increasing age. Does this change in length of weathering time affect island agriculture? Is Maui more fertile than Kauai?

JONES: Yes, definitely.

CMS: Mt. Waialeale on Kauai has the highest rainfall recorded on earth. What kind of clays are found there?

JONES: A couple of students hiked up there to the Alakai swamp—it takes about three or four days round trip — and took some cores. Material washes into the swamp from higher areas. The swamp is about 500 feet below the summit.

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Jones, *continued*

CMS: How much rainfall is there?

JONES: The first year that it was measured accurately, they got 640 inches—53 feet. In the cores that the students took we found layers of completely dehydrated halloysite interspersed with layers of completely hydrated (10-angstrom) halloysite, indicating weather changes. These weather changes very easily could have come about by glacial periods alternating with interglacial periods. During the glacial periods, sea level would drop substantially, something like 100 meters, which makes the island higher by 100 meters. During the interglacial periods, when sea level rises, the island was that much lower. These changes in relief would substantially alter the amount of rainfall coming from the prevailing trade winds, assuming that they were the same kind of winds then as we have today. The amount of sunny periods would be altered substantially. We feel that this is one of the primary reasons that there have been cyclic weather changes on the islands.

This population increase is happening mostly where people are the poorest and can least afford to use high tech agriculture.

CMS: It is amazing that hydrated halloysite survives at the surface, because one hour or less in the sun would be enough to destroy it.

JONES: Yes; in other words, in that particular area it never quits raining. It is always in the fog; therefore, it never dries out. If there were extended sunny periods, as there might be if sea level changed, then it could dry out.

CMS: You have been doing a lot of work with oxides and hydroxides in tropical soils.

JONES: Yes. About six years ago I was asked to join a group that was investigating a bauxite reclamation site on the island of Kauai that had been established in 1958. The purpose of the experiment was to determine if a mined-out area, which contains roughly equal quantities of goethite and gibbsite (about 40% each), could be reclaimed back to productive pasture. In 1958, trials indicated that in order to bring the soil solution up to a phosphate level of 0.1 ppm, over 950 kg/ha of trebel superphosphate had to be applied at a cost (in 1990 dollars) of over $1000/ha. Even as late as 1984 there was an argument about what was sorbing the phosphate — gibbsite or goethite. Chemical methods weren't getting us anywhere, so I turned to XRD. Samples that were very different in their ability to sorb phosphate produced qualitatively similar-looking XRD patterns. Therefore the task was to quantitatively, or at least semiquantitatively, determine the *differences* in the XRD patterns.

By ignoring the fact that there may be strains in the crystallite lattice, peak full width at half maximum and peak shape have shown an excellent correlation between goethite diffracting domain size and phosphate sorption. There is no such correlation with gibbsite. The argument is not yet over. What about the unaccounted-for 20% of the bauxite? A publication is nearing completion that explores all of the data that can be extracted from the whole sample by XRD curve fitting/peak decomposition.

The computer program named Pi'o Pili Pa'a (Hawaiian for curve close fit) is now in its 24th version. There have been substantial changes made since I distributed copies of the program at the Sacramento meeting. I also plan to have copies available for interested parties at the Missouri meeting.

CMS: You organized The Clay Minerals Society annual meeting in Hawaii in 1982. How was this idea conceived?

JONES: I was very impressed with the Jamaica meeting, and realized that Jamaica was similar in many respects to Hawaii; but, on the other hand, there were aspects of the island that were very dissimilar. John Hower was president of CMS then, and in talking to him I mentioned, "Now that you have seen Jamaica, you should see Hawaii." I suppose I opened my big mouth when I shouldn't have, but went on to say that we should have a CMS meeting in Hawaii some day. There wasn't much of a reaction from John except for a few grunts, and with the pleasant conversation we left it at that. About a year later I received a phone call (from whom I can't recall) asking me to put the invitation in writing.

One of the first big problems that we found is reproducibility of specimen preparation. We try as hard as we can to make uniform slides, but may get as much as 50 percent deviation in peak areas.

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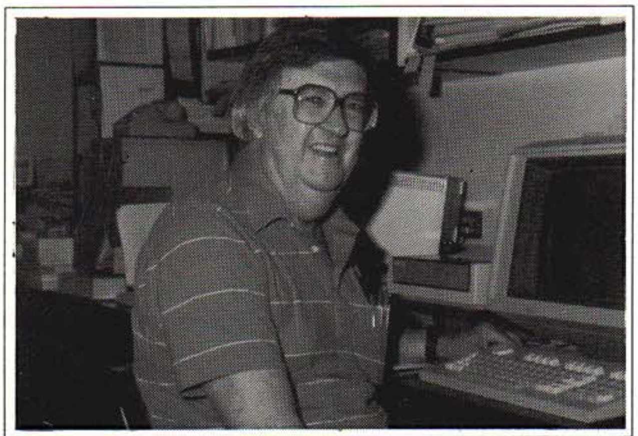
Jones, *continued*

Waikiki would have been a terrible place to invite the world's foremost geologists, mineralogists, and soil scientists; but Hilo is a quiet town, not much different than it was 100 years ago, and it is close to the world's most active volcano, Kilauea. Madam Pele wouldn't budge an inch while the CMS was in Hilo. A year later an eruption



Rolly Jones

started that hasn't stopped. As of 20 May 1990, 139 homes have been destroyed. We set a record at the meeting that hasn't been broken: there were more wives and children in attendance at the Hawaii meeting than at any other CMS meeting. My super wife, Barbara, took the spouses in tow, and my daughter, Kimberly, took charge of the children. Joe Dixon was CMS president, and we put him, his wife, and his son in the presidential suite, which had cooking facilities. Seems that young Dixon and Kimberly cooked up a scheme to do some cooking, complete with umpteen children. Joe and Mrs. Dixon were much nicer about the invasion of their suite than I think I would have been.

CMS: I hear that you were a movie star.

JONES: I was involved with filming an episode for *Planet Earth*, a PBS series that aired about two years ago. The producers had written to inquire if Goro Uehara and I would go on camera to tell them all about the mica (illite) and quartz that is deposited in Hawaii as tropospheric dust. Before they came, Goro and I collected some tropospheric dust samples from the field and ran XRD and electron microscopy on them. When the producer arrived, he was absolutely not interested in the E.M.'s because he said that everybody had E.M.'s of all sorts. XRD's were okay — not many of their episodes delt with XRD.

The day the Planet Earth filming crew showed up was Barb's and my anniversary and a state holiday; we were scheduled to leave for Molokai on the 4 pm plane. First, Goro took about three hours giving his all for a geomorphology talk on relief maps of the islands. Then the entire crew came to my lab and immediately announced that the place was too noisy. I had to turn off everything, including the air conditioner. In Hawaii, no A.C. is bad news, unless you like saunas.

Next, they took about 10 shots of me explaining the whole process of XRD. The producer was on my case continually about looking at the camera — yet I was supposed to "almost" look at the camera! After every conceivable angle of me and the XRD was shot, the producer spotted some size 11 rubber stoppers (great big ones) on the lab bench. They were the most scientific things he had seen yet — he had to have close up shots of me doing something with those stoppers — "What do you mean it can't be done? That's exactly the shot I want." No table in my lab was good enough for such crucial shots; we had to find another. I did my best to make an XRD specimen with the stoppers, while the camera zoomed in for some good, tight shots. All this while Goro and I were giving the "science talk" that we were instructed to say. We had already explained everything that had to do with the subject of tropospheric dust; so now it was time for some real "science talk."

The time was almost 3 pm, and I was begging the producer to be excused, but he had to get one more shot of those all-important stoppers that the world was depending upon to solve the tropospheric dust mystery. Finally they let me go with the promise that Goro would take the camera crew to the field to see the dust first hand. While the dust was settling on their lenses, Barb and I just made the plane, and I had a wonderful time with my bride of 32 years. Goro returned from the field at about 10 pm.

About 6 months later came the moment we all were waiting for — to see the fruits of my 9 hours and Goro's 14 hours of work: about 30 seconds of me making an XRD specimen with number 11 rubber stoppers, while talking "science" with Goro! Period. All the rest ended up on the cutting room floor. Barb had written to most of our friends and relatives alerting them to be on the lookout for the dusty TV stars. After the episode aired, we got calls and letters saying that they had taped it, but were not sure which part was me.

CMS: How did you get into clay science?

JONES: Well, I started out as a chemistry major as an undergraduate at the University of Arizona, Tucson, and then got interested in agricultural chemistry.

CMS: How did you happen to get interested in agricultural chemistry?

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Jones, *continued*

JONES: In the first place, I was offered a job; in the second place, it interested me because my father was a rancher. He had large areas of property in Arizona, and I'd always been interested in clay. I went to work for Dr. Duwayne Anderson, who now is at Texas A & M. One thing led to another. He asked me to take a course from Wykoff in electron microscopy. Nothing ventured, nothing gained; so I did, and I've been an electron microscopist ever since. I've been a member of the Electron Microspopy Society of America for 30 years.

CMS: Do you have electron microscopes in Hawaii?

JONES: Yes, both a TEM and an SEM. Fortunately I don't have to take care of them; I just use them. We never had anything like XRD or XRF with Anderson. He left Arizona, went to the Cold Regions Research Engineering Laboratory, and was the administrator who was principally involved in letting Bob Reynolds do his work there. I got my master's with Anderson at the same time Gary Sposito did, so we went through together. Then I went to work for Stan Buol, who bought an XRD and an XRF. Never having seen these before, and not knowing much about them, I made a college career out of learning everything I could. I got interested in finding different algorithms for the minimization of nonlinear functions, because they are useful in XRD and XRF work. My program will work just as well in XRF as XRD, and I've used it for people in the chemistry department. So it has been an evolutionary process.

CMS: How did you end up in Hawaii?

JONES: There was a western regional mineralogy meeting in Tucson. I gave a paper (I had not yet finished my Ph.D.). Like every meeting, all these people show up. You shake hands with everybody, and say hello hello, and forget who it was. I didn't catch a single name. A day or so later, toward the end of the meeting, people came around and toured the lab, shaking hands all over again, hello hello, still can't remember who it was you talked to. Forgot about it; completely forgot about it. About six weeks later, out of the blue, came a letter from Dr. L. D. Swindale, chairman of the department at Hawaii, saying I'm going on sabbatical, would you like my job? At that time there weren't equal opportunity regulations where you have to take a hundred applications. I wrote right back and said yes. Originally it was supposed to be temporary. Swindale was going to stay two years in Rome, and I was supposed to stay just two years. But when he came back, G. D. Sherman retired; Swindale moved up to the associate directorship, leaving his job open. By that time, about 4 years had gone by, and they said why don't you apply for tenure, which I did, and I got it. I've been there ever since.

CMS: One more question—where do you get your sportcoats?

JONES: Well, Barbara bought this one for me at a garage sale.

By-laws changes

Once a year, the CMS newsletter publishes the following section from the CMS Constitution:

Article IX. By-laws and Amendments

Section 1. By-laws. The by-laws of the Society may be amended as follows:

(a) By a majority of the voting members present in person or represented by proxy at a meeting duly called for the purpose, at which there is a quorum, provided that a copy of the proposed amendment and notice of the meeting shall have been mailed to such voting members not less than twenty (20) nor more than eighty (80) days before the meeting at which the action is to be taken; or

(b) By a vote of two-thirds (2/3) of the entire Council at a meeting duly called for the purpose; or by mail ballot upon a vote of three-fourths (3/4) of the entire Council. All amendments approved by the Council, either at meetings thereof or by mail ballot, shall be voted on by the membership at the next Annual or Special Meeting of the Society.

Section 2. Proposals of Amendments. Any twenty-five (25) voting members may, by letters addressed to the Secretary, recommend to the Council the amendment of a By-law. If the Council shall approve the amendment, the Council may adopt it, subject to later vote by the membership at a duly called meeting. If the Council shall disapprove the amendment, it shall so inform the proposers and refer it to the membership for a vote at a duly called meeting, if the proposers so request.

Section 3. The Executive Committee may suspend the operation of any rule or By-law only until the next regular meeting of the Council.

Symposium
Colloid and Surface Chemistry of Clay Minerals
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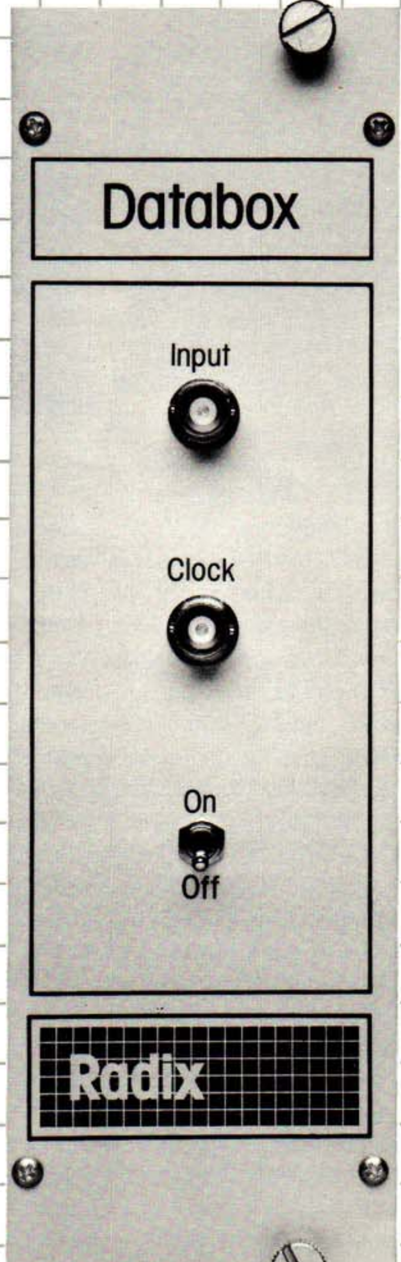

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Society Archives

Tales of Grim

Most members of The Clay Minerals Society are aware of the professional stature of Ralph Grim, who passed away last summer. A number of his students and colleagues have generously contributed the following glimpses of the man, in an attempt to give us an insight into his more personal side.

Art White

I worked for Dr. Grim at the Illinois Geological Survey in the forties and then received my doctorate in 1955. I knew Dr. Grim for 53 years.

When my wife and I didn't have a car during and right after World War II, Dr. Grim went out of his way to take us home from work during bad weather. One day when I was a freshman at the University and working for Dr. Grim at the Geological Survey, I went to work with the flu. When he realized I didn't feel well. he sent me back to my room to go to bed and rest, saying that if the Survey wouldn't pay for my time, he would.

One day I was filling a constant temperature bath tank with water, which usually took from 15 to 20 minutes. Instead of waiting until the tank was filled, I left and did some work in another laboratory. While I was gone, the tank overflowed, and when I returned, Dr. Grim was out there mopping up the water. He never said a word, but turned the mop over to me. The janitor offered to mop up the water, but Dr. Grim wouldn't let him.

One of the tasks Dr. Grim liked to assign a new employee was to make a suspension of various clay minerals that would be thin enough to separate into particle-size fractions: first a suspension of kaolinite, then of illite, and finally of Wyoming bentonite. This usually resulted in all the containers in the laboratory being filled with a suspension of Wyoming bentonite as the employee added more and more water to thin the suspension to the point where the particles would settle freely.

Ralph Grim at the Illinois Geological Survey in the 1950's *Photo contributed by both Ken Towe and Art White*

When I was a graduate student after World War II, Dr. Grim and I went into the field. One night we rented a hotel room with twin beds. There were no towels. He called down to the desk to ask about the towels and was told that he had to rent them for $1.50 per person. The room itself was $1.50 a night—a fair sum at the time. He told them to forget the towels. There were two chests of drawers with linen scarves and some chair-arm covers. We used the chair-arm covers as wash cloths and the linen scarves as towels.

Dr. Grim had the ability to see the gist of a problem. It was rumored that in a university staff meeting, he would sit and listen to others argue about a problem. After a certain amount of arguing, and sometimes quarreling, Grim would state what he understood the problem to be and what he thought the solution could be. Most would agree, and they would go on to the next item.

W. Arthur White, Ph.D. 1955
Urbana, Illinois

Sam Patterson

As part of a U.S. Geological Survey project on mapping and evaluation of bentonite deposits, I was assigned to work under Dr. Ralph Grim at the Illinois Geological Survey in 1948. This assignment was because Ralph was unsurpassed in the knowledge of the mineralogy of bentonite and in the methods of testing it for use in drilling muds and foundary sand bonds. It was a very fortunate opportunity for me to work under Ralph's supervision and to study under him when he moved across the

continued on next page

Patterson,
continued from previous page

University of Illinois campus from the Survey to the Department of Geology.

Ralph believed more firmly than many clay mineralogists that research should be done in such a way that the results would be of value to man. He was always the perfect gentleman and very rarely got irritated, but one of his exceptional students found a way to displease him on the subject of pure research. This man, with a fresh Ph.D. in hand and Ralph's recommendation for a choice position in the petroleum industry, was interviewed in Texas. He told the company people that he was interested only in pure research and that applied research was not for him. Obviously he didn't get the job, but he was successful in locating a corner in Ralph's doghouse.

Ralph Grim not only ranked with the world's leading clay mineralogists, he was an outstanding economic geologist specializing in clays. He was also an exceptional professor with particular abilities to project knowledge to students and to direct research projects.

Sam H. Patterson, Jr., Ph.D. 1955
Reston, Virginia

Haydn Murray

I had completed my field work on the petrology of a pegmatite in New Hampshire for my Master's degree in the summer of 1949, and Dr. Grim had just joined the faculty at the University of Illinois, moving from the Illinois Geological Survey. I had completed one year of graduate work and was a teaching assistant in mineralogy. My intention was to complete the Master's degree and go to work for an oil company, as I had received some attractive offers in the spring of 1949. In late August, Dr. Grim called me and asked if I was interested in a new fellowship in clay mineralogy established by Illinois Clay Products of Joliet, Illinois. I discussed it with him and decided to accept, and that started my long career in clays.

I took Dr. Grim's course in clay mineralogy that fall, and he was an outstanding teacher. He was one of the most considerate men I have ever met. He did not have children of his own, so he sort of adopted his graduate students, and he was a friend and advisor to them. I never heard him say an unkind word about anyone. When he went over a report or a thesis draft, he would say, "What does this mean?" and I would explain it. Then he would say, "Then write it that way." He arranged a job at Indiana University and the Indiana Geological Survey for me, which was an excellent position, when I finished the Ph.D.

Six years later I was offered a job at Georgia Kaolin Company, and the person I consulted about this possible move was Dr. Grim. He advised me to take it because it would give me an opportunity to learn the industrial applications of the clay minerals. Throughout the years at Georgia Kaolin Company, Dr. Grim was a consultant and gave us excellent advice. I truly revered the man and can say that he molded my career.

Haydn H. Murray, Ph.D. 1951
Bloomington, Indiana

Grim's Students

Grim had at least 40 graduate students. The following list, culled from the University of Illinois files, may not be complete. Apologies to any who have been omitted, and thanks to Randy Hughes, Dewey Moore, and Haydn Murray for compiling the list.

Richard Lee Berger, Bruce Forbes Bohor, Patrick James Sherwood Byrne, Barbara Schenck Collins, Elton LeRoy Couch, Robert William Doehler, John Brown Droste, James Lynwood Eades, Ray Edward Ferrell, Jr., Robert Burton Furlong, John Alexander Ferguson, Paulo Miranda de Figueiredo, Robert Bernard Graf, Jeff Henderson, Randall E. Hughes, William Davis Johns, Edward Charles Jonas, William Joseph Lang, Guerry H. McClellan, Charles Frederick Metzger, Jorg Walter Meyer, Eugene Allen Monroe, Haydn Herbert Murray, Kedar Narain, Bruce Warren Nelson, Robert Leslie Niemann, Ira Edgar Odom, Meredith Eggers Ostrom, Walter Edward Parham, Sam Hunting Patterson, Jr., Demetrio Hidalgo Pulanco, Herman Ellis Roberson, Robert Sidney Roth, Leonard Gene Schultz, William Calhoun Shover, Sushil Kumar Siddhanta, Raymond LeRoy Slovinksy, William Calhoun Smith, Thomas William Smoot, Charles Arnold Sorrell, Charles Winthrop Spencer, Rodney Tampa Tettenhorst, Edwin Wilson Tooker, Kenneth McCarn Towe, Don Murray Triplehorn, Elpedio De La Cruz Vera, Floyd Michael Wahl, David Knowlton Webb, Jr.,William Arthur White, Paul Adams Witherspoon, Roger Glen Wolff.

Professor Grim's Rubles—Rod Tettenhorst

On a corner of my desk I have a manilla folder labeled "Professor Grim's Rubles." Perhaps the membership of the Society would enjoy hearing of this long-standing saga. We, who were students of Professor Grim, had heard this story as early as the late 1950's. As he told it to us, his original book *Clay Mineralogy*, published in 1953, had been translated into the Russian language, but Professor Grim had not received any royalties. His reaction was more one of amusement than anything else, for he understood well that procedures and customs were different in the Soviet Union than elsewhere.

This story did not resurface until an evening in October 1988 when my wife and I had the pleasure of dining with Professor and Mrs. Grim and Steve Altaner and Norma Vergo in Champaign-Urbana. We were exchanging bits of information when I mentioned that my eldest son was a Russian scholar and that he would be studying at the Pushkin Institute in Moscow from January to May 1989, and that my wife and I planned to visit him on a tour in March.

Professor Grim retold the story of the rubles. I think I can speak for all of his students that we always hoped we could reciprocate the many kindnesses he showed us. So, I seized the opportunity to suggest that my family and I would like to try to obtain his rubles for him. My enthusiasm was high when I indicated that the time might now be right for a resolution of this problem, with the new spirit of *glasnost* that was sweeping the Soviet Union. Professor Grim liked the idea but was hesitant for two reasons. He did not want it to cause any trouble for us, and he didn't want us to get our hopes too high because of his own experiences in the Soviet Union during the 1930's. An example is the following story he related to us.

He had traveled the country by train with a tour group. One day after an especially long and hot ride, the group arrived tired and hungry at a town where their meal had already been prepared. The meal consisted mainly of whole, boiled fish which had been left to stand in an open pot under a blazing sun. Also, a swarm of insects had congregated around their meal. One of the women on the tour promptly fainted. She was carried into a room in a hotel nearby, and a doctor was summoned. Professor Grim recalled that the most striking feature of the doctor was his full head of beautiful, black hair. The doctor glanced at the prostrate woman, and then he spied a pitcher of water, a wash basin, and a bar of soap on a sideboard. Before attending to the lady and to the utter amazement of the assembled tour group, the doctor proceeded to carefully wash his hair. That story should have convinced me that the pursuit of Professor Grim's rubles might not be a straightforward matter. Nevertheless, we decided to proceed.

Ralph Early Grim *Photo contributed by Art White*

Shortly after our October meeting, Professor Grim sent me the correspondence (two letters and two replies) with the Soviets concerning the rubles. They were dated 1964-65. He was told (in Russian) that his rubles were being held in account in a publishing house and that he could claim them on his next visit, which never came to pass. We maintained an active correspondence on this matter through May of this year. I found it to be a very nice way to keep close contact with my professor, and I think we both felt it was a bit of an adventure.

I wrote to the U.S. Embassy in Helsinki upon receipt of the documents from Professor Grim. Unfortunately, the embassy did not reply until shortly after my son had returned home; they cited a crush of work for the delay. However, they gave me the address of a group of lawyers in Moscow "who specialize in matters such as this." I wrote to the lawyers in May and have not as yet received a reply. Presumably, Professor Grim's rubles remain in the account of the publishing company.

It would give me great pleasure to resolve this matter for him, and I would appreciate any suggestions. I plan to continue my efforts, as my son plans a more extended stay in Moscow in the future. To those of us who were his students, the name of Grim was magical. He was, truly, a giant in our field of study and a very special person to all who knew him.

Rodney T. Tettenhorst, Ph.D. 1960
Columbus, Ohio

Ken Towe

My own personal story about Dr. Grim concerns his response to my suggestion that we publish the results of my thesis on the facies distribution of clay minerals in the Devonian Hamilton Group of New York. After I had defended the dissertation, I went into his office and presented him with the idea that we should prepare a joint paper for publication. He looked up from his desk and said, "Ken, you did all the work; there's no reason to add my name to your paper." I found this reply to be as surprising as it was refreshing because there were others in the Department at Illinois at that time with a decidedly different attitude toward their students' thesis work. I paused for a moment to recover and collect my thoughts and then said to him, "Dr. Grim, I'm aware that my name on a joint paper will probably do little to add to your reputation, but you were my advisor and I was hopeful that your name on the paper would help me a little bit." He laughed and said, "Oh well, if you think so, go ahead." The paper was published jointly in the *American Journal of Science* in 1963, and his input to the preparation of the manuscript was very meaningful.

Kenneth M. Towe, Ph.D. 1961
Washington, D. C.

Herman Roberson

Whenever I think about my "Grim years" at the University of Illinois, I recall very vividly certain Grim qualities and actions which significantly affected me as a person and as a scientist. I recall Dr. Grim's strong and consistent support and encouragement. He took a positive approach to just about everything. These qualities helped to make him a wonderful research advisor. His approach—suggesting broadly conceived problems, then giving students the opportunity to follow through as creatively as they could—was ideal, in my opinion. When I did run into snags, which I invariably did, Dr. Grim was right there suggesting options I hadn't considered. He seemed to be there whenever I needed him. I remember one of the last occasions we worked together as student/mentor. I had submitted the last few chapters of my dissertation. Dr. Grim had only a few days to critique this material because of a week-long trip he was to make. He was kind enough to have me come to his home on Sunday to discuss his suggested revisions. This made it possible for me to receive my degree on schedule.

Dr. Grim had a great sense of purpose, a quality which made it possible for him to accomplish so much. He also took time to have fun. He loved to play golf. I was not, and am still not, a golfer. But I still remember his eagerness to get out onto the course. Perhaps his ability to balance his work and play made him so even-tempered and tolerant. His sense of humor was also well-developed. He never took himself too seriously. He could laugh with the rest of us even when his long-time compatriot, Bill Bradley, made fun of a Grim 'turn of phrase' in a recent Grim paper.

It was truly a wonderful experience to be able to work for Dr. Grim. He was a man of great integrity, great spirit, and great intellect. He was warm and supportive—a first rate human being. No one could ask for a better role model.

Herman E. Roberson, Ph.D. 1959
Binghamton, New York

Len Schultz

Reflections on Ralph Grim by one of his students: words that first come to mind are helpful and unobtrusive. If he were asked, Dr. Grim would do anything he could to help, spend any amount of time discussing problems and pointing out alternatives and pertinent literature. If he were not asked, the student was given completely free rein to do as he saw fit, to develop his ideas and present them in his own way—sink or swim.

As one example, take the origin of underclays, either as soils due to *in situ* weathering or as essentially unaltered sedimentary rocks with unusual physical characteristics due to a unique depositional environment. Professor Grim's students, in their publications, have come down on both sides of the question, as Grim has summarized in his treatise, *Clay Mineralogy*. Yet, to learn which origin Grim, himself, originally advocated, the reader must go back to his 1938 publication with Victor Allen. The treatise presents all sides of the question in a fair, concise manner, in the same civil fashion with which Grim habitually dealt with his students.

Leonard G. Schultz, Ph.D. 1954
Denver, Colorado

Hong Kong 1975—Wally Parham

Dr. Grim and his wife attended a small cocktail party in Hong Kong one evening for some attendees of the post-conference field trip of the 1975 International Clay Conference-Japan. The gathering took place at Robert Black College of the University of Hong Kong where I was spending the month. Dr. Charles Peng*, a friend of mine and a mineralogist who had studied under Professor Kerr at Columbia University, arranged the party especially so that he could meet Dr. Grim in person.

During the evening, Dr. Grim asked me if I would show him and Mrs. Grim some of Hong Kong the following day. Dr. Peng, a genuinely nice person, also was standing in our group. He insisted that it would be his honor and pleasure to personally show the Grims the mainland countryside. We all agreed, and so we left early in the morning for what turned out to be a marathon visit to nearly every outcrop in the Colony.

The temperature was about 100 degrees, and the humidity about the same. Dr. Peng, eager to describe Hong Kong as he drove, paid little attention to the heavy traffic in the narrow streets as he weaved through the tenement area of Kowloon. The street was thronged with people and vehicles of all sorts. Dr. Peng, while describing the sights, changed lanes without looking and managed to tear the bumper off of an ancient truck he had just passed. All movement on the street stopped. People came from everywhere to watch the distraught truck driver bemoan his lost bumper. People pressed against the car and peered in the windows out of curiosity, talking all the while. The noise of the crowd was unbelievable! Truly chaos! A glance at the Grims in the back seat told me that this was not quite what they had envisioned as Hong Kong sightseeing.

This was a once-in-a-lifetime occasion for Dr. Peng; he outdid himself assuring that the Grims missed nothing. Roadcuts, outcrops, dams, foundations, quarries, stop after stop across the New Territories. At last we stopped for lunch in mid-afternoon at the floating restaurant in Shatin. It was nearly empty by then.

We sat around a table with a large tureen of hot corn and crab soup that Dr. Peng knew was the house specialty. The heat of the steaming soup, the hot tea, the draining car ride, and the blazing afternoon sun had taken their toll. Needless to say, the food was hardly touched.

Before leaving, nothing would do but that the Grims had to have their pictures taken sitting in two ornate Chinese thrones. The two special seats were mounted on a platform and framed by a red and gold, hand-carved, wooden backdrop. Dr. Grim's strained smile endured photo after photo. Then on to the new Chinese University for a sweltering yet complete tour of all parts of the campus.

On through the mountains, villages, and into the rush-hour traffic jams and finally, late in the day, to the Hilton Hotel where the exhausted Grims were staying. Dr. Peng was beaming from his enjoyment of spending the day with the Grims. They thanked Dr. Peng several times for a truly unique outing in the torrid zone.

Before letting the Grims escape to their air-conditioned rooms, I convinced Dr. Grim that a short, relaxed, mini-tour of Hong Kong Island tomorrow might be just what the doctor ordered. He looked skeptical, but agreed. The next morning I hired a car and driver who delivered us to the Repulse Bay Hotel, a local colonial landmark stretched across the base of the mountain on the back of the island. We had a leisurely, mid-morning breakfast on the white colonnaded veranda overlooking the ocean. The remainder of the morning's outing was slow and easy, designed just to enjoy the scenery. We were back to the Hilton by noon so they could do some shopping.

I have often wondered with all of the world traveling Dr. Grim did, how many times he experienced other such trying days in the field and yet maintained his interest and cordiality. He was a real gentleman.

Walter E. Parham, Ph.D. 1962
Vienna, Virginia

* Now deceased

Dick Hay

I knew Ralph only for the last six years, and he was a special person. He had the spirit of a much younger man and was fully active in clay mineral work to the very end, which came the day after returning from a consulting trip.

He was in excellent health and enjoyed his friends (especially former students) and his golf, which I played with him many times.

As far as I am aware, Ralph failed to achieve only one of his goals—to reach 88. He died a few months short of the age of 88.

Richard L. Hay
Ralph E. Grim Professor of Geology
Urbana, Illinois

Letters,

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higher temperatures and consequently an enhanced hydrologic cycle and increased chemical weathering rates. These conditions could lead to increased rates of formation of pedogenic kaolinites and subsequently, after erosion and transportation, to increased rates of deposition of kaolinite in marine environments. The lack of kaolinite in the preserved sedimentary rock mass for over 3 billion years prior to the Mesozoic most likely does not record its pedogenic history of formation, but is a result of its diagenetic conversion to another phase like chlorite with increasing age/burial temperature.

The sedimentary rock record forms the major source of information in terms of its chemistry, mineralogy, isotopic and biotic composition for deciphering the history of Earth's surface environment. We must keep in mind that some of the attributes of the record do not record hydrosphere-atmosphere conditions at the time of formation but diagenetic/metamorphic events. As geologists, we need to unravel the primary features of the rock record from the secondary to interpret Earth's history. The "diagenetic fence" through which all sediments move leaves a substantial imprint on them. Dr. Keller has put forward a number of cogent questions involving kaolinite that bear on the issue of the distribution of all sedimentary attributes through geologic time—are they primary or secondary features of the sedimentary lithosphere? For kaolinite, the answer may entail both interpretations.

Fred T. Mackenzie
Honolulu, Hawaii

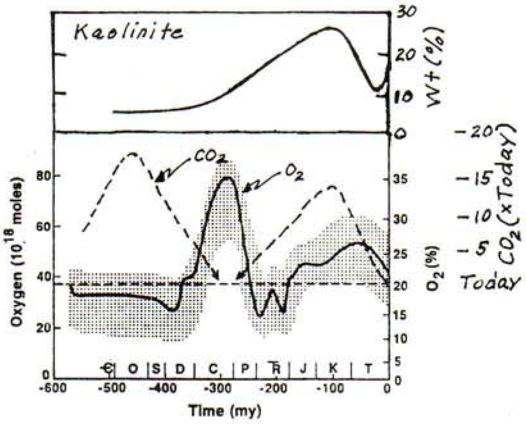


Figure 1. Observed Phanerozoic distribution of kaolinite compared with calculated atmospheric CO_2 and O_2 levels. (Modified from Weaver, 1967; Berner and Canfield, 1989; Morse and Mackenzie, 1990).

Diano documentation needed

Editor:

Derek Bain, the editor of our journal *Clay Minerals,* has just passed on to me a request from a member of our Group, David Jenkins. David recently visited an institute in Pakistan where they were trying to get an old automated XRD system working after some long period of disuse, during which time mice had nested in one of the units and gnawed through some cabling! They replaced the cabling, but in general seem to be hindered by the absence of any operating manuals or other documentation. The system, dating from the 1970's, was manufactured by a company thought to be American, and called Diano, which has apparently gone out of business, or at least ceased trading under that name, as far as we know.

I have never seen such a system in Britain, but I wondered if one of the CMS members might have, or know about, Diano XRD systems. What we need is either someone using such a system who would be willing to loan the relevant documentation for photocopying, or someone who can provide any addresses or other leads enabling the people concerned to obtain this information themselves, assuming that it is still available somewhere.

I would be very grateful for any help you might be able to give in this matter to help our Third World colleagues. Anyone in such a position could contact either myself at Schlumberger Cambridge Research, P.O. Box 153, Cambridge CB3 OHG, England, or David Jenkins directly. His address is: Dr. D. Jenkins, School of Agriculture and Forest Sciences, University College of North Wales, Deiniol Road, Bangor, Gwynedd LL57 2UW, Wales, United Kingdom. Telephone: 248-351151; FAX: 248-364717.

Peter L. Hall, Hon. Secretary
Clay Minerals Group
Mineralogical Society

Keller, Brindley, and Bradley stories requested

Future issues of *CMS News* will highlight Walter Keller, George Brindley, and Bill Bradley. Students, friends, and colleagues of these men who would like to contribute articles or photographs are requested to contact the Society Office soon.

Upcoming Course

Geostatistics: Theory, Practice, and Personal Computer Application

This course introduces the participants to the basic concepts of geostatistical methods and statistical analysis of spatial data, and then focuses on the applications of geostatistical technques for tasks such as mapping, simulation, sampling design, and management under uncertainty. In special sessions, participants are introduced to U.S. EPA's GEO-EAS software package and receive hands-on experience in the use of this software.

Conducted by Georgia Tech Education Extension, July 9-13, 1990, in Atlanta, Georgia. Cost is $895. For more information, contact Education Extension, Georgia Institute of Technology, Atlanta, Georgia 30332-0385. Phone: (404) 894-2547.

Position Sought

Innovative, teamwork-oriented, clay chemist seeks regular staff position from which to engage in R and D in mineral-mediated chemistry and its applications. Analytical methods development a special interest, particularly quantitative analysis of clay mineral, or mineral mixtures and clay organic mixtures. Extensive recent experience in examining relationships between clay mineral spectroscopic properties and surface reactivity. Have emphasized use of diffuse reflectance spectroscopy with correlation analysis (applied to study of clay/iron/water/O^--center interactions). Overall compositional and electron paramagnetic resonance (EPR) data have been used as constituent data for statistical analyses. Extensive work in luminescence properties of clay minerals. Pilot studies of clay structural and energetic parameters controlling kinetics of reactions releasing water, conducted under reaction conditions (wet/dry, freeze/thaw) in which the moisture content is cyclically varied. Experienced in instrumental analysis, chemical separations (solid and liquid chromatographies, HPLC, GC), wet chemistry and vacuum techniques.

Have a special interest in applications of minerals in areas of environment, health and hygiene, and agriculture. Would be interested in QC applications of Near Infrared Reflectance Analysis (NIRA). Presently S. F. Bay Area-based. Will relocate either within, or outside this area. Starting date negotiable, preferably before 10/1/90.

Lelia Coyne, 2332 Cheshire Way, Redwood City, CA 94061. Phone: (415) 604-5968 (work) or (415) 368-6455 (home).

Coyne co-edits book for American Chemical Society

Lelia Coyne is co-editor, along with Stephen W. S. McKeever and David F. Blake, of *Spectroscopic Characterization of Minerals and Their Surfaces*, the American Chemical Society's Symposium Series No. 415. It provides an overview of the types of spectroscopic methods in current use for characterization of crystal structure, chemistry, morphology, and excited states of minerals. Authors include a number of CMS members. It is available from the American Chemical Society, 1155 Sixteenth Street, N. W., Washington, D. C. 20036 for $94.95 (U. S. & Canada) and $113.95 (Overseas). For more information, call (202) 872-4600.

Robertson reviews history of British clay study

Robert H. S. Robertson has authored a short book as an occasional paper of the Clay Minerals Group of The Mineralogical Society, titled *The History of Clay Research in Great Britain*. Prefaced by M. J. Wilson, the paper is meant to be a personal review of the subject. Robertson, who began his clay research at the age of 15, was the fourth Chairman of the Clay Minerals Group (in 1953) and an early colleague of G. W. Brindley. It is available from the Mineralogical Society, 41 Queen's Gate, London SW7 5HR, England.

Feats of Clay

Horton H. Morris

Horton H. (Tex) Morris, president of SSI Consultants in Peaks Island, ME, and retired vice president of research and development for Freeport Kaolin Company, was honored with TAPPI's Coating and Graphic Arts Division Award at a special awards ceremony during the 1990 Coating Conference in Boston in May.

S. W. "Bull" Bailey, will be awarded the Neil A. Miner Award for excellence in teaching by the National Association of Geology Teachers. The award will be presented at the NAGT luncheon at the GSA meeting in October. At another luncheon at the same meeting, Bailey will receive the MSA Roebling Medal.

W. D. Keller was honored in May as a Sesquicentennial Professor at the University of Missouri, Columbia.

Reed and Peggy Glasmann are the proud parents of Joshua Reed, born April 7 and weighing in at 10 pounds. Reed and Peggy have three other children, as well as a foster child.

Gene Whitney is on a six-week trip to Pakistan where he is advising their Geological Survey on clay science.

Dougal McCarty and **Jeff Moe,** students of **Graham Thompson** at the University of Montana, have received tuition scholarships to begin Ph.D. studies with **R. C. Reynolds, Jr.,** at Dartmouth.

Please help us recognize our members' achievements by sending in announcements of awards, grants, promotions, new positions, as well as marriages, births, retirements, and other relevant passages.

New Members

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

Meredith A. Aronson
Dept. of Materials Science
Mines Bldg., University of Arizona
Tucson, Arizona 85721

Dr. Philippe C. Baveye
Unit of Soil Science, Bradfield Hall
Cornell University
Ithaca, New York 14853

Mr. Joel K. Davidson
4820 W. 15th Street
Lawrence, Kansas 66044

Dr. Mauricio P. F. Fontes
Departamento de Solos
Universidade Federal de Viçosa
36570 Viçosa - MG -
Brasil

Mr. William E. Gardner
Technology of Materials
721 E. Gutierrez
Sanata Barbara, California 93103

Mr. Arthur F. Greene
1056 Lakeland Avenue
Lakewood, Ohio 44107

Mr. Zhaojun Hu
Beijing Book Company, Inc.
701 East Linden Avenue
Linden, New Jersey 07036

Mr. David J. Keller
1308 Oak Street
Rolla, Missouri 65401

Mr. Robert P. Kingsbury
7 O'Shea Lane
Laconia, New Hampshire 03246

Mr. Leo C. Klameth
241 Wedgewood Drive
Lincoln, Nebraska 68510

Prof. Ronan Le Dred
8, rue des Pyrénées
68400 Riedsheim
France

Dr. Lucy McCartan
926 National Center
U. S. Geological Survey
Reston, Virginia 22092

Ms. Marina G. Oliver
Box 4109
Texas Tech University
Lubbock, Texas 79409-1053

Mr. Budi Rochmanto
Kampus UNHAS Baraya BX-6
Ujungpandang, Sulsel
Indonesia

Dr. Ed L. Schrader
Dept. of Geology, Millsaps College
1701 N. State St.
Jackson, Mississippi 39210

Mr. Louis P. Solebello
1412 Oakbrook Drive, Suite 100
Norcross, Georgia 30093

Ms. Brinda C. Stephens
119 N. Whitney Avenue
Cookeville, Tennessee 38501

Mr. Keith R. Stultz
Southern Clay Products
P. O. Box 44
Gonzales, Texas 78629

Ms. Thilagavathi Veeriah
CORE Lab. Malaysia Sdn. Bhd.
Lot 10B, Jalan 51A/223
46100 Petaling Jaya
Selangor, Malaysia

Research Grants deadline approaching August 1

Purpose:

The research program is designed to provide partial financial support of masters and doctoral research for graduate students of clay science and technology in United States universities. (Pass this to qualified students).

Selection:

Applications will be judged on a competitive basis. The qualifications of the applicant, the financial need of the research project, and the design of the research project shall be considered. Applicants selected will be nominated by a four-member CMS committee and approved by the CMS Council. Members and nonmembers of the CMS are eligible. Applicants must be U. S. citizens and not affiliated with a foreign university.

Application:

Each applicant must complete an APPLICATION FOR RESEARCH GRANT form available from the CMS office and must obtain confidential evaluations from two faculty members at his or her university. Use the APPLICANT APPRAISAL form provided with the application.

Use of Funds:

Individual grants will not exceed $2,500. Grant money may only be used for the costs of travel by the grantee to conduct research, room and board associated with research-related field work, or for the costs of equipment, supplies, and analyses required to complete the research. Recipients can apply for grants on subsequent years. Application forms and appraisals (6 copies) must be postmarked by August 1 and sent to the Society Office.

J. B. Dixon

1990 Ballot Addendum

(continued from page 1)

The Clay Minerals Society

Ballot Addendum 1990-1991

OFFICERS

For three-year term 1990-1993

(Circle yes or no)

For Secretary Nominee:

Don Scafe YES NO

For Treasurer Nominee:

Kenneth M. Towe YES NO

Please make your selections, cut out or xerox this ballot, and return to
The Clay Minerals Society
P. O. Box 880
Evergreen, Colorado 80439
before August 1, 1990.

Biographical Data on Nominees for CMS Secretary and Treasurer

Don Scafe, Nominee for Secretary

Education: Ph.D. Texas A&M University (Geological Oceanography) 1968; M.S. Univ. of Kansas (Geology) 1963; Hon. B.Sc. Univ. of Western Ontario (Geology) 1960.

Experience: Research Officer, Mineral Resources Section, Alberta Geological Survey 1967-present.

Research & Publications: Primarily interested in the use of clays as industrial minerals. Research has been oriented to bentonite, kaolinite, and the clays and shales of Alberta as ceramic raw materials. Current research is on the sand and gravel resources of the province plus the availability of low alkali clays for cement production.

Professional Memberships: Alberta Professional Engineers, Geologists and Geophysicists Association (APEGGA), Secretary of The Clay Minerals Society, Sigma Xi.

Kenneth M. Towe, Nominee for Treasurer

Education: Ph.D. University of Illinois at Urbana (geology) 1961; M.S. Brown University (Geology) 1958; A.B. Duke University (Geology) 1956

Experience: Research Geologist, National Museum of Natural History Smithsonian Institution 1964-present; Post-doctoral Fellow (Geology), California Institute of Technology 1962-1964; Research Associate (Chemistry), Electron Microscope Laboratory, University of Illinois 1960-1962.

Research & Publications: Research and publications on electron microscopy/diffraction of clay minerals and colloidal iron oxides; clay mineral diagenesis; biomineralization. Current research interests in the fields of Precambrian paleobiology, atmospheres and iron-formations.

Professional Memberships: CMS activities: Charter member; Council and Executive Committee; Policy & Administration Committee; Publications Committee; Membership Committee; Finance & Budget Committee; Research Grants Committee, Treasurer 1982-present. Fellow: AAAS, GSA, MSA.

Ask the Clay Doctor

(Not a real doctor)

Dear Clay Doctor: What are future directions for research in clay mineral crystallography?
Refined Structure, Madison

Dear Refined Structure: In the future, clay crystallographers will not use noxious radiations, such as X-rays, to study clay. Clays have been ultraviolated long enough! Tomorrow's crystallographers will grow giant clay crystals. Then the structure of montmorillonite, for example, will be determined directly, as it should be, by walking through the crystal with a protractor and a meter stick. Wait! Did you remember to neutralize your static charge before coming in here? Look out! Here comes an interlayer cation!

Dear Clay Doctor: One of my colleagues maintains that only large crystals (the larger the better) have healing and psychic powers. On the other hand, I believe that microscopic crystals, especially clays, can have very powerful healing and soothing effects. Who is right?
New Age, Mendocino

P.S. Why does your byline carry the disclaimer "not a real doctor"?

Dear New Age: From a completely impartial viewpoint, I will have to side with clay. Clay frequently is used in medicines, not only because it is soothing, but also because it is the cleanest substance. By definition, clay is the finest matter; therefore, nothing finer can cling to it. In other words, clay can never get dirty because it already is dirt. Another reason for its use is that it is, quite literally, dirt cheap.

There is a large literature devoted to the miraculous properties of clay. For example, a monochromatic X-ray beam shined on clay will be reflected, but only at certain angles. Some clays emit bursts of light when dried and can be fired to produce the finest porcelain. Other clays store and provide essential nutrients for growing plants. Magical stuff!

However, there is one strange incident to report. Late one evening, when X-raying a CMS Source Clay, the plotter pen, instead of tracing the 7 Å peak for kaolinite, wrote in large, scrawly letters, "This is Satan. You are my slave, human scum. Stick your head in the X-ray beam." I called the Siemens repairman. He sprinkled holy water on the X-ray tube, and it sizzled. I haven't had any trouble since, except that, every now and then, the plotter pen runs out of ink.

P.S. I am not a real doctor because I do not have a doctorate in reality.

Graham Cairns-Smith, co-author with Hyman Hartman of Clay Minerals and the Origin of Life, *cited in the last two columns, punches out the Clay Doctor during a recent visit to the Society Office.*

Dear Clay Doctor: Why are large kaolinite deposits not found in early Paleozoic rocks?
Mud Dauber, Columbia

Dear Mud Dauber: This question is beyond my ken; therefore I must refer you to the Society's kaolinite expert, Prof. Walter Keller at the University of Missouri. He should know what happened to early Paleozoic clays, because he was there. However, I disagree with Dr. Keller's assessment, stated in the last newsletter, that kaolinites are finicky vegetarians. I have never known a kaolinite deposit to refuse a good stake.

Dear Clay Doctor: My colleagues and I were sitting around the lab when the conversation (as it usually does this time of year) turned to baseball and clay. There was some talk of Don Mattingly and the New York Yankees, but I was more interested in Bo Jackson and the Kansas City Royals. Tell me, what clay would Bo Jackson study if he were a clay mineralogist?
Baseball Clayer, East Lansing

Dear Ball Clayer: Bo Jackson would study palygorskite-definitely. Don Mattingly would not study clay. He would join an oil company and go into administration.

Dear Clay Doctor: Nothing personal, Sir, but I think that your column is a bit flaky, if you know what I mean.
Humorless Sandstone Petrologist, Cambridge

Dear Sandstone: I *do* know what you mean. Thank you, Sir. I appreciate it. There is no higher compliment to one who studies clay than to be called a flake.

The Clay Doctor is available for consultation. Please send contributions to CMS News.

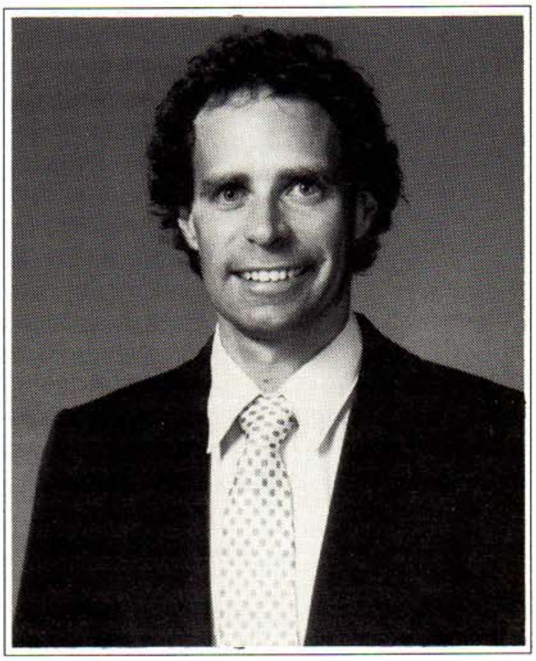
Commentary

Opportunities in Clay Science: Lunar and Mars Exploration Initiative

On the twentieth anniversary of the United States' first manned lunar landing, President Bush charted a new course for the human exploration of space: "... a long-range continuing commitment. First, for the coming decade, for the 1990's, Space Station Freedom, our critical next step in all our space endeavors. And next, for the next century, back to the Moon, back to the future, and this time, back to stay. And then a journey into tomorrow, a journey to another planet, a planned mission to Mars. Each mission should and will lay the groundwork for the next."

Throughout time, humans have pondered visiting and living on the Moon, Mars, and other planetary bodies. We are now entering an era where such dreams can become reality. The nation, through the National Aeronautics and Space Administration (NASA), is considering several options to attain the goals set forth by President Bush. The strategy for implementing the Lunar and Mars Exploration Initiative begins with robotic missions to characterize the lunar and martian environments prior to human exploration. The next step will be the establishment of a lunar outpost that will support science and lead to a self-sufficient human colony. The lunar outpost will provide the ideal location to develop the systems and experience to prepare for the next step of the Lunar and Mars Exploration Initiative—the establishment of an outpost on Mars.

These missions will likely not take place until the first two decades of the 21st century; however, the planning of these missions has to start now if they are to be conducted in a timely manner. Research and technology development is necessary to insure the success of these missions, and clay science will no doubt play an important role. Several research and technology areas will require the expertise of clay scientists, including (1) characterization of clay minerals and materials from planetary surfaces where weathering has taken place (e.g., Mars), and (2) development of methods for on-site resource utilization (e.g., development of agricultural "soils," life support materials) to reduce resupply from Earth and help achieve the strategic goal of self-sufficiency.



Douglas W. Ming *Photo by NASA*

Robotic Missions

Several rover and sample-return missions for Mars are being proposed as part of the Lunar and Mars Exploration Initiative. These robotic missions will characterize the martian environment prior to the establishment of human-tended outposts. Rovers must have on-board instrumentation which collectively allows sample characterization, selection for Earth return, and documentation as well as measurement of sample properties that are unlikely to survive the return trip to Earth.

In contrast with the Moon, the evolution of Mars has included chemical weathering and, undoubtedly, formation of hydrous, authigenic minerals at low temperatures. Hydrous, authigenic minerals (possibly phyllosilicates and zeolites) will (1) serve as indicators of ancient weathering environments and provide the best direct test of hypotheses for climate change on Mars, and (2) provide major regolith sinks for martian atmospheric gases, water, and organic compounds. The successful characterization of the martian environment will depend on proper sampling and analysis of martian clay minerals or their equivalents. Advice from clay scientists is needed to insure that mission designs, science instrumentation, and sample-collection methods correctly address the clay-mineral problem. It will also be necessary to have the advice of scientists in real time with the mission to make decisions about the characterization and collection of samples. Research necessary to fill the technology needs of the mission will have to begin immediately if the time schedule for the first Mars sample return mission is to be met.

Characterization of Martian Samples

Returned samples from Mars will probably be characterized by scien-

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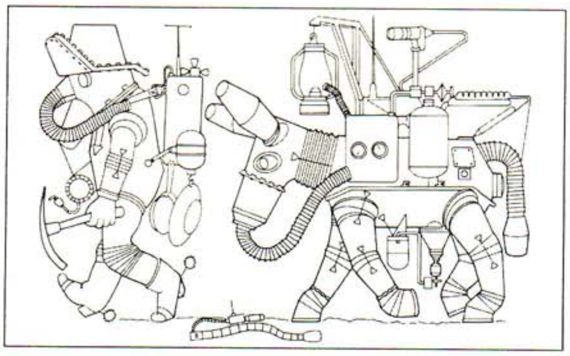

Exploring other planetary surfaces will be exciting and challenging for clay scientists in the first two decades of the 21st century.

tists who have been actively involved in Mars surface analog studies and mission planning. Researchers will be required to fully verify their experimental procedures with substitute material before using actual martian material. Typical allocations of martian sample will probably be in milligram quantities; therefore, it will be extremely important to design experiments or methods of examination for such small sample sizes.

To date, extraterrestrial samples have been brought back from the Moon and a number of extraterrestrial samples have been found on Earth and in the Earth's atmosphere as meteorites and interplanetary dust particles. No direct mineralogy measurements have been preformed on martian surface materials. It seems logical that clay scientists should be involved in the analysis of returned martian surface materials that have been exposed to aqueous weathering conditions.

On-Site Resource Utilization

The use of lunar and martian on-site resources has the potential to benefit the establishment of outposts on the Moon and Mars. It might be possible to use lunar and martian resources to produce rocket propellents such as oxygen and hydrogen, construction materials (e.g., ceramics), life support materials (e.g., agricultural "soil," materials used in water, air, and waste regeneration), and other materials too numerous to mention here. One of the major benefits from on-site resource utilization is the establishment of self-sufficient lunar and martian outposts. Trade studies have also shown that the use of lunar and martian resources will significantly decrease the required launch mass from Earth to support these missions. The decrease in launch mass can translate into billions of dollars saved throughout the Lunar and Mars Exploration Program.

Hydrous minerals have not been found on the Moon, and it is thought to be completely void of water. It may be possible to alter lunar materials to produce minerals or other materials that can be used for various applications at a lunar outpost. For example, mild hydrothermal alteration of lunar basaltic glasses may produce hydrous minerals, such as zeolites, phyllosilicates, and tobermorites, which in return may be used in life support, construction, and chemical processes.

Unlike the Moon, Mars might have water tied up in the regolith in the form of hydrous minerals. These minerals may be a source of water for a Mars outpost, and methods will have to be designed to extract water from the regolith. If minerals that exhibit ion-exchange, adsorption/desorption, and other unique properties do not exist on Mars, it may be possible to synthesize these materials from the martian regolith in much the same manner as described earlier for the Moon. Because a wealth of experience in hydrous mineral formation lies with the clay science community, it again seems logical that clay scientists should be involved in basic research and technology development for the utilization of lunar and martian resources.

Challenges and Benefits to Society

The Lunar and Mars Exploration Initiative presents the science community with exhilarating challenges and significant opportunites into the first part of the next century. The Initiative will enhance a scientific foundation of information about the geology, geochemistry, atmospheres, and surface characteristics of the planetary bodies of our solar system, thereby significantly enhancing our understanding of our own planet as a system. It will allow humans to break the bond to Earth and set forth on a journey into space.

The success of the Exploration Initiative will rely on cooperation and teamwork from all the disciplines of the scientific and engineering communities, and clay scientists should play an integral part. The Lunar and Mars Exploration Initiative will be a giant step in striving for the vision of our nation's space program: "humanity expanding its presence and activity beyond Earth orbit and into the solar system, fulfilling mankind's aspirations to explore, to discover, to understand, and to apply what we have learned for the betterment of life on Earth and in space." And who knows what the future holds; a clay mineralogist may be one of the first humans to set foot on another planet.

Douglas W. Ming
Houston, Texas

***Proceedings of the 15th Conference on Silicate Science and Silicate Industry*, held in Budapest, Hungary, June 1989.** Price is US $54 plus postage ($6 surface or $9 airmail). Order from Omikk-Technoinform, 1428 Budapest, P. O. B. 12, Hungary.

Directory Correction

The telephone number for Allen Press on the back of the new CMS Membership Directory should read 1-800-627-0629.

Commentary

Some Thoughts about Clay-Organic Complexes and Their Application to Environmental Problems

The application of clay-organic complexes to environmental improvement (i. e. clean-up of oil spills) seems to have been initiated by the work of Spike Jordan (Baroid) in the 1940's. His work was based on the pioneering research of C. R. Smith, J. E. Gieseking, and S. B. Hendricks on organic cation exchange on clay minerals. They demonstrated the great change in clay surface properties when organic cations were placed on the cation exchange sites of the mineral. Since that time, application of clay-organic complexes to a wide variety of commercial enterprises has occurred. These complexes have been used in such widely disparate products as cosmetics and lubricants. Over the years, the subject of organic-clay systems has attracted many scientists who have investigated the nature of interaction between different kinds of organic molecules and mineral surfaces, as well as the effect of organic adsorption on clay mineral properties.

When long-chain alkylammonium cations are placed on the exchange sites of clay minerals, the properties of the surface are changed from a hydophilic nature (due to hydrated exchangeable metal cations) to one of extreme hydrophobicity. This property makes them attractive to molecules which are poorly water soluble, but in turn highly soluble in organic solvents. Thus, this kind of clay-organic surface can be pictured as an immobilized organic solvent into which organic molecules will partition from water, the degree depending upon their relative attraction for water vis-a-vis the organic clay surface. This principle has been applied to research on the removal of a wide variety of organic molecules from water, many of which are considered to be environmentally unsafe. The efficiency of some clay-organics approaches that of carbon, one of the most widely used adsorbents.

Max M. Mortland *High Iron Photos*

The kind of clay mineral is an important factor in preparing clay-organic complexes which have a maximum adsorption capability. Clay minerals which have only external surfaces (illites, chlorites, kaolinite, etc.) will have limited surfaces available, while swelling clays (smectites, and in some instances, vermiculites), which have both external and internal surfaces, often provide large capacities for adsorption of hydrophobic molecules out of water.

Another variable important in preparing clay-organic complexes for these purposes is the nature of the organic cation placed on the mineral surface. The most hydrophobic (and in turn organophilic) complexes are prepared with quarternary ammonium cations with long alkyl groups on them, like hexadecyltrimethyl ammonium (HDTMA) or the even more hydrophobic dioctadecyldimethylammonium (DODMA). Placing the latter cation on the exchange complex of smectite requires special preparation since it is only slightly soluble in water. The relatively small tetramethyl ammonium (TMA) cation, when on the exchange complex of smectite, has some properties more like metal cations in that it does have a finite solvation energy (32K calories/mole) for water and does not cover all of the mineral surface. Surface area measurements (nitrogen) of TMA-smectite give values near 200 M^2/g, which means large areas of surface oxygens belonging to silica tetrahedra are exposed and provide an adsorption medium quite different from that where long chain alkyl groups cover the surface. For example, it has been shown that TMA-smectite prepared from Wyoming bentonite (C.E.C. = 90 meq/100g) is a very strong selective adsorbent for benzene *from water*, the amount being about two-thirds of the amount adsorbed in a vapor system in the absence of water. While some water is in the interlamellar space hydrating the TMA ions, the silicate surface itself still prefers the benzene to water in a water system. This is instructive because it tells us something about the fairly hydrophobic nature of the silicate surface in the *absence of hydratable metal exchange cations* which are chiefly responsible for the hydrophilic nature of clay mineral surfaces. The fact that the minerals talc and pyrophyllite, which have no hydratable exchangeable metal cations, are difficult to wet with water is in support of this conclusion. When TMA-saturated Arizona smectite (C.E.C. = 120 me/100g) is used as an adsorbent for benzene from water, much less benzene is adsorbed because of the higher charge density and thus the closer packing of TMA ions. This excludes much benzene from the internal surfaces merely on the basis of molecular/pore size considerations.

The above discussion illustrates the different kinds of surfaces obtained with different organic cations on the clay surface, which is translated into different adsorption processes for slightly soluble organic molecules out of water. In the first case, it is similar to a partitioning phenomenon from water into an immobilized organic solvent (i. e., HDTMA- or DODMA-smectite). In the second case (i. e., benzene into TMA-smectite), the silicate surface itself is involved. It is obvious that one can create a variety of clay-organic surfaces depending upon the nature of the cations. For example, if an aromatic surface is desired, one can make it by placing tris bipyridyl or orthophenanthroline complexes of metal cations on the exchange sites. With such a variety of clay-organic complexes possessing different adsorption properties, it is possible to tailor complexes to accomplish specific adsorption tasks (i. e., the removal of specific organic toxicants from water).

Another interesting capability of some clay-organics (i.e. HDTMA-smectite) is their very strong adsorption of enzymes (proteins in general). In some cases, the enzyme is very active in the adsorbed state, in some cases equalling that of the enzyme in homogeneous solution. In other cases, the enzyme, though adsorbed, may have no activity at all depending upon the kind of organic on the clay and the enzyme. It is thought that the adsorption process involves hydrophobic bonding between hydrophobic portions of the enzyme and the hydrophobic alkyl group of the quarternary ammonium ion. Enzymes which are active in the adsorbed state may have their active sites far removed from the adsorption site so they may function freely, while inactive enzymes may have their active sites close to the adsorption sites which interfere with their function. Clay organics with immobilized active enzymes may have a future place as bio-catalysts for environmental and industrial uses.

Some thought has been given to regeneration of clay-organics which have been used as adsorbents in improving water quality, for reuse. One solution is to extract the clay-organic complex with its adsorbed contaminant in a Soxhlet type arrangement using a solvent into which the adsorbed species will readily partition from the clay-organic. For example, it was possible for us to remove 100 percent of trichlorophenol adsorbed on HDTMA- and DODMA-smectites using methylene chloride as a solvent. However, only 71 and 60 percent of adsorbed pentachlorophenol was removed from these same clay-organics in the same extraction period. Presumably these extracted clay-organics could be reused over and over again, thus contributing to the economics of their use, although little research seems to have been done in this area.

The possible use of appropriate clay-organics in the construction of land-fill or organic contaminant sites seems obvious. Their function would, of course, be to adsorb and thus retard the movement of potentially damaging organics. They would probably be either incorporated in dispersed clay barriers or as separate clay membranes.

The future would seem to hold many possibilities for the use of clay-organics in the solution of environmental problems. An ultimate goal for the use of clay-organics in the improvement of water quality might be to combine the adsorption function and a catalytic function. The result would be a system which takes environmentally damaging molecules out of water and then degrades or alters them to more benign species. The catalytic function might be provided by an appropriate enzyme or metal-based catalyst. The wide variety of clay-organic complexes of different properties that are possible would suggest them to be a fruitful field for future research and application.

Max M. Mortland
East Lansing, Michigan

The Clay Minerals Society
27th Annual Meeting

will be held October 6-11, 1990

It will be sponsored by:
University of Missouri-Columbia
Department of Geology
Department of Agronomy
UMC Research Reactor

The meeting will be preceded on Saturday, October 6, by a workshop on "Neutron Scattering and Diffraction."

Three scientific sessions are planned:
General Session
Clays in Sandstones Symposium
Keller 90-Kaolin Symposium,
the latter to honor Prof. Emeritus W. D. Keller in his 90th year.

On Wednesday, October 10, an all-day field trip is planned to visit deposits of central Missouri refractory clays and related soils.

Inquiries can be made to:
Prof. W. D. Johns
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