FRIENDS OF MINERALOGY
Pennsylvania Chapter

NEWSLETTER

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CHAPTER BUSINESS

President's Message

As another summer starts, all F.M., Pa. Chapter, members should have by now paid their dues for the year 2000. We also should all be thinking about how to add to the Fall Symposium, and not just how we can be entertained by those who happen to be in charge of it.

To make this organization work, it needs the contribution of time, effort, and ideas, by everyone, and not just the officers. Please, if you have a reasonable idea that is operational from a logistical standpoint, get in touch with me, and go ahead and set it up. We are all short of time and energy, and contacts seem to be drying up overnight, as many of the older quarry companies seem to be getting gobbled up by newer and larger conglomerates If you have an "in" anywhere, see what you can set up for us.

Roland Bounds, President

Officers and Chairmen of the Chapter

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F.M., Pa. Chapter, Treasurer's Report

Arnold Mogel, Treasurer, reports that the Chapter's funds, as of Dec. 31, 1999, are as follows:

Checking Account	$ 2467.34
Savings Account (Savings)	264.33
Savings Account (Grant Fund)	1937.00
Total	$ 4668.67

Dues

Thanks to all who have sent in their 2000 dues, which are now $15.00 ($10.00 for seniors and students). Send dues for 2000, and back dues, to Marge Matula (address above).

Web Site: News Flash

David Saja (geo@yahoo.com) organized a Web site last winter for the Pa. Chapter, Information on the Chapter activities, such as the Symposium and publications, were to be found there, and students applying for the Grant Fund award could download an application. Then the web server, having decided that the non-profit e-mail site belonged to a child, deleted both the e-mail and web site. The server is not cooperative, so David may have to start all over.

The Pennsylvania Chapter Memorial Fund: Student Research Grant Program Modernized

This year, David Saja, chairman of the the Pennsylvania Chapter's Memorial Fund Student Research program, took advantage of the computer Internet and the new Chapter Web site, which he had set up.

In mid-February, a letter of introduction and enclosed flier were mailed to the chairpersons of 77 geoscience departments in Pennsylvania and four surrounding states, New York, New Jersey, Maryland, and Delaware. This continues the policy of the Board of Directors that, due to the number of members of the Chapter in adjoining states, research in mineralogy of those states will be accepted in grant applications.

During the first week according to David, there was some interest (43 hits, or Web site call-ups), but by the time of the application deadline, there was a total of only 49 hits on the Web site, and only one student had applied. Richard J. Orner, of Kutztown State College was considered to be very well qualified, and has been awarded the grant.

David considers that, ok, it is only a $500 grant; this is the first year applications have been available on the Internet, rather than by mail; and we'll just have to wait for next year to see if there really are any students out there doing basic mineralogical research! Members of the Chapter can help by personally contacting professors and geology clubs.

By next winter, the application forms and detailed information about the grant program will be posted at the new web site, for the convenience of applicants.

Coming Events

July 15: "Broken Back Minerals" Open House; 10 a.m. to 3 p.m. at Roland Bounds' home, 315 Stamford Drive, Newark, Del., off Rt. 896; call 302-731-8407.

Aug. 18-20: Gem and Miners Jubilee: Lebanon Expo Center, Rt 72 and Rocherty Road.

Sept. 16 and 17, 35th Annual Show of the Central Pennsylvania Rock and Mineral Club; Zembo Shrine, Harrisburg, Pa.; Sat., 10 a.m.-6 p.m., Sunday, 10 a.m. to 5 p.m.

Sept. 16-17, Winfield and Meckley Quarries, Annual Open House.

Oct. 7, Autumn Mineralfest, sponsored by the Pennsylvania Earth Sciences Association; Macungie Memorial Park Building, Macungie, Pa., from 9 a.m. to 3 p.m.

Oct. 28, 11th Annual Fluorescent Mineral Show of the Rock and Mineral Club of Lower Bucks County, Pa.; 9 a.m. to 5 p.m., Fairless Hills, Pa., (Larry Kennedy, 609-882-6819).

Nov. 3, 4, and 5, Symposium in Remembrance of Dr. Arthur Montgomery; Claymont, Del.; Friends of Mineralogy, Pa. Chapter, c/o George Rambo, Claymont, Del. (302-798-4163).

FURTHER INFORMATION ON THE FRONDEL-MONTGOMERY EXPEDITION TO MADAGASCAR, 1963

The Winter, 1999, issue of the *F.M., Pa. Chapter, Newsletter* included an article by Arthur Montgomery (written in 1965, but first published here) about an expedition to Madagascar in 1963, in the company of mineralogist Clifford Frondel, a professor at Harvard, and his wife, Judith Weiss, also a geologist. The article led up to their arrival at a pegmatite locality well known for rhodizite, but did not go on to describe what minerals were found there, although Montgomery did refer to the French literature.

In answer to a query from the editor, Carl A. Francis, curator of the Harvard University mineral collections, wrote (p.c., March 2000) that he had turned to the Mineral Museum mineral database and found eight catalog numbers for pegmatite minerals from Manjaka, collected by Clifford Frondel. The species include rhodizite (the object of the effort, as Carl observed), beryl, elbaite, manganapatite, and spodumene. In addition, there are another eight or so mineral specimens from a variety of occurrences that Cliff purchased in Madagascar. There is no record in the Harvard database, according to Carl, that Arthur Montgomery donated any of his expedition specimens to University.

Included with Carl's letter was a copy of an article by Frondel and Jun Ito (1965), which the editor had not been able to locate, probably because "Composition of Rhodizite" appeared, in English, in a German periodical, *Tschermaks Mineralogische und Petrographische Mitteilungen* (Band 10, Hef 1-4, pages 409-41). Carl noted that the article doesn't say much about the trip, but verifies the date as 1963.

Frondel wrote ....."Numerous well-crystallized specimens of rhodizite were obtained in 1963 at Manjaka, Madagascar., At this locality, as already briefly noted by the French author, Lacroix, in 1912, the rhodizite is associated with rubellite, pink spodumene, albite, microcline, and quartz as the chief minerals, and with pink beryl, manganapatite, behierite, and lithia mica as accessory minerals. At all other localities, the rhodizite also is associated with rubellite in lithia-pegmatite."

Thanks to Carl Francis for this information. According to Carl, the lack of a reply from the Frondels themselves is unfortunately due to their poor health.

Is there anyone who knows what became of Arthur Montgomery's specimens from this expedition? Each one would be evidence of his delight and interest in this expedition to a far-off, exotic land.

LETTER TO THE EDITOR

The editor received (March, 2000) a letter from Cecil Caldwell, Ambler, Pa., concerning the area of the old lead-zinc mines, now covered by a reservoir, at Peace Valley Park, New Galena, Pa. He writes (tongue-in-cheek):

....."I've been there many times, usually to fish, but on one occasion when the water was low, in the fall, I invited John Kadlecik and Max Tietjens to go with me. They would look for minerals and I would fish. None of us had any luck.

"Later, on a cold winter day, my bride and I were walking along the shore after the lake had been lowered for seasonal repairs of docks. Several rocks recently freed from their watery grave were now in full view. One was heavy. It was galena. Would you call that a floater?"

Editor's Comment: "Does anyone else have a good mineralogical fish story?"

THE GREAT ZEOLITE HUNT:

A Footnote to the Friends of Mineralogy, Pa. Chapter, Symposium Topic, 1999

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In 1948, a researcher at Union Carbide's Linde Company division at Tonawanda, New York (a suburb of Buffalo), aware of the industrial possibilities of zeolite minerals functioning as molecular sieves, conceived the notion of synthesizing these minerals. The Linde Company, by the way, is perhaps best known to the public for its green oxygen bottles and its "Linde Stars," synthetic blue star sapphire gemstones.

Experiments to produce zeolite molecular sieves in the laboratory were successful, and by the mid-1950's had found an important and lucrative market in the oil industry. These were based on the zeolites' special ion exchange properties and reversible adsorption of water molecules in the zeolite structure. The new zeolites were used in gas separations, in removing moisture, CO_2, and H_2S from natural gas streams, and in catalytic cracking at oil refineries, resulting in markedly improved gasoline recoveries from crude oil. Before long, almost all U.S. refineries were using molecular sieve units. The Linde Company received a special achievement award in 1961 for its development of molecular sieves from *Chemical Engineering* magazine, among others.

Dr. Donald Breck, one of Linde's pioneer researchers, made the following introductory statement to his lengthy treatise, published in 1974: "Rarely in our technological society does the discovery of a new class of inorganic materials result in such a wide scientific interest and kaleidoscopic development of applications as has happened with the zeolite molecular sieves."

By 1957, Union Carbide became concerned that naturally occurring zeolite deposits might make inroads into their large investment in synthetic zeolites and expansion of market. At that time, they were selling for around $2.00 a pound. A field geologist, Richard H. Olson, was assigned to make an investigation. He started by visiting the classic collecting localities at Paterson, New Jersey, and Nova Scotia. These localities were promptly rejected as impractical sources for the required tonnages. However, in the literature research for zeolites, an article in the *American Mineralogist* by Bramlette and Posnjak (1933) titled "Zeolite Alteration of Pyroclastics," opened up a new and promising horizon. During the summer of 1958, Union Carbide geologists, directed by Richard Olson, began examining some of the very extensive Tertiary volcanic ash beds in the West, which were reported to contain zeolites. Vitric ash beds, made up of tiny glass shards blown out of volcanoes, are quite common in the valleys and dry lake beds in the Basin and Range Province. Sequences of these Tertiary volcanics, containing lava flows, as well as ash and tuff beds, are not only widespread in the Province, but are very thick.

The zeolite minerals in these sedimentary tuff and ash deposits of volcanic origin are microscopic in size, and, unlike their basaltic rock counterparts, are of little interest to mineral collectors. Zeolite mineral identifications and grade estimates depend entirely on X-ray diffraction analysis. The zeolite ash or tuff beds are usually light-colored, white-to-yellow or tan in color, and, as they are light- weight and compressible ("punky" is the field term), these rocks can be easily cut or sawed into blocks. In some areas, there were small quarries in these beds, and nearby ranch buildings were constructed of this material by the early settlers.

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The writer was an exploration geologist at Union Carbide's Grand Junction, Colorado, office in 1958 and 1959. My involvement in the zeolite project began with a three-day visit to the Linde Company offices in Tonawanda, N.Y., in early April, 1959. By that time, the Linde Company knew of several erionite, clinoptilolite, and phillipsite deposits, mostly in altered volcanic ash beds in Nevada, and a few in Oregon and California. There were also a few known occurrences of chabazite, analcime, and mordenite in Arizona and Nevada. Chabazite and erionite have properties closest to Linde's commercial synthetic zeolites, so they were considered the most promising as possible substitutes. There were talks with Dr. Donald Breck, Linde's zeolite program director, and with Dr. Fred Mumpton, a recent Penn State geochemist graduate, who were soon to become prolific authors, tracing developments of both the synthetic and natural zeolites.

The writer was assigned full-time to zeolite explorations after the Linde visit in April, and began working with geologists at the Union Carbide, Reno, Nevada, exploration office, mapping, sampling, and staking claims on some of the most promising erionite and chabazite deposits in Nevada. At the end of 1959, it was decided to expedite the search for zeolite deposits by dividing the favorable region into three parts. The northern sector was assigned to a geologist in Reno. I moved to Las Vegas, Nevada, to take care of the central sector, and Ted Eyde out of Tucson, Arizona,was assigned to the southern sector.

The stepped-up search for zeolite deposits was highly successful, and we made a surprising number of new discoveries during this seven-month final phase of the project. Over one hundred zeolite prospects were found in the central sector (southern Nevada, southeastern California, and northwestern Arizona), but most were composed of clinoptilolite or mordenite in the tuff beds. Only one chabazite and two erionite prospects were discovered, which was disappointing, but only about a third of the sector had been adequately checked. The zeolite exploration was terminated at the end of August, 1960, and Ted Eyde in Tucson prepared the summary report. We surmised at the time that Linde Company officials were reasonably well assured that natural zeolites were not a serious threat to their synthetic zeolite markets. Nonetheless, this activity ushered in an important, new industrial mineral category, and Ted Eyde was to become "Mr. Zeolite" due to his many talks and published articles promoting the uses of the natural zeolites.

The story of the discovery and exploitation of the important chabazite deposits north of Bowie, Arizona, was recounted by Eyde (1978). The thin, zeolitized volcanic ash beds north of Bowie, Arizona, form ledges in a series of ancient lake bed sediments. The ledges crop out on both sides of the San Simon Wash for a distance of about six miles. The outcrops were first described in 1875 in one of the U.S. Government's early Territorial surveys, but attracted little attention. Three men from Bowie noticed the outcrops, and thought they might be useful for light-weight ornamental stone, so some claims were staked. Another Bowie resident, Frank Clark, was attracted to some of the ledges mottled and banded by iron oxides, and he, also, staked some claims. He fashioned the zeolitic material into bookends, paper weights, and pencil holders, selling them at souvenir stores along the main highways. A sample from one of the claims was submitted to the Linde company in 1958, and found to be high-grade chabazite, but its exact location was not known. However, it was tracked down in 1959 through Frank Clark, when one of his novelty items was recognized as probably containing zeolites. Ted Eyde then sampled some of the deposits, confirming the chabazite content, and followed up by

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staking claims for Union Carbide. The word soon got around, and three other companies acquired adjoining claims and leases: W.R. Grace & Co., the Norton Company; and Letcher and Associates. It was quite a trick mining a six-inch bed of the chabazite ore and shipping a high-grade product. Once uncovered, the surface of the zeolite bed had to be carefully cleaned , and the ore hand-mined into blocks, using chisel-like hammers.

Ted Eyde arranged for the first shipments of chabazite ore for Union Carbide in 1962, amounting to 165 tons. He left the company at the end of 1963, but returned to the Union Carbide Bowie property in 1977 as a consultant, after he had set up his GSA Resources, Inc., consulting firm. In 1968, Eyde was able to purchase the W.R. Grace properties, so his GSA Resources became one of the four mine operators. By 1977, the four operators at Bowie shipped about 2000 tons a year of product, most of it for use for natural gas purification and dehydration. A more recent account of the company's chabazite mining operation at Bowie appeared in a short article in *Pay Dirt* magazine in May, 1997. According to an Eyde report in 1998, GSA Resources had become the largest producer at Bowie.

The 3rd edition (1960) of the SME-AIME series, *Industrial Minerals and Rocks,* has not a word about zeolites, not even in the index, according to R.H. Olson (1983). Then a chapter on zeolites unexpectedly appeared in the 4th edition (1975), and in the 5th edition (1983), there is a comprehensive chapter, with an introduction by Olson. It includes three summary articles, the first by Dr. Donald Breck, telling about the Linde Company's synthetic zeolites, their properties, and applications. The second article, by Dr. Richard A. Sheppard, describes the zeolites found in sedimentary rocks. His zeolite location maps and accompanying lists of descriptions are presented by Olson in the introduction. Sheppard remarked that after zeolite exploration peaked in the early 1960's, it resumed again after 1970 in the search for zeolite deposits suitable for pollution-control processes. The third article, by Dr. Fred Mumpton, formerly with the Linde Company, comments on the commercial utilization of natural zeolites, and includes several excellent photographs. A few years earlier, Dr. Mumpton had organized "Zeolite '76, an International Conference on the Occurrence, and Utilization of Natural Zeolites," in Tucson, Arizona. It was sponsored by (his) State University College, Brockport, New York, and the University of Arizona, in Tucson.

In his abstract, published in connection with the 1976 Conference, Mumpton wrote..... "In less than 20 years' time, the status of the zeolite group of minerals changed from that of a museum curiosity to one of a full-fledged industrial mineral commodity. This remarkable transformation is due in large part to the belated recognition in the late 1950's of the widespread occurrence of zeolite minerals as major constituents of Cenozoic sedimentary rocks of volcanic origin, and to research efforts of several industrial organizations during this period on the development of commercial applications for synthetic molecular sieves. The realization that such materials (natural zeolites) were also capable of being utilized in numerous areas of industrial and agricultural technology provided the impetus for the exploration and development programs that have taken place on natural zeolites since that time in dozens of countries of the world."

In Mumpton's article in *Industrial Minerals and Rocks* (1983), he lists and describes the following recognized uses of natural zeolites under these headings: dimension stone; pozzolanic (from a porous variety of volcanic tuff) cements and concrete; lightweight aggregate; filler in paper; ion-exchange processses; air separation; animal nutrition; agricultural products;

and gas adsorption and catalyst. A U.S. Bureau of Mines report by Robert A. Clifton (1987) gives a very thorough and technical review of the properties and uses of both natural and synthetic zeolites.

In addition to the *Industrial Minerals and Rocks* volumes, the annual review issue of the SME-AIME *Mining Engineering* monthly magazine now routinely includes a section on zeolites, usually prepared by Ted Eyde. In his review for calendar year 1999, in the June, 2000, issue of *Mining Engineering*, he reported that worldwide production of natural zeolites was about 3.5 million short tons, of which more than 3.3 million short tons were consumed in low-value-added agricultural applications. He points out that this large figure masks the importance of the industrial market sector that is growing as a result of the development of new applications, and further reports that companies in the United States and Canada mined and sold about 60,000 short tons of natural zeolites in 1999.

At one time, according to Eyde, most of the chabazite produced by his GSA Resources Company was used to remove radioactive isotopes from low-level reactor effluents and process streams, much of it sold to the Oak Ridge National Laboratories in Tennessee. Clinoptilolite is now generally used for soil conditioners, amendments, and turf builders.

A list of the major natural zeolite producers of 60,000 short tons in the U.S,. and Canada during 1999 is included in the June, 2000, article. Canada was represented by two producers of clinoptilite, and the same zeolite species was also produced in Wyoming, Nevada, New Mexico, Oregon, and Texas. Two producers, including Ted Eyde's company, mined chabazite in Bowie, Arizona.

Epilogue

The eight months in 1960 working out of Las Vegas, Nevada was an exciting time. Seven chartered Cessna aircraft flights helped guide my secret ground exploration. I prospected off-road by myself, recorded data and road map locations, and returned to town each night. After an emergency appendix operation in Tonopah, Nevada, at the end of June, I moved back to Reno in early September, That ended the field phase of the zeolite project. I went on to an interesting and satisfying career in economic geology, finally retiring from the Missouri Geological Survey.

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