Ohio Geology Newsletter WINTER 1985

Division of Geological Survey

ADDITIONAL NOTES ON OHIO DIAMONDS

Diamond discoveries in Ohio.

The occurrence of diamonds in the Great Lakes area, including Ohio, was the subject of a previous article in *Ohio Geology* (Fall 1982). In that article, three Ohio diamonds, all found in the last century, were described: a stone found in Cuyahoga County, south of Cleveland, about 1870; an occurrence in Hamilton County about 1880; and a discovery in 1899 in Clermont County. None of these occurrences could be documented as to precise locality and all of the diamonds are now lost. Since that article was written, another Ohio diamond has been discovered and additional stones, described in obscure documents or not previously recorded in the literature, have come to my attention.

NEW OHIO DISCOVERY

In June 1982, Jeni Croft, then a ninth-grade student at Schrop Junior High School near Akron, found a nearly perfect octahedral diamond in a sand and gravel deposit only a few hundred feet south of the school. She found the diamond after only about 15 minutes of searching during a rock-and-mineral-identification exercise in the class of earth-science instructor Nicholas Frankovitz.

Frankovitz recognized the significance of the stone and took it to Vern Friberg, a mineralogy professor in the Department of Geology at the University of Akron, who confirmed the identity of the specimen as a diamond. The stone was less than ⅛ inch in maximum dimension and had a pale bluish-gray color. No carat weight was determined. Other members of the geology faculty at the University of Akron, along with a local jeweler, also examined the stone.

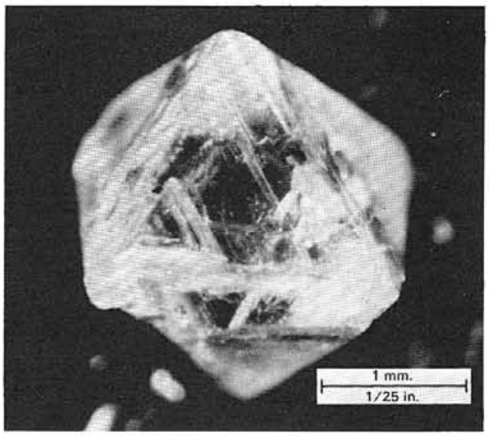
The diamond was returned to its discoverer, Jeni Croft, and it was soon lost, much to her chagrin. Although this turn of events is most unfortunate, there is no doubt that this specimen was a genuine diamond.

The glacial deposit from which the diamond was collected is a Wisconsinan kame, according to the glacial geology map of Summit County by George W. White. Frankovitz reported that the area of kame in which the diamond was found was used as a borrow pit for highway fill. The deposit is dominated by quartz sand. This is the first Ohio diamond for which a precise, documented locality is available.

Although the diamond was found in 1982, it did not come to the attention of the Survey until 1984. At that time the discovery received wide media attention, initiated by an article in the *Akron Beacon Journal*. Wire-service accounts appeared in papers across Ohio and articles were carried in the *New York Times* and *USA Today* in August 1984.

OTHER OHIO DIAMONDS

An additional Ohio diamond, not listed in the primary resource articles of Gunn (1968) cited in the



Small diamond found in 1974 in Wisconsin. Photo courtesy of Wisconsin Geological and Natural History Survey.

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ODNR
OHIO DEPARTMENT OF NATURAL RESOURCES

Richard F. Celeste, Governor • Lt. Gov. Myrl H. Shoemaker, Director

Chief's corner by Horace R. Collins

We have recently seen copies of Synthetic Aperture Radar (SAR) imagery covering the Cleveland and Canton 1:250,000-scale quadrangles (each quadrangle covers about 4,580 square miles). SAR is not a new technology, but it is just now starting to become publicly available through the U.S. Geological Survey's EROS Data Center in Sioux Falls, South Dakota. Most geologists that we have talked with that have seen SAR imagery think it is an exciting and promising geological tool.

One advantage SAR imagery has over other remote-sensing systems is that it is not affected by vegetation, cloud cover, snow, or other conditions which could interfere with the quality of the product. SAR imagery is, in fact, usually acquired at night. Another advantage is that the entire area being scanned is in focus and image resolution remains the same over many miles.

SAR imagery is especially good for identifying what geologists call linears. Linears are straight or gently curved features that commonly are related to fractures in the rocks of the earth's crust. Fractures in turn are very commonly of major significance in the location and production of oil and gas. SAR imagery will undoubtedly be an extremely valuable tool as exploration for oil and gas goes deeper into the earth. Intersecting sets of fractures also are of particular interest to underground miners, as these areas frequently have weak roof conditions which can lead to roof falls. Roof falls in coal mines are the major killer of underground miners. There is an obvious advantage to knowing in advance of mining where potential danger areas may be located. Other applications we envision are in the areas of groundwater hydrology, geological hazards, and base-metal exploration, to name a few. Data obtained from SAR imagery also will be useful to public agencies responsible for the protection of the environment and the wise use of our geologic resources.

We are happy to see that the USGS is making a commitment to place SAR imagery in the public domain through the EROS Data Center. To date only two of 12 quadrangles covering Ohio are available from EROS. We hope to see the rest of the state completed in the not too distant future.

TIMELINE

The Ohio Historical Society recently began publication of a full-color magazine known as *Timeline*. This bimonthly publication features nontechnical articles on Ohio's past that span a broad range of topics from recent history to archeology to geologic history. Subscriptions are $15.00 per year. For more information, contact: *Timeline*, The Ohio Historical Society, 1982 Velma Avenue, Columbus, Ohio 43211 (telephone: 614-466-1500).

OHIO GEOLOGY

A newsletter published quarterly by the Ohio Department of Natural Resources, Division of Geological Survey, Fountain Square, Columbus, Ohio 43224. Telephone (614) 265-6605.

Editor: Michael C. Hansen
Secretary: Donna M. Swartz
Layout and design: Philip J. Celnar
Phototypist: Jean M. Lesher

News items, notices of meetings, etc. should be addressed to the attention of the editor. Change of address and new subscriptions should be addressed to the attention of the secretary.

continued from page 1

previous *Ohio Geology* article on diamonds, was recorded by Wuestner (1938). According to Wuestner, the diamond, of unspecified size, was found about 1908 by Roy McVitee on the Taylor farm on Sugar Camp Run, 2 miles upstream from its junction with the East Fork of the Little Miami River at Perintown, Clermont County. Wuestner saw the diamond in the Duhme Jewelry Store in Cincinnati soon after its discovery and related that the collector sold the stone for $125 and it was then resold for $1,000.

Warren Walker of Columbus informed me that his local inquiries, about 20 years ago, concerning the Perintown diamond indicated that this stone was found on a limestone ledge behind a house on the west side and near the mouth of Wolfpen Run. This stream is in the first valley west of Sugar Camp Run, where Wuestner had indicated the diamond had been found. The discrepancy in locations cannot be presently resolved. This area of Clermont County is underlain by Ordovician bedrock (Kope and Fairview Formations) that is capped by glacial till of Illinoian age.

James L. Murphy of Columbus, formerly of Salem, called my attention to a diamond that had been collected in a gravel pit near Salem, in northeast Ohio, sometime in the early 1950's. James Gurlea of Salem, owner of the gravel pit, provided the following account.

The gravel pit (now inactive) was in a glacial kame near Egypt Road on the Middle Fork of Little Beaver Creek, about 1 mile east of Salem and just east of the Columbiana-Mahoning County line (NW¼, sec. 33, Green Township, Mahoning County). The diamond was found in the gravel pit by a jeweler from the Akron-Canton area, who retained the stone. Gurlea recalled that the diamond was about half the size of a pencil eraser, dull white in color, cloudy, and with crystal faces.

This discovery apparently created much interest in the Salem area, as Gurlea recalled that numerous people visited his gravel pit in order to search for additional diamonds. None were reported to have been found, however. Apparently, newspaper accounts of this diamond discovery were published, but I have not been able to locate them as yet nor has the *Salem News* because of our inability to establish the precise year of discovery of the Salem diamond.

There appears to be little doubt as to the authenticity of this occurrence, although additional confirming evidence of the identification of the stone would be reassuring. The Survey welcomes any additional information, including year of discovery or newspaper accounts, that pertain to the Salem diamond.

According to James L. Murphy, a brief newspaper account on November 4, 1921, indicated that George L. Miller of Circleville (Pickaway County) discovered a diamond in the gizzard of a chicken and sold the stone to a local jeweler for $100. There is no indication if this stone was naturally occurring or if it was a cut diamond that had fallen out of a ring in the barnyard and was later ingested by the chicken. This presumed diamond occurrence must be regarded as somewhat dubious, based on present data.

These diamonds raise the total for Ohio to at least six, and possibly seven, separate occurrences: three in northeastern Ohio, three in southwestern Ohio, and one dubious account in the central part of the state. Although the discovery of six or seven diamonds in an area as large as Ohio during a period of more than a century suggests that these stones are extremely rare items, it must be kept in mind that each discovery was purely fortuitous and relied heavily on the curiosity of the discoverer to retain and make further inquiry about the unusual stone. In addition, all of these diamonds were apparently quite small in size. To my knowledge, no systematic search has ever been conducted in Ohio for diamonds.

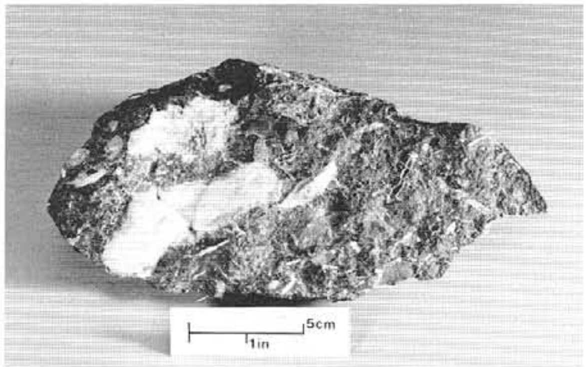
THE SEARCH FOR DIAMONDS

What are the possibilities of success in a search for additional diamonds, and ultimately their source, in Ohio? Certainly, a random search of glacial deposits for additional diamonds would be similar to searching for the proverbial needle in the haystack. However, rapidly increasing knowledge of the origin and geology of diamond-bearing rock and better understanding of the geology of Ohio and adjacent areas give a new perspective to the search for the sources of the Great Lakes diamonds.

The traditional view has been that these diamonds were plucked up by the Pleistocene glaciers from an unknown area in the vastness of the Canadian shield and carried far southward by the ice to their present locations. The wide distribution of these diamonds across several states, and even their wide distribution within Ohio, suggests that they did not come from a single source. It can be argued, perhaps, that the complex movements of at least four major ice sheets and the subsequent and equally complex transport of glacial sediments by meltwater could have dispersed diamonds from a single source over a considerable area. In addition, the complexity of these multiple episodes of transport would serve to mask clues to such an extent that tracing the original distant source would be an impossible task.

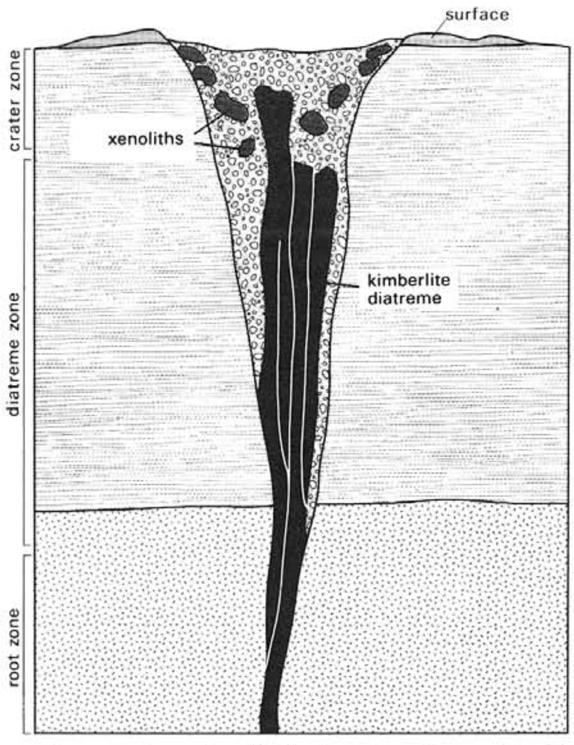
A Canadian-shield origin of the Great Lakes diamonds remains a viable hypothesis; indeed, several intrusions of the rock type that bears diamonds are known from the Canadian shield north of the Great Lakes area in Ontario and Quebec. However, a mitigating factor is that many of the diamonds, including the Akron stone, found in the Great Lakes area are remarkably fresh and unabraded. Although the hardness of diamonds is legendary, they do commonly exhibit evidence of abrasion from long-distance transport.

Where then, if not the Canadian wilderness, did the Ohio diamonds originate? Again, that question cannot be answered directly, but some observations on the geological occurrence of diamonds and on the geology of Ohio provides some latitude for speculation.



Specimen of kimberlite from Elliot County, Kentucky. The light-colored areas are inclusions (xenoliths).

Diamonds are known to occur only in an igneous rock called kimberlite—an ultramafic (containing dark-colored ferromagnesian minerals) rock composed of larger grains of minerals such as olivine, phlogopite, magnesian ilmenite, magnesian garnet, chrome diopside, and enstatite set in a fine-grained matrix. Only one in 10 kimberlites contains diamonds and only one in 100 is commercially economic, and even in the richest ones diamond can only be considered as a trace mineral.



Cross section of a kimberlite pipe (diatreme) with inclusions (xenoliths) of wall rocks. Diagram courtesy of Wisconsin Geological and Natural History Survey.

The origin of kimberlites is not well understood. They are derived from within the earth's mantle (below the crust) at depths of 90 miles or more, and make their way to the surface through comparatively narrow pipes (diatremes) at speeds that some researchers have suggested may exceed the speed of sound (Mach I, more than 700 mph). Kimberlites occur in dikes and pipes and are irregularly shaped, gradually narrowing downward. Their surface area is small, ranging from perhaps 30 feet to as much as a mile in diameter. Most kimberlite pipes record multiple episodes of intrusion.

Many people immediately think of Africa in regard to kimberlites, especially diamond-bearing ones; however, they have been found on every continent and range in age from 1,750 million years to 20 million years. Known kimberlites tend to occur in clusters, and surprisingly are most common in stable platformtal areas (cratons) rather than in areas in which mountain building has been a dominant force. Kimberlites are thought to be localized in stable regions by ancient basement-fracture zones (rifts) that may have provided a zone of weakness along which the kimberlite forced its way to the surface.

When the Fall 1982 *Ohio Geology* article on diamonds was written the aeromagnetic anomaly map of Ohio (see *Ohio Geology*, Summer 1984) had not been prepared. This map reveals a striking area in west-central Ohio, from the Ohio River to Lake Erie, that has been interpreted as a zone of ancient basement fracturing (rifting). No kimberlites are directly indicated by this map, although the small size of these bodies of rock and the spacing of the magnetic data points (1 to 2 miles) on this reconnaissance-scale map would preclude such observations. The intriguing aspect of this map, in regard to the current discussion, is that the stable setting of Ohio is punctuated by complex and fractured basement rocks, similar to the general scenario for kimberlite occurrences. As pointed out in the article on the aeromagnetic map, a non-diamond-bearing kimberlite is known to outcrop along this fracture zone only about 50 miles south of the Ohio border, in Elliot County, Kentucky. In addition, cuttings of a rock identified as peridotite, which is related to kimberlite, were reported from a well drilled in 1909 near Waverly, in Pike County.

If the Ohio diamonds were derived from kimberlites within the state or perhaps a short distance northward, and transported only a few miles by glacial and stream action, why have none of these bodies of igneous rock been found? The obvious conclusion would be because no kimberlites are present; however, such a conclusion may be premature at this time. Many kimberlites weather very rapidly, so their surface record may consist only of a peculiar oxide-stained clayey soil known as "yellow ground." Secondly, even skilled geologists, trained in studies of sedimentary rocks, may fail to recognize an obscure outcrop of highly weathered kimberlite. Finally, and perhaps most importantly, about two-thirds of Ohio is covered with a thick mantle of glacial drift. This drift prevents direct observation of the bedrock in many counties of the state except at a few stream or quarry exposures. Should kimberlites be present in the rocks beneath Lake Erie, their obscurity would be even further enhanced.

An important aspect in determining the source of the diamonds, that is, the location of diamond-bearing kimberlites, is to look for concentrations of kimberlite indicator or satellite minerals such as magnesian ilmenite, pyrope garnet, and chrome diopside, among others. Many of these indicator minerals tend to decompose rapidly as they are carried away from their parent kimberlite and high concentrations of them may be indicative of a nearby intrusion.

Another helpful clue in recognizing kimberlites is that the kimberlite groundmass commonly contains blocks of rock (xenoliths) that were plucked from the walls of the pipe during ascent of the kimberlite. Such boulders may be quite large (up to several hundred feet in diameter) and some may have been derived from considerable depth. Diamond-bearing kimberlites were discovered about a decade ago in Colorado and Wyoming on the basis of "outliers" of Ordovician and Silurian limestone located nearly a hundred miles away from exposures of rocks of similar age. Eventually, it was recognized that these outcrops of limestone were actually inclusions (xenoliths) in kimberlite pipes.

Could some of the enigmatic crystalline erratics reported from south of the glacial border, traditionally interpreted to be of glacial origin (see *Ohio Geology*, Winter 1984), actually be blocks of igneous basement rock that were carried to the surface as kimberlite xenoliths? Could the less resistant kimberlite be weathered to such an extent that it is not recognizable, whereas the resistent granitic inclusion remains conspicuously as an "erratic"? This suggestion should, perhaps, be added as one hypothesis among several working hypotheses on the origin of at least some of these boulders. Such an hypothesis could be tested with a closely spaced ground magnetic survey and sampling for indicator minerals in the vicinity of these "orphan" erratics. This idea is purely speculation, of course, but enduring enigmas sometimes require new approaches.

The lure of diamonds has long captured the human imagination, and each new diamond discovery creates considerable interest among would-be treasure seekers. The century-old riddle of the Great Lakes diamonds is far from solved, but an increased understanding of the geology of Ohio provides additional clues to the solution.

—Michael C. Hansen

FURTHER READING

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Gunn, C. B., 1968, A descriptive catalog of the drift diamonds of the Great Lakes region, North America: Gems and Gemology, Summer, p. 297-303; Fall, p. 333-334.

Pasteris, J. D., 1984, Kimberlites: complex mantle melts: Annual Review of Earth and Planetary Sciences, v. 12, p. 135-153.

Wuestner, Herman, 1938, Collecting minerals in southwestern Ohio: Rocks and Minerals, whole no. 86, v. 13, no. 9, p. 259-268.

SURVEY STAFF CHANGES

COMINGS

Michael P. Angle, Geologist, Regional Geology Section.
C. Scott Brockman, Geologist, Regional Geology Section.
Kim E. Daniels, Laboratory Geologist, Regional Geology Section.
Edward V. Kuehnle, Cartographer, Technical Publications Section.
Michael R. Lester, Cartographer, Technical Publications Section.
Toni McCall, Word-Processing Specialist, Regional Geology Section.
Brian E. O'Neill, Geologist, Regional Geology Section.
Katherine M. Peterson, Geologist, Regional Geology Section.
Ronald G. Rea, Geologist, Regional Geology Section.
Ernie R. Slucher, Geologist, Regional Geology Section.
Lisa Van Doren, Cartographer, Technical Publications Section.

AND GOINGS

David E. Richardson, Cartographer, Technical Publications Section, to investment counselor, Columbus.

STREAM ANTICLINES

Stream anticline along West Fork (a tributary of Mill Creek), 1 mile north of Cumminsville, Hamilton County, Ohio. Note the small anticline and high-angle reverse fault in the interbedded shale and limestone of Late Ordovician age. Quaternary gravel overlies these rocks. Photo by N. M. Fenneman. From Ohio Geological Survey Bulletin 19.

Early in the morning of June 2, 1877, the son of a central Kentucky farmer observed an interesting and unusual geologic event. As he led his horse to a watering place near a stream, there came a roaring sound beneath the earth, violent enough to cause his horse to break away from him. He then witnessed the bedrock in a nearby stream heave up with such force that rocks flew up from the stream bed. The activity persisted and travelled upstream at the rate of a slow walk for about 150 feet before disappearing beneath the stream bank. Rumbling sounds were frequently heard the rest of the day as the rock beneath the surface continued to rupture. The result was an upwarped ridge, known as an anticline, of bedrock about 3 feet wide, 10 inches high, and 150 feet long with a crack at the crest that emerged parallel to and within the stream bed.

Small stream anticline in the Bedford Shale at Stebbins Gulch, Geauga County. Photo by Tom Yates, Holden Arboreum; 1978.

Similar small upwarps, or stream anticlines, have been documented numerous times within shale-rich rocks exposed in Ohio. For instance, Tom Yates, a naturalist for Holden Arboretum, found a stream anticline in Stebbins Gulch, Geauga County. He noted that the siltstone and shale layers of the Bedford Shale (Lower Mississippian) had ruptured parallel to the stream bed, creating a ridge about 20 feet long and 10 inches high. The upwarp formed within a 3-week period, but movement probably occurred quickly.

The dimensions of the stream anticlines range from a few inches to several feet high at the crest and several to many tens of feet wide. Their length may be as much as ½ mile, but is generally 50 feet or less. Reverse faults commonly are associated with the anticlines. The faults occur at a low angle and may have displacements of only a foot or two. The axes of both the faults and the folds generally are parallel to the stream valleys in which they occur, although they may cut obliquely or transversely across a stream.

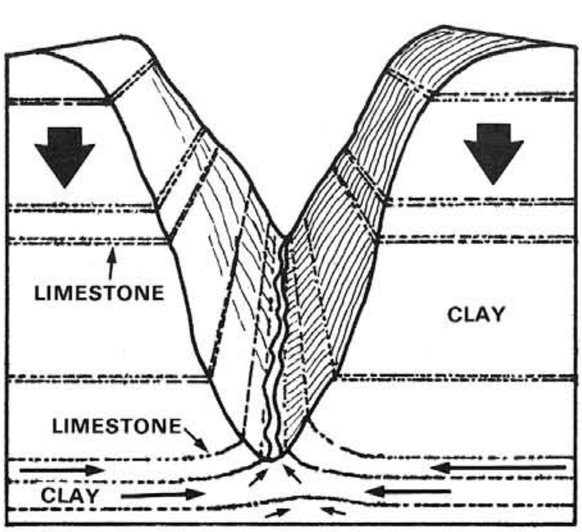
In southwestern Ohio this deformation has been observed exclusively in interbedded limestones and shales of Ordovician age. One researcher found stream anticlines were best developed where there was a greater ratio of limestone to shale. Other studies, however, have found these structures restricted to units dominated by clay or mudstone.

These faults and anticlines die out quickly within overlying and underlying strata and have been observed only in stream beds in areas of deeply dissected topography. Oddly enough, these features have never been found in roadcuts of the same rocks.

The eyewitness account presented earlier verifies that stream anticlines are forming today and are not necessarily ancient features. The fact that they are associated with modern drainage patterns is additional evidence of their recent formation. Further evidence that these structures formed after lithification of the sediment is the occurrence of crumbled and brecciated mudstones in the fault planes.

Recent studies of these features are in disagreement concerning the relationship between the faults and folds and local and regional geologic structure. An investigation in central Kentucky found no relationship between two nearby normal faults and stream-anticline orientation. However, several studies in southern Ohio concluded that there was a slight preferred orientation of the faults and folds.

The configuration of these features suggests these rocks underwent lateral and upward pressure. The origin of the compressive stresses is not apparently related to stresses in the earth's crust; therefore, other modes of pressure generation must be considered.



Development of a stream anticline by differential pressure created by erosion. Greater weight of rocks on hills creates downward pressure (large arrows), which squeezes clay (small arrows) towards area of lesser pressure in the stream bed, where rock layers are upwarped.

A probable explanation for the generation of compression within the rocks is the flow of clay due to differential pressure. Streams eroding steep-sloping valleys remove a great deal of the weight of rock units (lithostatic pressure) from the underlying rock, creating a differential pressure between the hills and the streams. As erosion proceeds, this pressure difference reaches a critical point, whereupon the clays and shales become unstable. The plasticlike shale or clay flows toward an area of least resistance—the stream bed. Eventually, the increased volume of shale generates enough force to cause the surrounding brittle limestone beds to rupture. This movement is expressed at the surface as small anticlines and reverse faults.

Another probable, yet minor, cause for the formation of these features by pressure is expansion of clays in the stream bed. The clays and mudstones may absorb water, which infiltrates the mud through a series of fractures or joints. The increased water content of the shales causes expansion and creates lateral and upward pressure. In the final analysis, it may be a combination of both unloading by erosion and clay mineral expansion that determines where the stream anticlines and reverse faults emerge.

Features similar to stream anticlines, but having more complex folds and larger faults, exist in the Chagrin Member of the Ohio Shale (Devonian) and the Bedford Shale in northeastern Ohio (see *Historical vignettes*). Unlike stream anticlines, these features formed before the sediment was hardened into rock and thus are referred to as soft-sediment deformations. Loosely compacted deposits, generally mud, were squeezed by the weight of subsequent accumulations of sediment and formed the folds and faults.

Very little work has been published concerning stream anticlines and their genesis. The source of pressure which creates these features is speculative. The Survey's bedrock mapping program is currently in progress in Clermont and Hamilton Counties, counties in which the Ordovician limestones and shales are at the surface. Geologists conducting this research will collect more information on the occurrence and relationship of these features and may shed additional light on their origin.

—Mac Swinford
Regional Geology Section

FURTHER READING

Hoffmann, H. J., 1966, Deformational structures near Cincinnati, Ohio: Geological Society of America Bulletin, v. 77, p. 533-548.

Simmons, G. C., 1966, Stream anticlines in central Kentucky: U.S. Geological Survey Professional Paper 550-D, p. D9-D11.

Shaler, N. S., 1877, Scientific problems: Kentucky Geological Survey Report of Progress, v. 3, pt. 7, new ser. (2d), p. 43-50 (407-414).

RESEARCH IN OHIO GEOLOGY 1982-1983

The Survey's most recent biennial tabulation of research in the geological sciences in Ohio is now available. *Research in Ohio geology 1982-1983* includes titles and descriptions of M.S. theses and Ph.D. dissertations completed or underway during the reporting period as well as other academic, government, and industrial research. Copies of the 1982-1983 *Research in Ohio geology* are available free of charge from the Survey.

—Merrianne Hackathorn
Technical Publications Section

MAGGIE SNEERINGER RECEIVES EMPLOYEE OF THE YEAR AWARD

Margaret R. Sneeringer, a geologist in the Regional Geology Section, was the 1984 recipient of the Survey's annual "Employee of the Year" award. This distinction, which recognizes superior effort and contribution by an employee of the Survey, was presented to Maggie by Division Chief Horace R. Collins at ceremonies held during the Survey's annual holiday luncheon.

Maggie, the Survey's mineral statistician, is responsible for compilation and production of the annual *Report on Ohio mineral industries.* The 1983 report, issued in mid-1984, was the first one in this series for which the Survey was entirely responsible for gathering, compilation, and publication of mineral statistics for Ohio. Not only did Maggie produce this report in record time, but she was also responsible for several innovative changes in methods of data gathering. Many Ohio mineral producers have complimented the Survey on this report and on Maggie's efforts in improving the accuracy, efficiency, and timeliness of the compilation of Ohio's mineral statistics.

Maggie came to the Survey in 1982 after receiving a B.S. degree in geology from Louisiana State University, an M.S. degree in geochemistry from MIT, and working as a consulting geologist in geothermal exploration in New York. She lives in the Columbus suburb of Worthington with her husband, Mark, who is also a geochemist. Maggie enjoys gardening, collecting antiques, and needlework in her spare time.

ROCK AND MINERAL SHOW

Several central Ohio rock and mineral clubs will sponsor the "Wonderful World of Gems" rock and mineral show April 27-28, 1985, at Veterans Memorial Auditorium in Columbus. A large number of exhibitors and dealers from throughout the country will have spectacular minerals, fossils, and jewelry for display and sale.

1985 OHIO GEOLOGY SLIDE CONTEST

The Survey will once again sponsor the Ohio Geology Slide Contest. Winners will receive award plaques at ceremonies to be held at the 1985 Ohio State Fair. Last year's contest attracted more than 100 entries.

Any 35-mm color slide that portrays some aspect of the geology or mineral resources of Ohio is eligible for entry and individuals may submit a total of two slides. Popular topics in previous contests include scenic outcrops, mineral-industry operations, and mineral and fossil specimens. Slides are judged on the basis of geologic significance, artistic composition, and technical quality.

For a list of rules and an official entry blank, write: Ohio Geology Slide Contest, Ohio Department of Natural Resources, Division of Geological Survey, Fountain Square, Building B, Columbus, Ohio 43224. Entries must be postmarked by May 31, 1985.

SAND AND GRAVEL RESOURCES OF TRUMBULL COUNTY

The Survey recently released Report of Investigations No. 125, *Sand and gravel resources of Trumbull County, Ohio,* authored by Dennis N. Hull, Head of the Regional Geology Section. This 1:62,500-scale map depicts the distribution of sand and gravel in outwash and kame deposits and the distribution of lake deposits and alluvium. Sand and gravel resources are classified by categories of reliability.

The map is accompanied by a brief text describing the deposits and the methods of investigation. Tables portray the grain-size distribution and composition of selected samples and the tonnage of sand and gravel by type of deposit and reliability category for each township within the county.

This report, RI 125, is available from the Survey for $6.00, which includes tax and handling.

1985 OHIO ACADEMY OF SCIENCE MEETING

The 94th Annual Meeting of the Ohio Academy of Science will be held at the University of Cincinnati and the Cincinnati Museum of Natural History on April 19-21, 1985. The theme of this year's meeting is "The Legacy of Daniel Drake."

A large number of geology papers will be presented on Saturday, April 20, including several papers by Survey staff members on the mapping program. The geology field trip on Sunday, April 21, will examine classic Ordovician rocks in southwestern Ohio and will be cohosted by the University of Cincinnati and the Division of Geological Survey. For additional information on the meeting, contact the Ohio Academy of Science, 445 King Ave., Columbus, OH 43201. Telephone: 614-424-6045.

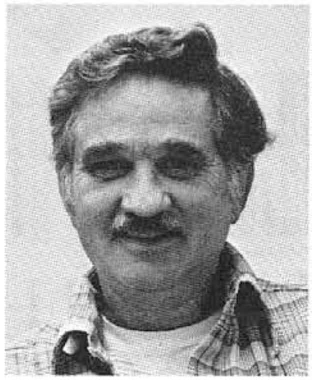
Anyone with an interest in geology is encouraged to consider membership in Section C, Geology, of the Ohio Academy of Science. Please contact the Academy offices at the above address for details.

Historical vignettes

Small thrust fault and folds in the Bedford Shale (Lower Mississippian) along Bates Creek southeast of Painesville, Lake County. Charles S. Prosser, professor at the Ohio State University and Survey geologist, holds hammer at thrust plane. Such features are thought to have formed soon after deposition as a result of soft-sediment deformation. Photo by W. C. Morse, 1909.

SURVEY STAFF NOTES

Jack Gray



Jim Wooten

John D. Gray is Head of the Subsurface Geology Section, a position he has held since 1982. Jack, originally from Warren, came to the Survey in 1978 after completing B.S. (Youngstown State University) and M.S. (University of Akron) degrees in geology. His research interests are structural geology and sedimentary petrography. Jack was the principal compiler of the Ohio report for the U.S. Department of Energy Eastern Gas Shales Project. He is now involved in a study of the Trenton Limestone of northwestern Ohio.

Jack lives in Lancaster with his wife and two children and enjoys rock collecting and tennis as hobbies.

James Wooten is a geology technician in the Subsurface Geology Section and has been with the Survey for 20 years. Jim performs a variety of duties, but his principal responsibilities involve collecting, washing, labeling, and storing cores and samples of well cuttings from oil and gas wells. He particularly enjoys the variety of his duties and meeting people from the oil and gas industry. Jim is a veteran of the Korean conflict and is a member of the Ohio National Guard. Bowling and softball are favorite hobbies. Jim, a Columbus native, is married and has two children at home.

OHIO EARTHQUAKE MAP AVAILABLE

The Survey recently released Open-File Map No. 212, *Ohio earthquakes, including border-region events.* The 1:500,000-scale (1 inch represents about 8 miles) map shows county subdivisions for Ohio and bordering areas of adjacent states and the latitude-longitude grid. The scale of this map is the same as other popular Survey maps, including the aeromagnetic, geologic, gravity, and oil and gas fields maps.

Epicenters for the more than 150 known historic earthquakes in Ohio and adjacent areas are depicted by a symbol representing Modified Mercalli intensity, and the year of occurrence is noted. Instrumentally located earthquakes also are indicated. The map is updated as new earthquakes are reported. Copies of OF Map 212 are available from the Survey for $7.56, which includes tax and handling.

MAP PRICE INCREASE

Recent price increases by the U.S. Geological Survey have necessitated an increase in prices charged by the Ohio Geological Survey for USGS maps. The prices listed below do not include tax or handling charges for mail orders.

7½-minute (1:24,000) topographic maps	$2.50
1° x 2° (1:250,000) topographic maps	$4.00
Topographic map of Ohio (1:500,000)	$4.00
Relief map of Ohio (1:500,000)	$4.00
Glacial map of Ohio (Map I-316)	$3.60
Magnetic anomaly map (GP-961)	$2.40

QUARTERLY MINERAL SALES, JULY-AUGUST-SEPTEMBER 1984

Compiled by Margaret R. Sneeringer

Commodity	Tonnage sold this quarter[1] (tons)	Number of mines reporting sales[1]	Value of tonnage sold[1] (dollars)
Coal	10,501,512	205	333,963,794
Limestone/dolomite[2]	8,673,358	94[3]	30,648,536
Sand and gravel[2]	10,478,449	223[3]	32,524,868
Salt[2]	799,029	5[4]	6,906,566
Sandstone/conglomerate[2]	610,342	26[3]	6,630,671
Clay[2]	207,964	27[3]	1,318,801
Shale[2]	576,903	21[3]	1,021,250
Gypsum[2]	51,066	1	485,127
Peat	7,457	4	35,628

[1]These figures are preliminary and subject to change.
[2]*Tonnage sold* and *Value of tonnage sold* include material used for captive purposes. *Number of mines reporting sales* includes mines producing material for captive use only.
[3]Includes some mines which are producing multiple commodities.
[4]Includes solution mining.

ACID-RAIN BIBLIOGRAPHY

The U.S. Geological Survey recently published a 1,600-entry bibliography on acid rain. Copies of this 282-page publication, Circular 923, *Acid precipitation—an annotated bibliography,* are available free of charge from the U.S. Geological Survey, Eastern Distribution Branch, 604 S. Pickett St., Alexandria, VA 22304.

Ohio Department of Natural Resources
Division of Geological Survey
Fountain Square, Building B
Columbus, Ohio 43224

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