FALL 1987

Ohio Geology Newsletter

Division of Geological Survey

COCORP TRAVERSE ACROSS OHIO

by Michael C. Hansen

Approximate location of COCORP traverse across Ohio.

Some of the backroads of Ohio witnessed an unusual procession during September and October 1987, as five 22-ton vibrator trucks owned by Seismograph Services of Tulsa, Oklahoma, thumped their way in tandem across the state from Indiana to the Ohio River. The miniature mechanical earthquakes generated by this equipment sent vibrations to depths of 25 miles or more in an effort to explore Ohio's last frontier. This investigation may unravel some of the long-standing enigmas in Ohio geology and will provide the first look at the deep crustal structure beneath the state.

This project is being directed by COCORP, an acronym for Consortium for Continental Reflection Profiling, an organization of academic, government, and industrial geologists based at Cornell University in Ithaca, New York. The National Science Foundation-funded project carries out investigations of deep crustal structure beneath the United States using seismic reflection profiling as the primary data source. Since its beginning in the mid-1970's, COCORP has carried out reflection profiling in a variety of geographic areas and geologic terranes in the United States. It is the goal of this organization to eventually crisscross the country to such a degree that a detailed picture of the deep crust will emerge.

The technique for obtaining these data is not a new one, as seismic reflection profiling has been utilized by oil companies for a number of years. However, oil companies are primarily interested in the several thousand feet of sedimentary rock that overlie the crystalline basement rocks. In contrast, the COCORP data must be obtained from depths of 25 to 30 miles—through the entire crust and into the upper part of the mantle.

The data from seismic reflection profiling are obtained by sending energy in the form of waves—vibrations—into the ground, where the waves travel downward until they encounter boundaries between different rock types. Some of the waves bounce off these boundaries, known as reflectors, and return to the surface, where they are recorded by sensitive instruments.

The vibrations are hydraulically generated by a 3-foot by 7-foot steel pad beneath a specially designed truck. The pad is lowered onto the ground so that most of the weight of the truck rests upon it. At a radio signal, all five trucks in tandem begin to vibrate in unison for 28 seconds, gradually increasing the frequency of vibrations from about 8 cycles per second to about 40 cycles per second. This technique, using truck-mounted hydraulics to create vibrations, was developed by Conoco Oil Company and is known as VIBROSEIS.

Vibrator trucks in tandem on a county road in Coshocton County. Flat pads beneath the trucks create the vibrations that penetrate deep into the crust.

continued on next page

ODNR
OHIO DEPARTMENT OF NATURAL RESOURCES

Richard F. Celeste, Governor • Joseph J. Sommer, Director

Chief's corner by Horace R. Collins

This edition of *Ohio Geology* will be the last issued during the Division's Sesquicentennial Year. Our founding 150 years ago in March 1837 has been celebrated throughout 1987. The Sesquicentennial Committee, composed of Phil Celnar, René Fernandez, Merrianne Hackathorn, Mike Hansen, and Larry Wickstrom, has given us an interesting series of events to commemorate the year.

The Division started the year with a new logo, which is printed immediately below the return address on this newsletter. This logo has been used on all mailings and publications during 1987 to call attention to our 150th anniversary. On March 27, the actual date of the passing of the original legislation establishing a Geological Survey, over 200 people attended an open house in the Division's offices. The evening of the 27th saw 300 individuals in attendance at a celebration banquet. Dallas Peck, Director of the U.S. Geological Survey, was our guest speaker, and a newly designed medal named after W. W. Mather, the first State Geologist, was awarded to Myron T. Sturgeon for outstanding contributions to the geology of Ohio and to the Division of Geological Survey.

The Division prepared a display on the Division's history which was shown at the Eastern Section meeting of the American Association of Petroleum Geologists, the Ohio State Fair, and other occasions. The Division also received lengthy citations from the Governor and from both the Ohio House and Senate. These citations have formed a year-long display at the Survey offices.

Members of the Division's staff developed and/or participated in three field trips during the year. Two trips, the Midwest Friends of the Pleistocene and the Eastern Section AAPG, were designed for the professional geologist and were very well attended and received. A third trip to Caesar Creek State Park was created more for amateur paleontologists and drew 250 participants.

In addition to our regular publication series bearing our Sesquicentennial logo, special articles commemorating this anniversary were published in *Geotimes* and in *Rock and Minerals*. A special commemorative edition of the annual *Report on Ohio mineral industries* was also issued. As a finale, a time capsule containing specially designed lapel pins, commemorative coffee mugs, and other memorabilia of the Sesquicentennial is being assembled to be opened in 2037 during the Bicentennial Year.

This has been a memorable year for all of us privileged to be associated with an organization with such a long and honorable history. It has truly been an honor for me and I think also for all the staff. Few of those on staff during this year will be living to celebrate the Bicentennial Year, but to those who are and those serving in 2037 we say "keep up the traditions of service which were the hallmark of the first 150 years."

OHIO GEOLOGY

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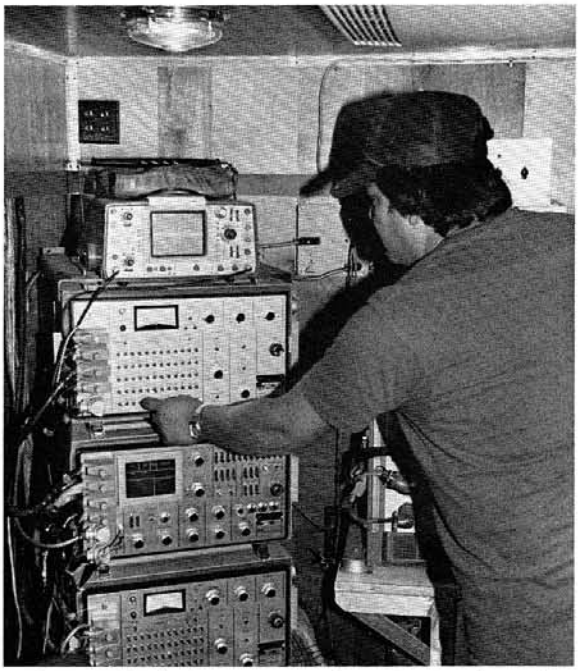
Halftones: Robert L. Stewart and Edward V. Kuehnle

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.

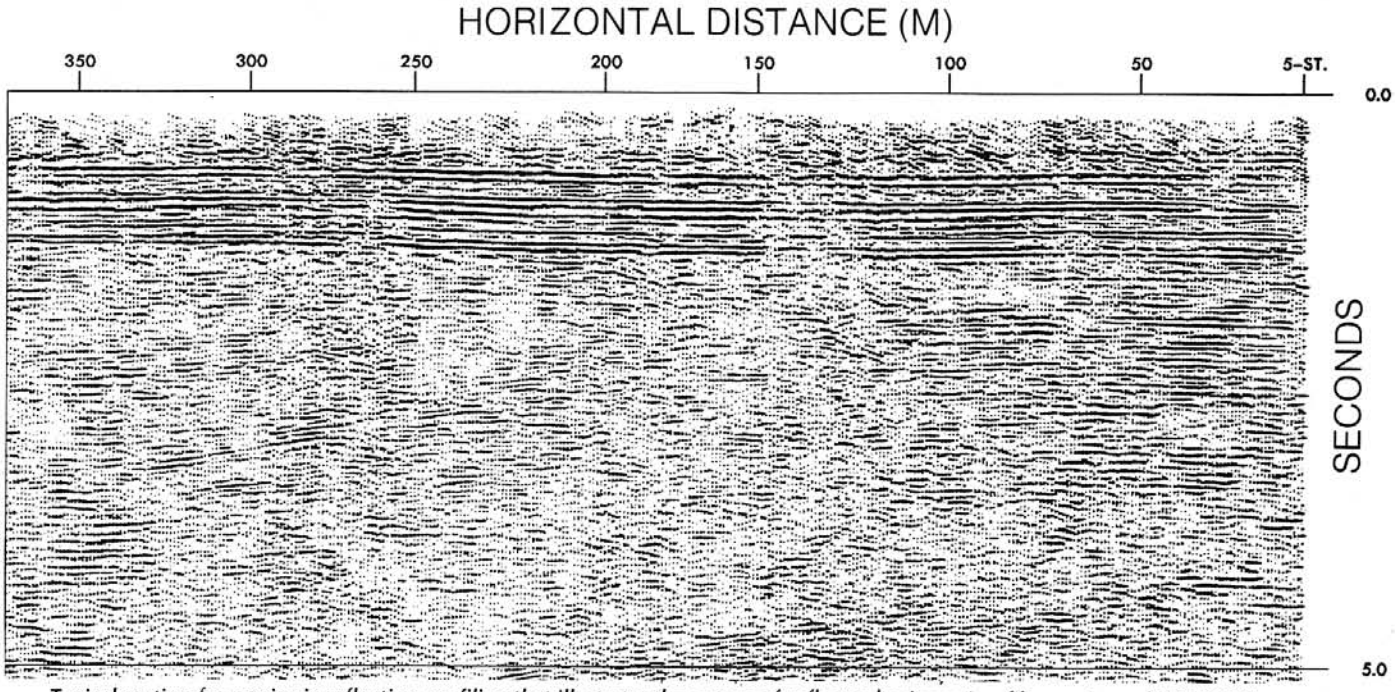
continued from page 1

At the conclusion of the vibration sequence the trucks raise their hydraulic pads and move forward a distance of about 20 feet and repeat the vibration process. At this snail's pace the trucks advance only 2 or 3 miles per day, although the rate is sometimes speeded up because the trucks do not vibrate on bridges, over culverts or pipelines, or within 300 feet of homes.

Reflected waves that return to the surface are recorded by an array of miniature seismographs known as geophones. The geophones are linked by cable, with one geophone spaced every 12 feet over a distance of 6 to 8 miles. As the trucks slowly inch forward across the countryside, the geophones and their linking cables are continually picked up at the back end of the array and moved forward, ahead of the advancing vibrator trucks.



Operator in the instrument truck monitoring the various data-recording devices.



Typical section from seismic reflection profiling that illustrates the nature of reflector horizons (profile courtesy of COCORP).

The data received from the array of geophones are recorded on computers in an instrument truck. The data tapes are then processed and analyzed at COCORP headquarters at Cornell by a giant computer system known as MEGASEIS. The results obtained from data processing are displayed in the form of a continuous cross section that uses distance along the traverse on the horizontal axis and travel time of the seismic waves (which is an indicator of depth) on the vertical axis. Such seismic cross sections look like a series of short, subparallel, indistinct lines that are punctuated here and there by bolder and more continuous lines. These lines represent reflections of the seismic waves from boundary zones deep in the crust. Even an inexperienced observer can pick out the more obvious reflections; however, it takes trained and skilled personnel to discern the less obvious ones and to identify such features as faults and other geologic structures. Perhaps the most challenging aspect of the interpretation process is placing the observations in a meaningful geologic context.

As noted in the "Chief's corner" in the Summer 1987 issue of *Ohio Geology*, the current COCORP traverse across Ohio is in response to a proposal submitted to COCORP by the Division of Geological Survey in 1983. Our primary interest in this project was an investigation of a north-south-oriented zone in western Ohio that appears to be a major area of discontinuity in basement rocks.

Data from limited numbers of oil and gas wells that reached basement rocks in this area of the state indicate that the rocks in westernmost Ohio are unmetamorphosed granites or fine-grained equivalents that are about 1.2 to 1.5 billion years old. Basement rocks in west-central and eastern Ohio, however, are between 0.8 and 1.1 billion years old and consist primarily of metamorphic rocks.

This transition zone between older rocks on the west and younger rocks on the east has been interpreted by some geologists to be the southward extension of a Canadian structural feature known as the Grenville Front. Interestingly, this area also coincides with the eastern edge of the Cincinnati Arch (also known as the Indiana-Ohio Platform).

The aeromagnetic map of Ohio (see *Ohio Geology*, Summer 1984) suggests that the basement rocks in this north-south zone in west-central Ohio contain numerous features interpreted to be intrusions of igneous rocks and faults. On the basis of these aeromagnetic data it has been suggested that this area represents a zone (known as a failed rift) along which the continent began to split apart in Keweenawan (Late Precambrian) time.

The COCORP line was also planned to cross the area of the most frequent and intense earthquake activity in the state, a region commonly referred to as the "western Ohio seismic zone" or the "Anna area," in reference to a Shelby County community that has experienced a number of earthquakes. There is currently very little understanding of why seismic activity is localized in this area. It has been suggested that a branch of the proposed failed-rift zone extends northwest through the Shelby-Auglaize County area. Another, less widely accepted suggestion is that the Anna area represents a link between the New Madrid earthquake zone in the Mississippi Valley and the zone of earthquake activity along the St. Lawrence River.

Location of COCORP seismic lines from 1975 through mid-1987.

Instrument truck used to record data picked up by the array of geophones along the COCORP line.

Although our understanding of the Precambrian basement rocks of Ohio has increased by several orders of magnitude since aeromagnetic and gravity maps recently became available, we still have little more than a rudimentary understanding of what may be characterized as Ohio's last frontier. The COCORP line will provide us with a tantalizing glimpse of the basic crustal structure beneath the state and may answer long-standing questions such as those concerning the Grenville Front and the western Ohio seismic zone. Detailed results of the COCORP traverse will not be available for about a year from the time of completion of the line; however, preliminary analysis of the data set from western Ohio indicates the presence of steep, eastwardly dipping reflectors that exhibit a signature very similar to a profile across the Grenville Front in the Georgian Bay area of Canada. We will keep readers of *Ohio Geology* informed of progress and new developments in the interpretation of the COCORP traverse.

ACKNOWLEDGMENTS

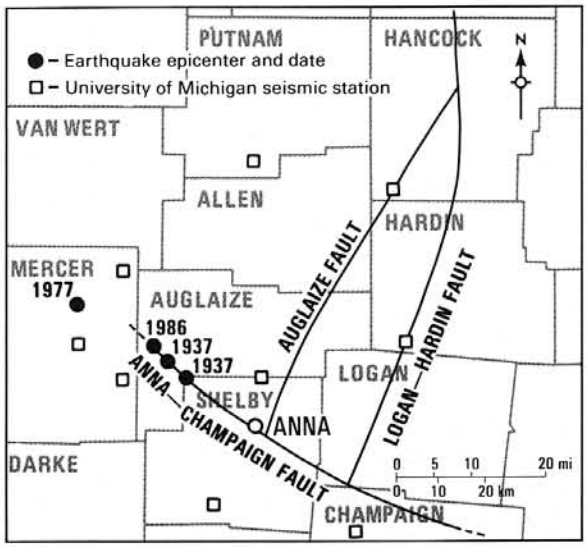
We thank Thomas L. Pratt of COCORP at Cornell University for information used in this article.

CHAMPAIGN AND CLARK COUNTY SAND AND GRAVEL REPORTS

The Division of Geological Survey recently published Report of Investigations No. 136, *Sand and gravel resources of Champaign County, Ohio,* and Report of Investigations No. 137, *Sand and gravel resources of Clark County, Ohio.* Both reports are authored by Richard A. Struble. These maps, at a scale of 1:62,500, depict the distribution of sand and gravel deposits in each county by mode of origin (outwash, kame/esker) and resource category (measured, indicated, inferred). In addition, the reports contain explanatory texts, strip logs of water wells and measured sections, and tables listing resource tonnages by township, pebble counts, and sieve analyses.

Champaign County, with a 6-billion-ton resource, and Clark County, with a 5.7-billion-ton resource, each contain significant deposits of sand and gravel. These reports will be of particular interest to those involved in exploration for deposits of sand and gravel and to local planning agencies. Report of Investigations No. 136 and Report of Investigations No. 137 are available from the Survey for $10.20 each, which includes tax and mailing.

JULY 1986 AUGLAIZE COUNTY EARTHQUAKE



Proposed faults, major instrumentally located earthquakes, and distribution of seismic stations in the University of Michigan's Anna network in the western Ohio seismic zone.

In contrast to the 5.0 Richter magnitude earthquake in Lake County on January 31, 1986, the quake that struck Auglaize County in western Ohio on July 12, 1986, drew comparatively little attention. Although the Auglaize County earthquake was smaller (4.5 Richter magnitude), it was strongly felt in most of Ohio and parts of Indiana, Michigan, Kentucky, and West Virginia. It is probable that the early hour (4:19 a.m., EDT), the day (Saturday), and, by no small means, the fact that the July 12 event was not located near a nuclear power plant all contributed to the lesser attention given the July earthquake.

This earthquake was centered in western Auglaize County, near St. Marys. Damages were relatively minor. Electric power to about 30 homes in St. Marys was disrupted and the Joint Township District Memorial Hospital in this community suffered cracked plaster and dislodged floor tiles. Little additional damages were reported.

The 1986 Auglaize County earthquake occurred on the Anna-Champaign fault, a northwest-southeast-trending structure that has been interpreted to extend from Champaign County through Shelby, Auglaize, and Mercer Counties. This fault passes beneath the Shelby County community of Anna, the site of the most extensive earthquake damages in Ohio, in 1937.

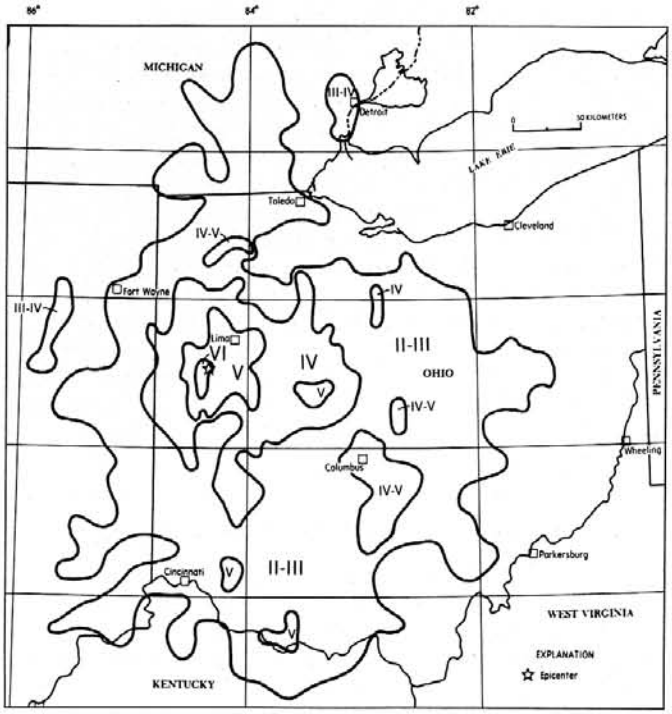
Two earthquakes, on March 2 and March 9, 1937, had Richter magnitudes of 4.7 and 4.9, respectively, and caused considerable damage in the town of Anna. Although these events were reported at the time to have had epicenters at Anna and were later reported to have had Richter magnitudes as high as 5.5, recent analysis of the seismic records by seismologists at the U.S. Geological Survey have adjusted the magnitudes downward and relocated the epicenters. These newly assigned epicenters are in the general vicinity of the epicenter of the July 12, 1986, event, although the paucity of seismographs in 1937 makes such relocations somewhat imprecise.

The July 12, 1986, St. Marys earthquake casts some doubt on the relocated epicenters of the 1937 events. There has been speculation that Anna received the brunt of damages

from the 1937 earthquakes because the community is located directly above the sediment-filled valley of the preglacial Teays River. This ancient river apparently followed the trace of the Anna-Champaign fault until it was obliterated by an early Pleistocene glacier and its valley was filled with nearly 500 feet of glacial sediment. The speculation is that ground motion is amplified by these unconsolidated sediments in the Teays River valley and that Anna, located over the buried valley, receives a greater degree of shaking than nearby communities located on shallow bedrock.

If this relationship was completely accurate, the 1986 earthquake at St. Marys in Auglaize County should have caused considerable shaking and perhaps some damages in Anna, similar to that of the 1937 events. This does not, however, appear to be the case and suggests that the 1937 earthquakes may have been closer to and perhaps southeast of Anna. Douglas Christensen of the University of Michigan has reached a similar conclusion corroborated by a seismic record made by a Jesuit priest in Wapakoneta (Auglaize County, north of Anna) on a three-component seismograph during the 1937 earthquakes. According to Christensen, first-motion data from these events indicate that the 1937 quakes could not have been in the quadrant southwest of Wapakoneta (where the 1937 quakes were recently relocated by the U.S. Geological Survey) and they were most likely in the southeast quadrant, which would place them at or southeast of Anna.

Such a relocation of the 1937 earthquakes would appear to be more consistent with the felt reports and damages from these events and would fit the observed pattern of shaking during the 1986 earthquake. This exercise in speculation emphasizes the uncertainty involved in locating historic earthquakes from which there are no seismic records or, as in the case of the 1937 Anna events, only sparse instrumental records. The degree of uncertainty of epicenter location, or



Isoseismal map depicting Modified Mercalli intensities experienced during the July 12, 1986, western Ohio earthquake. Courtesy of Carl Stover, U.S. Geological Survey.

the "error ellipse" associated with a particular historic earthquake, becomes even greater with many older events for which there are only sparse newspaper accounts.

Interestingly, the July 12, 1986, earthquake was not accompanied by foreshocks or aftershocks. The epicenter was located within the Anna network, a series of nine seismic stations operated by the Seismological Observatory of the University of Michigan. This network has the capacity to record very small microearthquakes in the area and would have recorded even tiny aftershocks.

The highest Modified Mercalli intensity observed for the July earthquake was VI, and confined to a small area surrounding the epicenter. Intensities of V were generally observed in a broader area surrounding the epicenter; however, several isolated areas of intensity V were delineated from isoseismal studies by Carl Stover of the U.S. Geological Survey. These areas are in northern Clermont County and along the Adams/Brown County line near the Ohio River. A small area of intensity V was reported in northern Union County. The reasons for these isolated areas of intensity V are uncertain.

DATA FOR JULY 12, 1986, WESTERN OHIO EARTHQUAKE

Date (UTC)[1]			Origin time (UTC)			Location		Richter magnitude	Depth (km)
Yr	Mo	Day	Hr	Min	Sec	Lat.°N	Long.°W		
86	07	12	08	19	37.9	40.544	84.354	4.5	10

Source: Douglas Christensen, University of Michigan

[1]UTC, Universal Coordinated Time, is equal to Greenwich Mean Time (GMT) and is used to standardize all earthquakes. To convert to local time (Eastern Standard Time) substract 5 hours (4 hours for Daylight Saving Time) from UTC. Note that events that occur in early morning hours on UTC are listed as a day later than local time.

Although the epicentral region, commonly referred to as the Anna area or the western Ohio seismic zone, has experienced at least 38 felt earthquakes since 1875, the origins of these earthquakes are still poorly understood. In part, this lack of understanding is because most of these events were not recorded on seismographs.

The July 12 earthquake is only the second one of any appreciable size to have occurred within the University of Michigan network since its installation in 1977. The first earthquake was on June 17, 1977, near Celina. The July 12 event is the first one in this area from which significant data can be derived. Analysis of the data from this earthquake by Christensen indicates that the Anna-Champaign fault is a near-vertical plane and movement was left-lateral strike-slip along this northwest-oriented fault.

Although the Anna area is the seismically most active region of the state, geologists currently have only minimal understanding of the geology of basement rocks in the region. There is some speculation that the Anna-Champaign fault is associated with a proposed failed rift zone in western Ohio. However, until additional data are derived from future earthquakes, deep drilling, and other investigations of basement geology in western Ohio, the cause of earthquakes in this area will remain speculative.

—Michael C. Hansen

MINERAL INDUSTRY HISTORY

As part of Sesquicentennial activities in 1987, the Division of Geological Survey has published Information Circular No. 54, *A historical sketch of the mineral industries in Ohio.* This

6-page report, authored by Division Chief Horace R. Collins, is reprinted from the Survey's *1986 Report on Ohio mineral industries.* The text, accompanied by numerous photographs, traces the early development and mining of flint, salt, clay and shale, coal, iron, oil and gas, gypsum, limestone and dolomite, sandstone, and sand and gravel in Ohio. IC 54 is available from the Division of Geological Survey for $1.81, which includes tax and mailing.

FRIENDS OF THE PLEISTOCENE

In conjunction with its Sesquicentennial activities, the Division of Geological Survey cohosted the 34th Field Conference of the Midwest Friends of the Pleistocene in Mansfield May 15-17, 1987. The Friends of the Pleistocene is an organization composed primarily of professional glacial geologists and soil scientists, but is open to anyone interested in studying the Pleistocene Epoch, or Ice Age. This was the first Friends of the Pleistocene conference in Ohio since 1962 and the concept of "bringing the Friends back to Ohio" was very well received by all 72 participants, who represented 13 states.

The field conference focused on the pre-Woodfordian (over 25,000 years old) tills in north-central Ohio. Exposures of these tills were examined in Ashland, Knox, Morrow, Crawford, and Wyandot Counties. Recent investigations have indicated that the complexity and variability of these till units is much greater than previously thought. Also, the age of these deposits has come under considerable debate, not just in Ohio, but in Illinois, Ontario, and other parts of the Midwest. The trip initiated numerous valuable discussions among the participants.

Coleaders of the trip, John Szabo of the University of Akron and Stanley Totten of Hanover College, Indiana, wrote most of the material for the conference guidebook. Barry Miller of Kent State University handled the financial and registration aspects of the conference. Survey geologists Rick Pavey, Mike Angle, Scott Brockman, René Fernandez, and Mike Hansen provided logistical support and additional articles and compiled the guidebook. In addition, Dennis Hull, Regional Geology Section Head, spoke to the group about the initiation and progress of the Survey's mapping program.

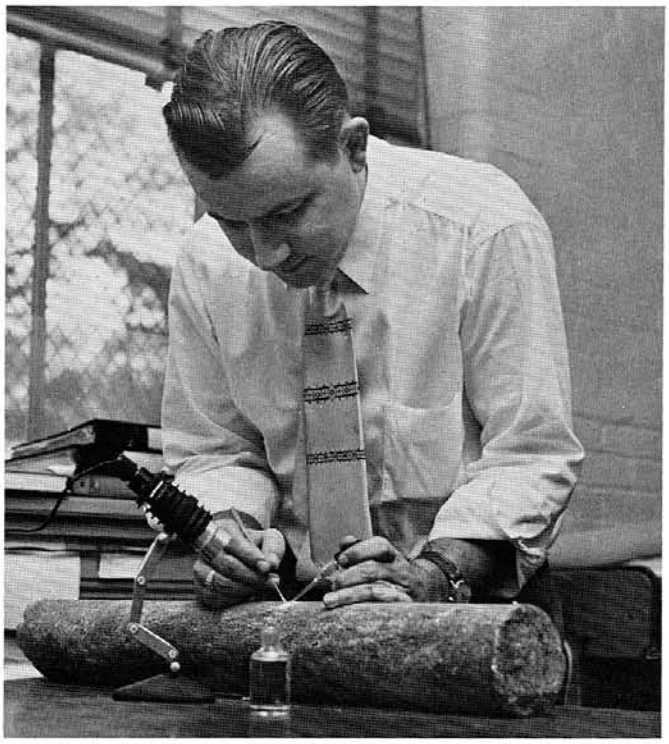
The Survey greatly appreciates the support of the quarry and gravel pit operators and other landowners that made this trip possible.

DIVISION FEATURED IN *GEOTIMES*

The July issue of *Geotimes*, published by the American Geological Institute, featured Ohio and the Division of Geological Survey. The magazine cover was a color photograph of Dan Cooper's large specimen of *Isotelus*, a genus of trilobite which is Ohio's official state fossil. This 8½-inch specimen was displayed by the Survey at the 1985 Ohio State Fair and is featured on a postcard distributed by the Survey.

This issue of *Geotimes* also featured an article on the Survey's Sesquicentennial which traced major events in the 150-year history of the organization. An additional article in the July issue of *Geotimes*, on the problem of indoor radon, utilized a diagram and a photograph from the Fall 1986 *Ohio Geology* newsletter article on radon.

GEORGE G. SHEARROW, 1926-1987



George Shearrow examining core from an oil and gas well in the Survey offices at Orton Hall, Ohio State University, 1956.

We are saddened to report the death of George G. Shearrow, former Survey geologist and Head of the Subsurface Geology Section. George died at his home in Worthington, Ohio, on November 12, 1987, after a long illness. He is survived by his wife, Evelyn, and three sons.

George was born in Chillicothe, Ohio, and served in the Naval Air Corps in World War II. He obtained a B.S. degree in geology from Michigan State University in 1950 and did graduate work at the Missouri School of Mines before coming to the Survey in 1951. In 1960, George left the Survey to become a consulting geologist. In 1968 he became a District Geologist for Quaker State Oil Corporation and then Geologist-Manager and Vice President of Quaker State Western. He retired from Quaker State in 1984.

While at the Survey, George authored numerous publications on Ohio's oil and gas industry and the geology of oil and gas fields in the state. He was particularly noted for his studies of insoluble residues as a tool in correlation of rocks.

George was a member of numerous professional geological organizations and societies and was well known and respected in the geological community. He will be missed by his many friends and associates.

COLOR GRAVITY ANOMALY MAPS AVAILABLE

U.S. Geological Survey Map GP-963, *Gravity anomaly maps of Ohio,* by T. G. Hildenbrand, is now available from the Division of Geological Survey. This publication, prepared in cooperation with the Division of Geological Survey, consists of five computer-drawn color anomaly maps at a scale of 1:1,000,000—complete Bouguer gravity, regional gravity, residual gravity, first-vertical derivative of the gravity field, and magnitude of the horizontal gravity gradient. GP-963 is

available from the Division of Geological Survey for $4.53, which includes tax and mailing.

These maps utilize the same database as USGS Map GP-962, *Complete Bouguer gravity anomaly map of Ohio.* This black-and-white contour map, at a scale of 1:500,000, is available from the Division of Geological Survey for $3.29, which includes tax and mailing.

DO WE HAVE ANY MAPS???!!

Often we hear this question. The answer?? . . . . YES!! . . . *1,724 different maps!* These include everything from USGS topographic maps to public-hunting-area maps. From maps of abandoned coal mines to backpacking trails. Glacial maps . . . earthquake maps . . . ground-water maps . . . soils maps . . . .

BUT WHAT ELSE DO WE HAVE???!!

The Publications Center of the Division of Geological Survey handles 311 various geologic publications . . . 49 different technical reports for the Division of Water . . . 368 pamphlets and books from other Divisions of the Ohio Department of Natural Resources.

We sell 7 slide sets which include 430 different slides . . . 4 types of wildlife hats . . . 3 different T-shirts . . . aprons . . . decals . . . patches . . . calendars . . . 16 mm films . . . postcards . . . paperweights . . . beltbuckles . . . .

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Each year, we handle 15,000 walk-in customers . . . 19,000 telephone calls . . . 36,000 mail requests. We distribute more than 300,000 publications each year!

BUT WHAT DO WE DO WITH OUR EXTRA TIME???!!

Our staff of four mail the Division's quarterly newsletter, *Ohio Geology,* to 3,000 people . . . maintain an exchange list with 300 geological surveys and universities around the world . . . maintain the Division's photo file of more than 3,000 negatives. In addition, we sell boat registrations . . . fishing licenses . . . hunting licenses. Each August you can find us at the Ohio State Fair with the Publications Booth.

But most of our time is spent . . . answering questions . . . counting maps . . . answering questions . . . mailing maps . . . and answering the question, *YES! We do have maps!*

QUESTIONS???
PLEASE ASK

Suzan Jervey, Section Head
Inaleigh Johnson, Public Inquiries Assistant
Donna Schrappe, Public Inquiries Assistant
Billie Wilder, Account Clerk

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SURVEY STAFF NOTES

Ed Kuehnle

Kim Daniels

Edward Kuehnle is a cartographer in the Technical Publications Section, where he is involved in a wide variety of cartographic projects, including production of color geologic maps. Ed came to the Survey in 1984 after completion of a B.A. degree in geography from the University of Cincinnati. He worked previously as a cartographer for a private map-making company and completed service in the Marine Corps, which included a year in Vietnam.

Ed particularly likes the challenge of bringing a manuscript map to the stage of a final, printed product. He is a native of Cincinnati and now lives in Columbus. Ed was recently engaged to be married and enjoys sports as a hobby.

Kim Daniels is a geologist in the Survey's sedimentology laboratory, where she is responsible for performing analyses on sediments and rocks collected by Survey field geologists. She operates a wide variety of laboratory equipment, including an x-ray diffraction unit.

Kim has a B.S. degree in geology from Ohio State University and came to the Survey in 1984 after working for a private engineering company. She lives in Westerville and enjoys studying tai chi chuan, jewelry making, and participation sports.

AERIAL RADIOMETRIC COLOR CONTOUR MAPS

The Division of Geological Survey has recently received U.S. Geological Survey Map GP-966, *Aerial radiometric color contour maps and composite color map of regional surface concentrations of uranium, potassium, and thorium in Ohio,* by Joseph S. Duval. These computer-generated color maps, prepared in cooperation with the Division of Geological Survey, are at a scale of 1:1,000,000 and depict the general surface distribution of uranium, potassium, and thorium in the state. The uranium map is particularly of interest because of the recent attention given to the occurrence of radon gas in homes in Ohio.

These maps present the same data as those in another USGS publication, Map GP-968, *Aerial radiometric contour maps of Ohio;* however, the maps in GP-968 are in black and white at a scale of 1:500,000. Both sets of maps are available from the Division of Geological Survey. GP-966 (color maps) is $4.53 and GP-968 (black and white contour maps) is $9.35. Both prices include tax and mailing.

SURFICIAL MATERIALS OF MEDINA COUNTY

The Division of Geological Survey recently issued Report of Investigations No. 133, *Surficial materials of Medina County, Ohio,* authored by Michele L. Risser. This 1:62,500-scale map, on a single sheet and accompanied by explanatory text, depicts the distribution of various sediments that characterize the upper 25 feet of the land surface of Medina County.

Most of these sediments were deposited by or in association with Wisconsinan glacial ice. Twelve separate categories of surficial materials are depicted on the map. Two tables also accompany the report. One table gives size analyses and Atterberg limits for 96 till samples collected in Medina County. The locations of these samples also are shown on the map. The second table gives a variety of engineering characteristics of Medina County till units. RI 133 is available from the Division of Geological Survey for $3.92, which includes tax and mailing.

QUARTERLY MINERAL SALES, APRIL—MAY—JUNE 1987

compiled by Sherry L. Weisgarber

Commodity	Tonnage sold this quarter[1]	Number of mines reporting sales[1]	Value of tonnage sold[1] (dollars)
Coal	8,099,633	206	255,158,335
Limestone/dolomite[2]	11,062,823	96[3]	42,693,048
Sand and gravel[2]	10,679,348	195[3]	35,843,719
Salt	631,289	5[4]	5,418,805
Sandstone/conglomerate[2]	528,796	23[3]	6,754,985
Clay[2]	330,488	30[3]	1,776,656
Shale[2]	454,713	19[3]	413,877
Gypsum[2]	69,099	1	656,441
Peat	7,105	3	57,399

[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.

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