

PROGRAMS AND ABSTRACTS VOLUME

THIRD MIDWEST MINERAL SYMPOSIUM

SPONSORS: Friends of Mineralogy Midwest Chapter and
Central Ohio Mineral, Fossil, Gem & Jewelry Show

SATURDAY APRIL 1, 2000

INVITED SPEAKER PROGRAM - 8:00 AM to 12:30 PM

8:05-8:10 ERNEST H. CARLSON, Kent State University, Kent OH. "Welcome & Introduction".

8:10-8:40 JOHN C. MEDICI, Ostrander OH. "Celestites of Ohio and Vicinity".

8:40-9:10 DAN BEHNKE, Northbrook IL. "Iron Country Microminerals".

9:10-9:40 TERRY HUIZING, Cincinnati OH. "The Four Twin Laws of Calcite".

9:40-10:10 ANDREW A. SICREE, Earth & Mineral Sciences Museum, Pennsylvania State University, University Park PA. "Inclusions in Minerals".

COFFEE BREAK

10:30-11:00 ANNE ARGAST, Indiana University/Purdue University, Fort Wayne IN. "Mineralogy and Mineral Chemistry of Proterozoic Tills in the Upper Peninsula, Michigan".

11:00-11:30 NELSON R. SHAFFER, Indiana Geological Survey, Bloomington IN. "Efflorescent Minerals - Flowers of the Mineral Kingdom".

11:30-12:00 HENRY BARWOOD, Indiana Geological Survey, Bloomington IN. "Forms of Quartz Found in Indiana Geodes and Cherts".

12:00-12:30 ALAN GOLDSTEIN, Falls of the Ohio State Park, Jeffersonville IN. "The Minerals and Paragenesis of the Irvington, KY - Corydon, IN Fluorite Area".

SUNDAY APRIL 2, 2000

FIELD TRIP: Duff & Son, Inc., Quarry, Huntsville, Logan Co., 9:00 AM to 12:00 PM.

CELESTITES OF OHIO AND VICINITY

John C. Medici
Ostrander, Ohio

Quarries and other excavations in northwest Ohio and surrounding states and Ontario have yielded a variety of deposits of celestite. Many of the highly productive areas are not far from Toledo, Ohio. Large crystals have been found at Maybee, Rockwood and near Newport, Michigan, and at Put-in-Bay, Clay Center and Portage, Ohio. Most of the celestites are white or blue, with some yellow or orange zoning sometimes. A deep orange celestite has been found in Ontario. Amherstburg, Ontario and Salem, Indiana are two sites outside the Ohio-Michigan area that are still current producers of celestites. Very few celestites in these midwest areas are clear enough to facet, but a few have yielded faceted stones, which are just a curiosity since they are too soft to be used in jewelry.

Iron Country Microminerals

Dan Behnke
Northbrook, IL

The native copper deposits of the Upper Peninsula of Michigan and the iron ore deposits of northern Minnesota, Wisconsin and Michigan have been of major importance in the economic history of the country going back 100 - 150 years.

Wherever mineral deposits are found mineral collectors are not far behind. As micromineral collectors know the specimen material available from the Copper Country is well documented but little has been written about the availability and variety of specimens found as microcrystals in the iron belts. I hope that this presentation will spark a bit of interest in the microminerals from the Iron Country and that even though the majority are dark brown to black the variety of forms makes searching for them worthwhile.

The iron ore deposits of the Lake Superior region are precambrian in age. The early precambrian deposits are found on the Vermillion range in Minnesota as cherty iron formations. The middle precambrian deposits are found on the Mesabi and Cuyuna ranges in Minnesota, the Gogebic range in Wisconsin and the Marquette and Menominee ranges in Michigan.

The ores are grouped roughly into six types based on the mineral and chemical composition, the ore structure and the geologic occurrences: soft ores; hard ores; conglomerate ore; siliceous ore; magnetite taconite ore and jasper ore.

The species that have been found in some of these deposits are as follows:

Iron oxides: goethite; hematite; and lepidocrocite

Manganese oxides: groutite; hausmannite; magnetite; manganite; pyrolusite and ramsdellite

Manganese borate: seamanite

Carbonates: calcite; kutnohorite; rhodochrosite; siderite; grunerite; and dolomite

Silicates: quartz; mica; chamosite; and talc

Sulfates: shigaite; and gypsum

Sulfides/sulfosalts: pyrite; jamesonite; and chalcopyrite

Phosphates: apatite

Further collecting and study I am sure will yield many more species as was the case in the Copper Country once collectors began looking at the microcrystals from that area.

THE FOUR TWIN LAWS OF CALCITE (and how to recognize them)

Terry Huizing
Cincinnati, Ohio

There are four, and only four, twin laws known for calcite. The key to recognizing them lies in examining the angles between the twin plane and the c-axis of the sub-individuals that comprise the twin. Typical calcite twins consist of two identical or nearly identical crystals that are joined along a composition plane across which each part is the mirror image of the other. Re-entrant notches are commonly present along the composition surface, providing clues to the presence of twinning.

This presentation will provide information on how to recognize each of the four calcite twin laws.

Inclusions in Minerals

Andrew A. Sicree, Ph.D.
Director, Earth & Mineral Sciences Museum
Pennsylvania State University

For many mineral collectors, the ideal specimen is a well-formed, flawlessly transparent euhedral crystal. Natural crystals, however, are never flawless under the microscope, and often those flaws are large enough and plentiful enough to cloud up an otherwise clear crystal. But for mineralogists concerned with the study of how minerals formed, these flaws are very useful, if they are inclusions.

A mineral is, by definition, a crystalline solid. A single crystal of a mineral ideally consists of a single phase. But within many natural crystals inclusions occur. These inclusions are small zones within the crystal which are composed of a gas phase, a liquid phase, another different mineral phase, or some combination of the three phases.

Inclusions provide mineralogists with data on the temperatures and pressures of mineral formation, the chemistries of the fluids from which crystals formed, and the order in which various minerals formed (their "paragenesis"). The operating assumption is that that which is inside a crystal generally formed before or at the same time as the crystal formed. Thus, for example, rutile inclusions in rutilated quartz are thought to have formed either before the quartz crystal grew or at the same time as the crystal grew. Note that this principle is not universally true because of the possibility of late alteration some crystals, and features such as exsolution lamellae.

Fluid inclusions are small amounts of fluid trapped within crystal during crystal growth. They are common in many minerals. Primary fluid inclusions are those which formed as crystal first grew, while secondary fluid inclusions formed later, typically by healing of cracks or alteration of primary fluid inclusions. Fluid inclusion volumes range $< 10 \mu\text{m}^3$ to $> 1 \text{mm}^3$ and crystals may have > 1 billion FIs per cm^3 . Some FIs contain multiple phases: solids (e.g., halite, sylvite), liquids (e.g., water, petroleum), and gas (e.g. carbon dioxide, water vapor). Although fluid inclusions cannot be seen in opaque minerals they are often present. Fluid inclusions vary in shape and can have rearranged their shapes to become more equant (e.g. "necking down" may occur). Leakage is not common in small inclusions in quartz, calcite, fluorite, sphalerite, but may occur in barite, gypsum. Using a petrographic microscope with a hot-cold stage, FIs can be studied in a variety of transparent crystals, such as quartz, dolomite, calcite, fluorite, cassiterite, sphalerite, barite, and gypsum. Heating inclusions (to the point where gas & liquid become one) yields homogenization temperatures, and cooling inclusions (to their freezing point) yields fluid salinities.

Mineralogy and Mineral Chemistry of Proterozoic Tills in the Upper Peninsula, Michigan

Anne Argast

Dept. of Geosciences, Indiana-Purdue University Fort Wayne, Fort Wayne, IN 46805

Early Proterozoic rocks resting on Archean basement occur in Dickinson County, Northern Peninsula, Michigan. These rocks, called the Chocoday Group, consist of three separate units; an arkose/conglomerate called Fern Creek Formation, an orthoquartzite called Sturgeon River Quartzite, and a dolostone called the Randville Dolomite. These rocks accumulated at the edge of the Archean-aged Superior craton during a time of tectonic quiescence and cratonic stability. These rocks were significantly deformed 1.85 Ga. ago as the volcanic island arc sequence of the Wisconsin Magmatic Terrane collided with the Archean craton, culminating in the Penokean Orogeny.

This study focuses on the specific origins of the Fern Creek Formation and Sturgeon River Quartzite. The origin of the Fern Creek is especially controversial. Some believe the Fern Creek originated as a sediment produced by a mass flow or in a fluvial environment. Others believe the Fern Creek is of glaciogenic origin. This is an important distinction as glacial sediments are reasonably rare megaevents of far-reaching use as a stratigraphic tool. Indeed, one interpretation correlates a possible glaciogenic Fern Creek with similar materials in Fenno-Scandinavia, carrying significant implication for plate distributions ca. 2 billion years ago.

This study uses a combination of bulk chemistry, petrography and detailed mineral analysis using Energy Dispersive X-ray Spectroscopy to evaluate the Fern Creek and Sturgeon River rocks. The analyses show Sturgeon River to be a typical, ultramature quartzite, produced originally as a sandstone in a stable platform environment. The rocks are nearly pure SiO_2 , with minor admixtures of other elements introduced by the detrital mixing of quartz and mica. The heavy mineral suite is restricted to small, well-rounded zircons and tourmaline.

The Fern Creek rocks most likely accumulated as a locally-derived glacial sediment eroded from the underlying Archean gneisses. Compared to the Sturgeon River, they contain much higher concentrations of Na_2O , K_2O , Fe_2O_3 and Al_2O_3 and are, in fact, similar in composition to the underlying gneiss. The Fern Creek sediments do not show evidence of hydraulic sorting of the type expected by fluvial deposition. The heavy mineral suite reveals zircons and tourmalines along with a complex suite of rare earth- and Thorium-bearing minerals that could have been derived from the many pegmatite bodies of the underlying gneiss.

Future work will be directed to understanding the origin of putatively correlative rocks found northward in the U.P. of Michigan. Preliminary analysis of these units reveals interesting similarities – and differences – to the Fern Creek/ Sturgeon River units. The extremely high concentrations of rare earth elements and Thorium also suggest the value of evaluating the source rock gneiss as a possible economic source for these elements.

Efflorescent Minerals - Flowers of the Mineral Kingdom

Nelson R. Shaffer
Indiana University, Bloomington, IN ,47405

At mine sites, outcrops, caves, and even dimension stone walls crusts of earthy or fuzzy efflorescent minerals can often be found. Sometimes copious quantities of colorful efflorescents come and go with the rains. Especially distinctive are yellow, orange, brown or white sulfate growths on black shale; less bright but more wide spread deposits also occur upon limestones. Oxidative weathering of minerals (especially sulfides) charge groundwater with salts which precipitate upon evaporation resulting in large amounts of very fine grained minerals. Analyses of such minerals can tell about hydrological conditions and help with reclamation efforts. Analyses of efflorescent minerals on building stones help diagnose stone stains and assist with remediation. Many speleothems form from efflorescents. Minerals from several groups form efflorescent displays with carbonates, sulfates, oxides, and silicates being the most common. While ephemeral such minerals can affect many geochemical processes and should be considered in any detailed investigation.

FORMS OF QUARTZ FOUND IN INDIANA GEODES AND CHERTS

Henry Barwood
Indiana Geological Survey

Indiana Geodes are known for the wide variety of minerals present in their interiors, but seldom is the quartz comprising the exterior of the geode noted. Recent microscopical studies of geodes and cherts from Mississippian formations in Indiana and adjacent states has revealed considerable variation in the nature of the quartz that more or less defines these geodes. Geodes are generally accepted as the silicified remains of early anhydrite/gypsum nodules that formed under evaporitic conditions in the Mississippian. The occurrence of geodes at this stratigraphic level is very widespread and extends from Iowa to Georgia. Thin sections of geodes show a characteristic sequence of quartz minerals that consist of : 1) banded coarsely spherulitic chalcedony that formed as gel-state replacement of anhydrite/gypsum 2) "cubic" and normal quartz crystals with abundant inclusions of gypsum/anhydrite 3) a thin layer of length-slow chalcedony 4) a layer of gray "zebraic", or twisted, chalcedony. Layers 3 and 4 are often absent and only included quartz crystals are found in the interior. Rarely a later growth of "cubic" quartz is found on the twisted chalcedony layer. Surprisingly little length-slow chalcedony is present considering the supposed evaporitic origin of the anhydrite/gypsum nodules. The geodes are abundant from the Ramp Creek Formation to the top of the Harrodsburg Formation, but are rare elsewhere. They are very rare in the Salem Formation and the overlying St. Louis Formation, which contains evaporite deposits that are mined for gypsum. Examination of chert and silicified fossils from the St. Louis shows that the silica is quite different from that found in the geodes. Gel-state banding is very rare as are crystals with anhydrite/gypsum inclusions. The cherts and especially the silicified fossils contain abundant fine fibrous spherulites and zones of length-slow chalcedony, while twisted chalcedony is virtually absent. These patterns of silicification suggest that the geodes formed in a carbonate ramp environment fed by descending brines from the facies represented by the St. Louis Formation. The anhydrite and gypsum nodules and associated silicification were generated during mixing of the descending brines with anoxic, silica and nutrient-rich basin waters below the mean wave base. Dolomitization and accompanying pyritization generated high pH fluids that precipitated the sulfate minerals and mobilized silica. The silicified anhydrite/gypsum nodules became geodes when the interior sulfates were dissolved and other minerals precipitated in the void.

THE MINERALS AND PARAGENESIS OF THE IRVINGTON, KY - CORYDON, IN FLUORITE AREA

Alan Goldstein

Falls of the Ohio State Park, Jeffersonville, IN

An area of mineralization stretches about 30 miles between Irvington (Breckenridge Co.), Kentucky and Corydon (Harrison Co.), Indiana. Hanson Aggregates Midwest Irvington, Mathes and Corydon Crushed Stone & Lime Co. quarries were investigated and thousands of specimens have been examined. It is dominated by vugs from a few centimeters to 2 meters in length which contain calcite, dolomite and fluorite in the upper St. Louis and lower to middle Ste. Genevieve Limestones of Middle Mississippian (Meramecean) age.

At first glance, the mineralization seems pretty simple. Closer examination reveals complex intervals of dissolution and deposition. There is evidence for repeated precipitation of calcite, dolomite and fluorite over an undetermined length of time. Mineralization is richer in fluorite in the southern portion of the study area. It is possible that fluorine gas migrated from extensions of faults associated with the Rough Creek fault zone.

The current list documented from this area includes: aragonite?, barite, bitumen, calcite*, chalcopyrite, dolomite*, ferroan dolomite, fluorite*, goethite ("limonite"), gypsum (in casts of gypsum or anhydrite), malachite, manganese oxide, marcasite, melanterite, millerite*, pyrite, quartz, and sphalerite. Those with the asterisk (*) occur in well-formed crystals.

This presentation will review the minerals and their paragenesis. It should be considered as a "work in progress." A new quarry has opened up in the study area. While I have been in contact with the company engineer, arrangements for a visit are still pending. This will provide valuable data from the middle of the mineralized area.

FIELD TRIP: C.E. DUFF & SON, INC., QUARRY, HUNTSVILLE, LOGAN COUNTY, OHIO

E.H. CARLSON, DEPARTMENT OF GEOLOGY, KENT STATE UNIVERSITY, KENT OH 44242

TRANSPORTATION, TIME & LOCATION: Field trip participants must provide their own transportation. Take Interstate 70W to Interstate 270N to U.S.33 which skirts Huntsville. The quarry is located about two miles N of Huntsville on the E side of Ohio Rte 117. Its about 70 miles from Columbus and the drive should take about 1.5 hours. Meet at the Scale House at 9:00AM Sunday April 5, 1998. Depending on the weather and collecting we will be at the site until 12:00 or 1:00PM. There are no restrooms at the site.

QUARRY RULES & GEAR: All field trip participants must sign Hold Harmless Agreements. Those participants under 18 years of age must be supervised by a parent or guardian at all times. Hard hats, safety glasses or goggles and boots are required. Participants must stay away from the walls!! Bring rock hammers and collecting bags, and collect from the piles of loose rock on the quarry floor. The quarry floor will likely be wet and muddy.

HISTORY: Operations began in the late 1950's. The quarry has two levels, the lower level being located at the N end of the site. The crushed rock is used mostly as a bed for driveways, roads, and building foundations.

STRATA: The rocks are brown to gray shaly dolostones of the Undifferentiated Salina Group, being Late Silurian (Cayugan) in age (Janssens, 1971). A section about 43 feet thick is exposed in the faces of the upper level, and an additional 25 feet in the lower level. The paleoenvironment of the Salina Group beds was supratidal to intertidal with very saline waters. Nodules of gypsum once present in the Salina rocks were dissolved selectively, forming spheroidal-shaped vugs whose walls are now lined with pyrite and other minerals. Fossils are rare.

GEOLOGIC STRUCTURE: The quarry lies near the crest of the Cincinnati-Findlay Arch, where the strata are nearly flat-lying.

MINERALS: The site is renowned for well-formed diploidal crystals of brassy pyrite that were first noted by Fisher (1975) and later documented by Richards and Chamberlain (1987). Cubic crystals of fluorite (light yellow and dark brown), white crystals of saddle dolomite, colorless rhombohedral crystals and white cleavage plates of calcite, and small crystals of ruby sphalerite with curved faces are present also. Pyrite collecting always has been best in the SE part of the quarry.

REFERENCES:

Fisher, H.H., 1975, Trapezohedral pyrite in Ohio. *Rocks & Minerals*, v. 51, p. 293.

Janssens, A., 1971, Preliminary report on the stratigraphy of Upper Silurian rocks of western Ohio, in J.L. Forsyth, ed., *Geology of the Lake Erie islands and adjacent shores*. Guidebook for annual field excursion, Michigan Basin Geological Society, p. 30-36.

Richards, R.P. and Chamberlain, S.C., 1987, Pyrite crystals from the Duff quarry. *Mineralogical Record*, v. 18, p. 391-398.

Swinford, E.M., 1995, Huntsville 7.5 Minute Geologic Quadrangle Map. Ohio Division of Geological Survey, Bedrock Geology Map Series.