STATE OF ARKANSAS

ARKANSAS GEOLOGICAL COMMISSION

Norman F. Williams, State Geologist

GUIDEBOOK:

ECONOMIC GEOLOGY OF CENTRAL ARKANSAS

Society of Economic Geologists
Field Trip No. 2
February 28 March 1, 1986

By

ARKANSAS GEOLOGICAL COMMISSION
With the assistance of:

Samuel A. Bowring
Ralph L. Erickson
J. Michael Howard
Leendert G. Krol
A. Wallace Mitchell
B. G. McNish
Don R. Owens
Charles G. Stone

Prepared by

THE ARKANSAS GEOLOGICAL COMMISSION
3815 West Roosevelt Road
Little Rock, Arkansas 72204

February, 1986

Reprinted with revisions, 1987

STATE OF ARKANSAS
Bill Clinton, Governor

ARKANSAS GEOLOGICAL COMMISSION
Norman F. Williams, State Geologist

COMMISSIONERS

C. S. Williams, Chairman .... Mena

David Baumgardner .... Little Rock

John Gray .... El Dorado

John Moritz .... Bauxite

Dorsey Ryan .... Ft. Smith

W. W. Smith .... Black Rock

Dr. David Vosburg .... State University

CONTENTS

ALCOA BAUXITE MINE, SALINE COUNTY, ARKANSAS*

by

Staff, Arkansas Geological Commission

Bauxite, the major ore of aluminum, was first identified in Arkansas by John C. Branner, State Geologist, in 1887, and has been mined commercially since 1899. Arkansas bauxite production in 1972 was over 2.0 million tons and for many years Arkansas has produced more than 90 percent of the domestic bauxite in the United States. At present the primary use of Arkansas bauxite is for making alumina chemicals. Other important uses are for abrasives, refractories, and alumina cements. Alumina is produced at Alcoa's plant.

In addition, there are three minor producers. The American Cyanimid Company and Stoufer Chemical mine and ship high grade dried bauxite and kaolinite clay to the chemical and abrasive industry, and the Porocel Corporation processes bauxite for the chemical industry.

The bauxite deposits are centered around intrusives of nepheline syenite. The nepheline syenites, and related igneous rocks of Late Cretaceous age, were intruded into highly folded Paleozoic beds. Subsequent erosion exposed parts of the intrusives to weathering and to partial burial later by sediments of Tertiary age. The bauxite deposits of central Arkansas are the result of lateritic weathering of the nepheline syenite during early Eocene times.

According to Gordon, Tracey, and Ellis (U.S. Geological Survey Prof. Paper 299), the bauxite deposits can be classified into four types:

(1) Residual deposits on the upper slopes of partly buried nepheline syenite hills.
(2) Colluvial deposits at the base of the Berger Formation (lowermost formation of the Wilcox Group of Eocene age).
(3) Stratified deposits within the Berger Formation.
(4) Conglomeratic deposits at the base of the Saline Formation (a formation in the Wilcox Group just above the Berger Formation).

Bauxite in the various mines differs considerably in its character and physical properties. Most of the bauxite is pisolitic, and ranges from very hard to soft and earthy. Generally, it is hard at the top of a deposit, firm to mealy in the middle, and clayey though not plastic at the base. In color it ranges from a light gray through tan and brown to red. Color is not necessarily an index of grade nor of the amount of iron present, as some of the brick-red bauxite has very little iron. The principal mineral in the bauxite is gibbsite (aluminum trihydrate). The chief impurities are silica, iron, and titanium. A significant concentration of gallium is present and can be recovered as a valuable by-product. Possibly in the future other by-products of alumina production and other alumina sources within the bauxite area may be utilized.

Briefly these possibilities are:

(1) Recovery of titanium, iron, and columbium from the black sands and red muds which are waste products from the alumina plant.
(2) Recovery of both the iron and alumina from the large deposits of high-iron bauxite.
(3) Recovery of alumina from the vast deposits of high-alumina clays associated with

***Adapted from: Arkansas Geological Commission, 1973, Field trip guide to four major mines in central Arkansas: Arkansas Geological Commission Guidebook GB 73-4, p. 3-4.**

the bauxite deposits (estimated to total over 100 million tons).

The A. P. Green Refractories Co. mines kaolinite clay that is found associated with the bauxite deposits for production of high heat duty clay refractories.

Bauxite reserves in the area are estimated at about 60 million long tons averaging 50 percent alumina and 10 percent silica, but assuming no cutoff on iron. Of this total about 56 million tons occur in Saline County and 4 million tons in Pulaski County.

References Cited

Gordon, MacKenzie, Jr., Tracey, J. I., Jr., and Ellis, M. W., 1958, Geology of the Arkansas bauxite region: U. S. Geological Survey Professional Paper 299, 267 p.

PRAIRIE CREEK KIMBERLITE (LAMPROITE)

by

L. G. Krol
Consulting Geologist
10040 E. Grand Avenue
Englewood, CO 80111

The Prairie Creek peridotite pipe (73 acres), situated in Pike County, Arkansas, has been the site of the only commercial diamond mine in the United States. It had been recognized as a peridotite since 1842 when it was first cited by W. B. Powell (Miser & Ross, 1923). In 1889, after the discovery of diamond-bearing peridotites in South Africa, later named kimberlite, Branner and Bracket realised the significance of the Prairie Creek pipe. However, it was not until 1906 that John W. Huddleston found the first diamonds near the mouth of Prairie Creek.

Since that time other smaller kimberlite bodies such as those at the American Mine and Kimberlite Mine, and others at Black Lick and Twin Knobs were discovered (fig. 1). Various efforts have been made to mine these bodies but, due to lack of adequate funding and experience, all failed sooner or later. The latest efforts were made by the Bureau of Mines in 1943-1944 and by the Glenn L. Martin Co. (the aircraft manufacturer) in 1948-1949. During the latter operation at Prairie Creek approximately 125,000 short tons of kimberlite were treated with a disappointing recovery of only 246 carats. A company report stated that the extraction methods were not satisfactory and recommended numerous changes and alterations in mill design. However, after costly renegotiations the company decided to give up on this diamond venture.

At that time the Prairie Creek property was owned by Howard Millar and after failing to attract further interest, he converted the area into a tourist attraction. Finally, in 1972, the Arkansas Department of Parks and Tourism bought the property and made it a State Park (fig. 2) where the public can look for diamonds in exchange for a minimal entrance fee. Since the park was opened to the public in 1972, it has been visited annually by 60,000 – 90,000 people. Several hundreds of stones are found each year, culminating in a record 1501 stones in 1983.

In addition to the production reported by the Glenn L. Martin Company, the following production figures have been reported for earlier operations (Fuller and St. Clair, 1956) during the period 1907-1930.

Kimberlite treated (MT)	57,868
Number of diamonds recovered......	14,026
Total wt. in carats (1 carat=0.2 gram) ..	7,845
Grade (carats/100MT)..............	13.56

The many modern improvements on recovery techniques and the resulting ability to recover smaller diamonds can possibly raise this grade significantly.

Estimates of how many diamonds have been produced from this area range from a conservative 25,000 stones registered by diamond buyers in New York up to the year 1940, to a very liberal figure of 300,000, including all illicit stones. A safe estimate is that approximately 50,000 stones have been produced to date. Some of the more famous are:

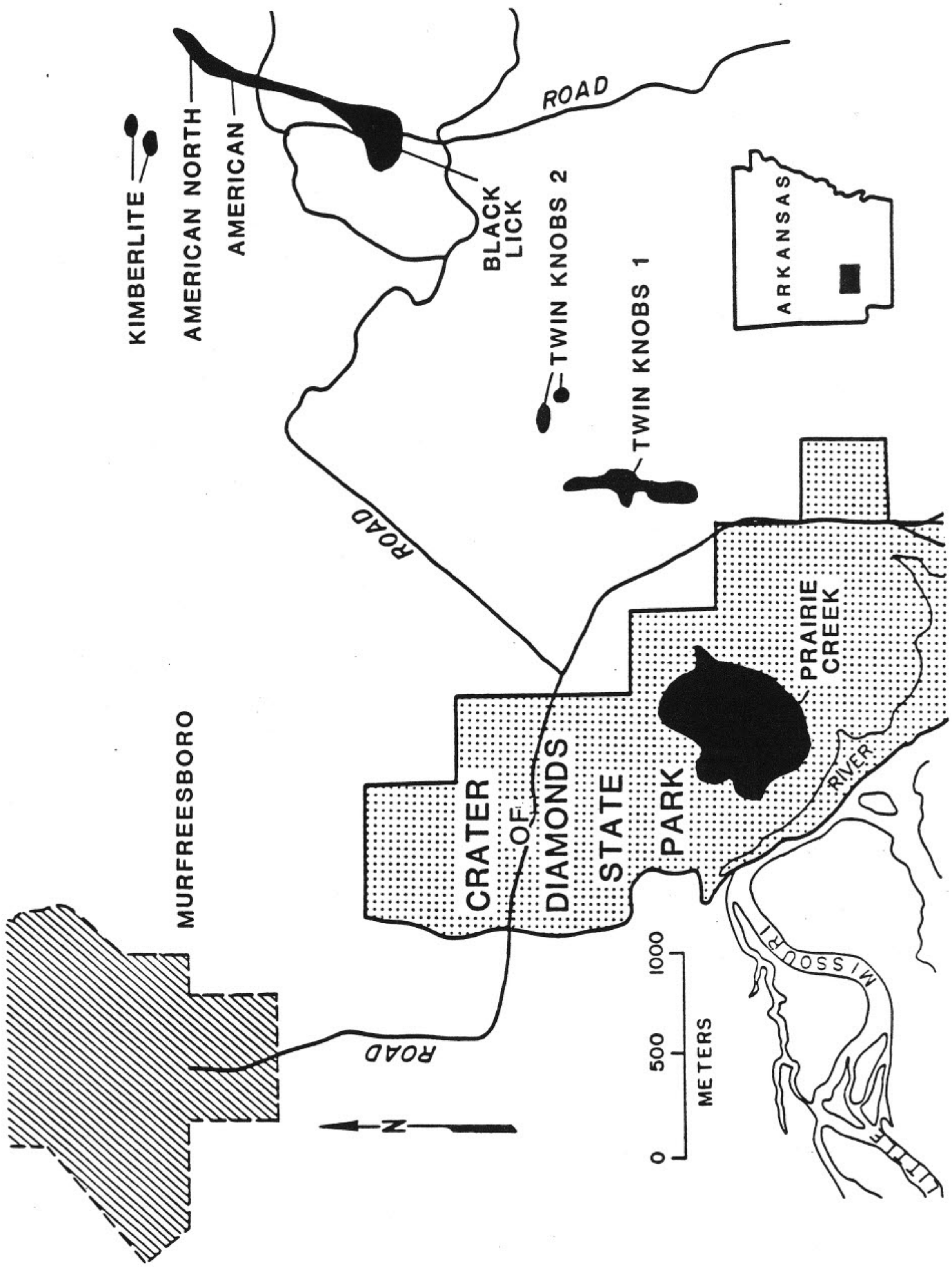


Figure 1. – Location of kimberlite (lamproite) bodies in Pike County, Arkansas. (From Michael A. Waldman et al., 1985.)

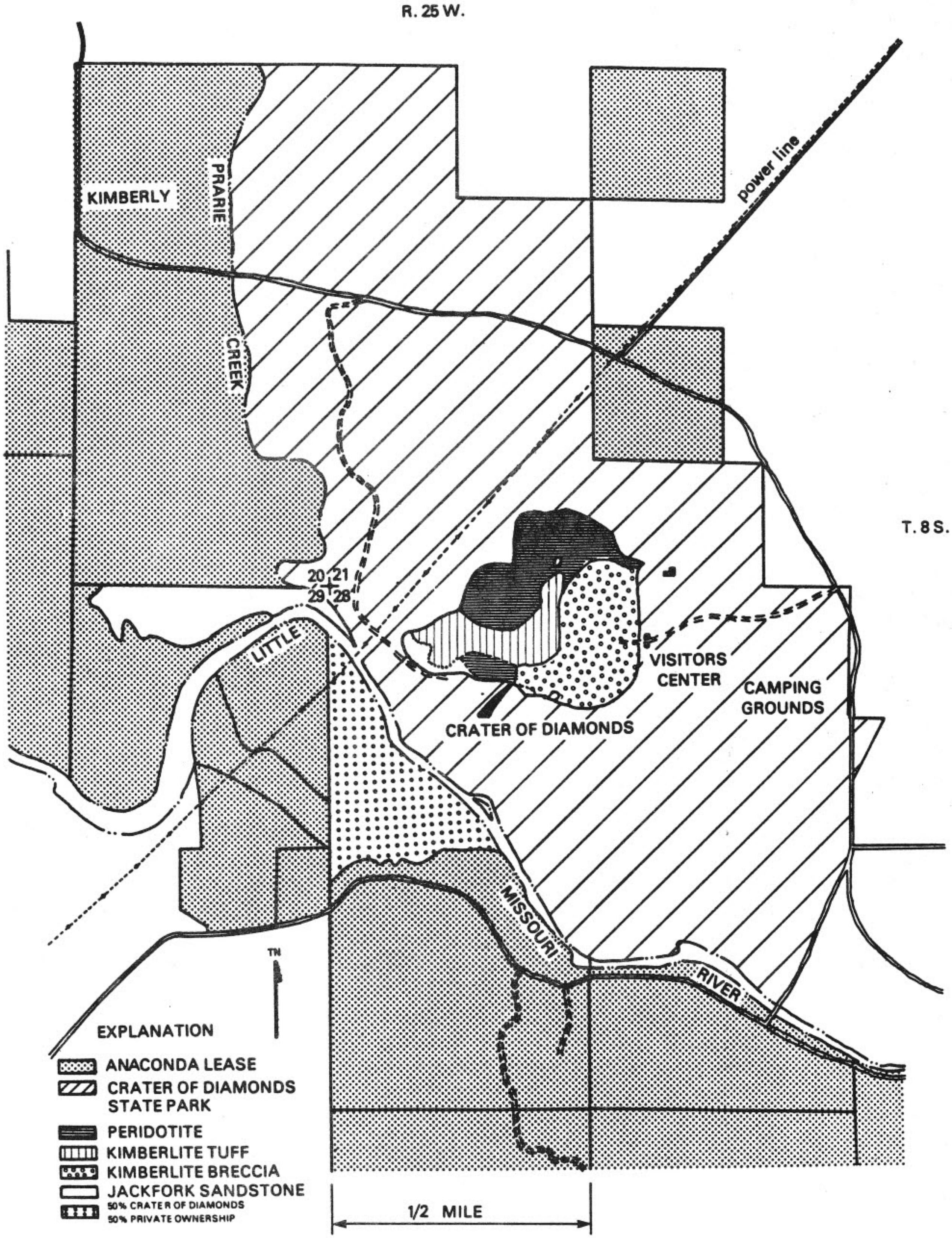


Figure 2. – Geology, land ownership, and lease holdings in the Prairie Creek area, Pike County, Arkansas.

1. The Uncle Sam (1924)	40.42	carats
2. Star of Murfreesboro (1964)	34.25	"
3. Amarillo Starlight (1975)	16.37	"
4. Star of Arkansas (1956)	15.31	"
5. Gary Moore (1960)	6.43	"
6. Eisenhower (?)	6.11	"
7. unnamed (1981)	6.07	"
8. " (1983)	3.02	"

During the last decade several major mining companies, convinced of the potential of the Prairie Creek deposit, renewed their interest in the pipe and surrounding areas. Although some extensions of known kimberlite bodies were established, no major new discoveries were made. A proposal to evaluate the Prairie Creek pipe, put forward by one company in 1981, was turned down by the Department of Parks and Tourism and several later efforts also failed.

The Prairie Creek pipe has always been described as a micaceous peridotite or kimberlite intrusion because of the presence of diamonds, its peridotite composition, and its texture. Although it was recognized that the intrusion was not a true kimberlite (Lewis, 1977; Bolivar, 1977) because of the lack or rarity of picroilmenite, pyrope, chrome-diopside and enstatite, it took the discovery of diamond-bearing ultrapotassic lamproites in Western Australia before it was established by Scott Smith and Skinner (1984b) that the Prairie Creek pipe has a closer affinity to the Western Australian olivine lamproite than to kimberlite. This is summarized in the following abstract by Scott Smith and Skinner (1984a):

"A new look at Prairie Creek, Arkansas"

"Previous studies of the Prairie Creek occurrence have identified three main rock types namely: "volcanic breccias", "tuffs and fine-grained breccias" and "hypabyssal kimberlite or peridotite". Our investigation confirms the presence of three distinct rock groups which include both magmatic and crater-facies types. The so-called "volcanic breccias" and "tuffs" are both considered to be predominantly of pyroclastic origin. Many features of these rocks are atypical of kimberlite and indicate a complex intrusion history. The magmatic rocks contain two generations of relatively abundant olivine in a fine-grained matrix composed of phlogopite, clinopyroxene, amphibole, perovskite, spinel, serpentine and glass. Although some petrographic features of these rocks are similar to those of kimberlites, the form of the euhedral olivine, presence of abundant glass and occurrence of potassic richterite are uncharacteristic of kimberlite but typical of lamproitic rocks. Both the groundmass phlogopite and the bulk rock have compositions intermediate between known lamproites and kimberlites. The data presented here shows that the Prairie Creek intrusion is not a kimberlite. Although in many respects Prairie Creek appears to be transitional between kimberlite and lamproite, it is considered that these rocks form an extension of the lamproite field."

The Arkansas lamproites are probably emplaced along mantle-tapping structures associated with the long-active Mississippi embayment rift system. This is suggested by the northeast alignment of the bodies parallel to the trend of the rift system. The more northerly trend within some of the lamproite bodies reflects a near-surface structural control.

A more detailed description of the geology, petrology and mineralogy of the Prairie Creek lamproite prepared by Meyer and Lewis for the Second International Kimberlite Conference field excursion is attached together with a paper on diamondiferous lamproites by Scott Smith and Skinner* and some additional information on kimberlites and lamproites.

***Editor's note: Both papers will be handed out as separates to attendees of Society of Economic Geologists Arkansas field trip, March 28-April 1, 1986.**

References Cited

Bolivar, S. L., 1977, Geochemistry of the Prairie Creek, Arkansas and Elliott County, Kentucky intrusions [Ph.D. thesis]: Albuquerque, University of New Mexico, 286 p.

Branner, J. C., and Brackett, R. N., 1889, The peridotite of Pike County, Arkansas: American Journal of Science, v. 38, p. 50-59.

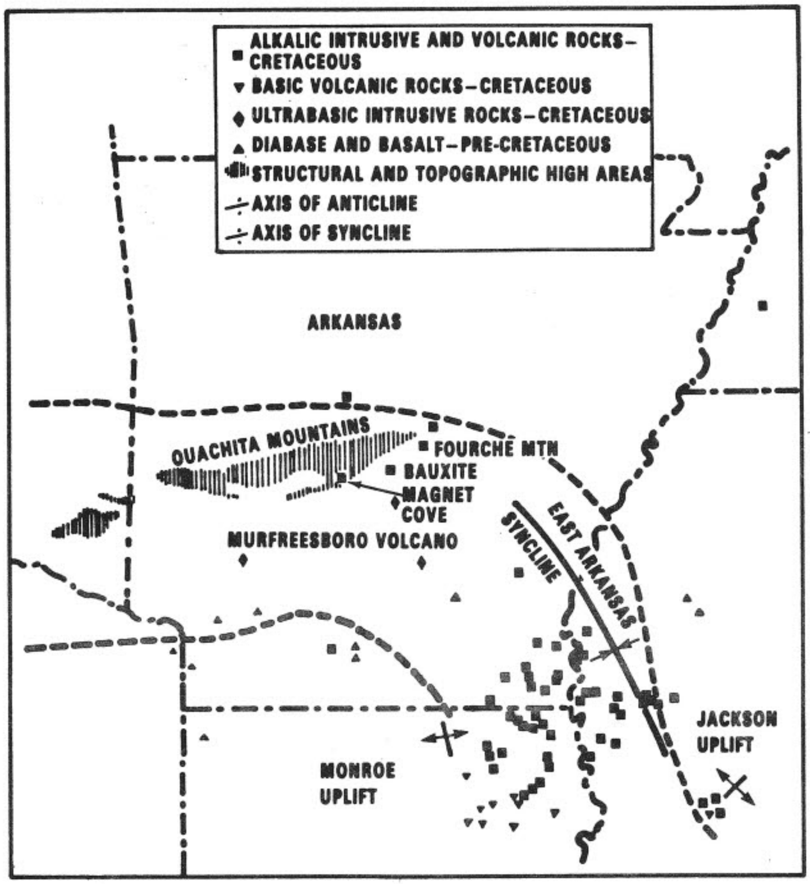
Lewis, R. D., 1977, Mineralogy, petrology and geophysical aspects of Prairie Creek kimberlite near Murfreesboro, Arkansas [M.S. thesis]: West Lafayette, Indiana, Purdue University, 161 p.

Miser, H. D., and Ross, C. S., 1923, Diamond-bearing peridotite in Pike County, Arkansas: U. S. Geological Survey Bulletin 735, p. 279-322.

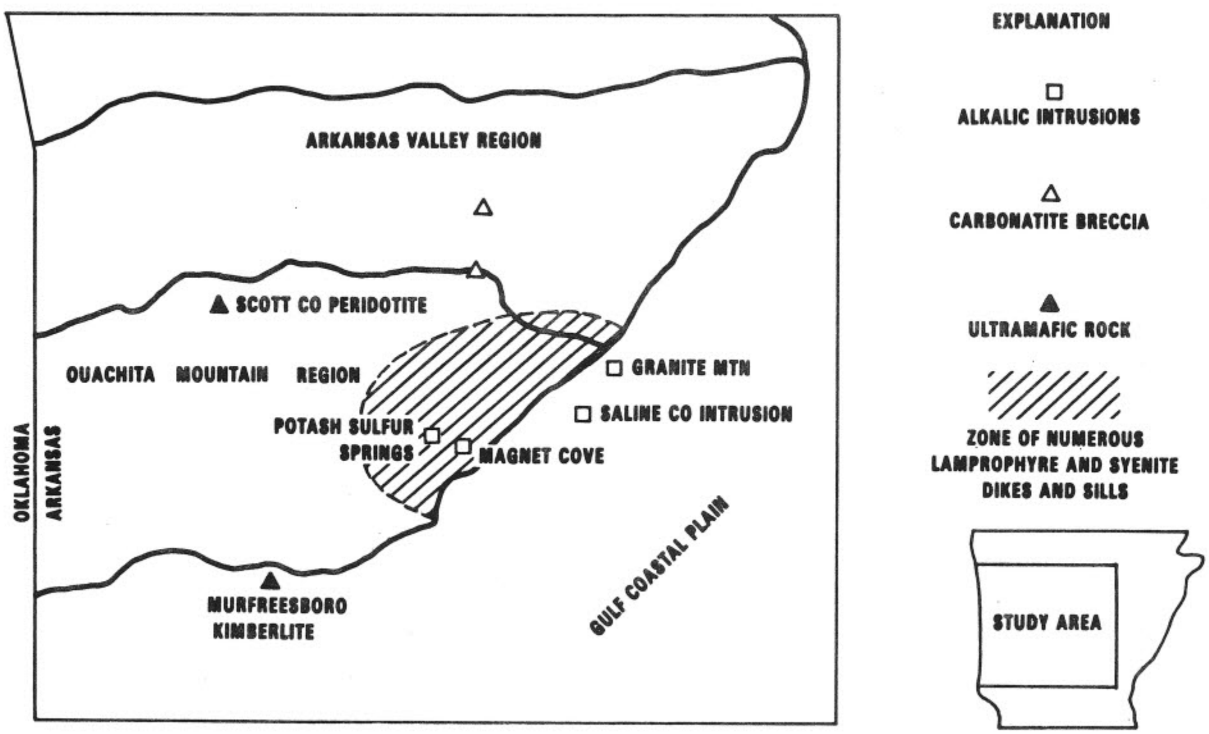
Scott Smith, B. H., and Skinner, E. M. W., 1984a, A new look at Prairie Creek, Arkansas, *in* Kornprobst, J., ed., Kimberlites and related rocks: Proc. of Third International Kimberlite Conference., v. 1, p. 255-284.

________________, 1984b, Diamondiferous lamproites: Journal of Geology, v. 92, p. 433-438.

Supplemental → *Material*



THE ARKANSAS ALKALIC PROVINCE



EXPOSED INTRUSIVE IGNEOUS ROCKS IN ARKANSAS

DIAMOND USES

INDUSTRIAL USES

Due to unique mechanical & physical properties — hardness, inertness, compressive strength, abrasion resistance, thermal conductivity

- O Abrasive — lapping, polishing, grinding, sawing, drilling: 95% industrial diamond consumption
- O Window — optical transmission properties: used in high P experiments, IR work & X-ray studies. Type II A stones transmit light from UV (.22 μm) to IR (3.7 μm and >6)
- O High pressure cells — generating & transmitting diamond anvils (1959)
- O Biology & medicine — diamond knives: cut 100-nm-thick sections
- O Radiation detector — flourescent when encountering ionizing radiation
- O Thermistor — resistivity of type IIB stones varies with temperature
- O Heatsinks — microwave diodes
- O Wire-drawing dies — tooling

COSMETIC USES

- O Gemstones, pieces of adornment

DIAMOND-BEARING ROCKS

KIMBERLITE

Ultrabasic rock with a porphyritic texture made up of megacrysts of olivine, enstatite, chrome-diopside, pyrope, picroilmenite, zircon and phlogopite set in a finer matrix of which serpentine, carbonate, phlogopite, magnetite and perovskite form the major constituents.

LAMPROITE

Ultramafic igneous rock rich in potassium and magnesium. Distinguished from kimberlites by the presence of amphibole, leucite and priderite, and general absence of the kimberlitic indicator minerals pyrope and ilmenite.

ALLUVIALS

Fluviatile and marine gravels derived from the above rock.

METEORITES

Irons, ureilites & impact structures

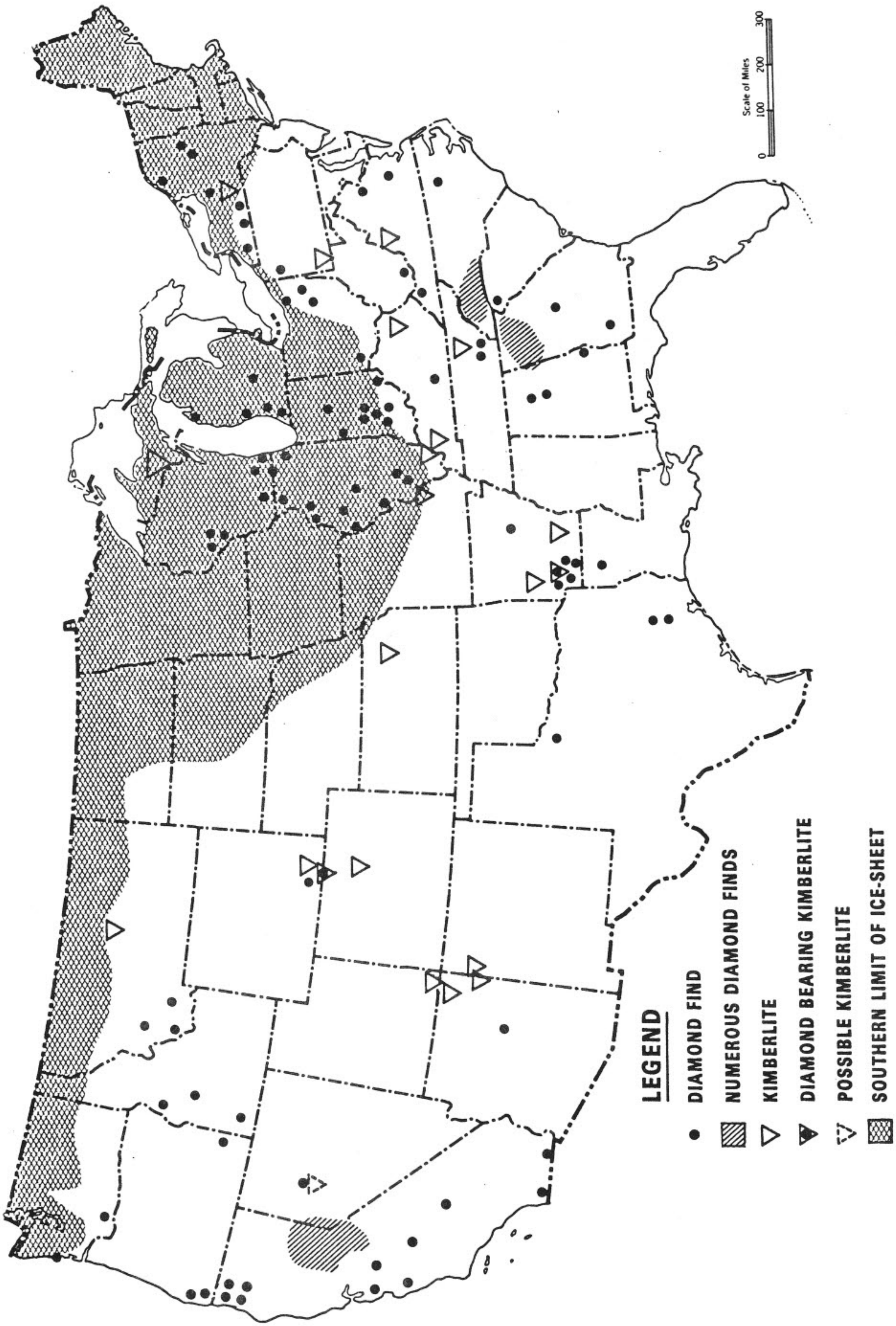
DEBATABLE OCCURRENCES

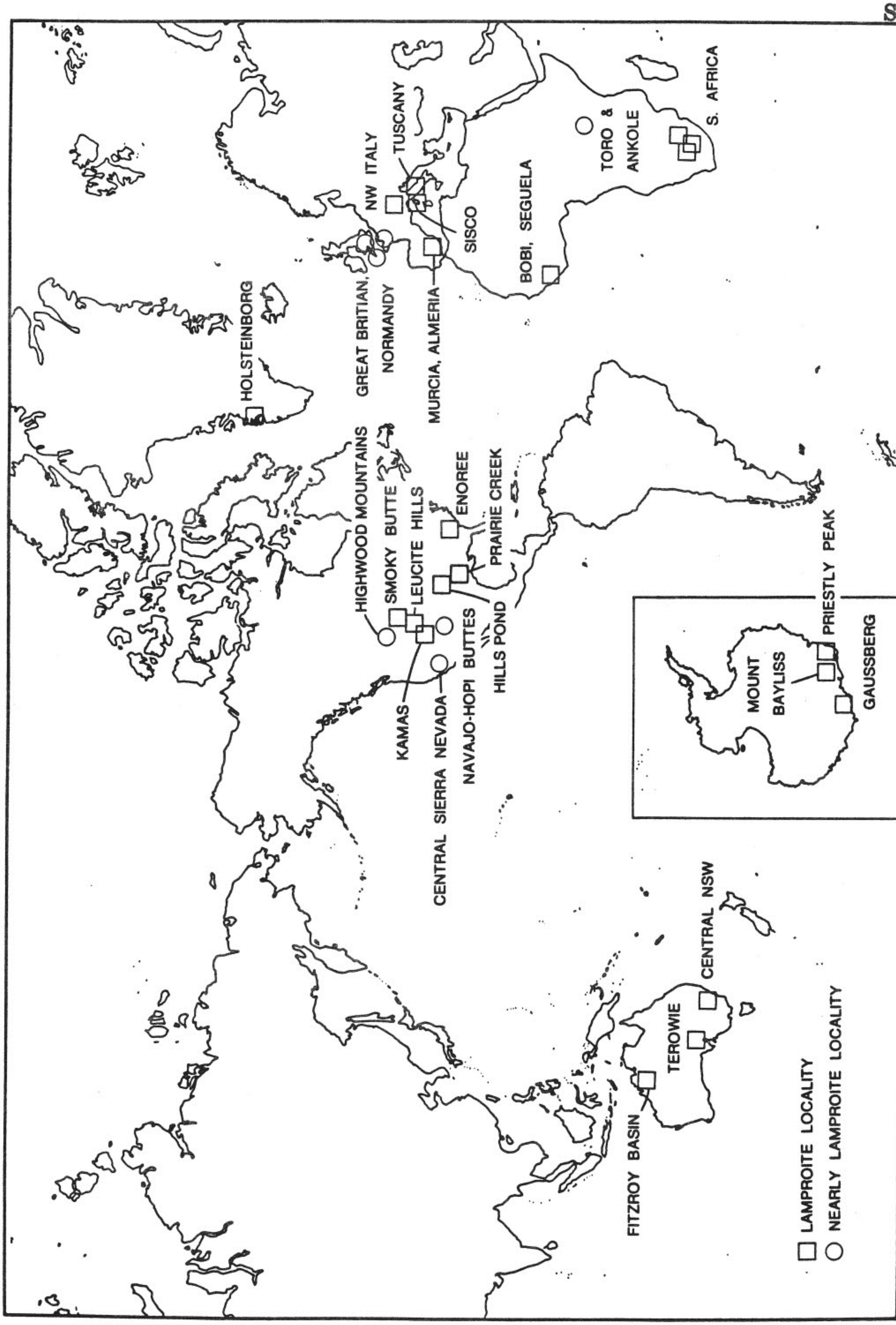
Alkali Basalts } Russia
Ophiolites }
Andesite — Indonesia

KIMBERLITES VS. LAMPROITES

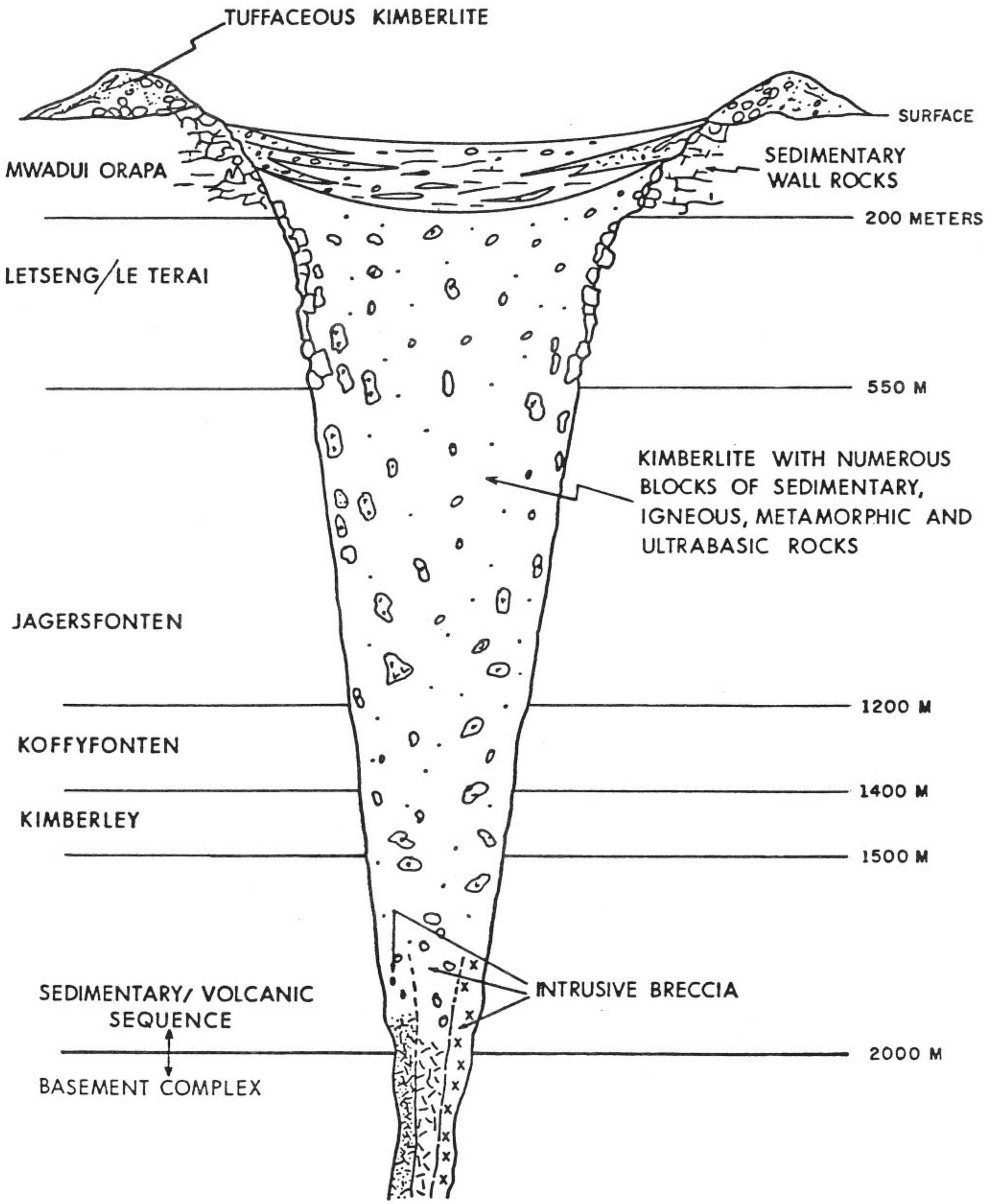
	KIMBERLITES	LAMPROITES
Occurrence	Cratons	Craton margins
Pipe morphology	Carrot	Champagne glass/funnel
Volatile content	High	Low
Volatile comp. $CO_2/(CO_2+H_2O)$	High	Low
Lava flows	No	Yes
Composition		
SiO_2	< 40 wt. %	> 40 wt. %
MgO	> 16	< 16
K_2O	< 5	> 5
Al_2O_3	< 6	6-12
Pyrope	Abundant	Rare
Ilmenite	Abundant	Rare
Leucite	Absent	Common
K-Richterite	Rare	Common
Primary Carbonate	Yes	No
Diamonds	Yes	Yes
Plagioclase	No	No
K-Feldspar	No	Yes

OCCURRENCES OF KIMBERLITES AND DIAMONDS




HOLSTEINBORG
GREAT BRITIAN,
NORMANDY
MURCIA, ALMERIA
NW ITALY
TUSCANY
SISCO
BOBI, SEGUELA
TORO &
ANKOLE
S. AFRICA
HIGHWOOD MOUNTAINS
SMOKY BUTTE
LEUCITE HILLS
ENOREE
PRAIRIE CREEK
HILLS POND
NAVAJO-HOPI BUTTES
CENTRAL SIERRA NEVADA
KAMAS
PRIESTLY PEAK
MOUNT
BAYLISS
GAUSSBERG
CENTRAL NSW
TEROWIE
FITZROY BASIN
LAMPROITE LOCALITY
NEARLY LAMPROITE LOCALITY

KIMBERLITE PIPE MODEL



BARITE IN THE WESTERN OUACHITA MOUNTAINS, ARKANSAS

By

A. Wallace Mitchell
Consulting Geologist
Glenwood, Arkansas 71943

Barite or $BaSO_4$, a heavy nonmetallic mineral used primarily as a weighting agent in drilling for petroleum, has been identified at several localities on the south flank of the Ouachita Mountains (Fig. 1). The largest, Chamberlain Creek, is located near Magnet Cove on the east end of the Mazarn basin (Fig. 2). This property for a number of years was the largest producing barite mine in the world. On the west end of the Mazarn basin several barite occurrences have been identified west and north of Hopper, Arkansas in the Fancy Hill district. They are known as the Fancy Hill (Henderson), McKnight, Dempsey Cogburn, and Gap Mountain deposits. Barite also occurs near Pigeon Roost Mountain northeast of Glenwood and near Hatfield and Dierks, Arkansas.

The properties near Hatfield occur in the Middle Division of the Arkansas Novaculite as small stratabound lenses of coarsely crystalline black to gray-green barite. There are similar occurrences at Boone Springs and Polk Creek Mountain northwest of Fancy Hill. The occurrences at Dierks are Cretaceous gravels and sands cemented by barite. All of these latter barite occurrences seem to have limited economic potential so discussion in this paper will concentrate on the bedded barites at Fancy Hill, McKnight, Dempsey Cogburn, and Gap Mountain.

Regional Stratigraphic Relationships

The commercial bedded barite deposits of the western Ouachita Mountains are restricted to the lower 100 feet of the Stanley Shale immediately overlying the Arkansas Novaculite (Fig. 3). The novaculite is on the order of 900 feet thick in this area and consists of three units. The Lower Division is between 250 and 400 feet thick. The Middle Division is 210 feet thick at Fancy Hill, 390 feet thick at Gap Mountain, and 364 feet thick at Caddo Gap. The Upper Division is 70 feet thick at Fancy Hill, 120 feet thick at Gap Mountain, and 118 feet thick at Caddo Gap. The upper surface of the Novaculite in this area is an 18 inch thick rubbly broken zone, in places cemented by pyrite (Fig. 4). This zone is very well displayed at the Dempsey Cogburn mine on the exposed Novaculite wall and also at Chamberlain Creek. On a regional scale this stratigraphic horizon is represented by a chert pebble conglomerate of greatly varying thickness. At Hot Springs the zone is the Hot Springs Sandstone Member, which is mapped in the basal Stanley Shale. In the western Ouachitas the zone is from zero to 25 feet thick and consists of chert or novaculite clasts, usually one inch or less in size, in a siliceous matrix.

Above the Novaculite is the Stanley Shale, an approximately 6000-foot-thick (Scull, 1958) turbidite sequence of shale and sandstone. It represents a radical change in depositional character from the Novaculite. Deposition changed from the very slow accumulation of mud to a rapid accumulation of turbidites with perhaps a ten-fold increase in the rate of accumulation. The lower 100 feet of the Stanley, where the barite occurs, is primarily shale, but some lenses of dense gray sandstone are present, and they increase

***Reprinted from: Stone, C. G., and Haley, B. R., 1984, A guidebook to the geology of the central and southern Ouachita Mountains, Arkansas: Arkansas Geological Commission Guidebook 84-2, p. 124-131.**

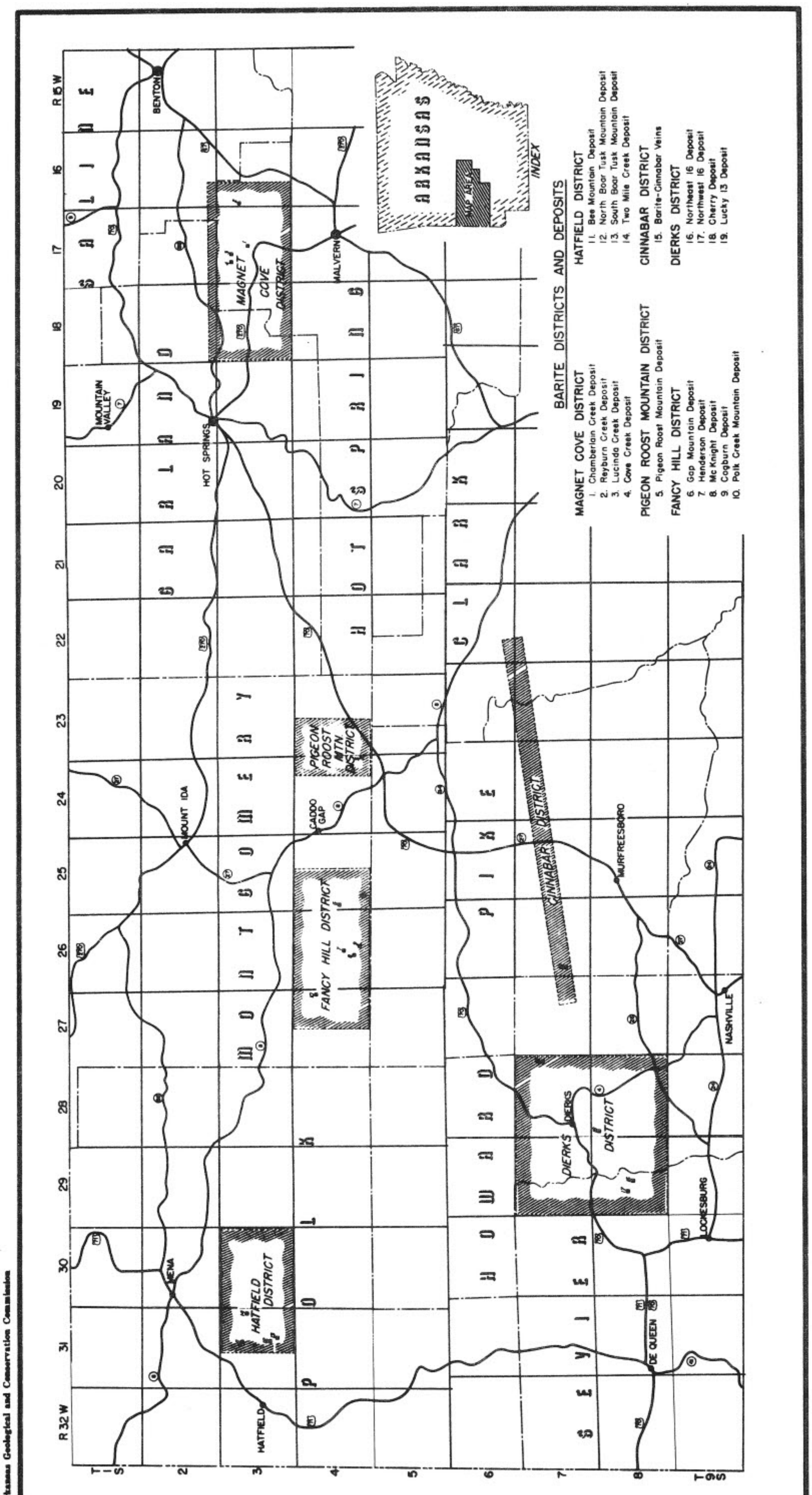


Figure 1. – Location map showing barite districts and larger known deposits in the Ouachita Mountains, Arkansas (from Scull, 1958).

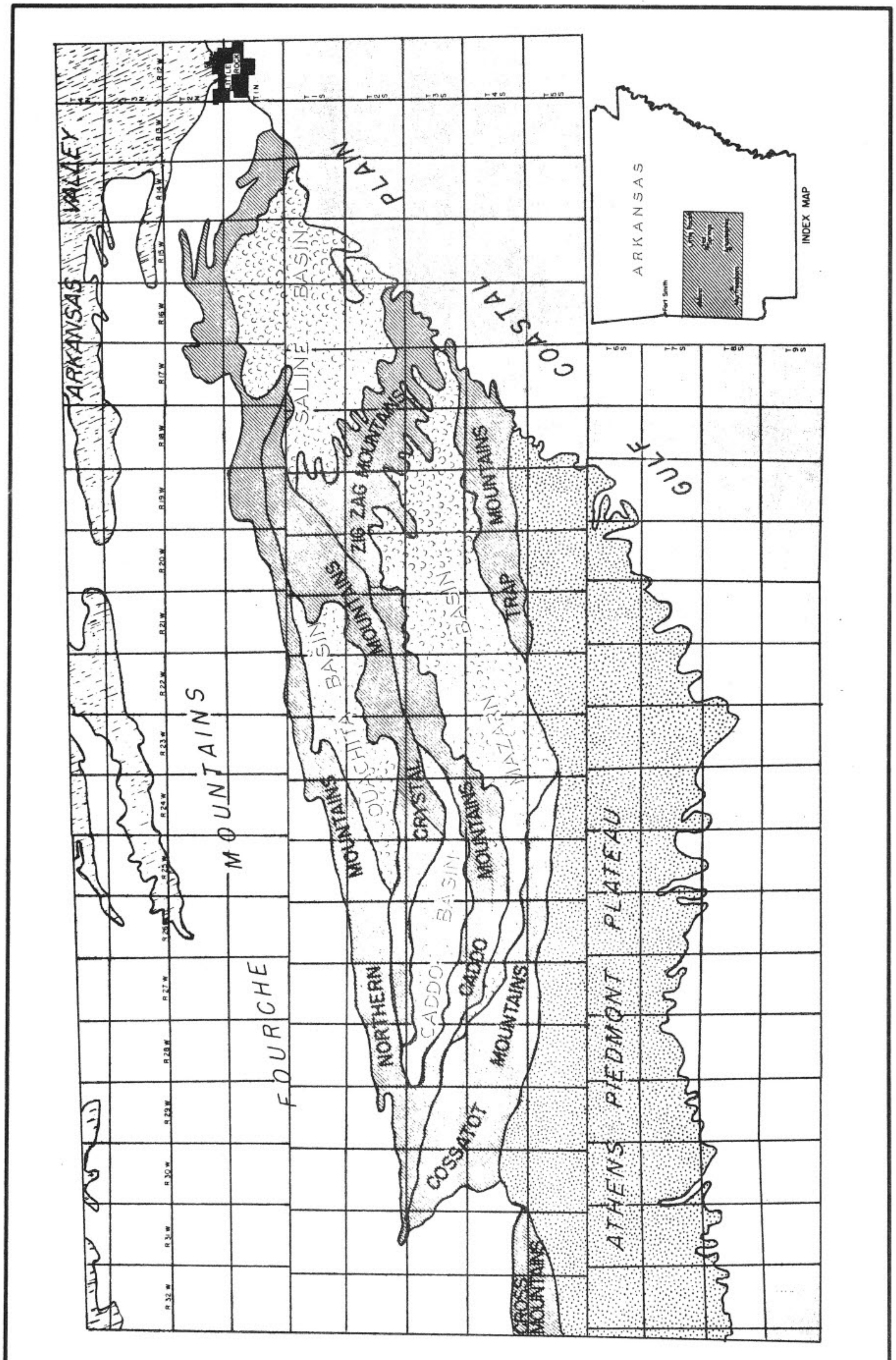


Figure 2. — Map showing physiographic provinces in the Ouachita Mountains, Arkansas (from Scull, 1958).

Mesozoic

Upper Cretaceous

Woodbine formation—tuffaceous sands and clays

Lower Cretaceous

Trinity formation—Pike gravel member at base, overlain by loosely consolidated sandstones with Dierks and DeQueen limestone lentils, some gypsum and celestite beds, maximum thickness 600 feet.

Paleozoic

Pennsylvanian

Jackfork sandstone—thick massive sandstone units separated by thinner and less extensive shale units, maximum thickness 6000 feet.

Mississippian

Stanley formation—gray-green weathering dark gray shale with thick siltstone and sandstone members, locally tuff beds near base, maximum thickness 6,000 feet.

Devonian-Mississippian

Arkansas novaculite

Upper Division—tan to gray massive calcareous novaculite, locally quartzitic, maximum thickness 120 feet.

Middle Division—thin-bedded dark colored novaculite and shale, maximum thickness 450 feet.

Lower Division—white to gray, dense, thick-bedded novaculite, maximum thickness 450 feet.

Devonian

Missouri Mountain shale—black, green and red fissile shale, maximum thickness 300 feet.

Silurian

Blaylock sandstone—tan to gray, fine to medium-grained, thin to medium-bedded quartzitic sandstone, intercalated gray to black graptolitic shale, maximum thickness 1500 feet.

Ordovician

Polk Creek shale—contorted and crumpled black graptolitic shale, maximum thickness 300 feet.

Bigfork chert—gray to black medium-bedded chert, thin black graptolitic shale partings, strongly crumpled, maximum thickness 800 feet.

Table 1. – Stratigraphic column for the Ouachita Mountains, Arkansas (from Scull, 1958).

Figure 4. — Novaculite breccia at the top of the Upper Division of the Arkansas Novaculite at the Dempsey Cogburn mine. The face on the right is a cross fault showing novaculite below the breccia zone.

upward from the barite.

One interesting stratigraphic relationship in this area which should be mentioned is the rapid thinning of the Blaylock Sandstone. Just south of the Dempsey Cogburn mine the Blaylock is about 600 feet thick and only three miles north it is absent.

Structure

The rocks are folded into a series of tight isoclinal folds which trend east-west. South of Fancy Hill the folds have broken along axial planes into a series of stacked thrust sheets which repeat the section several times. The sheet containing barite south of Fancy Hill appears to have torn into several pieces. Seismic work has shown that the barite on Fancy Hill forms a synclinal trough in the Back Valley to the south (Fig. 5).

The rapid thinning of the Blaylock from 600 feet to zero in three miles indicates that a growth fault was present through this area during Silurian time. Another indication of a possible deep structure is the presence of hot springs at Caddo Gap, also two miles southwest of Caddo Gap, and 3½ miles west of Fancy Hill. There are also two igneous dikes in the area, one at Pigeon Roost Mountain and in Long Creek near the last hot spring mentioned.

The presence of the barite, hot springs, dikes, and the thinning Blaylock all seem to point strongly toward a growth fault, which was active during Silurian time and reactivated at the end of Novaculite time. This reactivation caused the brecciation of the upper surface of the Novaculite and provided the conduit for hydrothermal fluids which precipitated sulfides in the form

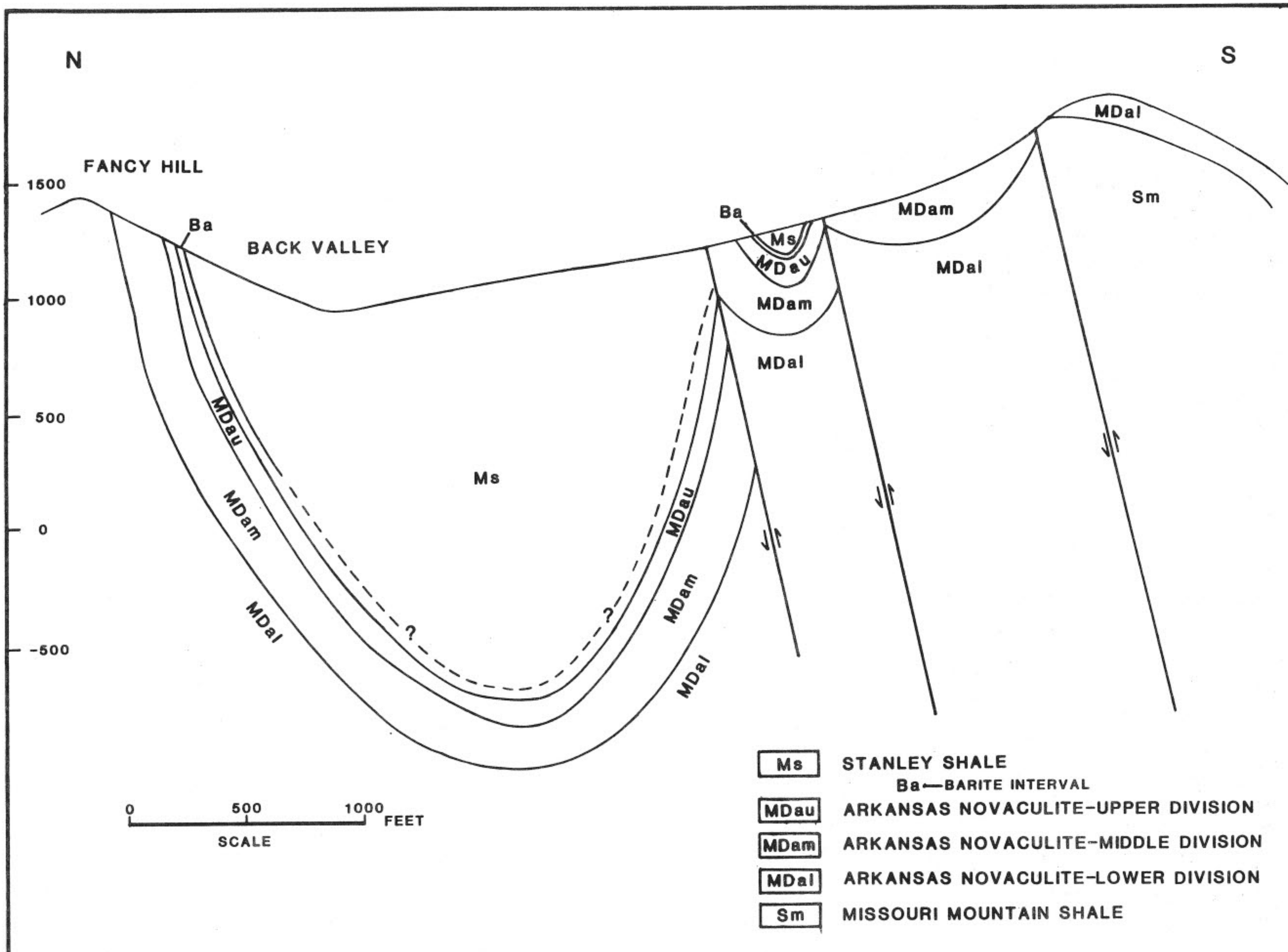


FIGURE 5: Section across Back Valley showing the generalized geology of the area (modified from E. F. Lawrence).

of pyrite, and later, barite. The growth fault also provided the relief necessary to form the chert pebble conglomerates and the Hot Springs Sandstone which probably accumulated as lobes at the base of canyons cutting across the escarpment (Fig. 6). Since this growth fault was a zone of weakness, it probably broke as a thrust fault during compression, and therefore cannot now be identified.

Orebodies

The barite deposit at Fancy Hill follows a nearly straight line along the south side of Fancy Hill for over 9000 feet and dips to the south at 80 degrees. A series of north-east trending cross faults of generally small displacement have offset the beds from one to ten feet, but in a few places much larger displacements can be seen.

The footwall of the deposit is primarily shale, 2 to 50 feet thick. On the east end barite rests on sandstone. The shales in places are highly carbonaceous and pyritic. Above the barite 10 to 40 feet of shale are overlain by gray sandstones.

The barite zone averages 15 or 20 feet in thickness, but varies from 0 to 40 feet. Three types of barite are common in the ore: (1) massive, finely crystalline gray to black ore of generally high grade (60–80% $BaSO_4$), (2) masses of coalesced nodules which form a solid layer of barite (40–50% $BaSO_4$), and (3) scattered nodules in shale (0–40%

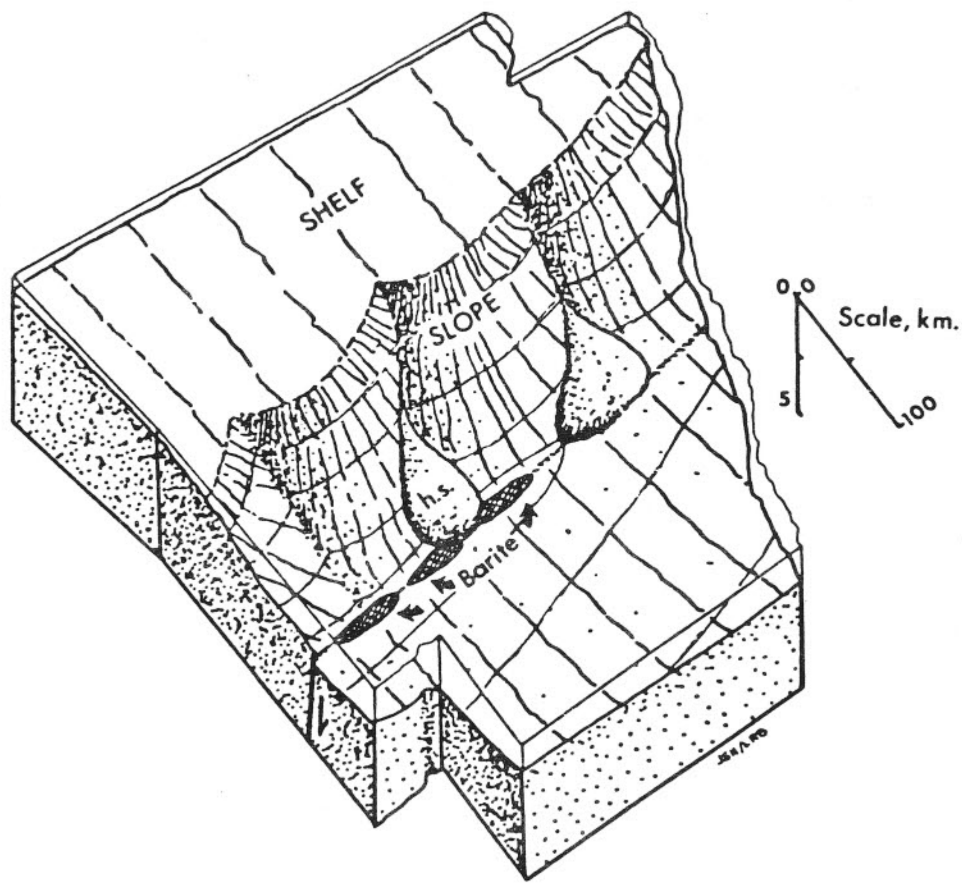


Figure 6. — Conceptual model showing the Hot Springs Sandstone Member (h.s.) and the growth fault along which hydrothermal fluids migrated to form pyrite and barite (modified from Hanor and Baria, 1977).

$BaSO_4$). Some fractures across the barite also contain crystals of barite up to two inches across.

Along strike the barite pinches and swells to form several distinct lenses of ore. Between the lenses, weak nodular zones can be seen in the shales. Down dip the continuity of the ore has been proven to depth of at least 600 feet. Toward the west two ore layers occur separated by interbedded shale and sandstone.

Origin

Based on the structural and stratigraphic features of the barite deposits, it appears that they are very much like the barite deposits of the Selwyn Basin in the Yukon Territory of Canada. In both areas the barite occurs in a sequence of rocks which represent initially a very quiescent depositional environment followed by growth faulting and deposition of sulfides and barite. In the Ouachita Mountains the growth faulting caused the brecciated upper surface of the Novaculite and provided the relief to form the chert pebble conglomerate and the Hot Springs Sandstone. It also provided a conduit for the hydrothermal fluids from which the barite precipitated. The barite probably formed in small local depressions in the seafloor which occasionally received influxes of mud and sand. The quality of the ore depended on the balance between barite and sediment influx; high-grade massive barite formed when sediment influx was near zero; as the rate of deposition increased, the quality would decrease and a more nodular ore would result; when shale completely overpowered the barite deposition, or barite influx decreased, then more sparsely nodular material was formed.

Since the Canadian occurrences are also associated with lead-zinc-silver deposits, there has been some interest in examining this area for metals. Since the structural and stratigraphic settings are so similar, this basin appears to be a good target for further metal exploration based on the sedimentary exhalative model.

REFERENCES CITED

Hanor, J. S., and Barria, L. R., 1977, Control on the distribution of barite deposits in Arkansas; *in* Stone, C. G., ed., v. 2, Ouachita Mountain symposium: Arkansas Geol. Commission, p. 42–49.

Scull, B. J., 1958, Origin and occurrence of barite in Arkansas: Arkansas Geol. Survey Inf. Circ. 18, 101 p.

GEOLOGY OF MAGNET COVE*

by

Staff, Arkansas Geological Commission

Magnet Cove is an area of unusual petrologic and mineralogic interest that derives its name from the presence of magnetite in the surface soil and from its basin-like shape. The Cove is located in northern Hot Spring County, Arkansas about 12 miles east of the city of Hot Springs. U. S. Highway 270 between Malvern and Hot Springs passes approximately through the center of the Cove.

The Cove lies at the eastern end of the Mazarn synclinorium about 1½ miles from where the Tertiary sediments of the Gulf Coastal Plain overlap the folded Paleozoic rocks. The parallel or almost parallel ridges and valleys adjacent to the Cove area are the topographic expression of plunging anticlines and synclines. The ridges are even-crested and are arranged in an unusual pattern that has given the name Zigzag Mountains to this subdivision of the synclinorium.

The sedimentary rocks cropping out in the immediate vicinity of Magnet Cove are Late Devonian and Mississippian in age. The oldest rocks belong to the Arkansas Novaculite and consist of novaculite with some interbedded shale. Overlying the novaculite is the Stanley Shale of Mississippian age. Two K-Ar ages of 97 ± 5 m.y. and 99 ± 5 m.y. and a Rb-Sr age of 102 ± 8 m.y. from biotites in the Magnet Cove intrusion, show it to be contemporaneous with the Potash Sulfur Springs body.

The Cove itself is an elliptical basin (fig. 1) with a maximum northwest-southwest diameter of about three miles and covers an area of about five square miles. The rim of the basin is broken through only at the two points where Cove Creek enters and leaves the Cove. The rim consists of an outer belt of light-colored nepheline syenites and an inner belt of phonolites. A large part of the Cove interior is covered by deep residual and alluvial soils that are presumed to be underlain by ijolite, a basic variety of nepheline syenite. Within the ijolite core are at least two large masses of carbonatite, one of which is exposed in the Kimzey calcite quarry.

There are three generalizations that may be made about the igneous rocks:

(1) They are all varieties of nepheline syenite.
(2) They contain a variety and abundance of titanium minerals.
(3) They become increasingly basic from the rim to the center of the Cove.

Several theories have been suggested for the emplacement of the Magnet Cove intrusives. J. F. Williams (1890) believed that the igneous rocks were formed during three different periods of igneous activity. The first period produced the basic nephelinitic rocks which constitute a large part of the interior basin. During the second period monchiquitic rocks filled the cracks in the first period rocks. The light-colored syenites of the Cove rim and numerous dikes were injected during a third period. H. S. Washington in 1900 suggested the differentiation of a magma in place.

R. L. Erickson and L. V. Blade of the U. S. Geological Survey made a detailed field and laboratory study of the Magnet Cove rocks. This project included the complete remapping of the Cove as well as intensive petrographic and geochemical studies of the igneous rocks. The work was published in 1963 as U.S.G.S. Professional Paper 425,

***Reprinted with revisions from: Stone, C. G., Howard, J. M., and Holbrook, D. F., 1982, Field guide to the Magnet Cove area and selected mining operations and mineral collecting localities in central Arkansas: Arkansas Geological Commission Guidebook 82-1, p. 23-24.**

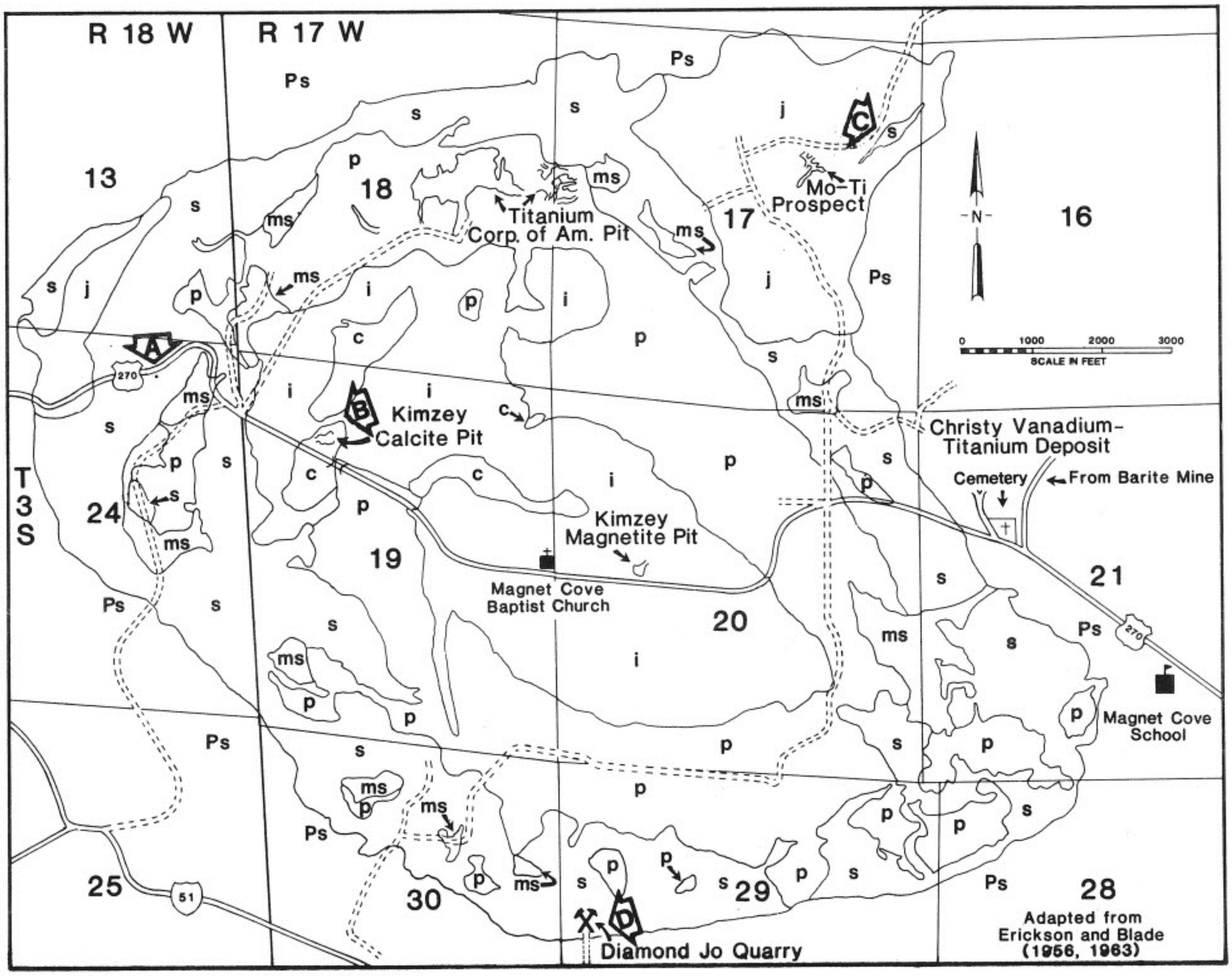


FIGURE 1 - BEDROCK GEOLOGY OF MAGNET COVE INTRUSIVE, ARKANSAS

LEGEND

CRETACEOUS

c	Carbonatite; residual and secondary phosphate rock derived from carbonatite.
j	Jacupirangite and subordinant sphene pyroxenite.
i	Garnet and biotite—garnet ijolite, undiff.; includes analcime—olivine metagabbro and minor lime silicate rock.
s	Garnet--pseudoleucite syenite, sphene—nepheline syenite, and garnet—nepheline syenite, undiff.; minor garnet—biotite melteigite and small dikes of sphene—garnet—nepheline syenite intruding jacupirangite.
p	Trachyte, phonolite, banded phonolite, and altered phonolite breccia, undiff.; small bodies of trachyte and tinguaite.

PALEOZOIC

ms	Metamorphosed sedimentary rocks.
Ps	Sedimentary rocks, undiff.; numerous igneous dikes are too small to be shown. An inner band, about 2000 feet wide, is a contact metamorphic zone.

Contact — approximate, indefinite, or gradational

Paved road

Bridge

Graded dirt road

Open pit, trench, mine, or quarry.

"Alkalic Igneous Complex at Magnet Cove, Arkansas". In revising the Cove map the authors used current terminology in naming the rock units and also made a number of significant corrections in the original map by Williams. The most important change was recognizing the band of rock lying on the Cove's inner rim, originally thought to be metasedimentary rock, as igneous rock – phonolite. They also correctly identified the so-called "tufa" in the Cove's interior as carbonatite residuum. In adapting this Geological Survey map for field trip use, many of the smaller rock units were necessarily omitted and similar rock types were combined into single units. For a more detailed examination of the rock types of Magnet Cove, the reader is referred to the U.S. Geological Survey Professional Paper.

A description of the rock names used on the geological map of Magnet Cove is included here as the terms are unfamiliar to many geologists:

Carbonatite –
Dikes and irregular bodies of coarsely crystalline calcite. Locally contains concentrations of apatite, monticellite, magnetite, perovskite, and black garnet.

Ijolite –
Fine- to coarse-grained rocks composed chiefly of nepheline, diopside and black garnet. Contains biotite in some places but does not have any feldspar.

Phonolite –
Fine-grained, gray to greenish-black rocks locally brecciated and banded.

Garnet-pseudoleucite syenite –
Light gray, medium-grained rock composed of white pseudoleucite, tabular feldspar, pyroxene and black garnet. The coarse-grained phase of this rock is composed of black garnet, nepheline, feldspar, and pyroxene.

The Magnet Cove intrusive complex and the surrounding host rock alteration zone, primarily the Arkansas Novaculite, have long been known for their unusual minerals. Over one hundred minerals are known to occur in the area. Some of the more outstanding minerals to the collector are: cyclic rutile eightling and sixling twins, paramorphs of rutile after brookite, brilliant lustered black brookite crystals perched on rusty smoky quartz crystals up to one foot long, plus black smoky quartz crystals, eighteen-inch-long aegirine crystals in pegmatite matrix (originally mistaken for tourmaline), pink eudialyte crystals, a variety of crystal forms of perovskite, clusters of octahedral magnetite, massive lodestone, black to dark brown melanite crystals intergrown with apatite needles, lime-green vesuvianite crystals, pyrite crystals coated with molybdenite, mica books to six inches across, and trapezohedral pseudoleucite crystals. The micromount collector visiting Magnet Cove should look for any rock containing cavities. Depending on the rock type, one may discover a variety of well crystallized minerals including kimzeyite (the only known location for this zirconium-bearing garnet), barite, pectolite, natrolite, labuntsovite, brookite, reticulated rutile, aragonite, diopside, orthoclase, brookite perched on rutile needles, aegirine, taeniolite (a lithium mica), and several newly discovered, not yet described species. The four localities to be visited are shown on the bedrock geologic map of Magnet Cove (fig. 1). With minor modifications, the stop descriptions are from Arkansas Geological Commission (1967).

Stop A. Crest of Cook Mountain – West Rim of Magnet Cove.

This stop is at the crest of Cook Mountain on the western edge of the Magnet Cove complex. From this point, you can see the low ridges that form the outer part of the complex. To the north and northeast there is a single ridge composed of sphene-nepheline syenite and garnet-pseudoleucite syenite. East and south of this point are two concentric ridges. The outer one is mostly garnet-pseudoleucite syenite and is continuous with the single ridge to the north and northeast. The inner ridge consists of trachyte.

Contacts are obscured here and only isolated outcrops can be seen. There are good exposures of sphene-nepheline syenite in the roadcut along the crest of the hill; and there is a sparsely exposed body of jacupirangite approximately 400 feet to the west. A small body of altered phonolite and breccia, which is a xenolith in garnet-pseudoleucite syenite, is located about 500 feet east of this point. This garnet-pseudoleucite syenite is exposed about 75 feet farther east. The areas between the outcrops provide a good example of saprolitic residual material. Remnant textures of the sphene-nepheline syenite are readily visible in the saprolite, particularly near the crest of the hill.

Sphene-Nepheline Syenite

Sphene-nepheline syenite comprises about seven percent of the exposed part of the Magnet Cove intrusive. At the crest of this hill the syenite is medium grained and exhibits megascopically identifiable pyroxene, hornblende, feldspar, nepheline, and sphene. Most of the syenite is equigranular, but some contains felsic phenocrysts. The syenite has a very heterogeneous texture and in places contains cognate and foreign xenoliths which are aligned parallel to an apparent flow lineation. About 300 feet east of the hill's crest is an outcrop of light gray sphene-nepheline syenite with a very fine-grained groundmass. Phenocrysts of green pyroxene and a few nepheline and alkali feldspar phenocrysts are visible in the rock. According to Erickson and Blade (1963) these two varieties of sphene-nepheline syenite are probably separate intrusions and the finer-grained rock is younger.

Stop B. Kimzey Calcite Quarry

This stop is near the center of the Cove, where carbonatite and eudialyte-nepheline syenite pegmatite are exposed. The carbonatite crops out along a north-trending zone about 3500 feet long and 500 feet wide and is best exposed here in the Kimzey calcite quarry (agricultural limestone) which is near the southern end of this zone. Other carbonatite is found in many parts of the central Cove. Erickson and Blade (1963) distinguished, during mapping, between carbonatite and residual phosphate, which was derived from the carbonatite by weathering.

The eudialyte-nepheline syenite pegmatite at this stop forms a small arcuate body that is concave southeastward. The pegmatite can be seen on both sides of U. S. 270 between the entrance to the Kimzey calcite quarry and the bridge over Cove Creek.

Carbonatite

Carbonatite occupies 1.8 percent of the exposed igneous complex and is considered to be a late stage of igneous activity (Erickson and Blade, 1963). The carbonatite consists largely of medium- to coarse-grained calcite and contains accessory minerals, which "...in approximate order of decreasing age, are apatite (light green), monticellite (brown), biotite, magnetite, pyrite, and perovskite (black)" (Fryklund, Harner, and Kaiser, 1954). Kimzeyite, a black zirconium garnet, was discovered at this locality (Milton and Blade, 1958, and Milton, Ingram and Blade, 1961).

Erickson and Blade (1963) note that "...inclusions of ijolite a few inches to more than 50 feet across" are found in the carbonatite. These xenoliths have peripheral alteration zones that consist of, from the border of the xenolith inward, magnetite, pyrrhotite, biotite, and idocrase (Fryklund, Harner, and Kaiser, 1954). The accessory minerals in the carbonatite are enriched somewhat in Ti, V, Nb, and rare earths.

Eudialyte-Nepheline Syenite Pegmatite

The eudialyte-nepheline syenite pegmatite covers less than 0.1 percent of the exposed area of the complex (Erickson and Blade, 1963). Erickson and Blade indicate that the pegmatite "...varies in texture from a fine-grained to very coarse-grained phanerite. The coarse-grained parts are well known for beautiful specimens of aegirine crystals up to 6 inches long, and ruby-colored eudialyte crystals up to 1 inch across. Williams (1891) has described in detail the mineralogy of the coarse-grained part. He mentions garnet, ilmenite, magnetite, nepheline, orthoclase, thomsonite, and wollastonite and describes aegirine, astrophyllite, brucite, eucolite, eudialyte, manganopectolite, microcline, natrolite, and sphene."

Stop C. Jacupirangite at Cove Creek

Jacupirangite, with assimilation derivatives of jacupirangite, and various dike rocks are exposed at this stop. Outcrops of the jacupirangite are rare in the complex and the two bodies of this rock that have been mapped were delimited by magnetometer surveys (ground magnetometer surveys show a high in excess of 10,000 gammas in the area) and panned saprolite concentrates (Erickson and Blade, 1963). There are two good exposures of jacupirangite along Cove Creek: one location is adjacent to the Mo-Ti prospect approximately 800 feet east of the bridge over Cove Creek and the other location, which is seen at this stop, is about 2000 feet east of the bridge. The contact between the Stanley Shale and meladiorite, an assimilation derivative of the jacupirangite, is exposed in Cove Creek about 1000 feet north of the northern limit of this outcrop.

The jacupirangite is cut by mafic and alkalic dikes. Some of the more noticeable ones at this outcrop include: (1) tinguaite— which forms a six-inch dike that runs approximately north-south along the east side of the creek and divides into three smaller dikes near the northern end of the outcrop; (2) pyroxene-biotite ijolite— as a four inch dike that runs east-west across the northern end of the outcrop and is cut by the tinguaite; (3) garnet-biotite melteigite— which is found near a small drill hole on the west side of the creek; (4) trachyte— cuts the garnet-biotite emlteigite dike near the drill hole; (5) fourchite— is found as a very fresh dike between three and five feet wide which forms a northeast-trending resistant unit in the creek bed approximately 200 feet downstream from the southern limit of the jacupirangite.

Jacupirangite

The jacupirangite covers 10 percent of the exposed area of the igneous complex. Erickson and Blade describe the jacupirangite as "typically a dark-gray fine-to-medium-grained phanerite that weathers to a dark brown or mottled reddish-brown and olive-green saprolite. Pyroxene is the chief constituent and always composes more than 50 percent of the rock. . . . The pyroxene crystals (salite), up to 10 mm long, appear to have formed as early crystal mush. . . . Magnetite-ilmenite grains as much as 6 mm across constitute about two to 25 percent of the rock. . . . Apatite, biotite, sphene, garnet and perovskite are always present, sometimes in proportions greater than 10 percent. Zeolite formed from the alteration of nepheline, calcite and cancrinite is common. Other accessory minerals include pyrite and pyrrhotite."

Stop D. Diamond Jo Quarry.

Follow an obscure road on the north side of the highway approximately 1000 feet to the Diamond Jo Quarry. At this stop there are excellent exposures of garnet-pseudoleucite syenite, nepheline syenite pegmatite, and metamorphosed Stanley Shale (Mississippian). The contact between the garnet-pseudoleucite syenite and the nepheline syenite pegmatite can be seen best at the top of the high wall to the northeast. Erickson and Blade (1963) suggest on the basis of chemical composition and spatial distribution of the two rock types that the nepheline syenite pegmatite is younger. The contact between the pegmatite and the wall rock is well exposed at the southeast edge of the quarry where it appears that the pegmatite was emplaced almost parallel to the bedding of the shale. Veinlets containing blue sodalite may sometimes be seen filling joint planes. Very little evidence can be found for a chill zone in the pegmatite which suggests that the country rock into which the pegmatite was emplaced had not cooled after emplacement of the garnet-pseudoleucite syenite.

Garnet-Pseudoleucite Syenite

The garnet-pseudoleucite syenite composes 21 percent of the exposed igneous complex and forms a nearly complete ring varying between a few feet and 2000 feet in width. According to Erickson and Blade (1963) the "typical fresh rock is light gray, medium grained, and composed of pseudoleucite, feldspar, black titanium garnet, pyroxene, and nepheline. Inclusions in the rock are abundant and include metamorphosed sediments and fine-to-coarse grained ijolite and melteigite fragments. Miarolitic cavities up to 3 inches across are common [on weathered faces]. . . . are generally automorphic, and include: tabular white orthoclase, needles of green aegirine, needles of colorless pseudowavellite, and short crystals of apophyllite . . . A coarser grained, more slowly cooled phase of the garnet-pseudoleucite syenite was mapped separately as garnet nepheline syenite and comprises about 3.5 percent of the exposed igneous rocks. . . . Earlier workers mapped this rock as part of the sphene-nepheline syenite but the presence of macroscopic garnet, absence of macroscopic sphene, and gradational contact with garnet-pseudoleucite syenite mark it as a coarser grained phase of the garnet-pseudoleucite syenite."

Nepheline Syenite Pegmatite

The nepheline syenite pegmatite occupies 0.2 percent of the area of the complex and forms small, irregular bodies near the outer contact of the igneous complex (Erickson and Blade, 1963). The rock contains ". . .barian sodic orthoclase (. . . as much as 30 mm long) with minor nepheline and cancrinite (interstitial). Black titanium garnet and zoned pyroxene are the chief mafic minerals and tend to be segregated in patches. Pyrite, calcite, and magnetite are accessory constituents. Blue sodalite and purple fluorite occur as thin skins, one-eighth inch thick, on vertical joint planes. Erickson and Blade (1963) note that the pegmatite, in contrast to the garnet-pseudoleucite syenite, contains no inclusions.

References Cited

Arkansas Geological Commission, 1967, Guidebook to Central Arkansas economic geology and petrology: Arkansas Geological Commission Guidebook GB-67-1, 28 p.

Erickson, R. L., and Blade, L. V., 1963, Geochemistry and petrology of the alkalic igneous complex at Magnet Cove, Arkansas: U.S. Geological Survey Professional Paper 425, 95 p.

Fryklund, V. C., Jr., Harner, R. S., and Kaiser, E. P., 1954, Niobium (columbium) and titanium at Magnet Cove and Potash Sulphur Springs, Arkansas: U.S. Geological Survey Bulletin 1015-B, p. 23-57.

Milton, Charles, and Blade, L. V., 1958, Preliminary note on kimzeyite, a new zirconium garnet (Ark.): Science, v. 127, p. 1343.

Milton, Charles, Ingram, B., and Blade, L. V., 1960, Kimzeyite, a zirconium garnet from Magnet Cove, Arkansas (Abst.): Geological Sociey of America Bulletin, v. 71, no. 12, pt. 2, p. 1930-1931.

Washington, H. S., 1900, Igneous complex of Magnet Cove, Arkansas: Geological Society of America Bulletin, v. 11, p. 389-416.

Williams, J. F., 1890, Eudialyte and eucolite from Magnet Cove, Arkansas: American Journal of Science, v. 3, p. 457-462.

Williams, J. F., 1891, The igneous rocks of Arkansas: A-kansas Geological Survey, Annual Report for 1890, v. 2, 457 p.

CHRISTY VANADIUM - TITANIUM MINE*

by

J. Michael Howard
Arkansas Geological Commission
3815 West Roosevelt Road
Little Rock, Arkansas 72204

We wish to thank Mr. Don R. Owens, geologist for United Metals Corporation (Umetco), a subsidiary of Union Carbide Corporation, for permission to visit the mine and for his assistance.

The Christy deposit is located on the east rim of Magnet Cove (fig. 1 of preceding stop description) about half a mile northwest of the community of Magnet. Drilling by the U. S. Bureau of Mines in 1949 was undertaken to establish the extent of the titanium mineralization (brookite) in the deposit. The deposit lies on the top and partly on the south slope of an east-west ridge of metamorphosed Arkansas Novaculite. This ridge is the south limit of the Chamberlain Creek syncline, which is overturned so that the sediments dip about 45^{o} south. A few hundred feet to the west of the deposit the syncline is truncated by a coarse-grained nepheline syenite intrusive. Analyses of core samples from the USBM project varied from less than 1% to a maximum of 26% TiO_2, averaging about 5% TiO_2 for the orebody. Appreciable percentages of V_2O_5 (1 to 2%) were encountered in several core samples. Union Carbide Corporation obtained leases on this property during their vanadium-titanium exploration program in Arkansas in the mid-1960's. The deposit was drilled out by Union Carbide shortly thereafter. A test pit, dug in 1975, was developmental work to allow testing of the ore for both amenability to their present mill at Wilson Springs and blendability of Christy ore with those of Wilson Springs. The Christy vanadium ore consists of goethite-rich clay and brookite and averages slightly less than 1% V_2O_5. In December, 1981 developmental work began for ore stockpile sites and water control ponds. Stripping of overburden to expose the orebody began in the Fall of 1983. Ore was mined until the Fall of 1985. Mining operations on this orebody have been idle since.

Minerals found with the vanadium ores, besides brookite, include smoky quartz, taeniolite, rutile, anatase, siderite, pyrite, and rarely eggonite ($ScPO_4 \cdot 2H_2O$).

Fryklund and Holbrook (1950) suggested that the Christy deposit was formed by the introduction of mineralizing fluids from the Magnet Cove intrusion into the folded and metamorphosed Arkansas Novaculite, with subsequent erosion and weathering of mineralized rock. In a recent investigation of TiO_2 polymorph-bearing vein deposits adjacent to the Magnet Cove intrusion, Viscio (1981) discovered adularia at the Hardy-Walsh brookite deposit (approximately 2 miles to the NNW) on the northern limb of the Chamberlain Creek syncline, suggesting that the brookite deposits adjacent to Magnet Cove may be an aborted initial phase of alkali metasomatism (fenitization) by late fluids from the Magnet Cove intrusion.

References Cited

Fryklund, V. C., Jr. and Holbrook, D. F., 1950, Titanium Ore deposits of Hot Spring County, Arkansas: Arkansas Division of Geology, Bulletin 16, 173 p.

Viscio, P.J., 1981, Petrology of TiO_2-polymorph-bearing vein deposits adjacent to the Magnet Cove intrusion [unpub. M.S. thesis]: St. Louis, Washington University, 93 p.

***Reprinted with revisions from: Stone, C. G., Howard, J. M., and Holbrook, D. F., 1982, Field guide to the Magnet Cove area and selected mining operations and mineral collecting localities in central Arkansas: Arkansas Geological Commission Guidebook 82-1, p. 13.**

GEOMEX QUARTZ CRYSTAL MINE*

by

C. G. Stone
Arkansas Geological Commission
3815 West Roosevelt Road
Little Rock, AR 72204

We wish to express our deepest gratitude to Mr. Paul Thompson, geologist, and other personnel of the Geomex Company for letting us have access to their quartz crystal mine and for their invaluable assistance in the examination of these classic deposits.

Mining of quartz crystals in the Ouachita Mountains of Arkansas has been going on for many years, the first miners probably being the Indians who shaped them into arrowheads. Because of the clarity and perfect shape of many of the individual crystals and crystal clusters, the principal market over the years has been as specimens in both individual and institutional mineral collections. During World War II about five tons of clear quartz crystals from Arkansas were used in the manufacture of radio oscillators to supplement the production from Brazil. Currently quartz crystals are being used for: manufacturing fusing quartz, which has many chemical, thermal and electrical applications; for seed crystals (lasca) for growing synthetic quartz crystals; and, of course, for mineral specimens. It should be noted that the "Hot Springs Diamonds" for sale in the local rock shops and jewelry stores are cut from Arkansas quartz crystals.

Quartz veins are numerous and are found in a wide belt extending from Little Rock, Arkansas to Broken Bow, Oklahoma, in the central core area of the Ouachita Mountains. These veins, up to sixty feet in width, commonly contain traces of adularia, chlorite, calcite and dickite. In a few places lead, zinc, copper, antimony and mercury minerals are associated with the quartz veins. At relatively few localities however, do individual quartz crystals and crystal clusters attain the size and clarity requisite for mining.

In the Ouachita Mountains there is a close association of quartz veins with fault zones. It is believed that the quartz veins represent, in part, dewatering processes that took place along the fault zones. The increase in pore fluids may well have contributed to overpressuring and related conditions and enhanced the overall faulting and folding process. The quartz veins with their associated minerals are presumed to be hydrothermal deposits of tectonic origin formed during the closing stages of the Late Pennsylvanian-Early Permian orogeny in the Ouachita Mountains.

The Geomex Mine is also known as the Coleman Mine, West Chance Area, Dierks No. 4 Mine and Blocker Lead (fig. 1). The quartz crystals occur in veins in limy sandstone and conglomeratic sandstone beds of the Blakely Sandstone (Ordovician). Beds of conglomeratic sandstone exposed in the pit contain abundant weathered meta-arkose and granitic boulders, cobbles, and pebbles, and some clasts of limestone, chert and shale. It is likely that these sediments were deposited in submarine fan channels and were derived from a granite-rich terrane to the north-northeast. It has been postulated by Stone and Haley (1977) and a number of other workers that these exotic boulders are likely Precambrian in age. Some have expressed the opinion that they represent early Cambrian accumulations. The report (this volume, p. 33) by Sam Bowring on boulders from this pit and other sites indicates a Middle Proterozoic age. This area includes many thrust-faulted sequences with at least two major periods of folding resulting in differing

*Reprinted from: Stone, C. G., and Haley, B. R., 1984, A guidebook to the geology of the central and southern Ouachita Mountains, Arkansas: Arkansas Geological Commission Guidebook 84-2, p. 42-45.

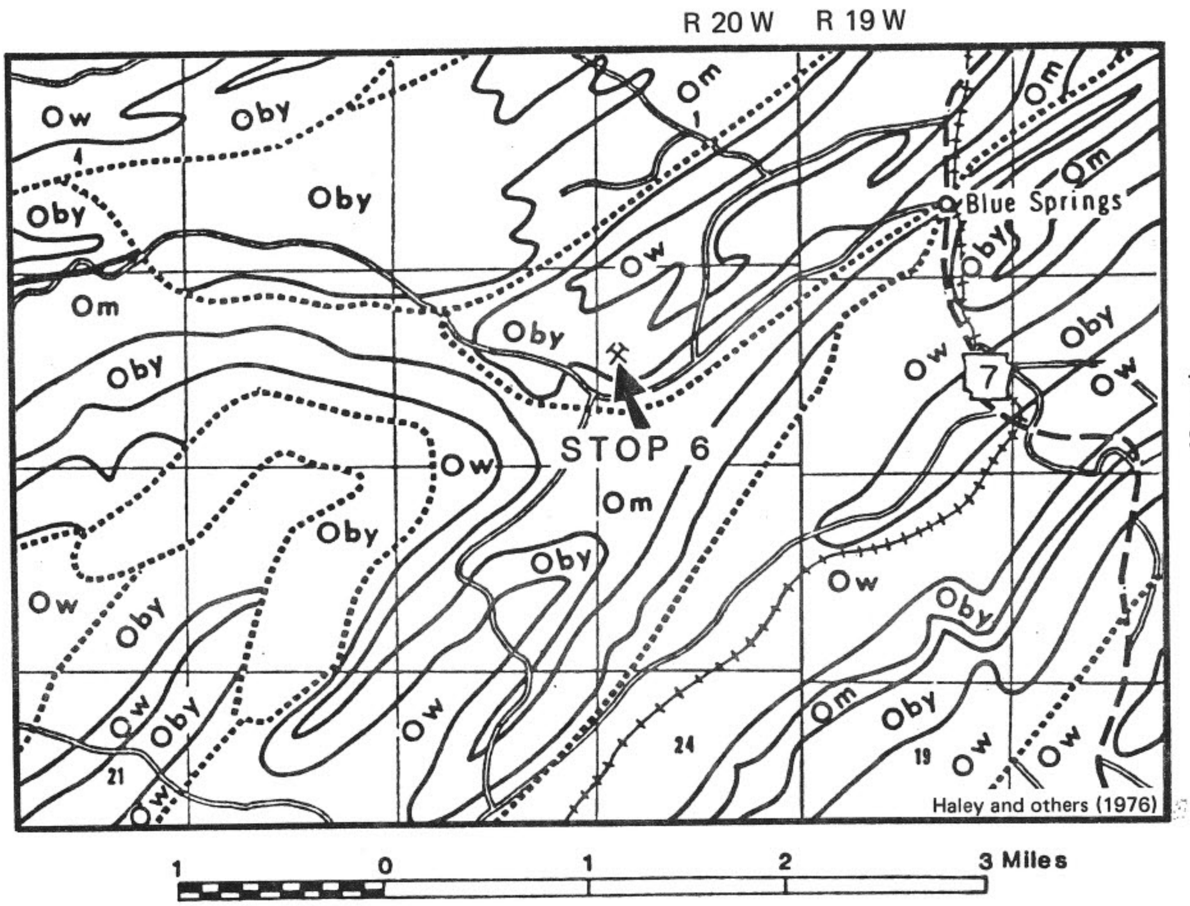


Figure 1. Geologic map of the Blue Springs area, Arkansas showing location of the Geomex Mine (stop 6).

attitudes in fold hinge lines and axial planes. The mine itself is situated on the nose of a large, complexly-deformed syncline.

The quartz crystal veins are fracture fillings with the larger and more productive cavities being located at the intersection of two veins. Mining operations are relatively simple, consisting initially of removing overburden and loose rock with a bulldozer to expose the crystal-filled cavities, and then removing the quartz crystals with hand tools. Individual quartz crystals up to five feet in length weighing as much as 400 pounds and clusters 15 feet in length weighing over five tons have been produced from these mines.

References Cited

Haley, B. R., and others, 1976, Geologic map of Arkansas: U. S. Geological Survey map, scale 1:500,000.

Stone, C. G., and Haley, B. R., 1977, The occurrence and origin of the granite-meta-arkose erratics in the Ordovician Blakely Sandstone, Arkansas, *in* Stone, C. G., ed., Symposium on the geology of the Ouachita Mountains, v. 1: Arkansas Geological Commission, p. 107-111.

Note:

The short article on the following page is reprinted here because it provides recent data on the age of the exotic granitic boulders from the Geomex mine.

U-Pb ZIRCON AGES OF GRANITIC BOULDERS IN THE ORDOVICIAN BLAKELY SANDSTONE, ARKANSAS AND IMPLICATIONS FOR THEIR PROVENANCE*

by

Samuel A. Bowring
Department of Earth and Planetary Sciences
Washington University, St. Louis, Missouri 63130

The occurrence and origin of beds of granitic cobbles and boulders in the Ordovician Blakely Sandstone in Saline and Garland Counties, Arkansas, have been the subject of much discussion. Of particular importance in determining the provenance of the granite boulders and cobbles is their age. Paleozoic Rb-Sr whole-rock ages from these boulders are not interpreted as crystallization ages (Denison and others, 1977), and thus three samples of granitic boulders and one sample of arkosic sandstone were collected from three localities for U-Pb zircon age determinations.

At the Uebergang uranium prospect in northern Saline County, Arkansas, numerous boulders and cobbles of granite and quartzite occur within the Blakely Sandstone in addition to a few cobbles of gabbro and porphyritic andesite. One granite boulder yielded abundant euhedral, slightly discordant, zircons that have an age of 1284±12 Ma.

Two granite boulders were collected from the Blakely Sandstone at Coleman's (now Geomex) quartz mine west of Blue Springs, Garland County, Arkansas. One boulder, about 1 meter in diameter, is a coarse-grained granite which yielded abundant euhedral zircons that range from colorless to dark brown. Four fractions of both clear and brown varieties are moderately discordant and lie on a chord which yields an age of 1350±30 Ma. A boulder of medium-grained granite from the same outcrop yielded discordant zircons with an age of 1407±13 Ma.

Detrital zircons separated from a sample of arkosic Blakely Sandstone from northern Saline County yielded several distinct populations of zircons that range from round to euhedral. Preliminary analysis of both rounded and euhedral fractions indicates a source age for the zircons between 1300-1350 Ma.

Analysis of zircons from the Blakely Sandstone yields ages that range from 1286-1407 Ma, possibly corresponding to a 1350-1400 Ma terrane of epizonal granites and rhyolites that extends from the Texas panhandle through eastern Oklahoma (Thomas et al., 1984). Although there are no known exposures of Precambrian rocks in Arkansas, the 1350 to 1400 Ma old terrane has been extended into the subsurface of Arkansas based on aeromagnetic signatures (Thomas et al., 1984). The simplest interpretation of the age data derived from the Blakely Sandstone is that the granite boulders and arkose were derived from Precambrian basement to the north, perhaps along submarine fault scarps, as suggested by Stone and Haley (1977).

References

Denison, R. E., Burke, W. H., Otto, J. B., and Hetherington, E. A., 1977, Age of igneous and metamorphic activity affecting the Ouachita Foldbelt, *in* Stone, C. G., ed., Symposium on the Geology of the Ouachita Mountains: Arkansas Geological Commission, v. 1, p. 25-40.

Stone, C. G., and Haley, B. R., 1977, The occurrence and origin of the granite-meta-arkose erratics in the Ordovician Blakely Sandstone, Arkansas, *in* Stone, C. G., ed., Symposium on the Geology of the Ouachita Mountains: Arkansas Geological Commission, v. 1, p. 107-111.

Thomas, J. J., Shuster, R. D., and Bickford, M. E., 1984, A terrane of 1350-1400 m.y. old silicic volcanic and plutonic rocks in the buried Proterozoic of the midcontinent and in the Wet Mountains, Colorado: Geol. Soc. Am. Bulletin (in press).

***Reprinted from: Stone, C. G., and Haley, B. R., 1984, A guidebook to the geology of the central and southern Ouachita Mountains, Arkansas: Arkansas Geological Commission Guidebook 84-2, p. 123.**

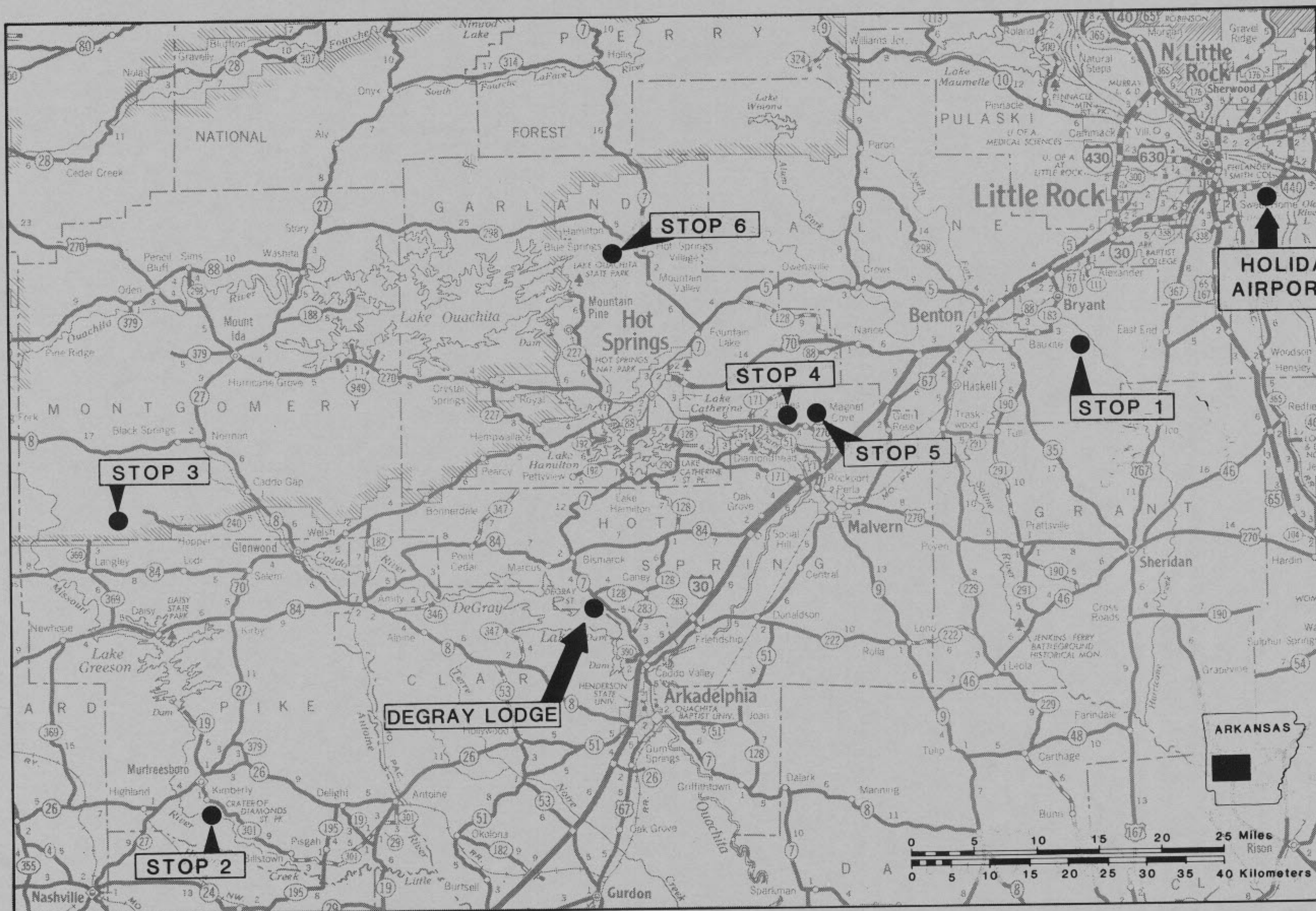
ADDENDUM: From Arkansas Geological Commission GB-67-1

Alternate stop: Magnet Cove Titanium Corporation Deposit. Site of old mill.
(Leader: Drew F. Holbrook)

Approximately 10 million pounds of rutile concentrates were produced from this open pit mine from 1932 through 1944. The rutile mined during this period was utilized in the manufacture of titanium alloys and ceramic raw materials. There has been no production since 1944, but the deposit was core-drilled by the U.S. Bureau of Mines in 1945.

The deposit is comprised of a variety of feldspar-carbonate-rutile veins and vein masses that cut the altered phonolite and breccia country rock. Extensive weathered and hydrothermal alteration to clay of both the veins and the phonolite-breccia country rock and the subsequent reworking of these clays by rainwash have obscured many of the vein-country rock relationships. The knobs of black, fine-grained igneous rock that project from the floor of the pit are phonolite. The most easily recognized type of vein is a hard, buff-colored, porous feldspar-carbonate rock that has abundant coarse pyrite and variable amounts of rutile. The rutile in the veins is characterized by its blue-black luster and striated crystal faces. It is estimated that the average grade of the ore in this deposit is about 3 percent rutile.

A small percentage of columbium is present in the ore and probably is in the rutile. Traces of vanadium, molybdenum and unknown radioactive mineral were found in the ore.



HOLIDAY INN AIRPORT EAST
STOP 1
STOP 2
STOP 3
STOP 4
STOP 5
STOP 6
DEGRAY LODGE
ARKANSAS
25 Miles
40 Kilometers
Little Rock
N. Little Rock
Hot Springs
Benton
Bryant
Malvern
Sheridan
Arkadelphia
Gurdon
Nashville
Murfreesboro
Glenwood
Mount Ida
Lake Ouachita
Lake Hamilton
Lake Catherine
DeGray Lake
Lake Greeson
NATIONAL
FOREST
GARLAND
MONTGOMERY
PIKE
CLARK
HOT SPRING
GRANT
SALINE
PULASKI
PERRY