INDUSTRIAL MINERAL DEPOSITS

NEVADA BUREAU OF MINES REPORT 14

NEVADA BUREAU OF MINES

VERNON E. SCHEID, DIRECTOR

REPORT 14

INDUSTRIAL MINERAL DEPOSITS OF MINERAL COUNTY, NEVADA

By N. L. ARCHBOLD

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1966

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MACKAY SCHOOL OF MINES

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RENO, NEVADA

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STATE OF NEVADA

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NEVADA BUREAU OF MINES

NEVADA MINING ANALYTICAL LABORATORY

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INDUSTRIAL MINERAL DEPOSITS OF MINERAL COUNTY, NEVADA

By N. L. Archbold

ABSTRACT

Industrial mineral commodities in Mineral County Nevada include diatomite, clay, brines, fluorite, barite, gypsum, aluminous minerals, pumice, perlite, stone, limestone, sand and gravel, and silica. Minor occurrences of graphite, mica, talcose material, alunite, and quartz crystals have been noted.

Large reserves of diatomite occur interbedded with Tertiary volcanic rocks at several localities in the county. All known clay deposits are bentonitic, formed by devitrification in Tertiary tuffaceous rocks or by hydrothermal alteration in andesite. Brines at shallow depths below saline playas contain large amounts of sodium carbonate, sodium sulfate, and sodium chloride; deeper brines may contain significant amounts of potash and lithia. Some boron salts have been produced from the surfaces of the playas. Fluorite veins cut Tertiary volcanic rocks in the extreme northeastern and southern parts of the county; whereas, bedded replacement and vein-type deposits of barite occur in a belt that trends northwesterly across the center of the county. A single deposit of gypsum in a Mesozoic sedimentary sequence has yielded all the county's production of gypsum. Andalusite, sillimanite, and corundum form disseminated deposits in a sericitic matrix at several localities near Hawthorne. Large reserves of pumice, perlite, building stone, limestone, sand, and gravel have not been exploited because they are remote from population centers and have low place value. One large body of milky quartz occurs in the granitic core of the Wassuk Range west of Hawthorne.

INTRODUCTION

Industrial mineral or nonmetallic deposits in Nevada have received considerably less attention than metallic deposits despite their comparable importance in terms of value produced. Several previous publications (Vanderburg, 1937; Ross, 1961) have described the metallic mineral deposits of Mineral County in some detail, but have only briefly mentioned the deposits of industrial minerals within the County. This report is an attempt to locate and provide general geologic descriptions of all deposits of this type within Mineral County.

In this reconnaissance survey, an effort was made to locate all deposits in Mineral County, previously referred to in the literature on Nevada's mineral deposits. Additional deposits were located through discussions with local prospectors, reference to county records on claim locations and assessment work, and examination of topographic maps or air photos. Some deposits have inadvertently been missed, but their exclusion here in no way reflects upon their present or potential value. The Nevada Bureau of Mines would welcome information on deposits missed in this survey, as well as deposits that are discovered in the future.

No effort will be made in this brief report to review characteristics, uses, processing, or marketing of the various commodities. Inclusion here would greatly expand the volume of this report and unnecessarily duplicate material covered in other publications.

Such information may be obtained through reference to the following publications:

"Mineral facts and problems," 1965, U. S. Bureau of Mines Bulletin 630, U. S. Government Printing Office, Washington, D. C.

"Industrial rocks and minerals," 1960, American Institute of Mining, Metallurgical and Petroleum Engineers (AIME), New York, N. Y.

"Mineral and water resources of Nevada," 1964, Nevada Bureau of Mines Bulletin 65.

Reports of this type derive much information from sources other than the author. Previously published sources are noted at appropriate places in the text, but it is not possible to cite the numerous instances where this survey was aided in various ways by individuals and property owners; their valuable assistance is gratefully acknowledged. The U. S. Bureau of Mines made tests on some clay samples through a cooperative project with the Nevada Bureau of Mines.

DIATOMITE

Diatomite represents one of the better potential industrial mineral resources; diatomite beds occur at or near the surface over several extensive areas in the county. The Great Lakes Carbon Corp. was, however, the only active producer of diatomite in Mineral County during the first half of 1965. The following account of the deposit owned by Great Lakes Carbon Corp. has been written by J. S. Horton, Chief Mine Engineer.

BASALT AREA. Great Lakes Carbon Corp. has been operating the Basalt diatomaceous earth quarries (no. 53 on plate 1) since 1944. The deposit straddles the Esmeralda-Mineral County line near Basalt Junction, Nev. The property covers some 2,500 acres adjacent to U. S. Highway 6 and is in T. 2 N., R. 33 E., and T. 2 N., R. 34 E., Mt. Diablo Base and Meridian.

The deposit represents the bed of an isolated embayment of a large fresh-water lake of the Tertiary period. During the interval of diatomaceous deposition there was a minimum of contaminants introduced by interior drainage into this embayment.

Structurally the deposit forms a shallow basin in the western sector, while the central and eastern zones are monoclinal. Stratigraphically the lacustrine sediments are composed of diatomite, argillaceous diatomite, calcareous diatomite, clay, sand and volcanic ash. This lacustrine section overlies basalt and andesite flows, and is itself overlain by basaltic flows.

Species of diatoms occurring in this deposit are of fresh water structure, Melosira predominating. More specifically the more abundant species are Melosira granulata, Stephanodiscus aslraea, and Eunotia robusta.

EASTERN CORNER OF MINERAL COUNTY. Diatomite deposits that cover a large area in the eastern corner of Mineral County (no. 44 on plate 1) show evidence of small production in the past, although all properties were idle in June of 1965. Diatomite lies at or near the surface throughout the general area shown on plate 1; in much of the surrounding area it may be covered by only thin layers of Tertiary volcanic rocks. Beds are nearly flat-lying but locally they show dips of up to 25 degrees. Thicknesses up to 25 feet are exposed, but total thickness of the beds probably exceeds this because

the contact with underlying rocks was not observed. The diatomite is mainly thin bedded and contains some interbeds of tuffaceous and shaly material which detract from the value of these deposits under present requirements for purity.

ALDRICH STATION. Axelrod (1956) has mapped diatomaceous rocks at Aldrich Station (no. 32 on plate 1) along the western border of Mineral County. The diatomite is in a series of shaly and tuffaceous sediments, 200 to 1,600 feet thick, that constitute a part of the Aldrich Station Formation. Plant fossils indicate a Pliocene age for the formation. In general, the diatomite beds are thin and impure; perhaps the best exposure is along the road at the base of Aldrich Hill, where the diatomaceous sediments form a white unit that dips about 40° W and appears to be at least several tens of feet thick. Scattered trenchs indicate some minor prospecting activity.

B and B GROUP. The B and B group of diatomite claims (no. 17 on plate 1) is in the southwestern part of T. 10 N., R. 35 E. about 14 line miles north-northeast of Luning. The claims were staked by Willis Belzer and Vern Bagby of Hawthorne, Nev. Thin-bedded diatomite is exposed in bulldozer trenches scattered over an area of at least 1 square mile. The diatomite beds appear to lie within a basin surrounded by Tertiary volcanic rocks, but the general absence of exposures prevents an adequate geological description of the deposit.

CLAY

All clay deposits that were examined in Mineral County are bentonitic type clays resulting mostly from hydrothermal alteration of andesite, or from devitrification of tuff or tuffaceous sediments. In general they contain substantial amounts of impurities in the form of gypsum veinlets, soluble salts, and clastic grains; however, some have been found to be suitable for limited use as sealing agents in reservoirs and canals, and as drilling muds. With the continued growth of Nevada's iron ore industry these clays will perhaps become important as bonding agents in the pelletizing process.

SNOWFLAKE AND CHIATOVICH DEPOSITS. The Snow Flake and Chiatovich clay deposits (nos. 18 and 19 on plate 1) are within a small basin of late Tertiary rocks that lies approximately 9 miles north of Hawthorne. The Chiatovich property, also known as the Mary claim or Montgomery property, is in sec. 14, T. 9 N., R. 30 E. The Snow Flake property lies on the common corner of secs. 2, 3, 10 and 11, T. 9 N., R. 30 E. and is also staked under the names of Snow Ball and Janice Gale. Ross (1961) states that 4,000 tons of bentonitic clay were mined from the Chiatovich property to 1956. This clay was used mainly for the sealing of reservoirs in the Hawthorne Naval Reservation. Many cuts and roads and one sizable quarry attest to the past production. No production has come from the Snow Flake property, the main work being several large bulldozer cuts. One prominent cut on the Snow Flake property can be seen from U. S. Highway 95 across the south end of Walker Lake. Both properties were idle when I visited them in February of 1965.

General lithologic units in the immediate region of the Chiatovich and Snow Flake properties are: (1) Triassic metavolcanic rocks of the Excelsior Formation, (2) intrusive plutonic rocks of presumed Cretaceous age, (3) an older volcanic-sedimentary complex which Ross (1961) correlates with the Esmeralda Formation of late Miocene and early Pliocene age, and (4) younger andesites and basalts. Recent terrace gravels, talus,

alluvial deposits, and dune sands cover much of the region. The Excelsior Formation and plutonic intrusive rocks form a small northwesterly trending basin where the Tertiary volcanic and sedimentary rocks are preserved (fig. 1).

The character of the Miocene-Pliocene volcanic-sedimentary complex changes markedly from north to south in the basin. In the extreme northern part, it consists dominantly of fresh biotite latite (?) which, in hand specimen, appears identical to flows mapped as pre-Esmeralda by Ferguson, Muller, and Cathcart (1953) near Crow Spring on the Coaldale quadrangle. Fossil wood in the biotite latite (?) in the NE 1/4 sec. 3, T. 9 N., R. 30 E. might give some evidence of the exact age of this unit. Southward in the basin, the dominant rocks are bentonitic tuffs, tuffaceous sandstone, and water-lain pumiceous tuffs. The tuffaceous rocks are widely altered to clay-like materials. Numerous rocks, intermediate between the types in the north and south, occur throughout the basin. Sedimentary, interfingering relationships are noted at some localities and intrusive relationships in others, but exposures do not generally permit observation of contacts.

Andesitic and basaltic rocks both overlie and intrude the older sequence of flows and tuffs. In general, these more mafic rocks occupy the topographic highs, and they locally show columnar or vesicular structures.

The Miocene-Pliocene complex of volcanic and sedimentary rocks is moderately tilted and cut by minor faults. Some of the features are doubtless due to slumping of incompetent units, but there also seems to have been some general tilting to the east.

The clay-like unit on the Snow Flake property can be traced for several thousand feet along the bottom of a northeasterly trending canyon in the NE 1/4 of sec. 10 and the SW 1/4 of sec. 2. The unit here strikes northeast, dips southeast and is perhaps 25 feet thick. Similar material is exposed in a bulldozer trench on the nose of a ridge in the NE 1/4 of sec. 10. The material in this latter trench is relatively flat lying and appears to be stratigraphically above the unit in the canyon. It is obviously bedded and contains numerous imprints of plant stems. Minor gypsum seams occur throughout the Snow Flake deposits.

Results of tests run by the U. S. Bureau of Mines on four samples from the Snow Flake prospect showed that the clay-like material was composed mainly of amorphous material with minor amounts of montmorillonite. The amorphous material is presumably very-fine-grained glass, and the montmorillonite is probably a calcium variety. Upon swelling, the raw material had a volume increase ranging from 15 to 90 percent.

The Chiatovich quarry is in a bentonitic tuff that covers a broad area and is probably about 30 feet thick. Gypsum, jarosite, and carbonate minerals occur in small amounts throughout the deposit. Three samples tested by the U. S. Bureau of Mines showed the bulk of the material to be composed of montmorillonite and volcanic glass. Volume expansion upon swelling was about 400 percent for the minus 325 mesh fraction from two samples.

SANTA FE CLAIM. Several bulldozer trenches expose montmorillonite clay on the Santa Fe claim (no. 30 on plate 1) in sec. 1, T. 8 N., R. 34 E. about 8 miles from Luning on the south side of State Highway 23. The description of this locality was supplied by R. H. Olson (written communication, 1962).

Montmorillonite clay occurs in highly altered portions of limestone of the Luning Formation close to an intrusive contact with quartz monzonite. A tactite zone approximately 150 feet wide lies between the exposed clay and the quartz monzonite. One bulldozer trench exposes clay for a length of about 60 feet and a thickness of 3 to 4 feet.

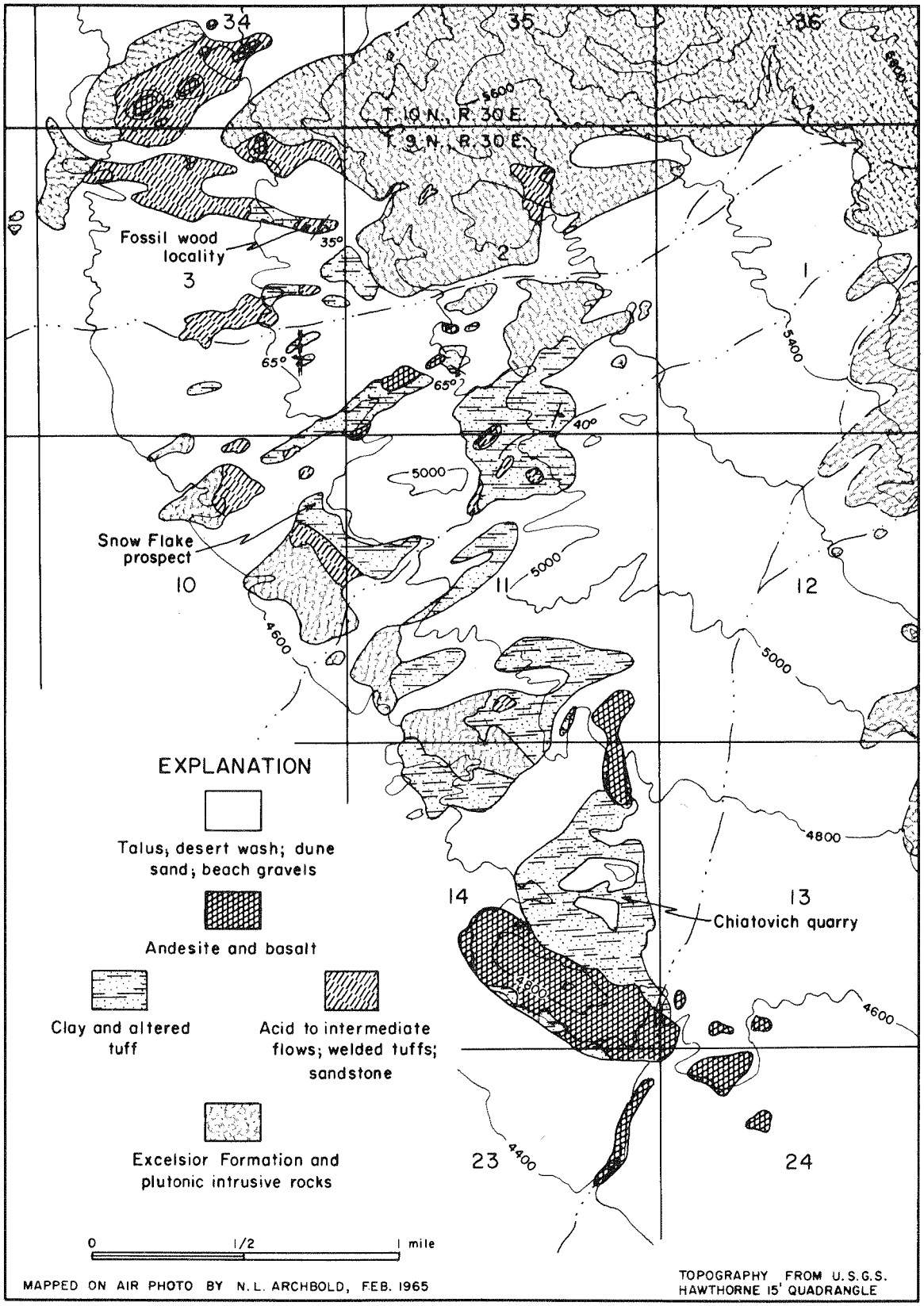

FIGURE 1. Geologic map of the area around the Chiatovich and Snow Flake clay properties, Mineral County, Nevada.

Results from the testing of one sample by the U. S. Bureau of Mines show that the clay is a calcium-type montmorillonite with a volume increase, upon swelling, of 70 to 80 percent. The Pyrometric Cone Equivalent of the sample was 8 at 1,236° C, and the cones showed extreme bloating with fusion to grayish color.

McMILLAN BENTONITE PROSPECT. The McMillan bentonite prospect (no. 40 on plate 1) is 2 miles east of Mina in sec. 10, T. 6 N., R. 35 E. Scattered pits and trenches expose bentonitic tuff over an area about 300 feet across. The bentonitic tuff appears to have a thickness of about 6 feet, and is overlain by andesite. Hand specimens of the bentonitic material contain identifiable biotite and quartz grains in small amounts.

UNNAMED DEPOSIT. Scattered exposures of bentonitic tuff occur near the mouth of the canyon leading to Battles Well about 3.5 miles northeast of Mina (no. 38 on plate 1). Individual exposures are up to several hundred feet across but may range up to 20 or 30 feet thick. These bentonites are essentially unprospected; small hand-dug pits are the only apparent attempt at exploration.

GOOD NIGHT CLAIMS. Bentonite clay crops out on the Good Night claims (no. 3 on plate 1) along the road about 4 miles west of Dead Horse Well and a few hundred feet east of the Walker River Indian Reservation boundary. The claims are in secs. 14 and 23, T. 12 N., R. 31 1/2 E. Neither the thickness nor lateral continuity of the bentonitic beds could be determined because of inadequate exposures; however, similar material crops out on the Reservation about 1 mile to the northwest. The clays occur in altered tuff beds, and X-ray analysis indicates the two main crystalline components to be labradorite and a montmorillonite clay.

CLAY, EL SOL, LA LUNA, AND LAS ESTRELLAS CLAIMS. Bentonite clay occurs on the Clay, El Sol, La Luna, and Las Estrellas claims about 15 miles north of Gabbs in the western part of sec. 21, T. 14 N., R. 35 E. (no. 11 on plate 1). The claims are owned by Mr. G. B. Gaylord of Reno, Nev. Brick-red bentonitic clays cover the floor of a topographic basin in altered Tertiary volcanic rocks. The basin is about 1,200 feet long and 600 feet wide. The clay has a thickness of at least 2 feet where it is exposed in several bulldozer trenches. Neither the base of the clay nor its contacts with the surrounding Tertiary volcanic rocks are well exposed. The deposit probably represents an altered tuff of Tertiary age. Tests by the U. S. Bureau of Mines on a single sample indicate the major constituent to be a mixture of sodium and calcium type montmorillonites capable of expanding to 360 percent of their original volume.

SODAVILLE BENTONITE DEPOSIT. The Sodaville bentonite deposit (no. 42 on plate 1) is in sec. 31, T. 6 N., R. 35 E. at the eastern end of the Excelsior Mountains about 1.5 miles southwest of Sodaville. The deposit has been staked at different times under the names of Bentonite, Clay Queen, Beauty Queen, Capitan John, Three Musketeers, and Bentonite King. According to Fulton and Smith (1932), the property was worked by the Cooper Shapley Bentonite Co. of Bishop, Calif., who shipped 9,000 tons to Los Angeles in 1929. Vanderburg (1937) credited the property with a production of 15,000 tons through 1937. The property was idle when visited in February of 1965.

The Sodaville bentonite deposit is within an area of altered andesitic volcanic rocks that appears to be about half a mile wide and 1.5 miles long in a west-northwesterly direction. A geologic sketch map for the immediate area of the clay pits is shown in figure 2. Four separate units are apparent in the area — two clay units, a strongly altered

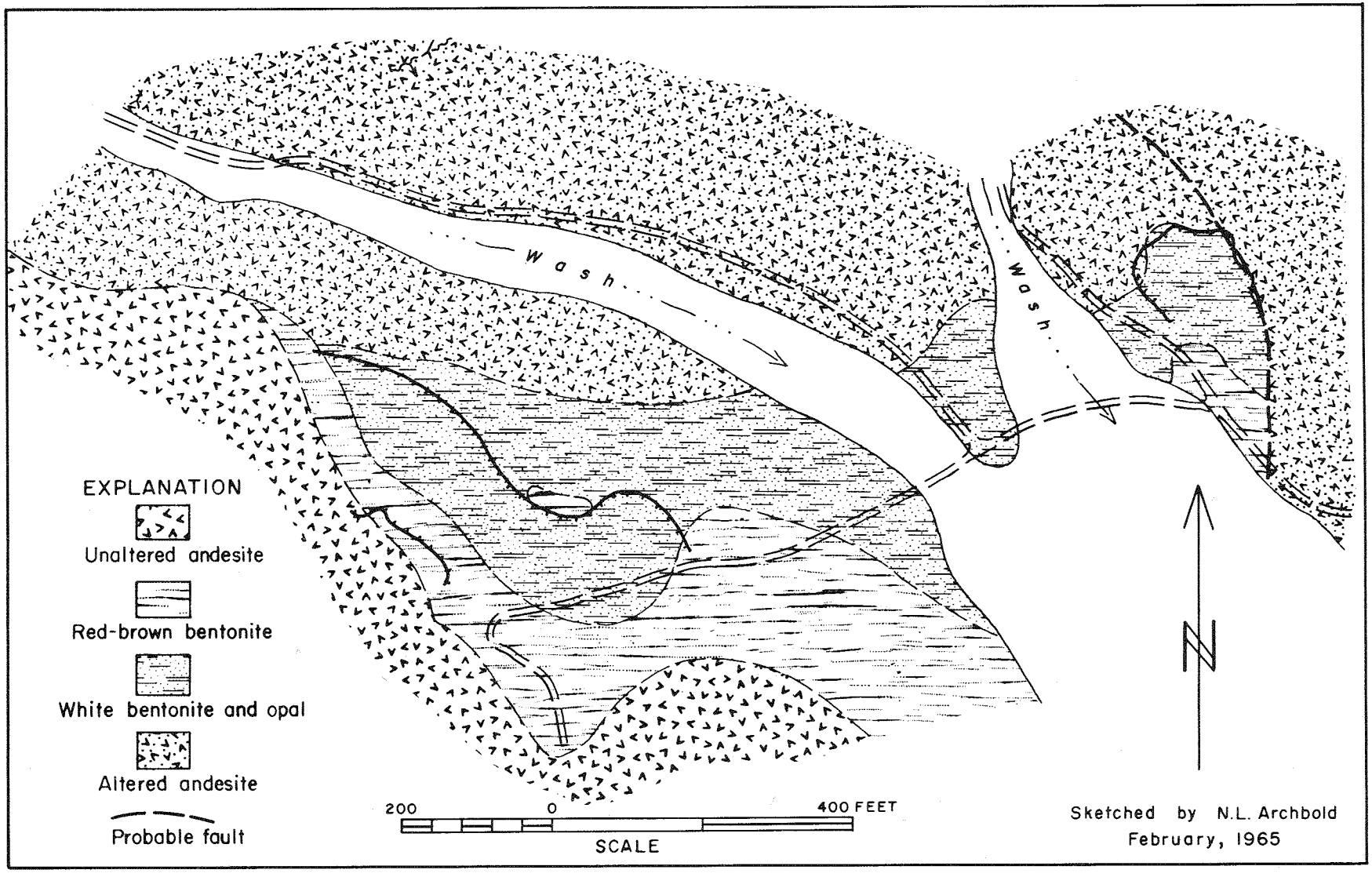

FIGURE 2. Geologic sketch map of the Sodaville bentonite deposit, Mineral County, Nevada.

unit, and a relatively fresh andesite unit. The clay and altered units were probably derived from the andesite.

Unaltered andesite crops out south and west of the clay pits (fig. 2); it caps hills and appears to be a relatively flat-lying unit. This andesite can be seen in various stages of alteration on the southwest side of the western pit and in the westernmost adit shown on figure 2. At these localities, identifiable relicts of andesite, up to a foot or two across, are surrounded by material in various stages of brecciation, silicification, and argillization.

A reddish brown, bentonitic unit, possibly 10 feet thick, underlies the unaltered andesite and crops out as a rim along the northern border of the andesite. The bentonitic material has a tuffaceous or cataclastic texture and shows many slickensided surfaces due to compaction or actual movement along a fault. This unit could be interpreted as marking the outcrop of a fault zone that dips gently to the southwest. Little of this material appears to have been mined despite the obvious bentonitic character of its weathered outcrop.

White, bentonitic clay mixed with porous, earthy, opaline silica crops out in an easterly trending zone, up to several hundred feet wide, on the north side of the reddish brown, bentonitic unit. Previous clay production has come from this zone, although good quality clay is only sporadically present.

Altered andesite, much brecciated, silicified, and stained by limonite, crops out north and east of the zone containing white, bentonitic clay and opaline silica. This altered andesite contains some minor gold deposits a few thousand feet west-northwest from the clay deposits.

The clay deposits were probably formed by hydrothermal solutions moving upward in a major west-northwest zone of faulting and brecciation which cut the andesite. The best clay was apparently localized below an impermeable zone that may represent gouge along a thrust fault. If these assumptions are correct, more clay might be present along the trace of the fault, and at shallow depths below fresh andesite in the area immediately south of the clay pits.

ENTERPRISE BENTONITE DEPOSIT. The Enterprise bentonite property (no. 56 on plate 1) is in sec. 6, T. 4 N., R. 36 E. (unsurveyed) on the east side of U. S. Highway 95 about 5 miles south of its junction with State Route 10 at Rhodes Marsh. Tuffaceous mudstone of the Esmeralda Formation crops out in dissected topography covering an area about 2,000 feet wide and a mile long. The mudstone is as much as 75 feet thick in some of the hills, so that an enormous volume of the material is present at the surface.

Weathered surfaces of the light-gray mudstone show the characteristic texture of bentonitic clay. Fresh samples can be obtained only by digging through the fluffy weathered zone, which is several inches thick on the steep slope. Lithologically, the mudstone appears relatively uniform throughout the area of exposure. It is mostly clay with scattered grains of quartz, tuffaceous material, and rock fragments, but some thin layers are markedly sandy. Thin veinlets of satin spar gypsum and thin crusts of saline minerals occur in many fractures.

SALINE PLAYAS

Saline playas represent one of the more important potential nonmetallic mineral resources in Mineral County. Three such playas — Double Spring Marsh, Rhodes Marsh, and Teels Marsh — have been worked for surficial deposits of halite, sodium carbonate, and boron salts. Future potential appears to be in the solar evaporation of subsurface brines. No examination of the playas was undertaken during this investigation and only

a brief review of each, taken from published data, is present here. Evaluation of the playas and their contained brines cannot be undertaken until deeper wells are drilled and the brines sampled.

DOUBLE SPRING MARSH. Double Spring Marsh (no. 2 on plate 1) is in the north central part of Mineral County about 8 miles east of Schurz. Around 1898, the Occidental Alkali Co., recovered 97- to 98-percent-pure sodium carbonate from the surficial salt deposits using a system of dissolution, filtration, and evaporation. According to Knapp (1898), about 500 acres of the playa were covered with a salt incrustation ranging from 2 to 14 inches thick and averaging about 6 inches thick. The average composition of the surface incrustation as given by Knapp is:

Constituent	Na_2CO_3	$NaHCO_3$	Na_2SO_4	NaCl	H_2O	Insolubles
Percent	20	25	15	10	15	15

The surficial crust of salts forms by capillary rise of solution through the underlying mud and subsequent evaporation at the surface. This crust accumulates very slowly in undisturbed areas but where it is removed it forms at the rate of about 1 inch per year.

TEELS MARSH. Teels Marsh (no. 48 on plate 1) is in the southern part of Mineral County where it covers an area of about 8 square miles. According to the description given by Vanderburg (1937), the marsh was first worked in the late 1860's as a source of sodium chloride for Aurora, Candelaria, and the Comstock. Then about 1872 it was the site of the first borax discovery in Nevada; thereafter, it was worked for borax until 1892 when the Death Valley deposits were discovered. Boron occurs principally in the mineral borax, as the presence of sodium carbonate prevents the formation of ulexite. Richest concentration of borax is on the surface of the salt incrustation that develops as a result of capillary rise of solutions and solar evaporation on the surface of the playa.

RHODES MARSH. Rhodes Marsh (no. 43 on plate 1) about 7 miles south of Mina, has received more attention than the other saline playas in Mineral County. The following description is abstracted from discussions by Phalen (1919) and Vanderburg (1937).

The playa was first worked for sodium chloride in the early 1860's to supply the mining areas of Aurora, Candelaria, and the Comstock. Borax was discovered in the 1870's shortly after the initial discovery at Teels Marsh. Rhodes Alkali and Chemical Corp. was formed in the late 1920's, and in 1930 the corporation erected a plant in an unsuccessful attempt to recover anhydrous sodium sulfate from Glauber's salt. A plant built in 1932 successfully recovered thenardite (Na_2SO_4) at the rate of about 150 tons per day, and this plant operated until 1933. Rhodes Alkali and Chemical Corp. reportedly produced about 20,000 tons of sodium sulfate and drilled numerous shallow auger holes that proved a reserve of 3,000,000 tons of sodium sulfate salts. The shallow brines contained an undisclosed amount of potassium.

The center of the playa was covered in 1919 by a layer of nearly pure sodium chloride that covered an area of about 1 square mile. Outside the central area the surficial salt was mixed with borax, ulexite, sodium sulfate, and sodium carbonate. In 1937 the summer water level was about 4 or 5 feet below the surface of the playa, and ulexite "cottonballs" formed a few inches below the surface. Thenardite occurred as lenses 3 to 5 feet thick overlain by 2 to 6 feet of silt and salt.

FLUORITE

Fluorite deposits are concentrated in two areas, one on the northeastern and the other in the southern part of the county. In both areas the deposits occur as typical epithermal veins in or associated with volcanic rocks of Tertiary age. Only one mine, the Kaiser or Baxter Mine, has yielded any sizeable amount of fluorspar.

Broken Hills District

The Broken Hills fluorite district, in the extreme northeastern part of Mineral County, consists of four separate properties; the K-Z mine and the West Slope prospect in the southwestern part of the district and the Kaiser and Little Fluorspar mines about 2 miles to the northeast. The relation between the fluorite veins on each property is shown schematically in figure 3.

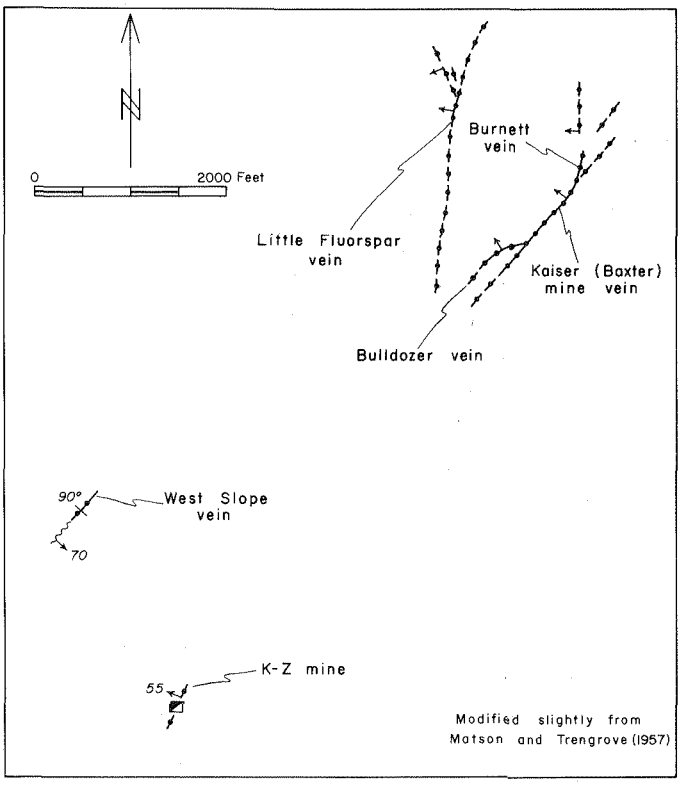

FIGURE 3. Sketch showing relation between veins in the Broken Hills fluorite district, Mineral County, Nevada.

All the fluorite veins are in Tertiary rhyolite that unconformably overlies weakly metamorphosed sedimentary and volcanic rocks presumed to be of Mesozoic age. The rhyolite is overlain by Tertiary volcanic rocks of intermediate composition. Veins are localized in faults or shear zones, and show characteristic features of open filling. Fluorite forms botryoidal and drusy coatings or veins within the rhyolite; cockade structure is common. The fluorite is mainly white, pale green, or lavender, and ranges from very fine grained layered aggregates to euhefral crystals about one-quarter of an inch across.

KAISER OR BAXTER MINE. The Kaiser or Baxter mine (no. 10 on plate 1) is the only major mine, having produced more than 200,000 tons of acid- and metallurgical-grade fluorite between 1928 and its exhaustion early in 1957. Matson and Trengove (1957) have described the deposit. According to them the main mineralized zone can be traced about 2,000 feet along a strike of N. 40° E. and about 700 feet down the dip which averages 50° to the northwest. The vein shows much pinching and swelling, but the average width is only about 1.5 feet.

LITTLE FLUORSPAR VEIN. The Little Fluorspar vein (no. 9 on plate 1) lies 500 to 1,500 feet north and west of the Kaiser vein and is roughly parallel to it. I visited this vein only briefly but it appears geologically similar to the Kaiser vein.

WEST SLOPE VEIN. The West Slope vein (no. 7 on plate 1) has also been called the McDowell or Black Cap vein. It can be traced about 500 feet along a strike of N. 40° E. and appears to be about vertical. On the southeast end it passes into a fault, with the same strike, that can be traced another 400 feet. The vein is less than 3 feet wide where it is exposed, and has been prospected in several shallow pits and one short adit. At least one hole has been drilled to intersect the vein near its northeast end. The vein does not appear to have produced any quantity of marketable grade fluorite.

K-Z MINE. The K-Z mine (no. 8 on plate 1) is about 2,300 feet south-southeast of the West Slope vein. It has also been referred to as the Spardome or Miller property. Fluorite occurs in a brecciated shear zone in rhyolite; the zone appears to trend about N. 20°-30° E. and dips about 55° to the northwest. It can be traced for about 100 feet on the surface. The fluorite-bearing zone has been prospected by several diamond drill holes and an inclined shaft, estimated to be 150 feet deep, with a short crosscut and drift. In the bottom of the shaft, fluorite is scattered across a width of about 40 feet, but no well-defined vein is present. Fluorite is in places coated with a soft white material that appears from the X-ray pattern to be a mixture of quartz and montmorillonite.

Southern Mineral County

Several fluorite prospects have been reported in the southern part of Mineral County near Mount Montgomery. The region has been variously referred to as the Buena Vista, Queens, Mount Montgomery, or Oneota mining district. No large scale production has been derived from the area, but several promising shows of fluorite suggest the existence of substantial amounts of the mineral.

FLUORSPAR KING AND BLUE BELL PROSPECTS. The Fluorspar King and Blue Bell prospects (no. 54 on plate 1) have also been referred to as the Summerfield and Overholzer mines and have most recently been staked as the Lode claims. The property is in a narrow, easterly-trending canyon in the southwest quarter of sec. 8, T. 1 N., R. 33 E. It can be reached by traveling up the old railroad grade which is seen on the south side of U. S. Highway 6, 1.7 miles southwest from Mount Montgomery. About 1 mile south along the grade there is an old railroad tunnel, and the property is about one-quarter mile up the canyon that leads eastward from the tunnel.

Brecciated rhyolite, cropping out along the canyon walls, is overlain by andesite along the rim of the canyon (fig. 4). These volcanic rocks overlie granite and appear to be faulted down against the granite about 500 feet west of the fluorite deposits. Fluorite occurs as vuggy, crustified veins along shears in the highly fractured rhyolite. Most veins strike about N. 25° W. and dip vertically to steeply eastward. Maximum width of the veins is about 4 feet; the longest vein is exposed for about 100 feet. All veins pinch out upward, making the overlying andesite devoid of fluorite. The fluorite in the veins is intimately associated with calcite and quartz. Several small shipments reportedly contained an average of 65 percent CaF_2. In addition to the veins, calcite and fluorite are widely distributed in the rhyolite as fracture coatings and small pods.

LINDA OR ST. JOSEPH PROSPECT. The Linda or St. Joseph fluorite prospect (no. 55 on plate 1) is on the Mineral-Esmeralda County line in the SW 1/4 (unsurveyed) sec. 29, T. 1 N., R. 33 E. The property is in a deep canyon off the northwest tip of Mustang

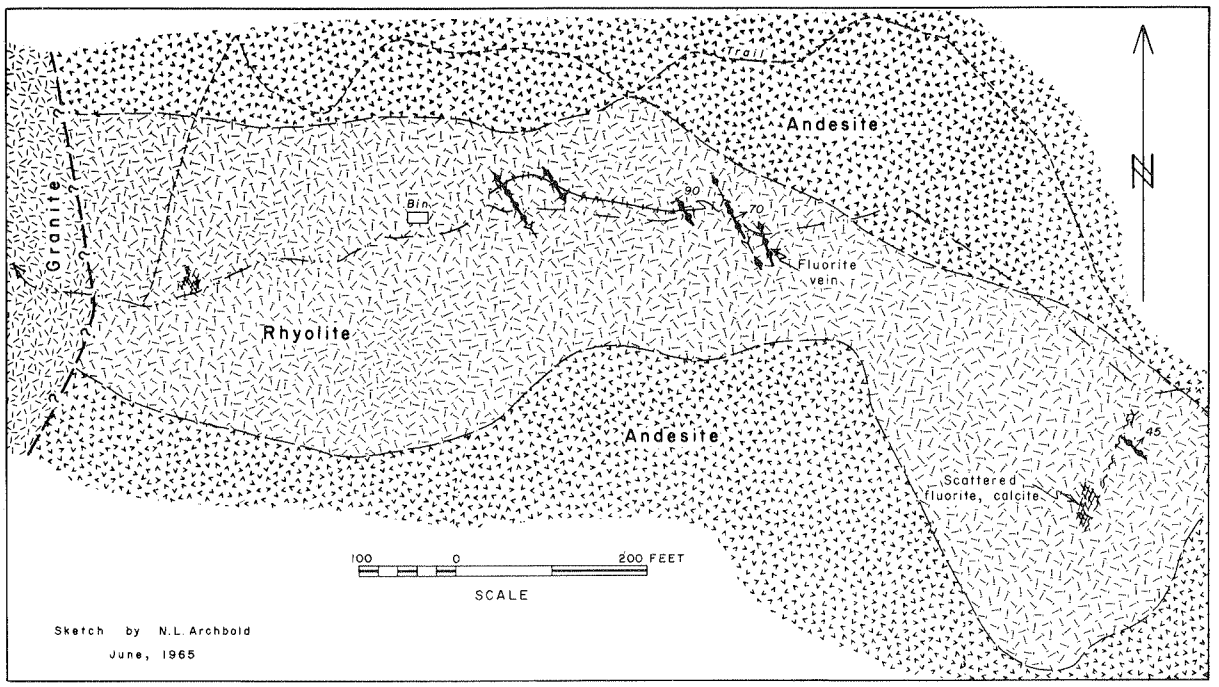

FIGURE 4. Sketch map of the Fluorspar King and Blue Bell fluorite prospects, Mineral County, Nevada.

Mountain; it can be reached by a road that leads up Queen Canyon then around the southwestern flank of Mustang Mountain.

Fluorite occurs as a vuggy discontinuous vein in shaly, schistose rocks thought to be of Cambrian age. Tertiary volcanic rocks overlie the sedimentary rocks. The vein is nearly vertical and strikes about N. 35° W.; it is up to 3 feet wide and can reportedly be traced for 1,000 feet. Individual fluorite crystals range up to 4 inches across.

Several shallow pits have been dug along the vein structure, but there has been no systematic exploration.

BARITE

Barite deposits in Mineral County occur as veins and as bedded replacement deposits. The vein deposits tend to contain whiter, coarser grained material; the bedded replacement bodies are finer grained and grayish to brownish. Barite for use as filler material, where high whiteness is required, is most likely to be found in the vein type deposits. Bedded replacement deposits of barite are a better source of material for use in heavy drilling media where volume and cost of mining are more important than the color of the product.

Most barite deposits in Mineral County, whether of vein or bedded replacement types, lie within a zone about 5 miles wide that trends N. 25° W. through the center of the county (fig. 5). This zone may represent partial control over migration and deposition of barite by some undefined feature in the deeper, basement rocks.

Vein Deposits

CRYSTAL MINE. The Crystal barite mine (no. 28 on plate 1), also known as the Kinkaid barite mine, is 11 miles east of Hawthorne on the south side of U. S. Highway 95, in sec. 21, T. 8 N., R. 32 E. The mine is on a patented claim owned by Frank W. Lewis

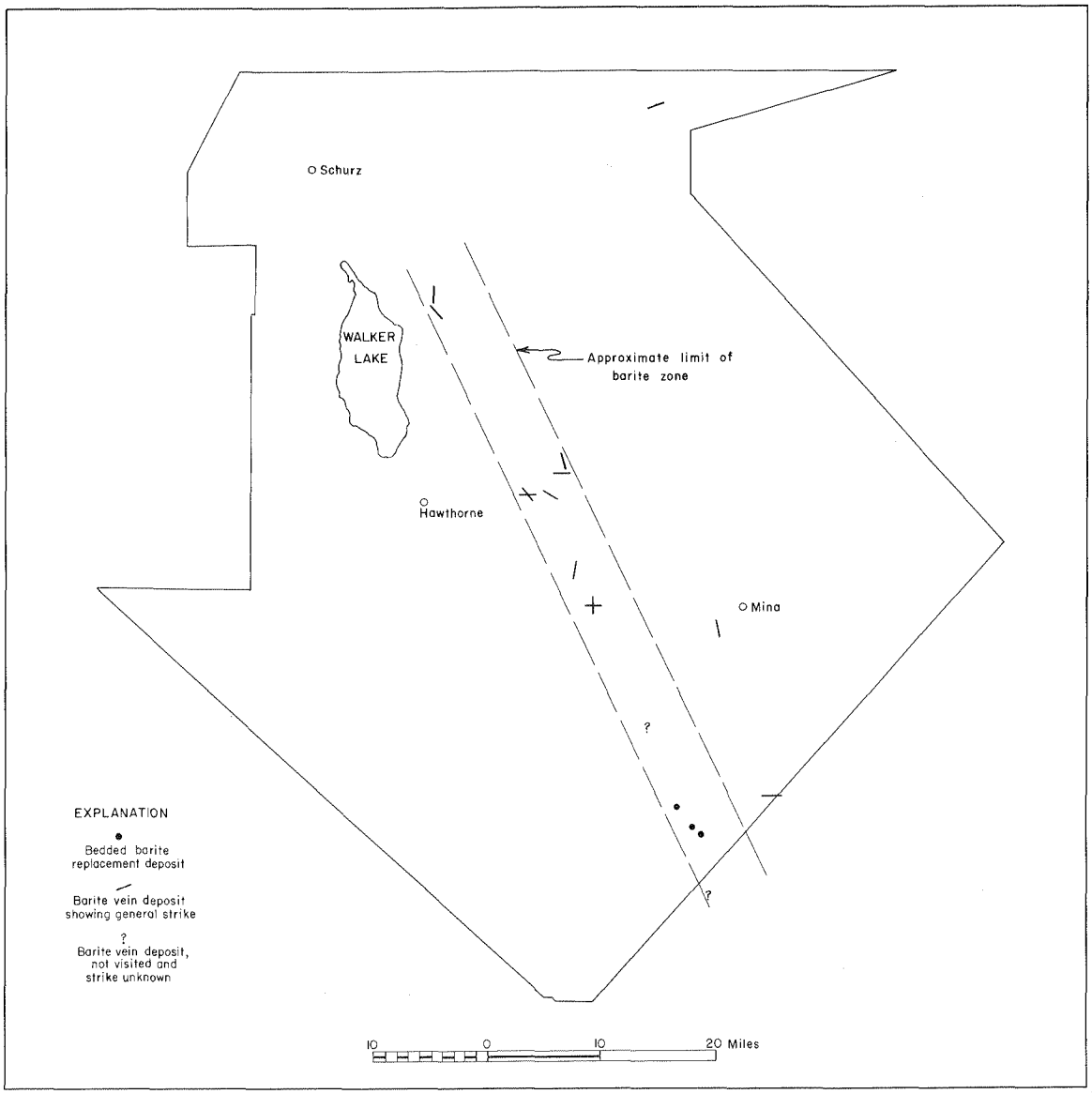

FIGURE 5. Map showing distribution of barite deposits in Mineral County, Nevada.

in 1965. Barite forms a vein in porphyritic andesite of the Excelsior Formation where it crops out in a flat area that is mostly covered by pediment gravels. A sketch of the surface workings is shown in figure 6. The barite vein strikes N. 60° W. and dips steeply to the southwest; maximum width as exposed in the surface workings is 10 to 12 feet. The vein appears to be continuous for at least 350 feet along its strike, but scattered barite occurs over a length of about 600 feet. A copper-stained shear trends parallel to the barite vein along its northwestern end; this shear occurs about 40 feet in the footwall of the barite vein. In the northwestern part of the mine area, the porphyritic andesite host rock is associated with metavolcanic rocks of the Excelsior Formation, but it is not clear whether the porphyritic andesite intrudes or is interbedded with these rocks. Also, a northeasterly trending shear zone may cut across the northwestern part of the mine area.

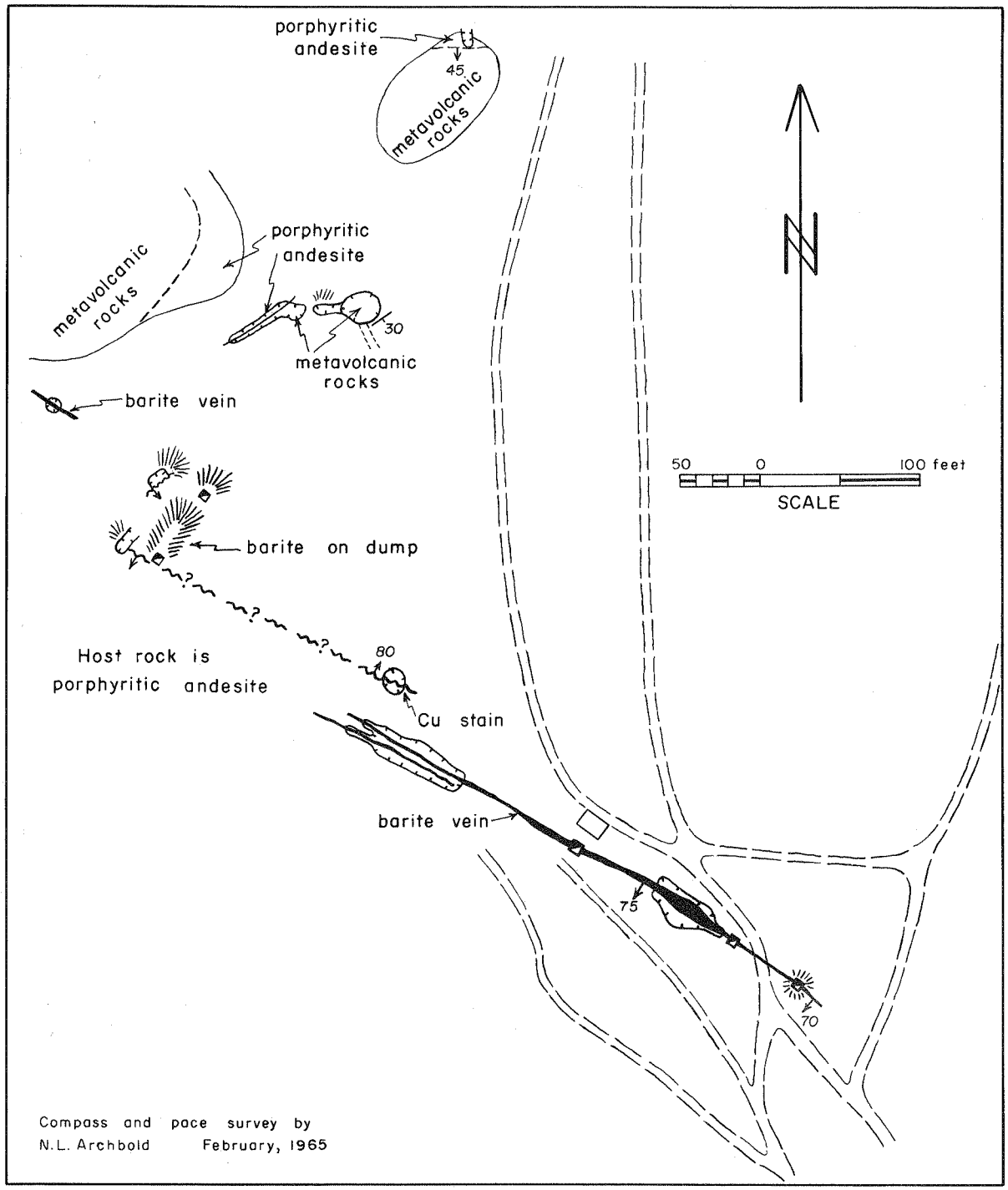

FIGURE 6. Surface workings and geology at the Crystal barite mine, Mineral County, Nevada.

Two samples, taken by the U. S. Bureau of Mines, across the Crystal barite vein gave the following values:

Percent $BaSO_4$	Specific Gravity
87.27	4.15
78.56	3.84

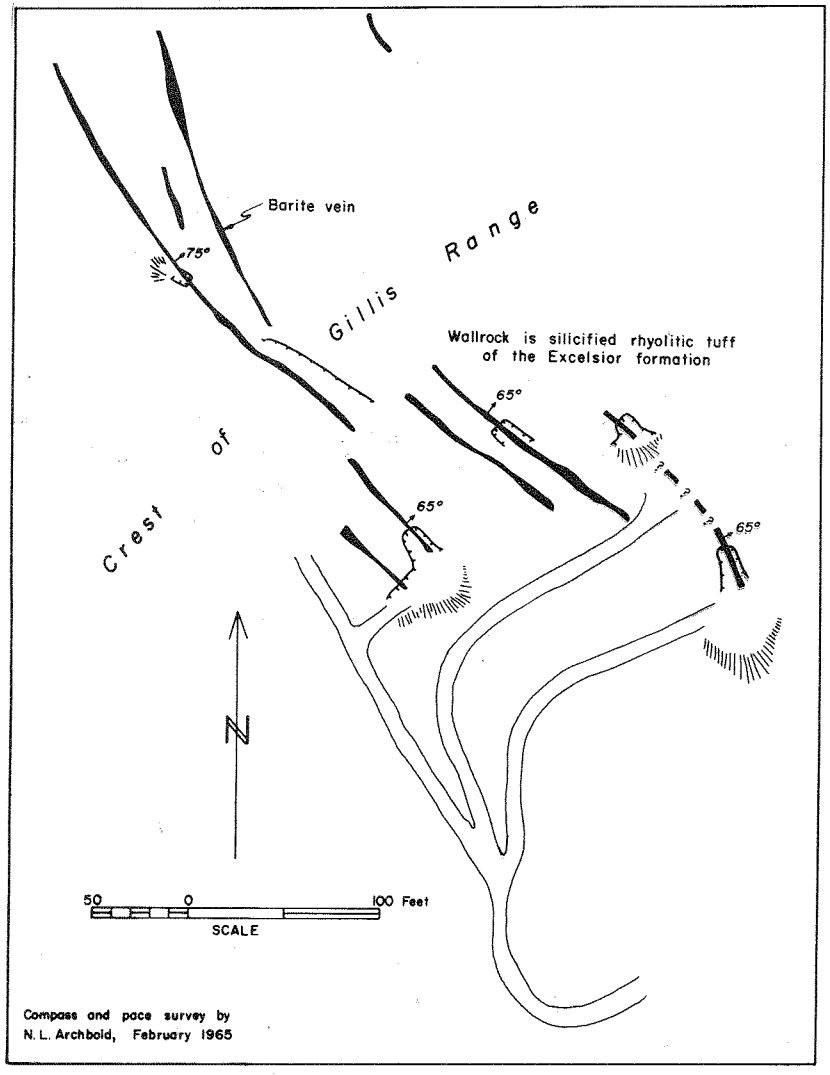

FIGURE 7. Map showing barite veins at the Gravity mine, Mineral County, Nevada.

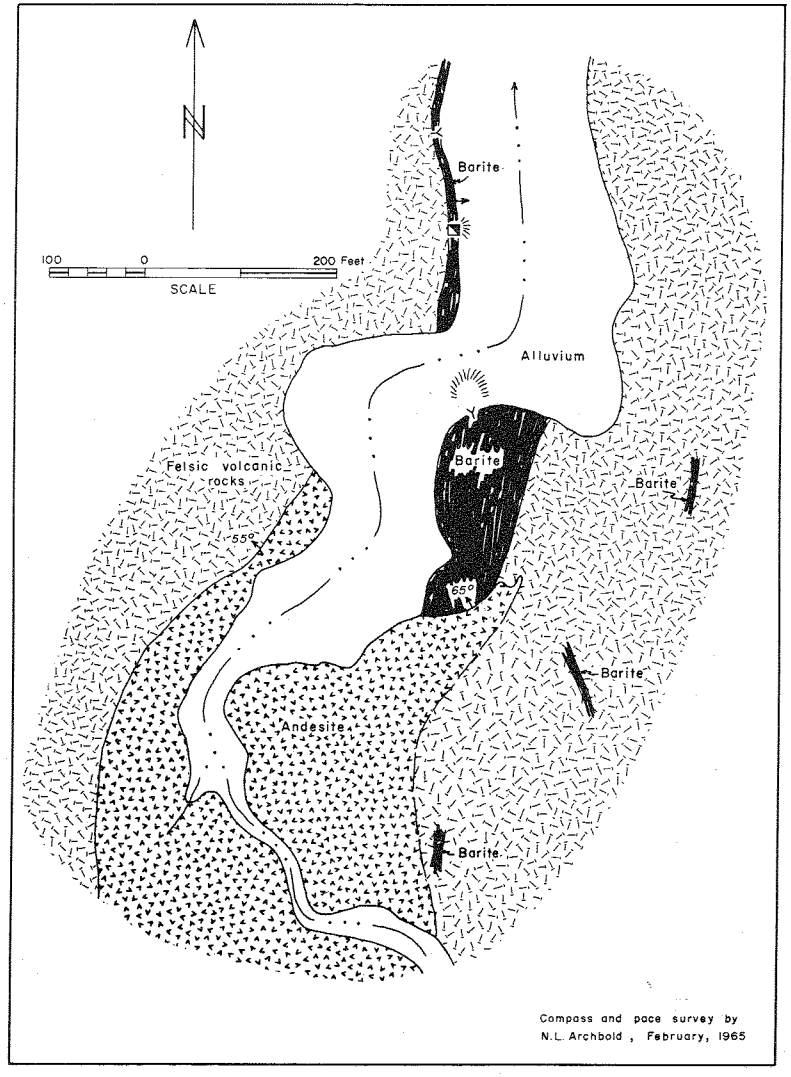

FIGURE 8. Geologic map of the Curley barite property, Mineral County, Nevada.

GRAVITY PROPERTY. The Gravity barite property (no. 14 on plate 1) is on the crest of the Gillis Range about 4 miles east-southeast from Nolan on the Southern Pacific Railroad. Access to the property is via a steep, winding road on the east flank of the Gillis Range. The property has also been staked under the names of Lakeview, Arlinda, and Lucy. Some barite from the property appears to be stockpiled at Nolan station, but workings on the property give no evidence of important production.

Barite veins on the property cut silicified rhyolitic tuff of the Excelsior Formation where it forms the upper plate of the Gillis thrust fault as mapped by Ferguson and Muller (1949; also Ross, 1961). Limestone of the Luning Formation underlies the thrust fault and is exposed several hundred feet vertically below the property on the east flank of the Gillis Range. Brecciated rocks of the thrust zone are well exposed along the access road to the Gravity barite property. The barite veins form several discontinuous units (fig. 7) that strike about N. 40° W. and dip 65° to the northeast. Maximum width of individual veins is about 6 feet, and the veins consist mainly of barite that ranges from fine-grained, sacchoridal aggregates to aggregates of blocky and tabular barite crystals up to 1.5 inches across. The barite is white to light gray and is associated with minor amounts of quartz and brown calcite with traces of galena, sphalerite, and secondary copper minerals. Most of the metallic minerals are in the more vuggy barite vein which lies farthest to the southeast, and which has been prospected with two shallow pits.

CURLEY PROSPECT. The Curley barite prospect (no. 13 on plate 1) is in the SE 1/4 sec. 29 and the NE 1/4 sec. 32, T. 11 N., R. 30 E. on the south side of Wildhorse Canyon about 4 miles east from Nolan station on the Southern Pacific Railroad. The property has been staked, at various times, as the Hidden Fortune, Galena, and Gillis. It appears to have been prospected from time to time since the early 1900's without having yielded any marketable product.

The Excelsior Formation of Middle Triassic age crops out in the canyon, and along the upper canyon walls it is unconformably overlain by acidic to intermediate volcanic rocks of Tertiary age. In the vicinity of the Curley barite prospect, weakly metamorphosed felsic and andesitic volcanic rocks constitute the Excelsior Formation (fig. 8). The felsic volcanic rocks are silicified, argillized, and brecciated. Andesite appears to intrude the felsic volcanic rocks as a lenticular body, up to 300 feet wide, dipping 55° to 65° to the northwest.

Barite veins and pods, with quartz and calcite are confined to the altered felsic rocks of the Excelsior Formation. The barite bodies have a general northerly trend and can be traced on the surface for at least 600 feet, with widths ranging up to 100 feet. The barite is mostly brecciated and mixed with some quartz and calcite; it forms blocky crystals and fine-grained sacchroidal masses. Traces of galena occur throughout the barite. Locally quartz and calcite constitute the bulk of the mineralized bodies.

BARIUM PROSPECT. The Barium barite prospect (no. 37 on plate 1) has also been staked in the names of Shirly, Snow Flake, and Sunshine. It is along the west side line of sec. 7, T. 6 N., R. 33 E. on a low, northerly trending ridge of weakly argillized and iron-stained granite. Widely scattered pods and veins of barite are exposed in numerous prospect pits and trenches over a zone that extends for about one-half mile north and south. The barite bodies are massive accumulations of tabular and blocky crystals, up to two inches across, with minor amounts of quartz and sulfide minerals. The largest pods are several feet across and the longest veins are exposed for several tens of feet. Veins strike generally to the north or east.

EAGLEVILLE DEPOSIT. The Eagleville barite deposit (no. 5 on plate 1) has also been known as the Highland group, and the property was held, as the Ace group, by G. L. Simkins in 1965. The deposit is on the north side of the Eagleville district in sec. 34, T. 14 N., R. 33 E. It has the form of a steeply dipping vein across the north flank of Eagle Hill (fig. 9).

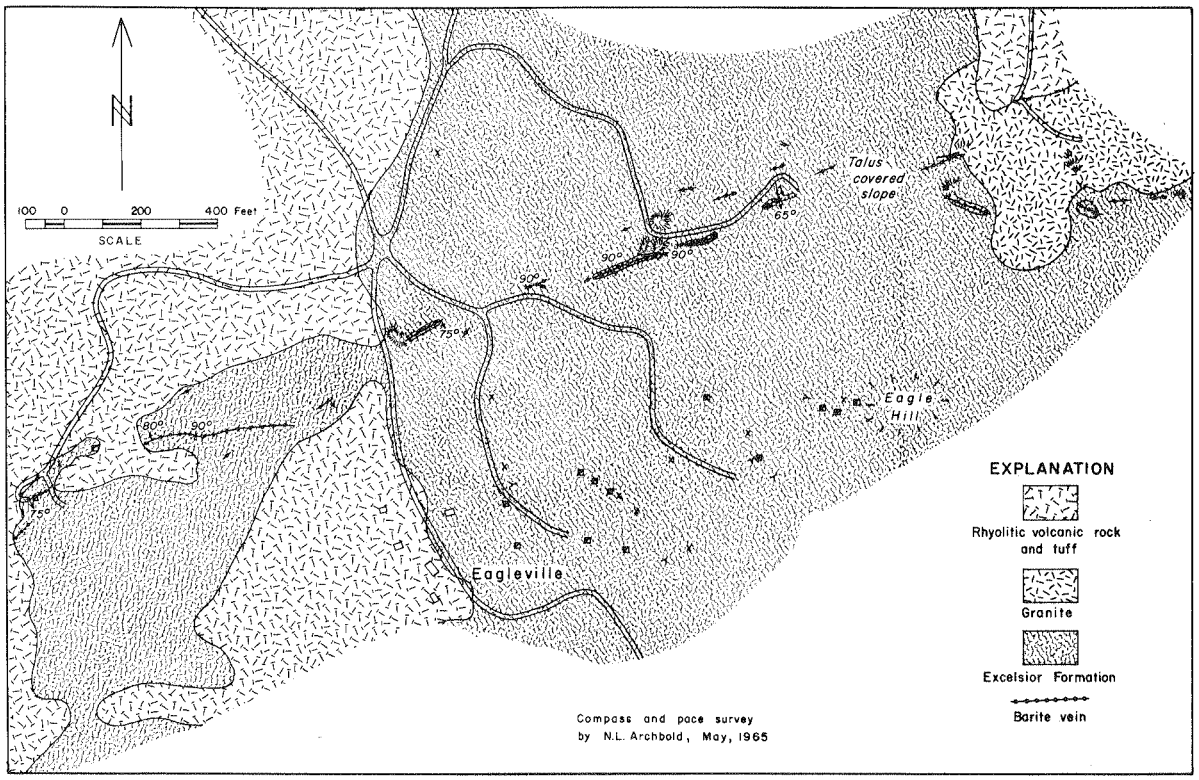

FIGURE 9. Geologic map of the Eagleville barite deposit, Mineral County, Nevada.

Three major rock units crop out in the area. The oldest consists of weakly metamorphosed volcanic rocks inferred to be part of the Excelsior Formation of Mesozoic age. The Excelsior Formation is intruded by granitic rocks and both are unconformably overlain by volcanic rocks of Tertiary age.

The Excelsior Formation consists of rhyolitic and andesitic rocks weakly metamorphosed to the extent that they have a quartzitic appearance. On Eagle Hill, the Excelsior is so coarse grained as to be dioritic in character, but it was not determined during the brief examination whether this rock derives its coarser texture from metamorphic effects or intrusive origin. The Excelsior is somewhat bleached and altered in the vicinity of the veins.

A granitic intrusive crops out in the northeastern part of the area and the entire region appears to be underlain by this granitic rock at shallow depth. Barite veins do not continue through the granite.

The Tertiary volcanic rocks are mainly rhyolitic tuffs and flows, but more mafic varieties are present off the northwestern corner of the mapped area.

Eagleville is best known for its production of gold from quartz veins. These veins were not mapped, but they strike northwesterly, dip steeply, and are concentrated in the

area just east of the abandoned buildings shown on figure 9. Barite veins, on the other hand, strike about N. 70° E. in a rather continuous zone to the north of the old gold workings. They are exposed for about 3,000 feet along this zone, are up to 6 or 8 feet wide and have been worked to depths of at least 100 feet. Shipments from the deposits reportedly contained an average of 96 percent $BaSO_4$. Substantial reserves may yet remain.

Several hundred feet north of the abandoned community of Eagleville, the barite veins show a discontinuity in strike. This discontinuity probably represents the intersection between the zone of barite veins and the shears in which the gold veins are localized.

UNNAMED DEPOSIT. An unnamed barite prospect (no. 27 on plate 1) occurs in the south central part of sec. 19, T. 8 N., R. 32 E. about 9 miles east of Hawthorne and 1 mile south of U. S. Highway 95. Prospecting of the barite bodies appears to have commenced in the early 1900's with the hope of discovering precious metal deposits. Work has been confined to three small areas which lie several hundred feet apart approximately along a north-south line. Andesitic and quartzitic rocks of the Excelsior Formation constitute the host rocks in each of the three areas, and the surrounding hills are capped with relatively flat-lying, younger basalts.

Two short adits have been driven in the northern area. An upper adit follows a shear zone, 1 to 2 feet wide at the portal, striking S. 85° E. and dipping 72° N. Secondary copper minerals stain the shear zone, but no barite was noted. A second adit is about 75 feet below the first. This second adit trends about S. 50° E. but there is no apparent structure at the portal and no barite was noted.

The central area consists of a shallow cut in the hillside several hundred feet south of the northern area. Here, a zone about 50 feet wide and 150 feet long contains irregular barite-quartz masses that trend easterly and dip steeply to the north. Largest barite-quartz masses are about 10 feet across and contain traces of chalcopyrite.

Several hundred feet still farther south, in the third area, small barite bodies are exposed in a trench that trends S. 40° E. and is about 125 feet long and up to 15 feet deep at its southwestern end. Barite forms brecciated lenses, up to 5 feet wide, striking about N. 20° W. The barite lenses contain minor amounts of galena.

In a flat area several hundred feet northwest of the central pit, scattered patches of limestone are exposed. The limestone shows some evidence of mineralization in the form of secondary copper minerals, iron oxide minerals, jarosite, and alteration to jasperoid.

UNNAMED DEPOSIT. An impure barite vein cuts quartzitic and andesitic layers of the Excelsior Formation in sec. 24, T. 3 N., R. 34 E. (no. 41 on plate 1), 3 miles southwest of Mina. Small prospect pits have been dug along the vein, but no notices of location were found by the writer when the property was visited in March of 1965. The vein is about 4 feet wide; it strikes N. 10° W., dips 50° to the east, and can be traced at least 300 feet on the surface.

CANDELARIA. Page (1959) has mapped barite veins about 1.5 miles southeast of Candelaria (no. 52 on plate 1). The main vein trends about N. 80° W. cutting weakly metamorphosed Jurassic(?) volcanic rocks (probably equivalent to the Excelsior Formation) and Triassic shale of the Candelaria Formation. It can be traced for about 1,200 feet. According to Page the veins are mostly less than 1 foot wide and are nearly vertical.

WESTERN CLAIM. Barite occurs on the Western claim (no. 35 on plate 1) in the Ashby district, sec. 26, T. 7 N., R. 32 E. A shallow bulldozer trench exposes a barite vein, 3 feet thick, that strikes N. 10° E. and dips 55° E. in steeply dipping shaly rocks. The vein cannot be traced laterally because the area is covered by alluvium.

BARIUM MINING CO. A barite vein (no. 24 on plate 1) in the northeast part of sec. 10, T. 8 N., R. 32 E. has been prospected by an organization known as the Barium Mining Co. The prospect, which was deserted at the time of my visit, appears to have had no production. The barite vein crops out on a steep hillside where it has been exposed in two small prospect cuts. The vein strikes N. 15° W. and dips 65° W.; it can be traced about 250 feet up the hillside with a maximum exposed width of about 5 feet. It consists of alternating stringers of barite and metavolcanic rocks of the Excelsior Formation. Individual stringers are up to 1 foot wide. Traces of secondary copper minerals are disseminated in the vein. Some of the barite is pink, possibly due to the presence of some foreign element.

UNNAMED DEPOSIT. Impure, discontinuous barite veins that trend easterly have been prospected for base and precious metals in the southwestern part of sec. 10, T. 8 N., R. 32 E. (no. 25 on plate 1). The veins cut sheared and altered rocks of the Excelsior Formation and are generally no more than a few feet wide. They can be traced sporadically for at least 1,000 feet. Locally they are heavily stained by secondary copper minerals.

ANNETT GROUP. Vanderburg (1937) refers to the Annett group of barite claims located "several miles east of Marietta." This deposit was not located; therefore, it is not shown on the county map, plate 1. According to Vanderburg, barite forms a series of parallel veins averaging 6 feet wide. The deposit has been explored through a tunnel, 80 feet long, and several open cuts.

Bedded Replacement Deposits

NOGUEZ MINE. The Noguez or Columbus barite mine (no. 51 on plate 1) is in sec. 22, T. 3 N., R. 34 E. on the north flank of Miller Mountains. The property was under lease, in 1965, to the Olsen Mud Service Co., of San Pedro, Calif. An estimated 25,000 tons of barite has been mined from the property for use in oil well drilling mud.

Barite occurs as bedded replacement bodies in Ordovician rocks of the Palmetto Formation. Most of the mine area is covered by ancient pediment or terrace gravels and by waste material, but barite is exposed in four open cuts scattered in an area about 200 feet long and 300 feet wide (fig. 10). The Palmetto Formation consists of dark cherty layers, 1 to 3 inches thick, which contain some zones of thinly interbedded gray shale. Prominent quartzitic aplite dikes, up to 30 feet thick, intrude the Palmetto Formation in the mine area.

Beds as exposed in the two western pits strike northerly and dip steeply eastward, while in the two eastern pits the strike is northeasterly with steep dips to the southeast. Very likely the Palmetto Formation in the mine area is tightly folded and perhaps thrust.

In the westernmost pit, a tuffaceous or possibly a mud flow unit unconformably overlies the Palmetto Formation and is in turn covered by more recent gravels.

Barite forms lenses parallel to the bedding in the Palmetto Formation, but these lenses do not occur within the quartzitic dikes. Where shale is interbedded with cherty layers, the chert is preferentially replaced by barite. The barite is very fine grained and light gray to light brown. There appear to have been at least three main lenses of barite up to 12 feet thick and perhaps as much as 350 feet long.

NOGUEZ NUMBER 2 DEPOSIT. The Noguez Number 2 barite deposit (no. 50 on plate 1) is in sec. 16, T. 3 N., R. 34 E. about 1 mile northwest of the main Noguez or Columbus

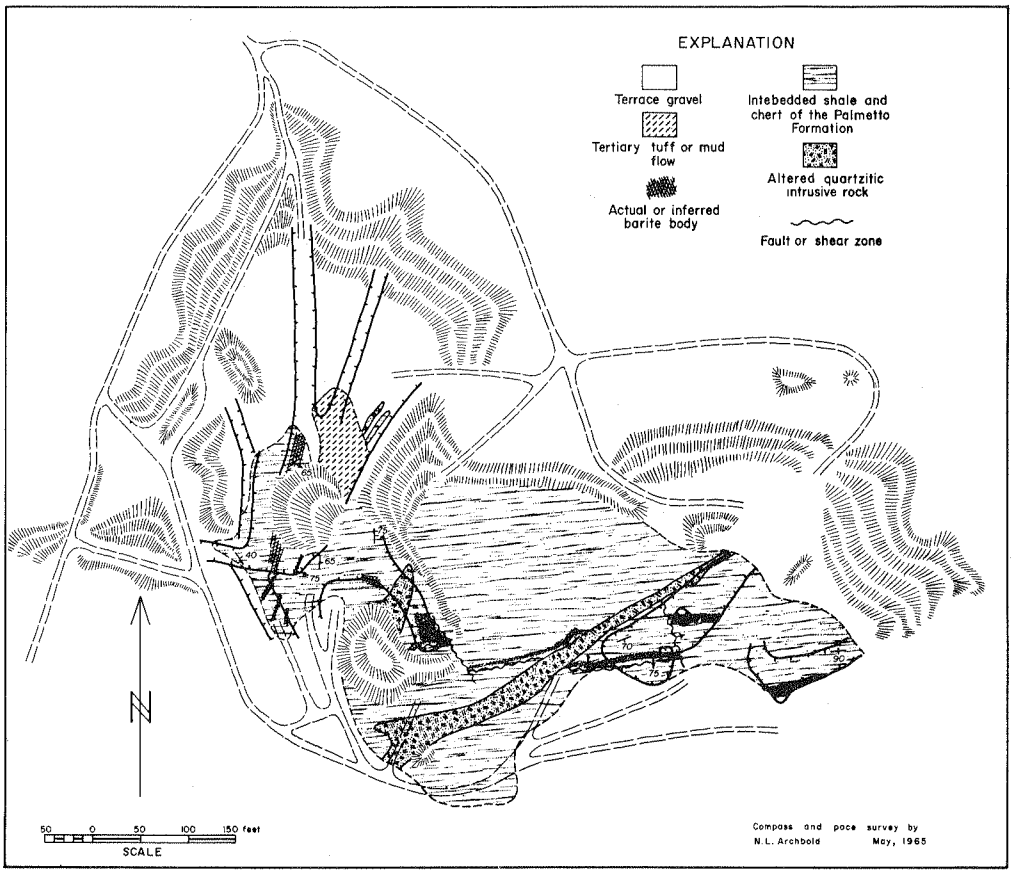

FIGURE 10. Geology map of the Noguez or Columbus barite mine, Mineral County, Nevada.

barite mine. Barite has been mined from a pit, about 60 feet wide and 40 feet deep, that trends 125 feet westerly along a fault or buried scarp. The fault or scarp strikes westerly and dips 63° N. with Ordovician chert of the Palmetto Formation on the footwall and rubble of Tertiary volcanic rocks and chert on the hanging wall. Barite forms a finer-grained, light-gray, bedded replacement deposit in the thin-bedded chert. The deposit, as exposed in the pit, appears to have been 50 to 60 feet long and about 10 feet thick with a strike of about N. 75° W. and a steep dip to the north. The barite terminates against the fault or buried scarp in the west end of the pit. Thin pods of soft limonite or wad occur along the margins of the barite.

GIROUX OR LITTLE SUMMIT MINE. The Giroux or Little Summit mine (no. 49 on plate 1) is about 6.5 miles south of Belleville and 1 mile east of State Highway 10 in sec. 8, T. 3 N., R. 34 E. A sketch of the deposit is shown in figure 11. Geologically, the Giroux deposit is similar to the Noguez deposits, in that, it is also a bedded replacement deposit in the Palmetto Formation. Barite pods and lenses can be traced for an estimated 2,000 feet in an easterly direction across the property, but only the productive area is shown in figure 11. Within this area, thinly bedded cherts with some shaly layers strike easterly and dip steeply to the south. A sandy, jasperoidal layer crops out about 300 feet north of the main barite body. This layer appears to be continuous across the property and is about 200 feet thick in the area north of the main barite body. The barite body itself is up

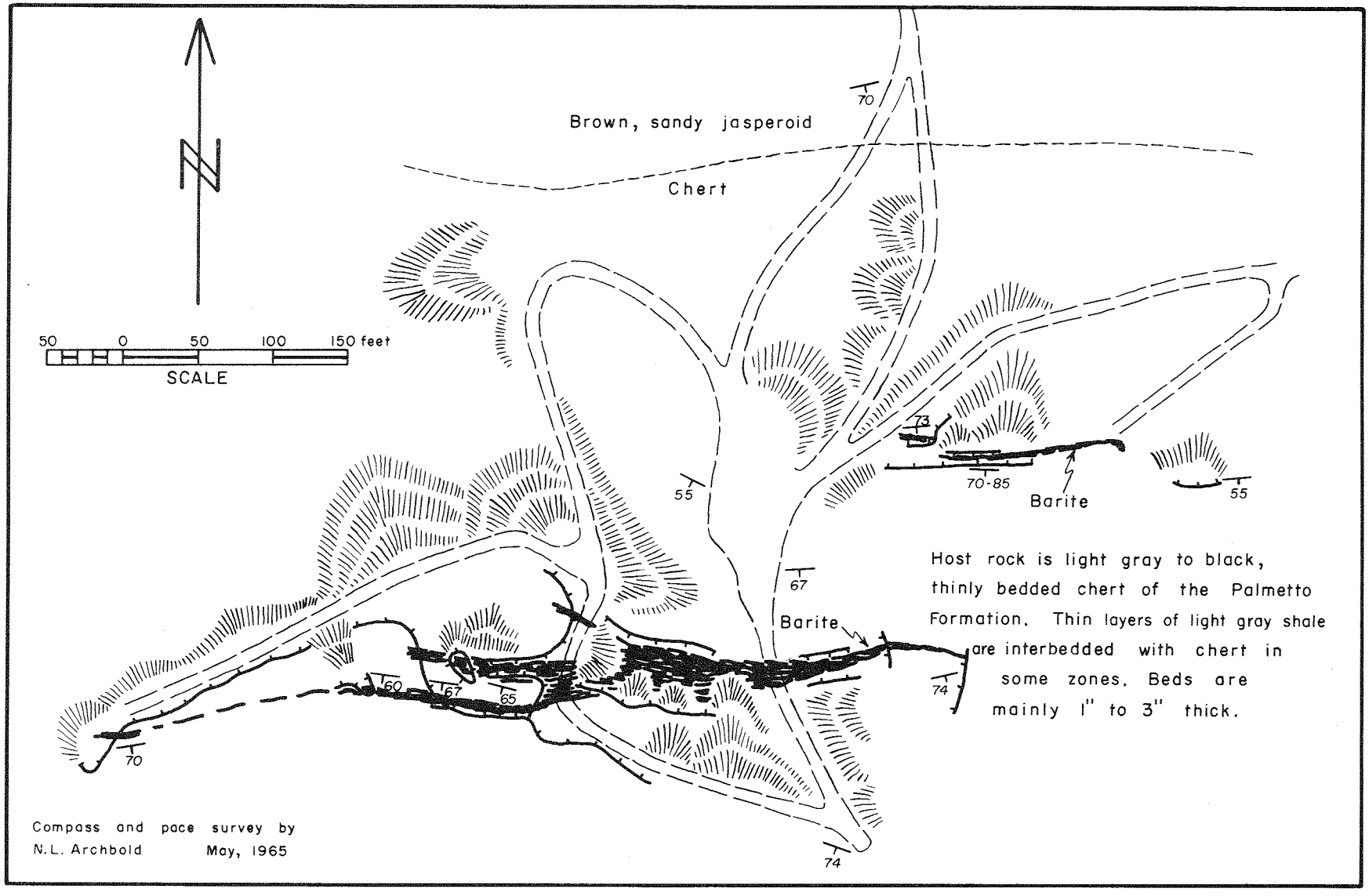

FIGURE 11. Sketch map of the Giroux or Little Summit barite mine, Mineral County, Nevada.

to 40 feet wide. The widest portion is about 200 feet long although it is nearly 500 feet long if the thinner lateral extensions are included. Other barite lenses on the property appear thinner and less continuous. The main lens has been mined to a depth of about 30 feet.

GYPSUM

Gypsum resources in Mineral County are represented by a single deposit. Buried and yet undiscovered deposits might exist in association with the many exposed limestones in the county, but new deposits would probably not be economically competitive with the currently producing deposits in Washoe and Clark Counties.

Old references have been made to deposits of gypsum interbedded with limestone in the area a few miles west of Hawthorne, but the rocks in the area appear to be mainly intrusive. Possibly some gypsum exists in the limestones of the Lucky Boy area a few miles southwest of Hawthorne but no sizeable deposits have been noted or explored.

REGAN QUARRY. The Regan gypsum quarry (no. 1 on plate 1), also known as the Winner or Copper Belt gypsum mine, is about half a mile east of the western boundary of Mineral County in the NW 1/4 sec. 6, T. 12 N., R. 27 E. Stoddard and Carpenter (1950) have presented a resumé of the mine's history and production. In recent years it has been idle.

The quarry is in a shallow topographic basin surrounded by low hills of sedimentary, intrusive and volcanic rocks (fig. 12). Mesozoic sedimentary rocks are the oldest rocks exposed in the immediate area. They crop out to the northwest of the quarry and consist of two general units. One unit is a dark limestone breccia, much contorted and containing angular blocks of limestone in a limestone matrix. Some shaly units occur in the limestone unit. On the hillside above and north of the limestone, the sedimentary rocks are mainly clastic and siliceous, somewhat metamorphosed by an intrusive that crops out north of the area shown on figure 12. The attitude of the sedimentary rocks is not evident from the surface exposures, but the strike and dip are not likely to be continuous over a very large area. Northwest of the quarry, the limestone unit appears to strike northwest.

The contact of the gypsum with other rock units is not exposed except along a fault on the southeast face of the quarry. In all probability, the gypsum is closely associated with the limestone unit either as the hanging wall or footwall. Gypsum is about 60 feet thick as exposed in the quarry, but the strike and dip of the body is not evident.

Granodiorite forms a low hill on the south side of the quarry; it intrudes the sedimentary rocks, and although contacts with the gypsum are not exposed, it probably also intrudes the gypsum not far from the south face of the quarry.

Two distinct units of Tertiary volcanic rocks crop out in the area around the quarry. They unconformably overlie the sedimentary rocks and the granodiorite. The only exposed contact between gypsum and volcanic rocks is on the southeast face of the quarry, where they are separated by a fault that strikes northeasterly and dips steeply to the southeast. The older volcanic unit is an ignimbrite that probably ranges in composition from rhyolite to quartz latite. Thin vitrophyric lenses occur at the base of the ignimbrite, and these are exposed on top of the limestone breccia northwest of the quarry, along the west side of the granodiorite hill, and along the road about 500 feet southeast of the quarry's center. A purplish welded tuff of unknown thickness overlies the vitrophyric lenses; it is best exposed in the road cut that forms the southeastern approach to the quarry. This purplish welded tuff contains lenses of compressed pumice an inch or more across as its most distinctive feature. Purplish welded tuff grades upward into a buff colored rhyolite or quartz latite containing

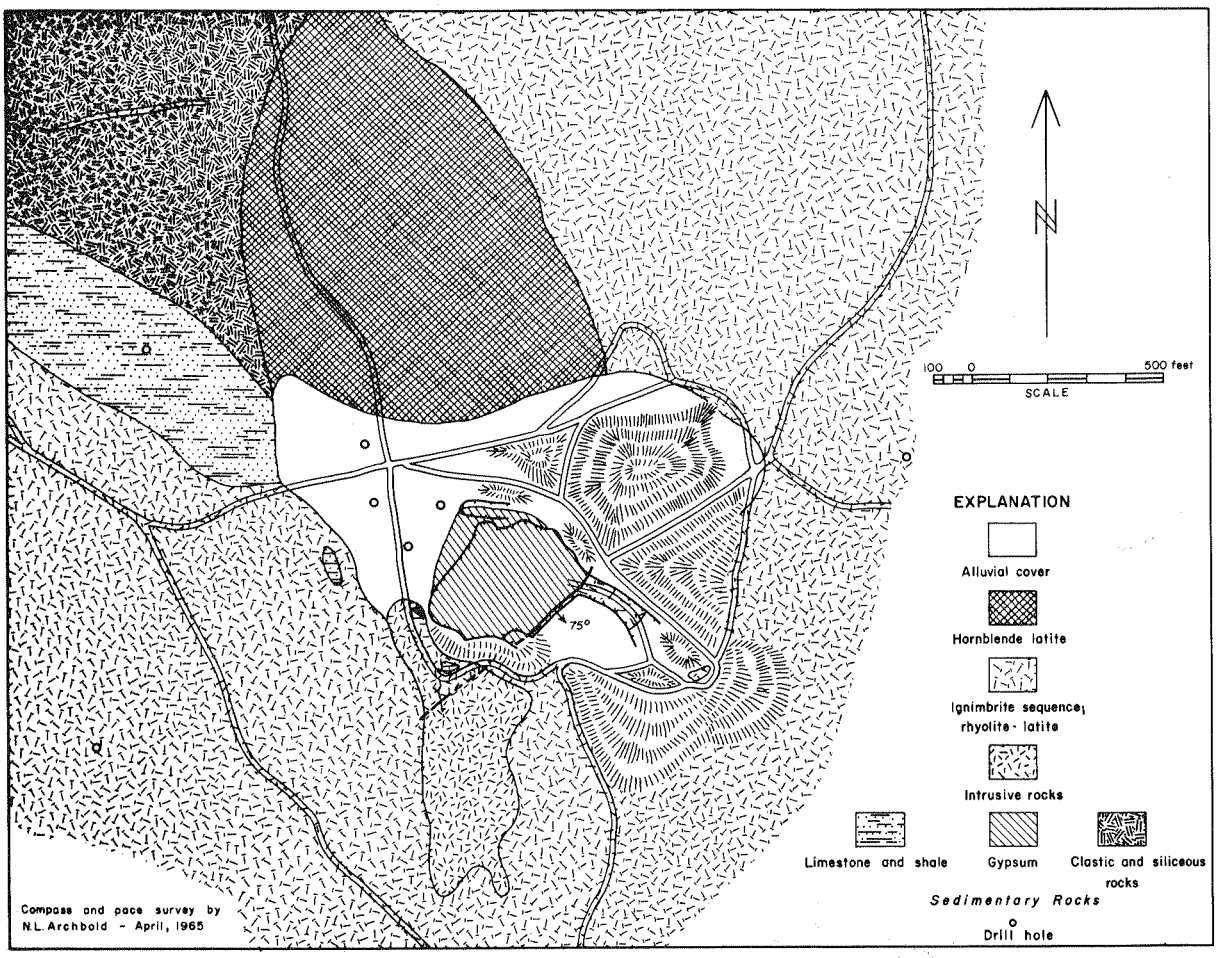

FIGURE 12. Surficial geology in the vicinity of the Regan gypsum mine, Mineral County, Nevada.

phenocrysts of quartz and sanidine(?) about one-eighth inch across. The attitude of the ignimbrite unit at the gypsum quarry is not known; in general, it seems to be relatively flat lying, filling in the ancient, topographically low areas. In the region surrounding the quarry, the ignimbrite unit can be seen dipping moderately to the west.

Hornblende latite(?), the second main unit of Tertiary volcanic rocks, crops out on a low hill to the north of the gypsum quarry. The rock contains minute needles of hornblende which serve to distinguish it in the field. The hornblende latite overlies Mesozoic sedimentary rocks to the west and the ignimbrite unit to the east.

ANDALUSITE AND CORUNDUM

Several occurrences of andalusite and corundum have been noted in Mineral County. Some tests have shown the presence of material suitable for use as a super-duty refractory, but it is unlikely that these deposits can economically compete with modern synthetic materials.

DOVER AND GREEN TALC MINES. The Dover and Green Talc andalusite mines (no. 20 on plate 1) are about 10 miles northeast of Hawthorne in the north central part of sec. 27,

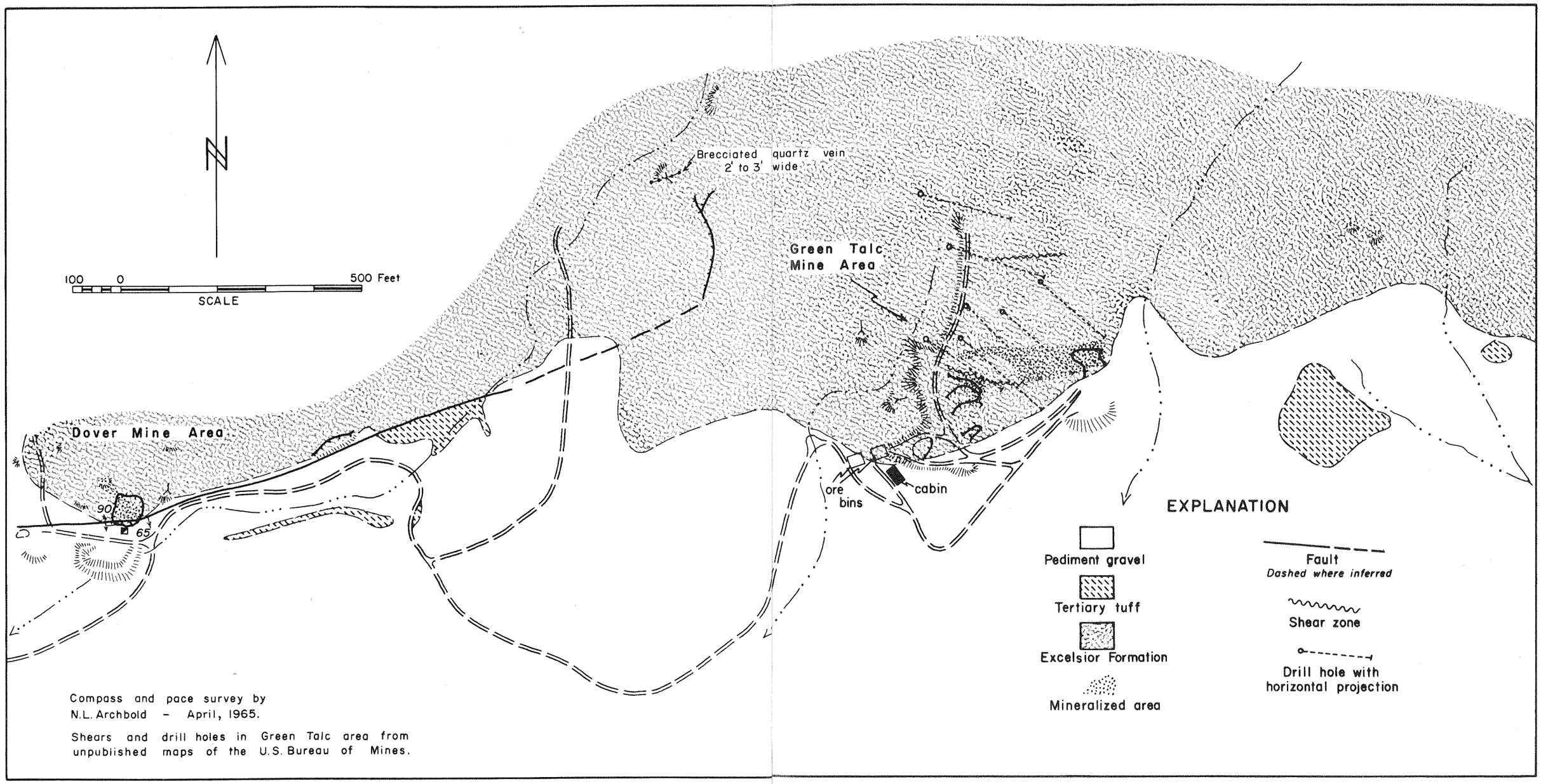

FIGURE 13. Geology in the vicinity of the Dover and Green Talc mines, Mineral County, Nevada.

T. 9 N., R. 31 E. The Dover has also been referred to as the Donnelly andalusite mine. The properties lie at the southern base of the Gillis Range, with the Dover mine on the west and the Green Talc mine about 1,700 feet east of the Dover. The Dover mine consists of a glory hole and a shaft as well as a short adit and several trenches and prospect pits. Vanderburg (1937) reported that the Dover shaft was 50 feet deep with a crosscut 56 feet long at the bottom; it appeared to be open, but was not entered during my visit in February of 1965.

The Green Talc mine belongs to Mrs. Esther Rea. It consists of two open pits, two short adits, and numerous prospect pits. The U. S. Bureau of Mines drilled seven diamond drill holes on the Green Talc property in 1952.

Tests on samples from the two properties have shown that some material suitable for super-duty refractories is available.

General geology in the vicinity of the Dover and Green Talc mines is shown in figure 13. Andalusite bodies are in metamorphosed volcanic rocks of the Excelsior Formation, and the Excelsior Formation is in fault contact with or is overlain by tuffaceous rocks of Tertiary age. Andesitic to dioritic rocks constitute the bulk of the Excelsior Formation, but rhyolitic and quartzitic rocks are also present. The deposits are within a wedge of rock that is more fractured and altered than the adjoining rocks. This wedge tapers to the northeast and is several thousand feet long and about half a mile wide across the base at the southwestern end where it is in contact with alluvium or younger volcanic rocks. At the Dover mine, a fault that strikes about N. 70° E. separates the Excelsior on the north from the Tertiary volcanic rocks on the south. The andalusite body at the Dover mine lies on the north side of the fault, and the mineralized zone on the surface appears to be up to 50 feet wide and 150 feet long along a northwest axis. The mineralized zone on the Green Talc property trends easterly and appears to be about 60 feet wide and 300 feet long. It is associated with numerous fractures and shears in the Excelsior Formation.

The andalusite at both properties occurs as fine disseminations and scattered blebs associated with white to green sericitic bodies and rock cut by quartz veinlets. Corundum, diaspore, and pyrophyllite are also visible in hand specimens of the ore. Klinger (1952) has described the microscopic features of the ore.

BISMARK CLAIMS. Aluminous minerals have been prospected on the Bismark claims (no. 22 on plate 1) about 12 miles northeast of Hawthorne in sec. 29, T. 9 N., R. 32 E. The property was explored with five diamond drill holes in 1952 as a Defense Minerals Exploration Administration project. Aluminous minerals occur in an elongate mass that trends about N. 30° E. and dips steeply eastward in metamorphosed volcanic rocks of the Excelsior Formation. The mineralized mass can be traced about 150 feet on the surface and is up to 20 feet wide on its southern end where it is covered by wind-blown sand. Andalusite is the predominant mineral with lesser amounts of corundum and diaspore according to Klinger (1952). The aluminous minerals are contained within a matrix of greenish to white sericite, and many fractures are coated with rosettes of pyrophyllite up to one-half inch in diameter. The property has had no production.

KENJAYS CLAIMS. Andalusite and corundum occur within muscovite schist lenses on the Kenjays claims (no. 21 on plate 1) about 1 mile west of the Bismark prospect. The Kenjays claims are owned by K. J. Palosky and are largely in the NE 1/4 sec. 31, T. 9 N., R. 32 E. Schist is exposed in prospect pits strung out for several hundred feet along a westerly trending zone, but it is probably in the form of lenses rather than a single

continuous unit. The muscovite or sericite matrix occurs as material that is silvery white, foliated and talcose, or dense and greenish. Andalusite and corundum were identified in crushed fragments from the rock and other aluminous minerals may be present. They form minute crystals or crystalline aggregates, up to one-half inch across, scattered through the muscovite or sericite matrix.

DEEP PROSPECT. The Deep prospect (no. 26 on plate 1) lies on a small isolated hill along the south side of U. S. Route 95 about 8 miles east of Hawthorne; it is in the northwest corner of sec. 24, T. 8 N., R. 31 E. Aluminous replacement bodies in rocks of the Excelsior Formation have been prospected with several small pits and narrow trenches, but the property has had no production.

Metamorphosed rhyolite and andesite of the Excelsior Formation crop out on the hill, andesite predominating on the north and rhyolite on the south side. The contact between andesite and rhyolite is very irregular but it appears to trend easterly and dip southerly. A quartz vein stained with secondary copper minerals strikes N. 15° W. and dips 67° W. cutting both andesite and rhyolite on the west side of the hill. Replacement bodies of aluminous minerals are confined to the rhyolite and occur along scattered shear zones that trend easterly to northeasterly. The replacement bodies are mostly less than 10 feet across where they are exposed and are scattered in an area about 300 feet across. The replacement bodies consist mainly of muscovite, either as a massive, soft greenish variety or as white, fine-grained, micaceous masses. Minute crystals of andalusite and corundum are locally disseminated in the muscovite. Klinger (1952) states that corundum predominates over andalusite. Most corundum seems to be associated with the fine-grained, white micaceous variety of muscovite. Rosettes of pyrophyllite about one-quarter inch in diameter coat many fracture surfaces.

PUMICE AND PERLITE

PUMCO QUARRY. The Pumco pumice quarry (no. 39 on plate 1) is on the north side of the road between Mina and Battles Well in sec. 25, T. 7 N., R. 35 E. Small amounts of pumice have been intermittently produced from the quarry for use in cinder blocks. Pumice occurs in a flat-lying bed capping a small knoll, and maximum diameter of the exposure appears to be about 300 feet. Exposures of the pumice bed can be seen in the quarry which is about 200 feet long and 8 feet deep. The pumice forms a white, bedded deposit consisting of poorly sorted, subrounded particles, up to one-half inch in diameter, in a fine-grained, unconsolidated pumice matrix. Thickness of the pumice bed in the quarry is about 4 feet, but the base was not exposed at the time of my visit. In a wash, immediately east of the quarry, very fine-grained, water-lain, pumiceous diatomite is exposed about 18 feet below the level of the quarry floor.

FLUFTROCK DEPOSIT. Perlite deposits are known in at least three areas near Aurora. The Fluftrock deposit (no. 45 on plate 1) is in Bodie Creek Canyon about 3 miles northwest of Aurora in the NW 1/4 sec. 1, T. 5 N., R. 27 E. An expanding and wallboard plant was built at Mason, Nev., in 1944 on the basis of this deposit, but both the plant and deposit are now abandoned. Tests by the U. S. Bureau of Mines showed that perlite from this deposit expanded 20 to 28 times its volume at temperatures ranging from 1400°C to 1700°C, to yield a product weighing 4 to 8 pounds per cubic foot. The perlite occurs as steeply dipping, dike-like bodies up to several tens of feet wide and 200 feet long.

The perlite masses trend mainly northward and are enclosed within envelopes of whitish, highly altered volcanic rocks.

DONNELLY DEPOSIT. The Donnelly perlite deposit (no. 47 on plate 1) is in Aurora Creek Canyon about 1 mile west of Aurora in the central part of sec. 13, T. 5 N., R. 27 E. The property appeared to be abandoned when visited in the summer of 1965. As in the Fluftrock deposit, perlite forms intrusive (?) pods in felsic volcanic rock that is bleached and altered to a mixture of clay, opal, and quartz. The largest perlite body may be as much as 1,000 feet long and 100 feet wide although it was not examined in detail.

PERLITE PLACER CLAIM. Perlite has also been reported on the Perlite placer claim (no. 57 on plate 1) about 1 mile north of Aurora in the south-central part of sec. 7, T. 5 N., R. 28 E. This deposit was not visited during the reconnaissance of Mineral County.

STONE

As used here, the term "stone" applies to both dimension stone and crushed stone used for ornamental purposes. Demand for such material has not been great in Mineral County owing to the small population and remoteness of the county. Only three previously worked deposits were noted during this reconnaissance. Many additional sources of decorative stone could no doubt be found if the demand were increased.

CONQUEST PROPERTY. Pink and white, fine-grained marble from the Luning Formation has been quarried from the Conquest property (no. 31 on plate 1), about 6 miles northeast of Luning, and crushed for use as terrazzo chips. The property was inactive when I visited it briefly in early 1965.

UNNAMED DEPOSIT. Layered andesite in the canyon 2.5 miles north of Aurora (no. 46 on plate 1) has been used as flagstone, and several truck loads were hauled to Reno early in 1965. The gray andesite breaks into flow layers 2 to 5 inches thick, but many of the slabs are slightly curved. The slight curvature and non-uniformity of thickness would probably tend to detract from the value of the deposit as a large scale producer of flagstone.

"MARBLE QUARRY." Small amounts of stone were once taken from "Marble Quarry" 4 miles northwest of Garfield Flat (no. 36 on plate 1). The rock is dark gray limestone containing many narrow veinlets of white calcite. The quarry is small and the stone obviously did not have wide-spread application as an ornamental material.

LIMESTONE

Limestone has received little attention in Mineral County owing to the relative remoteness of the area from centers of consumption, but supplies of high-calcium limestone may be available in the county. Limestone occurs mainly in the Luning Formation, which is widely distributed in the county. Casual observations indicate that the most pure zones in the Luning Formation may be in marbleized zones near intrusive contacts. Limestone also crops out in the Miller Mountain Formation on the south side of Miller Mountain along the Mineral-Esmeralda County line. It is a light colored, marbleized rock, presumably of early Paleozoic age, and may be relatively pure.

SAND AND GRAVEL

Sand and gravel are plentiful throughout Mineral County and there are numerous pits along the main highways. No deposits of high silica sand are known however, and nearly all sand and gravel production has been used for the construction of roads and railroads. Deposits suitable for this usage appear inexhaustible and no study was made of these deposits during my reconnaissance of the county.

The best deposits of gravel occur as ancient terrace deposits around Walker Lake, and pediment gravels, which are ubiquitous, furnish the next most important supply. In addition, deeply weathered, decomposed granites and material from the beds of intermittent streams has been used.

MISCELLANEOUS DEPOSITS

Miscellaneous types of deposits noted during this survey include graphite, talcose minerals, mica, alunite, and quartz or silica. Ross (1961) lists, in addition, two occurences of optical quartz crystals.

Graphite

KELLY PROSPECT. Graphite has been noted at two localities in the county. Schrader (1947) refers to the Kelly graphite prospect near the Kelly or Mabel mica prospect (no. 15 on plate 1). The prospect was not visited during this investigation and the exact location is therefore unknown. According to Schrader, the host rocks are jasperoid and aplitic quartz monzonite. Graphite occurs in a vein about 2 feet thick in which the graphite forms stringers up to 3 inches thick. The deposit has been explored through a shaft 16 feet deep with a crosscut and short drifts in each direction from the end of the crosscut.

SNOWBALL CLAIM. A graphitic schist has been prospected about 2.5 miles north of Kinkaid in the southern part of sec. 35, T. 9 N., R. 32 E. (no. 23 on plate 1). The prospect was most recently staked, as the Snowball claim, by K. J. Palosky. The graphitic schist crops out on the west side of a narrow canyon; it strikes northerly and is nearly vertical. At the prospect, the schist lens appears to be 30 to 50 feet wide and it can be traced about 150 feet along the strike. X-ray analysis indicates the graphite is impure and mixed with various other constituents.

Talcose Minerals

TALC OR LINDA PROSPECT. The Talc or Linda prospect (no. 12 on plate 1) is at the base of the eastern slope of the Wassuk Range about 20 miles north of Hawthorne. It is visible from U. S. Highway 95 opposite the turn-off to the Tamarack Point Campground, and shows up as a bleached area about 1,000 feet across.

The talcose mineral in the prospect is neither talc nor pyrophyllite but a silicate of magnesium and aluminum with an X-ray pattern that matches that of the light-colored, magnesium-aluminum chlorite, leuchtenbergite. Host rock for the deposit is a quartz monzonite that is sheared, bleached and intruded by dikes and sills of hornblende andesite in the vicinity of the deposit. The bleached appearance of the quartz monzonite results from the widespread development of chlorite replacing mafic minerals and, to some extent, feldspars. The main concentration of chlorite occurs along a shear zone that trends northerly and dips 20° to 30° E. The shear zone is intruded by sills of hornblende latite up to 10 feet thick that show chilled margins against chlorite bodies and quartz monzonite.

Locally, contacts between chlorite bodies and the hornblende andesite show slickensides and alteration of the hornblende andesite. Chlorite bodies along the shear zone occur as contorted lenses about 1 foot thick and several feet across.

Mica

MABLE OR KELLY PROSPECT. The Mable or Kelly mica prospect (no. 15 on plate 1) is in T. 10 N., R. 32 E. and is accessible by traveling about 11.7 miles northeast from Thorne on the Ryan Canyon road, then easterly on a road that branches across the flat to the Gabbs Valley Range. Two and one-half miles east from the intersection, the road crosses a wash, and the Mabel prospect is about one-quarter mile south of the road on the west side of this wash.

In February of 1965, the existing developments consisted of an open pit, about 30 feet long and 10 feet deep, with several shallow bulldozer trenches. Work dates from at least the early 1930's, and Vanderburg (1937) mentions the prospect in his report. It is unlikely that the prospect has yielded any marketable mica.

The prospect is on a sage- and soil-covered flat, but scattered exposures show the underlying rocks to be marble intruded by granite that is mainly unaltered. Fresh granite is the dominant rock type, but numerous prospect pits reveal small zones of tactite, "jasperoid," and altered granite. In the Mabel prospect pit, alternating layers of mica and altered granite form a zone about 15 feet thick that strikes N. 25° W. and dips 40° W. Muscovite forms three to four anastomosing veins, that individually range up to 3 feet thick. Muscovite is exposed for about 60 feet along strike at the main pit. A small amount of muscovite is exposed, 650 feet north of the main pit, in a shallow bulldozer trench, but no muscovite was discovered in a shallow trench, 100 feet north of the main pit. About 150 feet south-easterly from the main pit and along the strike of the muscovite vein, marble crops out on the side of the wash.

The muscovite forms greenish, randomly oriented books up to 2 inches across and one-half inch thick. Uniformly thin, "free-splitting" sheets cannot be obtained from the muscovite books owing to structural imperfections. Thus, muscovite from the Mabel prospect would have no application as commercial sheet muscovite.

Alunite

RAWHIDE. The epithermal precious metal veins at Rawhide (no. 4 on plate 1) contain large amounts of alunite according to Schrader (1947). He reports that much of the gangue in some veins is nearly pure alunite and that alunite veinlets traverse parts of the rhyolite host rock. One alunite sample from the Black Eagle mine yielded the following chemical analysis:

Compound	SiO_2	Al_2O_3	SO_3	Na_2O	K_2O	H_2O - 110°C	H_2O + 110°C
Percent	1.24	36.90	36.50	2.32	8.36	.20	14.17

UNNAMED DEPOSIT. Rather pure, fine-grained, white alunite has been prospected in a bulldozer trench in the NE 1/4 sec. 1, T. 6 N., R. 38 E. (no. 33 on plate 1). The alunite is within a broad zone of altered volcanic rocks that trends northwesterly and in which only the resistant rocks are exposed. A bulldozer cut exposes alunite at least 3 feet thick over a length of about 60 feet. Scattered quartz blebs and thin, incompletely altered stringers remain in the alunite.

BOVARD MINING DISTRICT. Schrader (1914) describes alunite veins at the Gold Pen and Valley View mines (no. 16 on plate 1) in the Bovard mining district, T. 11 N., R. 32 E. This deposit was not visited and the following description is abstracted from Schrader's report.

Alunite at the Gold Pen mine is associated with a northerly trending quartz vein in rhyolite. The vein is 3 to 10 feet wide and alunite forms a selvage 3 to 12 inches thick on each side of the vein. Locally the alunite is up to 2.5 feet thick. Schrader also notes alunite at the Valley View mine about 1 mile south of the Gold Pen mine. Alunite at the Valley View mine is in limestone and forms a vertical vein about 18 inches thick. Analyses of two alunite samples gave the following results:

Oxide	Percent Composition	
	Sample I	Sample II
Al_2O_3	36.0	38
Fe_2O_3	-	-
SO_3	33.5	38
P_2O_5	-	-
K_2O	Trace	3
Na_2O	-	6

Silica

SILICONE GROUP. The Silicone group of claims (no. 34 on plate 1), belonging to Mrs. Esther Rea, covers a quartz body in the NW 1/4 sec. 34, T. 7 N., R. 29 E. Milky quartz in granite crops out as a high ridge that trends west-northwest. The quartz body is about 1,300 feet long and 350 feet wide; contacts with the granite are covered but they appear to be steeply inclined. Two adits were driven at the northeast end of the quartz ridge, but they were intended to prospect the granite near the quartz and neither penetrated to the quartz body.

In surface exposures, the quartz body is well fractured but contains few inclusions of foreign material. Fractures are locally stained with iron oxides. There is no place to obtain a fresh sample uncontaminated by weathering effects but one surface sample reportedly contained 99.6 percent SiO_2.

Quartz Crystals

MALATESTA CLAIMS. The Malatesta claims (no. 29 on plate 1) in T. 7 N., R. 32 E. were not visited by the writer. Ross (1961, table 6.3) states that optical quality quartz crystals occur in veins, up to 2 feet thick, cutting a shear zone between limestone of the Luning Formation and intrusive granitic rocks. Individual crystals reportedly range up to 8 inches in length and three inches in diameter.

KENYON CLAIMS. On the Kenyon claims (no. 6 on plate 1), Ross (1961, table 6.5) recorded optical quality quartz in crystals up to 6 inches by 12 inches in a quartz vein within tactite. This property was not visited during the present survey.

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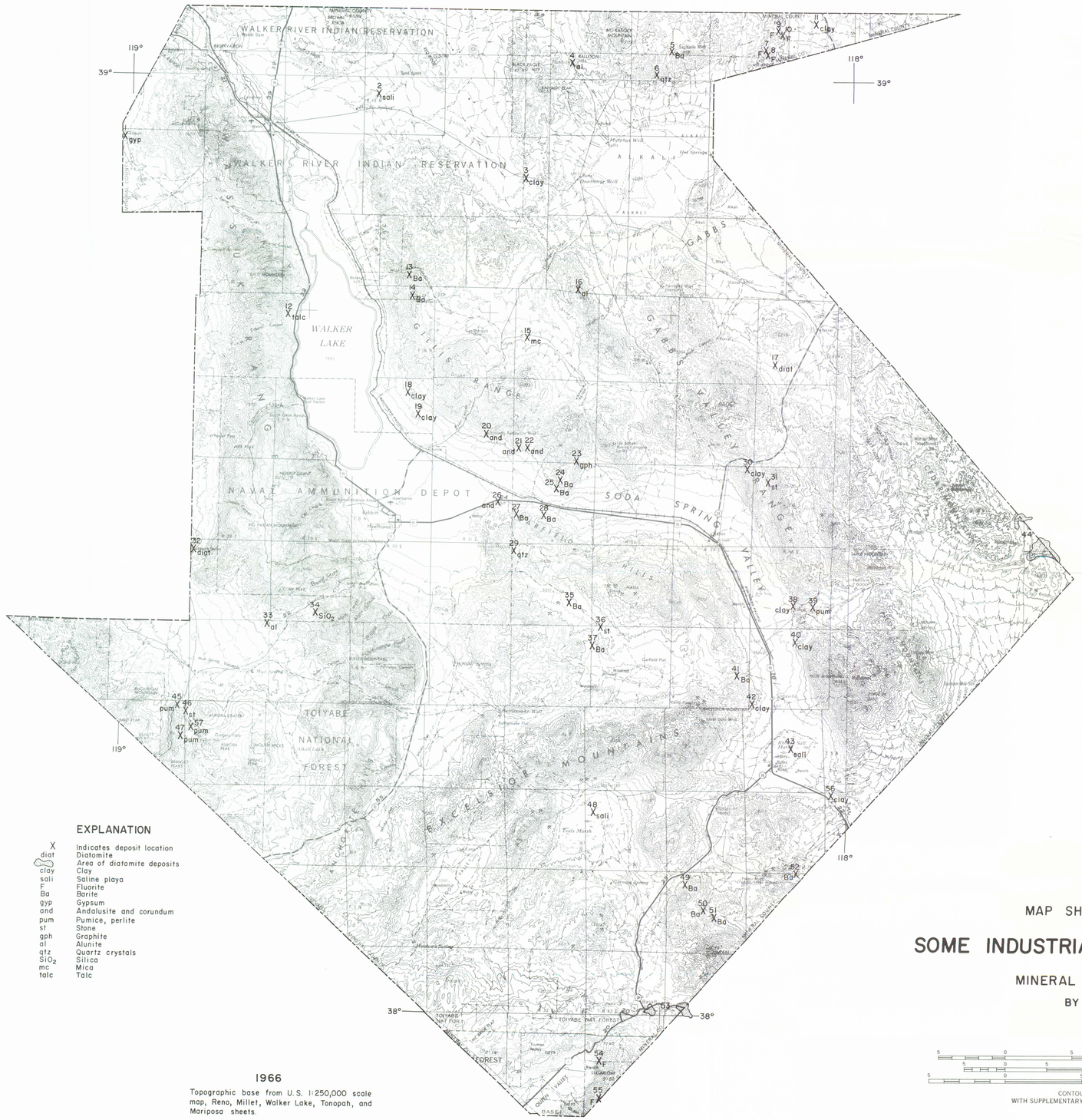

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EXPLANATION

X	Indicates deposit location
diat	Diatomite
	Area of diatomite deposits
clay	Clay
sali	Saline playa
F	Fluorite
Ba	Barite
gyp	Gypsum
and	Andalusite and corundum
pum	Pumice, perlite
st	Stone
gph	Graphite
al	Alunite
qtz	Quartz crystals
SiO_2	Silica
mc	Mica
talc	Talc

1966

Topographic base from U.S. 1:250,000 scale map, Reno, Millet, Walker Lake, Tonopah, and Mariposa sheets.

MAP SHOWING LOCATIONS OF SOME INDUSTRIAL MINERAL DEPOSITS IN MINERAL COUNTY, NEVADA

BY N. L. ARCHBOLD

Scale 1:250,000

5 0 5 10 15 20 Statute Miles

5 0 5 10 15 20 25 30 Kilometers

5 0 5 10 15 Nautical Miles

CONTOUR INTERVAL 200 FEET
WITH SUPPLEMENTARY CONTOURS AT 100 FOOT INTERVALS

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