THE GEOLOGICAL SURVEY OF WYOMING
Daniel N. Miller, Jr., State Geologist

PRELIMINARY REPORT No. 18

GEOLOGICAL AND GEOPHYSICAL INVESTIGATIONS OF KIMBERLITE IN THE LARAMIE RANGE OF SOUTHEASTERN WYOMING

by

W.D. Hausel, P.R. Glahn, and T.L. Woodzick

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Front cover. *View of the Laramie Anorthosite in the vicinity of the Radichal kimberlite intrusive. Photograph by W.D. Hausel, 1980.*

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LARAMIE, WYOMING
1981

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ABSTRACT

During stream sediment sampling in the central Laramie Range, a kimberlite blow was located by field crews. Magnetometer surveys of the blow area gave a strong magnetic response of 700 gammas over background; electromagnetic surveys were inconclusive.

In the Wyoming portion of the State Line kimberlite district, electromagnetic surveys clearly showed a linear anomaly believed to reflect an alluvium-covered kimberlite dike. Both regions were mapped for the purpose of searching for additional ultrabasic intrusives.

INTRODUCTION

Sampling surveys of stream sediments were initiated in two regions of Wyoming's Laramie Range where kimberlite intrusives had been previously reported. These two regions are portions of the central and southern Laramie Range (Figure 1). In the State Line District of the southern Laramie Range, numerous fragments of pyrope garnet, chrome diopside, subcalcic diopside, magnesian ilmenite, and some deep crustal and upper mantle nodules were collected in a drainage which bisects the Schaffer 16 and the Schaffer 18 kimberlite pipes in S$\frac{1}{2}$ sec. 16, T.12N., R.72W. (Hausel et al., 1979c) (Plate 1). Because of the anomalous amount of deep crustal and upper mantle material found in this drainage, and because a trend of kimberlite pipes bisects the drainage, geophysical surveys were run along the drainage in search of potential alluvium-covered kimberlite. Previous geophysical surveys conducted in this district were designed to determine the extent of known kimberlite pipes (Hausel et al., 1979a, 1979b; Puckett, 1971).

During the summer of 1980, field crews were directed by J. Radichal to a plug-like intrusive body located in the central Laramie Range. Through thin section work and whole rock chemical analysis, the intrusive was classified as kimberlite. The immediate area around this intrusive was mapped, geophysical surveys were conducted over the intrusive, and several hundred pounds of rock were collected for diamond testing. Results of the stream sediment sampling and diamond testing will be released in later reports.

STATE LINE DISTRICT, WYOMING

Location and Accessibility

The Wyoming portion of the Colorado-Wyoming State Line District is situated 20 miles south of Laramie, and immediately south of Tie Siding. This district was named by McCallum et al. (1975) for its location straddling the Colorado-Wyoming state line. The Wyoming part of the district extends 2.5 miles north, and the Colorado portion extends 12 miles south, of the border. Approximately 35 kimberlites have been located within this district (McCallum et al., 1977, 1979) (Figure 1). Most of the occurrences are within 2 miles of U.S. Highway 287 between Tie Siding and the state line. All access roads are controlled by local landowners. The surface and mineral estates of the Wyoming portion of the State Line District are subdivided into a rough checkerboard pattern of State and private land. The major private mineral estate owner is the Union Pacific Railroad. State sections include sec. 32, T.13N., R.72W. and sec. 4, sec. 6, sec. 8, W$\frac{1}{2}$ and NE$\frac{1}{4}$ sec. 10, W$\frac{1}{2}$, NE$\frac{1}{4}$, and SE$\frac{1}{4}$SE$\frac{1}{4}$ sec. 14, sec. 16, W$\frac{1}{2}$ sec. 18, and N$\frac{1}{2}$N$\frac{1}{2}$ sec. 20, T.12N., R.72W.

Geology

The geology of the State Line District is dominated by the nearly 9-mile diameter Virginia Dale ring-dike complex which is readily observ-

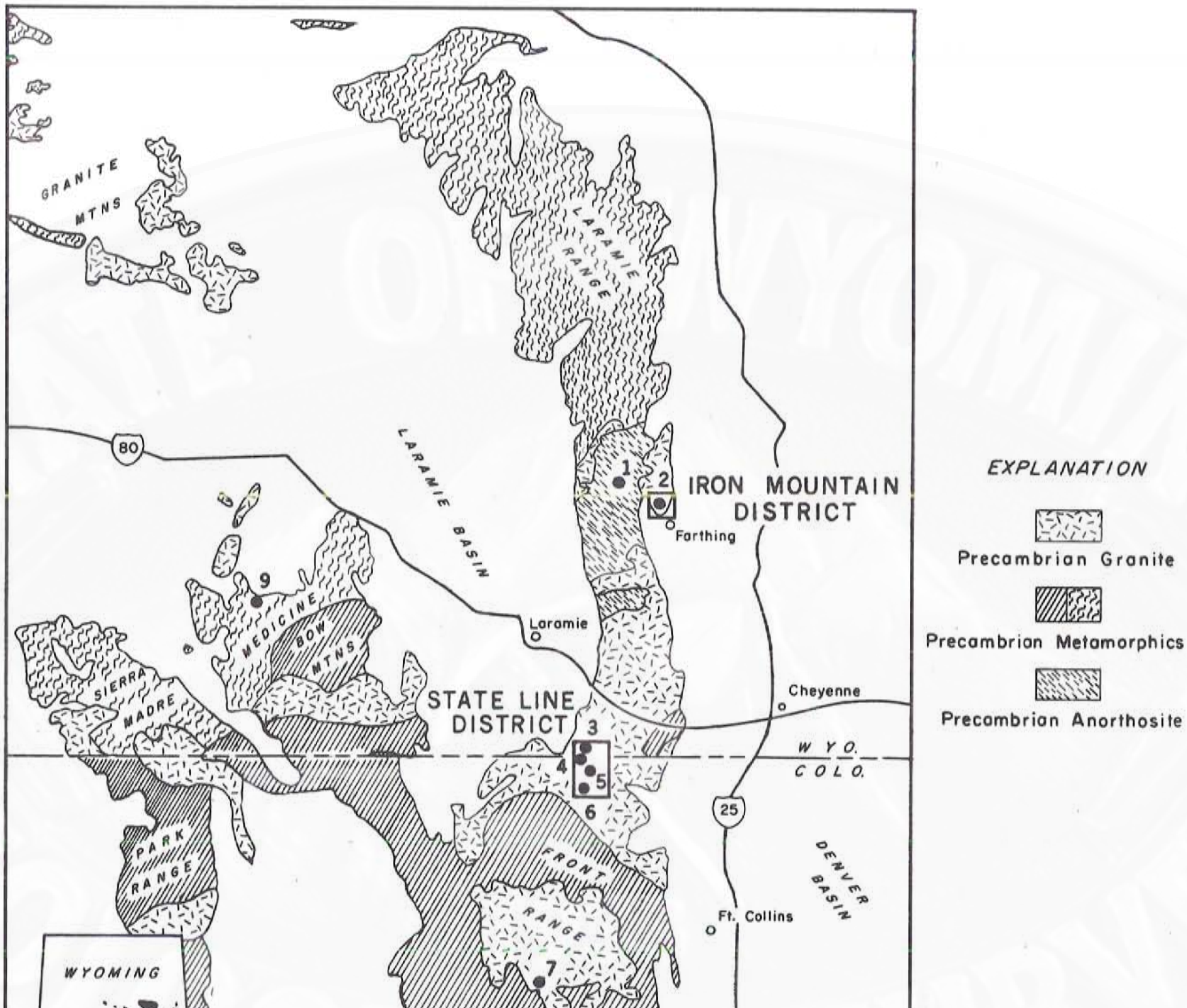

Figure 1. Location map showing known kimberlite and placer diamond occurrences. Numbered areas: (1) Radichal 1 kimberlite, (2) Iron Mountain district kimberlites, (3) the Aultman - Ferris pipes, (4) the Schaffer pipes, (5) the Nix-Moen pipes, (6) the Sloan pipes, (7) the Estes Park dike, (8) the Green Mountain pipe, and (9) the Medicine Bow diamond placer. Modified from Hausel et al., (1979b); McCallum and Smith, (1978); Oetking et al., (1967); and Renfro and Feray, (1972).

able on high altitude aerial photographs. The complex is part of the Sherman Granite batholith that discordantly intrudes a sequence of folded metamorphic rocks. Eggler (1967, 1968) subdivided the complex into four zones: an outer granite ring-dike, a composite zone of metamorphic and basic igneous rocks, and two inner core zones of quartz monzonite. To the south of the ring-dike complex, the Log Cabin Granite batholith locally intrudes the Sherman Granite.

Diabasic (andesite) dikes crosscut metamorphic rocks and granites of the Sherman and Log Cabin batholiths. These dikes occur from at least as far south as Golden, Colorado to as far north as the Iron Mountain District, Wyoming. In many places, single dikes can be traced for more than one mile.

These dikes are strikingly linear, reflecting joint control (Eggler, 1967, 1968; Hausel et al., 1979a, 1979b; McCallum and Mabarak, 1976). For example, 744 joint measurements in the State Line District show a maximum equivalent to the Precambrian diabasic dike trends of N10°W to N20°W (Hausel et al., 1979a; 1979b). Both the diabasic dikes and the granitic dikes were apparently emplaced during igneous activity associated with, and following intrusion of the Log Cabin and Sherman granites, and have roughly similar radiometric ages (1.42 b.y.) (Ferris and Krueger, 1964).

The sedimentary rocks nearest to the State Line District are Pennsylvanian sediments of the Fountain Formation which unconformably overlie Precambrian rocks to the north and west of the district.

Kimberlites in the district occur in a narrow north-south band about 2 miles wide and 15 miles long. Nearly 35 kimberlite dikes and pipes occur in the district (McCallum et al., 1977, 1979). These vary in surface extent from a few feet wide for some of the smaller dikes to nearly 1,800 feet for the two largest diatremes in their maximum dimension. (McCallum et al., 1977).

A few pipes in the Colorado portion of the district are fault controlled (McCallum et al., 1975). Many of the Wyoming kimberlites are aligned along northwest trends – about N20°W to N45°W – with a maximum between N30°W and N40°W (Hausel et al., 1979a, 1979b, 1979c). That these linear trends vary several degrees from trends of pervasive joints suggests that reactivation of predominant Precambrian joint systems was probably not important in the emplacement of most of the kimberlites. However, the Ferris 1 and the Schaffer 15 pipes do straddle Precambrian diabasic dikes, so reactivation of an older Precambrian structure may have played an important role in the emplacement of these pipes and possibly others.

In general, outcrops of kimberlite are rare. Mapping is commonly based on the characteristics of eluvium covering kimberlite, such as presence of blue ground, mantle and crustal nodules, vegetative differences (McCallum and Mabarak, 1976; Hausel et al., 1979b; Smith, 1977), or conductivity differences as measured by electrical resistivity surveys (Hausel et al., 1979a, 1979b; Puckett et al., 1972). Alteration of the host granites by kimberlite magma is minor to absent (McCallum and Mabarak, 1976; Smith, 1977).

Surface exposures of the State Line kimberlites are commonly elongate to ellipsoidal. Some, which contain abundant Paleozoic xenoliths are probably not as deeply eroded as those in the Iron Mountain District (McCallum and Mabarak, 1976). However, a few thousand feet of vertical pipe column were undoubtedly removed by erosion during the Ancestral Rocky Mountain and Rocky Mountain orogenies.

Within the Wyoming portion of the State Line District, two major types of Precambrian rocks crop out (Plate 1). In the southern half of the area the dominant rock is the Inner Cap Rock Quartz Monzonite, which is characteristically prophyritic. The dominant phenocryst type is tabular euhedral microcline which averages about 1 inch in length. Plagioclase phenocrysts are commonly $\frac{1}{2}$ inch in length. Most samples contain about 25 percent quartz and 5 to 10 percent dark minerals. The main ferromagnesian mineral is partially chloritized biotite. Magnetite is partially replaced by hematite. Some secondary sericite and epidote replace plagioclase (Eggler, 1967).

The Trail Creek Granite and the Inner Cap Rock Quartz Monzonite are facies of Sherman Granite. The Trail Creek Granite exhibits coarse-grained hypidiomorphic granular texture. Primary minerals are subhedral microline and plagioclase, anhedral quartz, subhedral hornblende, and minor biotite. Ferromagnesian minerals are extensively replaced by epidote, chlorite, biotite, and silica, and oxide minerals by hematite and meta-ilmenite (ilmenite and rutile) (Eggler, 1967).

Granitic dikes intrude all facies of the Sherman Granite and compositionally are hornblende quartz monzonites, biotite quartz monzonites, porphyritic alaskites, and equigranular fine- to medium-grained alaskites. Commonly, the granitic dikes are more resistant to weathering than the host rocks, and stand out as low-lying, linear ridges.

The diabasic dikes crosscut diorites, pegmatites, and granitic dikes. These diabases are predominately dark brown to black with diabasic, prophyritic, and aphanitic textures. Plagioclase phenocrysts or biotite clots (or both) in an aphanitic groundmass give some dikes a porphyritic or diabasic appearance. Compositionally, the rocks are andesitic (Eggler, 1967).

The older dioritic rocks are extensively feldspathized as a result of metasomatic reaction with the granitic magma (Eggler, 1967)

Much of the State Line area is covered by a thin blanket of grus developed on the Sherman erosional surface.

Geophysical Investigations

Previous geophysical investigations concerning kimberlite exploration and detection in the Laramie-Front ranges were reported by Hausel et al. (1979a, 1979b), Puckett (1971), and Puckett et al. (1972). The reader is referred to these papers for discussions on the geophysical differences between the Colorado-Wyoming kimberlites and the country rock.

During stream sediment sampling of drainages in the Wyoming State Line District in the 1978 field season, anomalous quantities of ultramafic material were recognized in a drainage, designated SLSS, that crosscuts the Schaffer kimberlite trend between the Schaffer 16 and 18 pipes (Hausel et al., 1979c). Although the large amount of ultramafic material may have been derived from the erosion of nearby pipes (Schaffer 3, 16, 17, and 18), it could also reflect a kimberlite dike or blow under the alluvial material between the Schaffer 16 and 18 diatremes.

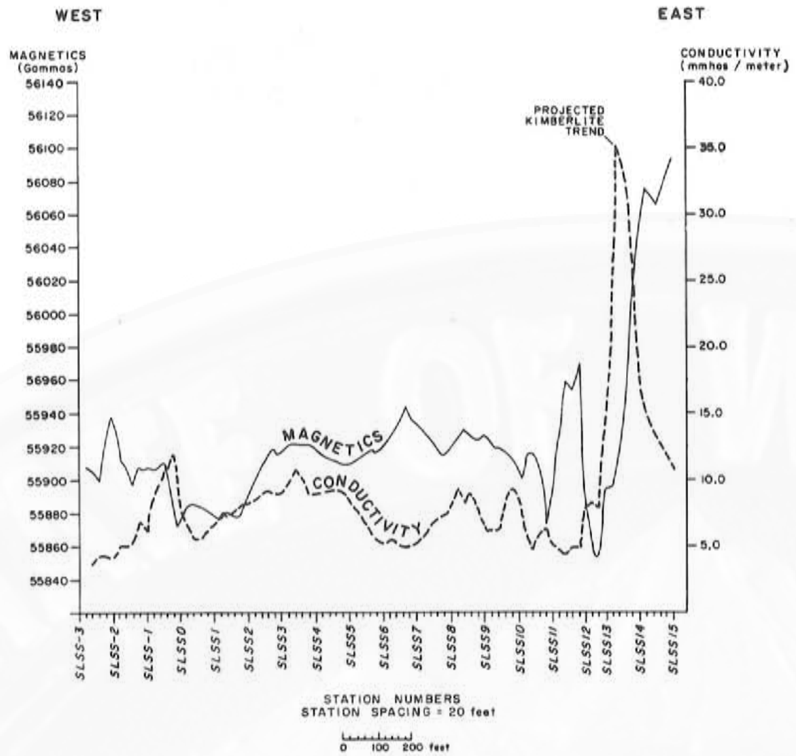

Figure 2. Magnetic and conductivity profiles in the SLSS drainage in the State Line District gave anomalous responses near the projected trend of the Schaffer group of kimberlites. This trend was examined in more detail, as shown in Figures 3 and 4.

To check this latter possibility, magnetic and electromagnetic profiles (Figure 2) were measured in an easterly direction in the SLSS drainage starting at the boundary between sections 16 and 21 (Plate 1). A Geonics EM-31 electromagnetic unit and a Geometrics proton precession magnetometer were used in the survey. The eastern edge of the survey coincides with the projected kimberlite trend, and electromagnetic and magnetic highs of 35 mmhos/meter and 56,100 gammas, respectively, were recorded. The electromagnetic high is compared to an average background of about 7 mmhos/meter, and the magnetic high to a magnetic background of approximately 55,900 gammas.

A grid was set up over the region where magnetic and electromagnetic highs were recorded. Results of the magnetic survey show a strong N20°W linear anomaly east of the projected trend between the Schaffer diatremes (Figure 3). This magnetic high appears to coincide with a diabasic dike that has a N20°W trend and crosscuts the Schaffer trend between the Schaffer 16 and 18 pipes. Additional magnetic studies of the diabasic dikes indicated that these dikes were commonly more magnetic than the surrounding granitic rocks.

Electromagnetic measurements gave a clear conductive anomaly along the Schaffer trend at about N35°W to N40°W (Figure 4). The high conductivity suggests the presence of a weathered kimberlite dike or blow enlargement which apparently connects the Schaffer 16 with the Schaffer 18. Where kimberlite is deeply weathered, the EM-31 electromagnetic unit is apparently an excellent prospecting tool for rapid delineation of kimberlite-granite contacts, or for prospecting for alluvium covered weathered kimberlite along structures containing exposed kimberlite. The electromagnetic

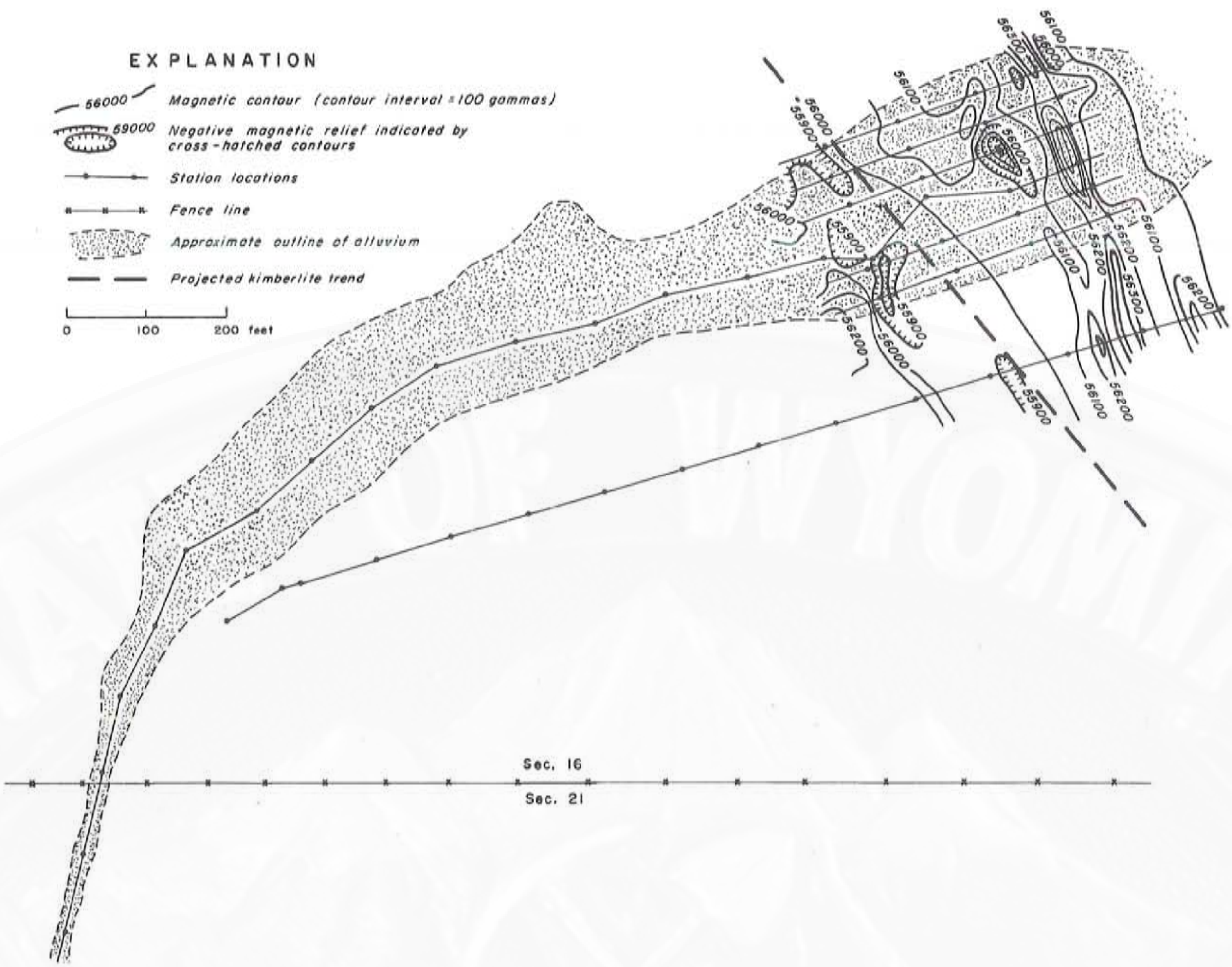

Figure 3. Magnetic contours in the SLSS (S½ sec. 16, T.12N., R.72W.) drainage show a good magnetic anomaly about 200 feet east of the projected Schaffer kimberlite trend. This anomaly corresponds to a diabasic dike.

survey gave results similar to those expected from electrical resistivity surveys. However, there is a major drawback in prospecting for alluvium-covered kimberlites by the use of electromagnetic and resistivity surveys. The electrical responses produced by buried, weathered kimberlites undoubtedly can be duplicated by buried clay zones, and possibly by water-saturated, alluvium-covered scour features or potholes. Furthermore, massive unweathered hardebank kimberlite under alluvial cover apparently will not produce an electrical anomaly within the enclosing granitic host rocks.

SHEEP ROCK AREA, CENTRAL LARAMIE RANGE

Location and Accessibility

The Sheep Rock area is situated in the central portion of the Laramie Range immediately south of State Highway 34 and north of Albany County Road No. 12. State Highway 34 provides paved access from both Wheatland and Laramie; Albany County No. 12 is a graveled road which

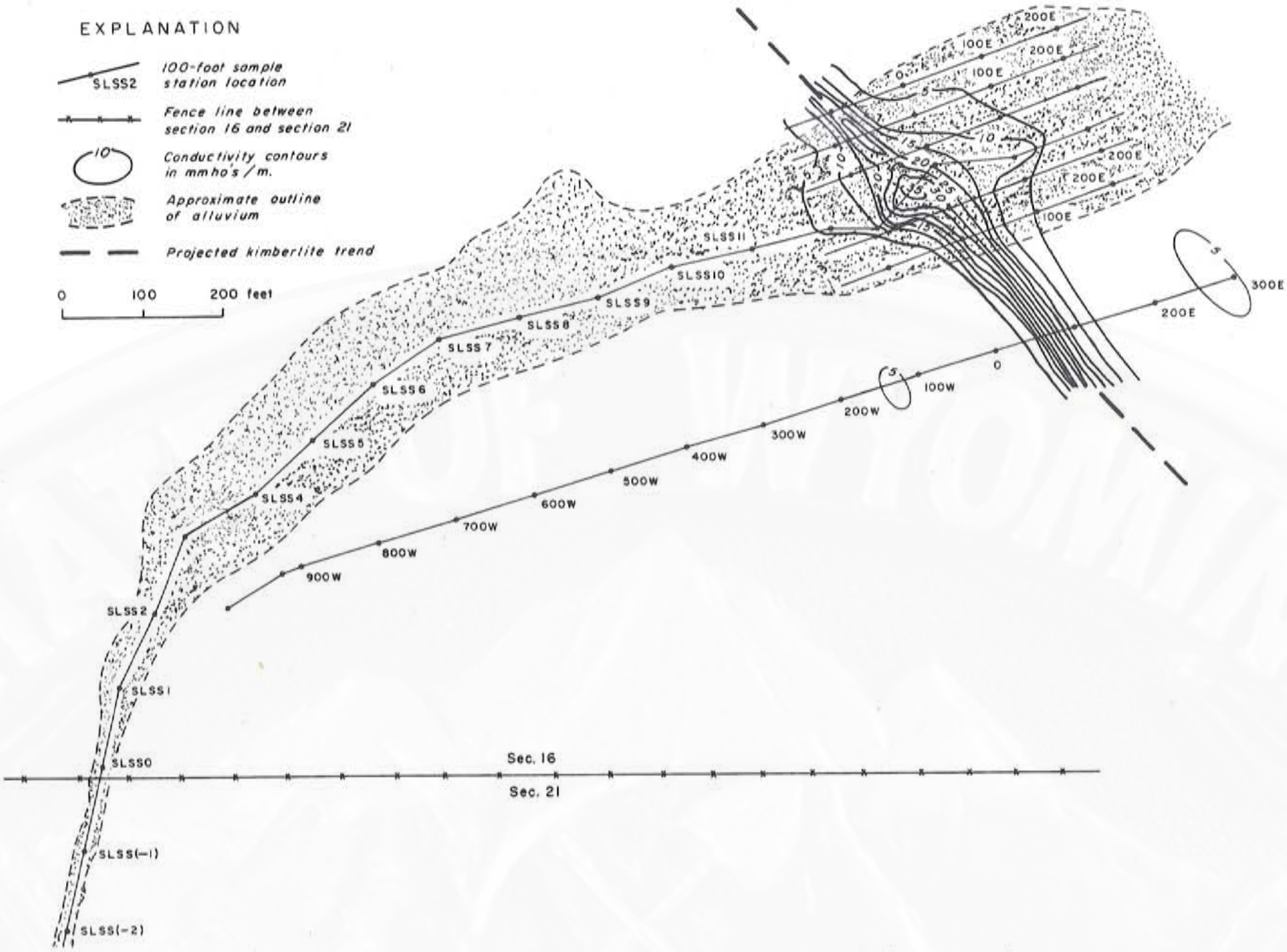

Figure 4. Conductivity contours produced in the SLSS (S½ sec. 16, T.12N., R.72W.) drainage line up well with the projected trend of the Schaffer pipes. This indicates that a kimberlite dike extends between the Schaffer 16 and 18 pipes under the alluvial cover of the SLSS drainage.

intersects Highway 34 on the eastern and western edges of Sybille Canyon.

Most of the surface and mineral estates in the Sheep Rock area are private property, with Union Pacific Railroad holding the majority of the mineral estate. The only known kimberlitic rock in the Sheep Rock area lies on privately owned surface and mineral estates. This intrusive reportedly was first recognized by D. Gold (M.E. McCallum, personal communication, 1980). As it is unnamed, we propose to name it the Radichal 1 kimberlite, after the present landowners.

Geology

The Sheep Rock area is situated near the northern margin of the Laramie Anorthosite complex (Figure 1). The anorthosite crops out over approximately 350 square miles and was emplaced into Precambrian sediments nearly 1.5 billion years ago (Smithson and Hodge, 1972). The northern margin of the complex is bounded by hornblende and hypersthene syenites and by amphibolite-grade greenstone belt rocks (Graff et al., 1981). Archean(?) gneisses and schists on the edge of the greenstone belt are dated at 2.5 billion years (Smithson and Hodge, 1972).

The southern margin of the anorthosite is in contact with younger Proterozoic age granitic rocks of the Sherman Granite batholith. These granites are dated at approximately 1.4 billion years (Peterman et al., 1968).

The east and west edges of the complex are flanked by Phanerozoic sedimentary strata in the Denver-Julesburg and Laramie basins, respectively. The north half of the eastern border is in contact with Sherman Granite. This portion of the Sherman Granite is host for at least 57 kimberlite dikes and blows (Smith, 1977) (Figure 1).

Two foliated anorthositic units crop out in the immediate vicinity of the Radichal 1 kimberlite (Plate 2). Exposures along the east bank of Middle Sybille Creek are predominantly gray, medium-grained anorthosite containing less than 10 percent dark minerals (commonly about 2 percent). Exposures along the west bank of the creek are predominantly medium- to coarse-grained, dark gray to black noritic anorthosite that commonly contains more than 10 percent dark minerals (Hagner, 1951; Newhouse and Hagner, 1957).

Numerous granitic dikes similar in composition to those found in the Sherman Granite cut the anorthosite. These dikes are predominantly medium-grained and commonly are coarse-grained to pegmatitic at dike intersections, where they are characterized by large broken fragments of potash feldspar and milky-white "bull" quartz.

In NW$\frac{1}{4}$ sec. 30, T.20N., R.71W., exposures of porphyritic kimberlite occur around a small prospect pit developed along the contact of the kimberlite with noritic anorthosite (Figure 2). The outcrop area is small, varying from approximately 25 to 40 feet in diameter.

Hand specimens of the kimberlite show subrounded to rounded, light green phenocrysts and xenoliths in a dark green to black groundmass. While fragments of anorthosite (?) are rare, black metallic ilmenite xenocrysts (?) are common and range in size from 3 inches to groundmass. The groundmass is highly serpentinized and carbonatized, and phenocrysts are anhedral to subhedral serpentine pseudomorphs after olivine and pyroxene. No chrome diopside or pyrope garnet was found. A whole-rock chemical analysis is presented in Table 1.

Table 1. Chemical composition of Colorado-Wyoming kimberlites (weight percent).

	a	b	c	d	d	b	a	a	e
Oxide	NX3s-1	IM1-8	ED1-1	SD1-86	SD1-88	IM16-5	NX4-16	NX4-16	RAD1-1
SiO_2	24.8 %	25.7 %	29.6 %	30.4 %	32.5 %	33.6 %	34.2 %	34.2 %	30.94%
TiO_2	1.4	2.6	5.2	0.90	0.60	3.0	0.75	0.95	2.73
Al_2O_3	3.1	2.1	2.7	1.9	1.9	2.8	2.4	2.7	3.06
Cr_2O_3	0.10	0.10	0.19	0.14	0.10	0.14	0.13	0.16	NA
Fe_2O_3	7.0	8.7	5.6	4.0	3.5	7.7	3.7	6.4	10.80*
FeO	1.3	0.87	5.0	2.0	1.9	3.8	2.1	1.5	NA
MnO	0.15	0.16	0.25	0.13	0.09	0.18	0.13	0.14	0.16
NiO	0.07	0.07	0.08	0.11	0.10	0.10	0.14	0.12	NA
MgO	22.2	12.6	23.1	25.9	27.4	28.4	31.2	30.7	28.61
CaO	16.2	19.9	10.2	14.8	12.5	5.1	7.9	6.8	9.02
Na_2O	0.07	0.05	0.03	0.04	0.03	0.05	0.07	0.09	0.01
K_2O	0.16	1.0	0.94	0.29	0.20	1.4	1.1	0.42	1.04
P_2O_5	1.4	0.35	0.09	0.35	0.15	0.35	0.15	0.03	0.24
BaO	0.06	0.07	0.07	0.03	0.01	0.08	0.07	0.08	NA
CO_2	10.5	21.0	5.8	8.9	7.0	1.7	3.5	2.2	NA
L.O.I.	10.0	4.4	9.9	10.2	11.6	11.2	9.8	14.0	12.88
Total	98.5 %	99.7 %	98.8 %	100.0 %	99.6 %	99.6 %	98.3 %	100.7 %	99.5 %

(a) Nix pipes (Smith et al., 1979)
(b) Iron Mountain district (Smith et al., 1979)
(c) Estes Park dike (Smith et al., 1979)
(d) Sloan diatremes (Smith et al., 1979)
(e) Radichal kimberlite
* Total iron as Fe_2O_3

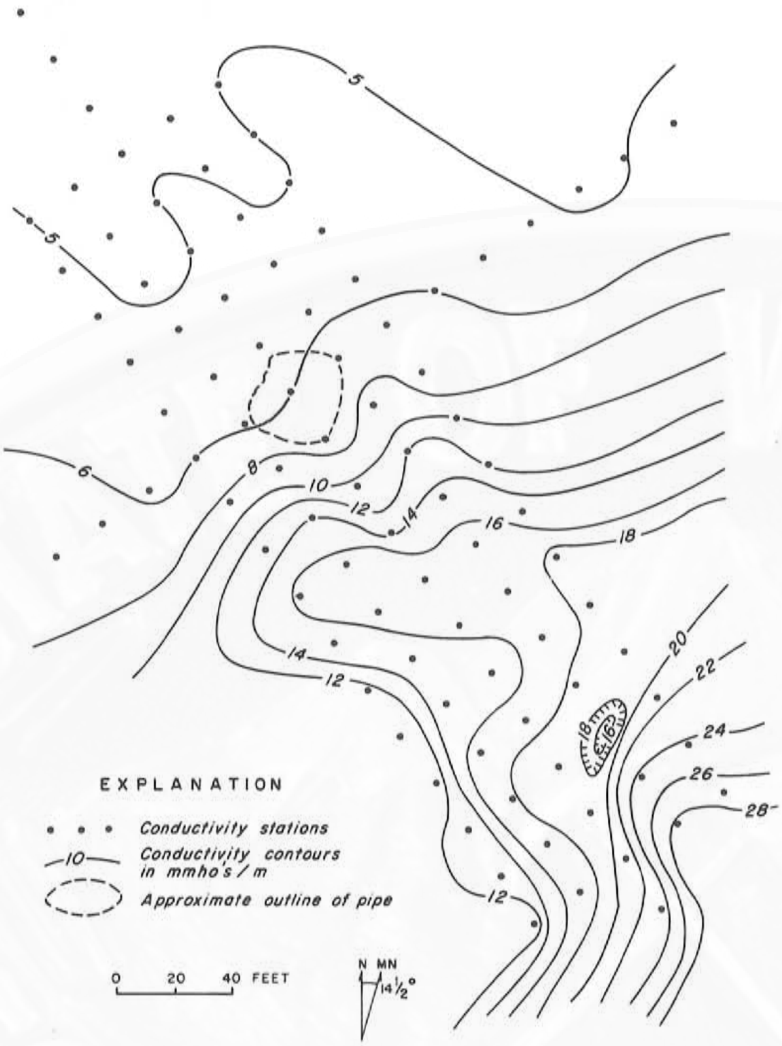

Figure 5. Conductivity measurements over the Radichal 1 kimberlite intrusive were inconclusive. The increase in the conductivity gradient to the southeast is in response to thicker accumulations of stream sediments along Middle Sybille Creek.

The age of the intrusive is not documented. However, it is assumed that the kimberlite was emplaced during the same intrusive episode as were kimberlites in the Iron Mountain and State Line districts which are dated as Devonian in age by Naesser and McCallum (1977).

Geophysical Investigations

The Radichal 1 exposure was examined with electromagnetic and magnetic grid surveys. A Geonics EM-31 electromagnetic unit and Geometrics proton precession magnetometer were used.

The electromagnetic signature over the "blow-like" intrusive was measured in the range of 6 mmhos/meter, essentially equivalent to that of the host noritic anorthosite (Figure 5). Low conductive measurements were expected over the hardebank, since resistivity sounding surveys reported by Hausel et al. (1979b) in the State Line District showed that hard, massive, unweathered kimberlite at depth produced resistivity highs (conductivity lows). The increase in the conductivity gradient to the southeast of the intrusive probably reflects an increase in the thickness of water-bearing alluvial gravels in Middle Sybille Creek. The electromagnetic survey in this case is not useful

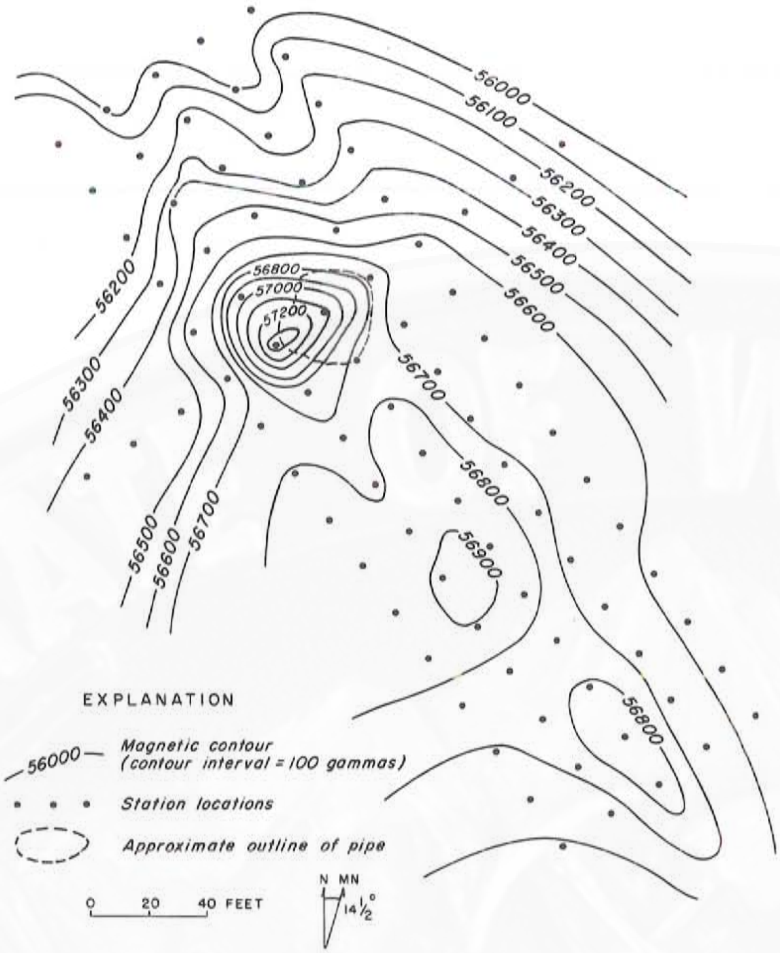

Figure 6. Magnetic measurements over the Radichal 1 kimberlite show a net magnetic anomaly of 700 gammas. The magnetic map also suggests a linear magnetic structure striking at N30°W to N40°W which may be the feeder dike for the Radichal 1 kimberlite.

in determining the size of the intrusive, and suggests only that weathered (clay-rich) kimberlite probably does not extend under the alluvial cover.

Magnetic measurements over unweathered Radichal kimberlite gave a localized high of nearly 57,400 gammas, a net anomaly of approximately 700 gammas above background (Figure 6). Of all the kimberlites tested in the Colorado-Wyoming kimberlite province, only the Nix 1 pipe in the State Line District has produced a greater magnetic anomaly (1000 gammas) (Hausel et al., 1979b; Woodzick et al., in prep.). The magnetic anomaly associated with the Radichal blow should be detectable by low altitude airborne surveys; however, the small area of the anomaly coupled with the presence of abundant magnetite-ilmenite deposits in the near vicinity diminishes the viability of airborne surveys.

The magnetic map of the Radichal blow not only indicates a pipe-like structure, but also suggests the presence of a buried linear structure intersecting the blow along a trend of N30°W to N40°W (Figure 6). The linear feature may be a feeder-dike for the blow. This trend was examined during geological mapping, but no additional ultrabasic material was observed.

Two to three hundred pounds of rock were collected from the Radichal blow for diamond testing. This material will be crushed and processed for heavy mineral concentrates. The concentrates will be processed for diamonds, using skin flotation and side-shaking grease tabling methods. Diamond testing is scheduled for the spring of 1981.

SUMMARY

Electromagnetic surveys were successfully used to outline a buried kimberlite dike connecting the Schaffer 16 and 18 kimberlite pipes within the State Line District. Although this type of survey apparently worked well in prospecting for buried, weathered kimberlite, features such as buried clay-rich zones, channel scours, and potholes could give similar geophysical responses. Therefore, care must be used in interpreting the results of this type of survey.

Electromagnetic surveys conducted on the Radichal 1 kimberlite in the Sheep Rock area were inconclusive. However, the Radichal hardebank occurrence in the Sheep Rock area did produce a strong magnetic anomaly as did the Nix 1 pipe in the State Line District (Woodzick et al., in prep.). But it does not appear that all massive kimberlite outcrops will produce strong magnetic anomalies. For example, outcrops of kimberlite in the Iron Mountain District are reported to produce only weak anomalies (Smith, 1977).

Both the Sheep Rock and Wyoming State Line areas were mapped in search of additional kimberlites. In the Sheep Rock area, a small kimberlite intrusive, apparently first discovered by D. Gold (M.E. McCallum, personal communication, 1980), was located, and named the Radichal 1 kimberlite. No additional kimberlites were found. In the State Line District, mapping during the 1978 field season led to the discovery of the Aultman 2 pipe and an extension of the Schaffer 5 complex (Hausel et al., 1979c).

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STATE OF WYOMING

1933

GEOLOGICAL SURVEY

EXPANDED EXPLANATION FOR PRELIMINARY GEOLOGICAL MAP OF THE WYOMING PORTION OF THE COLORADO-WYOMING STATE LINE DISTRICT

RECENT

Alluvium

Unconsolidated valley fill. Predominately angular to subangular arkosic gravels, sands, and silt.

Grus

Large grus fields or blankets of unconsolidated angular, coarse-grained mineral and rock fragment debris, formed by granular disintegration of adjacent and underlying crystalline rocks.

PENNSYLVANIAN

Fountain Formation

Continental red bed arkosic conglomerates and sandstones, with minor amounts of shale and limestone, resting unconformably on Precambrian crystalline rocks. Locally mineralized with native copper and copper carbonates at the Copper Float prospect (SW¼ sec. 29, T.13N., R.72W.) and at the King Solomon prospect (NE¼ sec. 15, T.12N., R.73W.) (Osterwald and others, 1966, p. 41).

DEVONIAN

Kimberlite Intrusives

Carbonatized and serpentinized ultrabasic intrusives containing abundant upper mantle, lower crustal, and upper crustal megacrysts, xenocrysts, and xenoliths. In outcrop, these form rough elliptical diatremes (pipes) and dikes exposed as weathered intrusives outlined by light gray to bluish gray serpentinized and carbonatized montmorillonitic clays (blue ground) supporting distinctive growths of grassy vegetation. Locally, some diatremes are recognized by abundant Lower Paleozoic carbonate xenoliths (Aultman 1 and Ferris 1), others by outcrops of greenish massive prophyritic kimberlite (Ferris 2). The dominant kimberlite type found in the diatremes is an intrusive breccia; in dikes, the dominant type is a massive porphyry. Several of the kimberlites contain accessory diamond (McCallum and others, 1979).

PRECAMBRIAN

Diabasic Dikes

Steeply dipping diabasic to andesitic dikes commonly forming low lying ridges. These are intrusive to all granitic rocks and also cut across diorite. Characteristically they are dark brown to black porphyritic to diabasic rocks containing small plagioclase phenocrysts and rounded to elliptical clots of biotite set in a dark aphanitic groundmass. In places they contain some remobilized granitic material and minor epidote. Dikes near the northern edge of the district (sec. 32) show silicification and epidotization, and contain minor specularite.

Pegmatites

Simple pegmatites forming resistant hills outlined by large angular fragments of bull quartz, microcline feldspar, and mica books, with accessory garnet and rare beryl. These, in general, are weakly radioactive, and register up to 2½ times the background radioactivity. Locally, several pegmatites have been mined for feldspar (Osterwald and others, 1966, p. 81).

Granitic Dikes

Hornblende quartz monzonite, biotite quartz monzonite, porphyritic alaskite, and alaskite dikes, forming resistant ridges.

Inner Cap Rock Quartz Monzonite (Eggler, 1967)

Light pink, weakly foliated porphyritic quartz monzonite with large tabular microcline and plagioclase phenocrysts set in a finer-grained groundmass. Ferromagnesian minerals show partial replacement by chlorite, and plagioclase is partially replaced by epidote and sericite.

Trail Creek Granite (Eggler, 1967)

Pink, coarse-grained hypidiomorphic-granular granite. Composed of microcline, plagioclase, quartz, hornblende, and minor biotite and oxides. Ferromagnesians show partial to complete replacement by epidote and chlorite.

Diorite

Fine-grained dioritic rocks. Microscopically exhibit subophitic, diabasic, and hypidiomorphic-granular textures and are composed of plagioclase, hornblende, biotite, and opaques.

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PR-18/Plate 1

The Wyoming Geological Survey, 1981

PRELIMINARY GEOLOGICAL MAP OF THE WYOMING PORTION OF THE COLORADO-WYOMING STATE LINE DISTRICT

Geology by W. Dan Hausel, 1979

EXPLANATION

RECENT

Alluvium

Grus
Derived from weathering of granitic rocks

PENN.

Fountain Formation

DEVONIAN

Kimberlite Pipes
Dashed where projected under alluvial cover.
(age based on determination made by Naeser and McCallum, 1977)

PRECAMBRIAN

Pegmatites

Diabasic Dikes

Granitic Dikes
(biotite quartz monzonite, hornblende quartz monzonite & alaskite dikes)

Inner Cap Rock Quartz Monzonite

Trail Creek Granite[1]

Older Dioritic Intrusives[1]
(Some areas overlain by weathered dioritic grus)

Fault or alteration zone

Fault with upthrown and downthrown side indicated

Island of predominate rock outcrop surrounded by grus.

Geologic contact—dashed where approximated and dotted where projected

Strike and dip of joint

Strike of vertical joint

Shear zone

Strike and dip of foliation

Prospect pit

Earthen dam

Abandoned mines

230 kv transmission line

[1] After Eggler, 1967

TN MN 14½°

0 ½ 1 Miles

SCALE 1:24,000

PRELIMINARY GEOLOGICAL MAP OF THE WYOMING PORTION OF THE COLORADO-WYOMING STATE LINE DISTRICT

Geology by W. Dan Hausel, 1979

EXPLANATION

RECENT

Alluvium

Grus
Derived from weathering of granitic rocks

PENN.

Fountain Formation (Pf)

DEVONIAN

Kimberlite Pipes (FERRIS 1)
Dashed where projected under alluvial cover. (age based on determination made by Naeser and McCallum, 1977)

PRECAMBRIAN

Pegmatites (peg)

Diabasic Dikes (Dd)

Granitic Dikes (Gd)
(biotite quartz monzonite, hornblende quartz monzonite & alaskite dikes)

Inner Cap Rock Quartz Monzonite (Icm)

Trail Creek Granite[1] (Tcg)

Older Dioritic Intrusives[1] (P€d)
(Some areas overlain by weathered dioritic grus)

Fault or alteration zone

Fault with upthrown and downthrown side indicated (D / U)

Island of predominate rock outcrop surrounded by grus.

Geologic contact—dashed where approximated and dotted where projected

Strike and dip of joint (77)

Strike of vertical joint

Shear zone

Strike and dip of foliation (82)

X *Prospect pit*

Earthen dam

Abandoned mines

230 kv transmission line

[1] After Eggler, 1967

TN MN 14½°

0 1/2 1 Miles
SCALE 1:24,000

The Wyoming Geological Survey, 1981

PRELIMINARY GEOLOGICAL MAP OF THE SHEEP ROCK KIMBERLITE DISTRICT ALBANY COUNTY, WYOMING

Geology by W. Dan Hausel, 1980

EXPLANATION

Quaternary and Recent alluvium and stream sediments

DEVONIAN (?)

Kimberlite

Dark-green serpentinized porphyritic kimberlite

PRECAMBRIAN

Pegmatites

Coarse-grained simple granitic pegmatites commonly outlined by bull quartz and pink orthoclase

Granitic Dikes

Fine-grained to porphyritic pink granitic dikes of similar composition to the Sherman Granite (Where measured, dip is noted)

Noritic Anorthosite

Gray coarse-grained to porphyritic, massive to foliated, anorthosite containing plagioclase and 10 to 20 percent orthopyroxene and magnetite-ilmenite

Anorthosite

Gray medium- to coarse-grained, massive to foliated, anorthosite with less than 10 percent orthopyroxene and magnetite-ilmenite

Marble

White fine- to medium-grained massive marble

Island of predominate rock outcrop surrounded by anorthositic grus

Contact

Strike and dip of joint

Strike of vertical joint

Strike and dip of foliation

Strike of vertical foliation

Shear zone

TN MN 14½°

0 ½ 1 MILE

SCALE 1:24,000

The Wyoming Geological Survey, 1981