**U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT**

R. 47½ E.

ANTELOPE SPRING, NEVADA

30 MINUTE SERIES

CACTUS **AND**

1,100,000 FEET
CENTRAL

SOURCE MATERIAL DATA

(A) U.S.G.S. Quad Maps

(B) U.S.F.S. Quad Maps

(C) B.L.M. Compilation

(D) State Highway Maps

Source Material Updated
With Photography

RECONNAISSANCE G of the NORTHERN KAWICH & SOUTHERN REV

by J. N. GARDNER, A. C. EDDY & F. E. GOF

& K. S. GRAFFT of UNIVERSITY

1980

SCALE: 1" = 1 MILE

REVISIONS

PLANIMETRY

STATUS

7-1978

BR ROAD

PRIMITIVE ROAD

ROAD

TRAIL

MISSANCE GEOLOGIC MAP

NORTHERN REVILLE RANGES, NYE COUNTY, NEVADA

BY D. J. & F. E. GOFF at LOS ALAMOS SCIENTIFIC LABORATORY

BY J. W. FT at UNIVERSITY of CALIFORNIA, DAVIS

1980

ANTELOPE SPRING, NEVADA

3 -116-3

1969

SHEET 1 OF 6

University of California
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LA-8390-MAP

UC-51

ISSUED: JUNE 1980

116°30' 38°15' 27°14' (TYBO)

27001
(LUNAR CRATER)

[illegible]

MAP ACCURACY STANDARDS
COLORADO 80225, OR WASHINGTON, D.C. 20242
SYMBOLS IS AVAILABLE ON REQUEST

GEOLOGIC MAP

WARM SPRINGS, NEVADA

LA-8390-MAP

UC-51

ISSUED: JUNE 1980

WARM SPRINGS, NEV.
N3800—W11615/15

1968

AMS 2780 III—SERIES V798

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UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

UNITED STATES
DEPARTMENT OF THE
CORPS OF ENGINEERS

SHEET 3 OF 6

STINKING SPRING QUADRANGLE
NEVADA-NYE CO.
15 MINUTE SERIES (TOPOGRAPHIC)

STATES
OF THE ARMY
ENGINEERS

Mapped by the Army Map Service
Published for civil use by the Geological Survey

Control by USC&GS and USCE

Topography from aerial photographs by photogrammetric methods
Aerial photographs taken 1952. Field check 1952

Polyconic projection. 1927 North American datum
10,000-foot grid based on Nevada coordinate system, central zone
1000-meter Universal Transverse Mercator grid ticks
zone 11, shown in blue

Dashed land lines indicate approximate locations

Unchecked elevations are shown in brown

CONTOUR INTERVAL 40 FEET
DATUM IS MEAN SEA LEVEL

FOR SALE BY U. S. GEOLOGICAL SURVEY, DENVER 2, COLORADO OR
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE

RECONNAISSANCE GEOLOGIC of the NORTHERN KAWICH & SOUTHERN REVEILLE RANGES

by J. N. GARDNER, A. C. EDDY & F. E. GOFF at LOS ANGELES

& K. S. GRAFFT at UNIVERSITY OF CALIFORNIA

1980

ROAD CLASSIFICATION
 Light-duty ——— Unimproved dirt - - - - -
 ○ State Route

STINKING SPRING, NEV.
 N3745—W11630/15

1952

FOR 2, COLORADO OR WASHINGTON 25, D. C.
 NO SYMBOLS IS AVAILABLE ON REQUEST

GEOLOGIC MAP

YREKA RANGES, NYE COUNTY, NEVADA

GOFF at LOS ALAMOS SCIENTIFIC LABORATORY

UNIVERSITY of CALIFORNIA, DAVIS

10

University of California
 LOS ALAMOS SCIENTIFIC LABORATORY
 Post Office Box 16637 Los Alamos, New Mexico 87545
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LA-8390-MAP
 UC-51
 ISSUED: JUNE 1980

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

UNITED STATES
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS

2700 11 SW
(REVEILLE)
1:24 000

KAWICH PEAK QUADRANGLE
NEVADA-NYE CO.
15 MINUTE SERIES (TOPOGRAPHIC)

(MELLAN)
2059 11

Mapped by the Army Map Service

Published for civil use by the Geological Survey

Control by USC&GS and USCE

Topography from aerial photographs by photogrammetric methods

Aerial photographs taken 1952. Field check 1952

Polyconic projection. 1927 North American datum
10,000-foot grid based on Nevada coordinate system, central zone

1000-metre Universal Transverse Mercator grid ticks,
zone 11, shown in blue

Dashed land lines indicate approximate locations

Unchecked elevations are shown in brown

CONTOUR INTERVAL 40 FEET
NATIONAL GEODETIC VERTICAL DATUM

FOR SALE BY U. S. GEOLOGICAL SURVEY, DENVER, COLORADO
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS

RECONNAISSANCE GEOLOGICAL **of the NORTHERN KAWICH & SOUTHERN REVEILL**

by J. N. GARDNER, A. C. EDDY & F. E. GOFF of

& K. S. GRAFFT of UNIVERSITY of CA

1980

0 FEET
TUM OF 192°

QUADRANGLE LOCATION

ROAD CLASSIFICATION

Light-duty ————— Unimproved dirt - - - - -

KAWICH PEAK, NEV.
N3745—W11615/15

1952

AMS 2750 IV—SERIES V706

University of California
LOS ALAMOS SCIENTIFIC LABORATORY
Post Office Box 1663 Los Alamos, New Mexico 87545
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GEOLOGIC MAP

WILLE RANGES, NYE COUNTY, NEVADA

at LOS ALAMOS SCIENTIFIC LABORATORY

of CALIFORNIA, DAVIS

LA-8390-MAP
UC-51
ISSUED: JUNE 1980

116°15' R. 51 E. 567000m.E.

R. 51 1/2 E.

R. 52 £

LIMIT OF MAPPING

Mapped by the Army Map Service
 Published for civil use by the Geological Survey
 Control by USC&GS and USCE
 Topography from aerial photographs by photogrammetric methods
 Aerial photographs taken 1952. Field check 1952
 Polyconic projection. 1927 North American datum
 10,000-foot grid based on Nevada coordinate system, central zone
 1000-meter Universal Transverse Mercator grid ticks,
 zone 11, shown in blue
 Dashed land lines indicates approximate locations
 Unchecked elevations are shown in brown

LIMIT OF MAPPING

3000 0 3000 6000 9000 12000
 1 5 0 1 2 3 4 5 6 7 8 9 10 11 12
 CONTOUR INTERVAL 40 FEET
 DASHED LINES REPRESENT 40 FOOT CONTOUR
 DATUM IS MEAN SEA LEVEL

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY
 FOR SALE BY U. S. GEOLOGICAL SURVEY, DENVER 25, COLORADO
 A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS

RECONNAISSANCE GEOLOGY

of the NORTHERN KAWICH & SOUTHERN REVEILLE

by J. N. GARDNER, A. C. EDDY & F. E. GOFF at LOS ANGELES

& K. S. GRAFFT at UNIVERSITY of CALIFORNIA

1980

DISCUSSION

General Geology: Rocks of both the northern Kawich and southern Reveille ranges consist primarily of widespread, multiple ash-flow sheets of Oligocene-Miocene age. The tuffs unconformably overlie Paleozoic rocks (shale, carbonate, and quartzite) at the north end of the Kawich Range along the Warm Springs fault zone, and within a structural horst in the northern Reveille Range. Early to late Miocene age volcanic rocks occur as shallowly emplaced intrusives, domes, lava flows, and eroded cinder cones throughout both ranges. The youngest volcanic rocks in the area are basalts dated at 5.7 ± 0.2 m.y. by K-Ar methods (Ekren et al., 1973). The youngest rocks are Quaternary age basin-fill sediments and alluvial fans within the broad valleys between the ranges.

The Kawich Range contains the remains of an ancient caldera (hereafter called Kawich Caldera) that was the source for most of the tuff exposed in the northern portion of the range. The center of the caldera is delimited by intracauldron tuffs and two piles of crystal-rich rhyodacite domes and lava flows, surrounded by younger, ring fracture, rhyolitic intrusive bodies. The caldera margins are poorly preserved because of extreme dissection along range faults and offset along a series of northwest-trending faults that cut the heart of the caldera. The thickness of intracauldron welded tuffs underlying the rhyodacite piles on the east side of the caldera approaches 1000 m. Two to three compound ash-flow cooling units are exposed outside the caldera margins as thick sheets, particularly on the west flank of the range and north of the Bellehelen fault zone. No other tuffs overlie those erupted from the Kawich Caldera in the map area. Magma resurgence occurred in the late Oligocene, based on K-Ar dates of 26.4 ± 1.3 m.y.b.p. (Teledyne Isotopes, written communication, 1979) on the Rhyodacite of Bellehelen Lakes, thereby limiting final stages of caldron activity to late Oligocene - early Miocene.

Post-caldera andesitic rocks of middle Miocene(?) age occur as dikes and flows scattered through the western and northeastern portions of Kawich Range. One patch of late Miocene(?) basalt lies south of the Golden Arrow Mine near Stinking Spring.

The northern Reveille Range was mapped previously by Ekren et al. (1973). A horst of Paleozoic rocks lies in the core of the range and is the location of extensive gold and silver mining operations. No Paleozoic rocks crop out in the southern part of the range, which is composed of a large fault block of welded tuff dipping gently to the east. The tuffs are locally intruded by latite plugs petrographically identical to plugs mapped by Ekren et al. (1973) that were dated at about 18.2 m.y. A field of dacitic to andesitic domes and flows of middle(?) Miocene age lies half-buried by alluvium in southern Reveille Valley. This lava field appears to be structurally down-dropped relative to the uplifted block of the Reveille Range along the Bellehelen Lineament (see below). Basalt flows petrographically equivalent to those mapped by Ekren et al. (1973) overlie the lava field and occur through much of the range.

Structure: Major structures in the map area are the Basin and Range faults, the Bellehelen Lineament and fault zone, and the Warm Springs fault. Both the Kawich and Reveille ranges have been uplifted along an echelon north-northwest-northeast trending Basin and Range faults. Most of these faults are normal faults, although high angle reverse faults do occur in both ranges. The west flank of Reveille Range exhibits a particularly striking range-bounding fault system about 18 km long. The range has been uplifted along these faults and gently tilted to the east as a large block offsetting basalt flows about 300 m.

The Bellehelen Lineament cuts through the Kawich Range as the

TABLE 1: Name, location, temperature, field pH, flow rate of eight surface meteoric waters and one hot Central Nevada.

No.	Name	Date	Location
<u>Surface Meteoric Waters</u>			
NV-2	Stinking Spg.	6/79	E $\frac{1}{2}$, S31, T1N, R49E
NV-3	Longstreet Creek	"	N $\frac{1}{4}$, S4, T1N, R49E
NV-4	Wild Iris Spg.	"	N $\frac{1}{4}$, S32, T2N, R49E
NV-5	Cap Henry Spg.	"	E $\frac{1}{2}$, S36, T3N, R49E
NV-6	Fang Spg.	"	Lat 37°56', Long 116°07'
223	Unnamed Spg.	7/67	NE $\frac{1}{4}$, S14, T2N, R47E
225	Unnamed Well	3/72	N $\frac{1}{4}$, S2H, T1S, R53E
226	Cedar Spg.	4/67	SE $\frac{1}{4}$, S21, T2S, R51E

Hot Spring at Warm Springs (Nanny Goat Spring)

NV-7	Hot Spring	6/79	SW $\frac{1}{4}$, S20, T4N, R50E
"	"	9/73	"
"	"	73	"

¹The pH of samples 223, 225, 226, and sample of Mariner

²Al = alluvium, T = Tertiary volcanic rocks and interbedded () = rock type at depth.

³Isotope determinations by L. Merliat, Dept. de Recherches al. (1974).

⁴G = This report; G & S = Garside and Schilling, 1979;

Qal

DES
ALLUVIUM -
gravels,

Qoa

OLDER ALLUV.
deposits;
distinguish
eroded al

Tsb

TERTIARY ROCK
OLIVINE BAS
flows &
basalt;
sitized
pyroxene
ground
maximum
of Ekren

Temperature, field pH, flow rate, source lithology, deuterium and oxygen isotopic character of geothermal waters and one hot spring of the Northern Kawich and Southern Reville ranges.

Location	Temp. °C	Field pH	Flow, l/min	Rock Type	$\delta D, ‰$	$\delta^{18}O, ‰$	Reference
EL, S31, TIN, R49E	27.8	6.8	Seep	Al(i)	-	-	G
MA, S4, TIN, R49E	18.9	5.5	80	Al(T)	-102.7	-13.65	G
MA, S32, T2N, R49E	14.4	5.3	20	Al(T)	-103.7	-13.90	G
EL, S36, T3N, R49E	13.3	5.7	12	Al(T)	-105.1	-14.05	G
Lat 37°56', Long 116°07'	18.3	6.2	4	Al(T)	-99.4	-13.00	G
NE, S14, T2N, R47E	29.4	7.8	-	T	-	-	G & S
MA, S28, T15, R53E	21.1	8.1	-	Al	-	-	G & S
SE, S21, T25, R51E	25.0	7.7	10	T	-	-	G & S
by Goat Spring)							
SW, S20, T4N, R50E	62.0	6.0	120	Al(P)	-113.5	-15.0	G
"	62.8	6.9	-	"	-	-	G & S
"	61.1	8.1	-	"	-113.7	-14.25	M

and sample of Mariner were determined in laboratory.

Granitic rocks and interbedded sediments (mostly Miocene age), P = Paleozoic sediments.

U.S. Geological Survey, Menlo Park, Calif., Dept. de Recherche et Analyse, Saclay, France, except sample from Mariner et

and Schilling, 1979; M = Mariner et al., 1974, 1975.

DESCRIPTION OF MAP UNITS

ALLUVIUM - Includes alluvium, colluvium, pediment gravels, terrace gravels, and fan deposits.

OLDER ALLUVIUM - Composed of older pediment and fan deposits; uplifted and tilted by Quaternary faulting; distinguished from younger deposits by uplifted and eroded alluvial surfaces.

TERTIARY ROCKS OF THE NORTHERN KAWICH RANGE

OLIVINE BASALT NEAR STINKING SPRING - Gray to black flows and minor interbedded red cinder deposits of basalt; contains tiny (2-3 mm) phenocrysts of iddingsitized olivine, plagioclase, and sparse clinopyroxene-plagioclase clots (5 mm) in a glassy groundmass; overlies tuff of Kawich Caldera (Tk); maximum thickness less than 120 m; included in Basalt of Ekren et al. (1971).

Tbr

RHYODACITE OF BELLEHELEN LAKES - Gray to white flows of porphyritic rhyodacite; includes of Cap Henry Spring; contains abundant phenocrysts of quartz, k-spar, plagioclase, biotite, and hornblende; displays up to 30 m of flow-breccia of unit; overlies Tuff of Kawich Caldera and Intracauldron Tuff of Kawich Peak (Tkr); thickness about 420 m; K-Ar age = 26.4 ± 1 biotite and 18.5 ± 0.9 m.y. on whole rock (Isotopes, 1979); (the younger, whole rock be discounted because of alteration evidence sample's groundmass which has probably lost of Ar, yielding a younger date).

Tlr

RHYODACITE SOUTH OF LONGSTREET RANCH - Gray flows, domes and sills(?) of porphyritic rhyodacite containing phenocrysts of quartz, k-spar, plagioclase, biotite, hornblende $\pm$ clinopyroxene; up to 10 m of flow-breccia near base; overlies Tuff of Kawich Caldera (Tkt), Tuff of Kawich Peak (Tkr) and Rhyodacite Northwest of Silverbow (Tpr); thickness about 250(?) m; uncertain relationship to Rhyolite of O'Brian's Knob of Ekren et al. (1971).

Tkr

INTRACAULDRON TUFFS OF KAWICH PEAK - Gray crystalline rhyodacitic welded ash-flow tuffs with a pumice-streaked appearance; contains abundant fragments of vitrophyre up to 0.5 m across; glassy groundmass; phenocrysts consist of quartz, k-spar, plagioclase, biotite, hornblende, and clinopyroxene; commonly an intracanyon tuff; overlies Tuff of Kawich Caldera (Tkt) and Rhyodacite Northwest of Silverbow (Tpr); thickness extremely variable; maximum thickness about 300 m.

Tpr

RHYODACITE NORTHWEST OF SILVERBOW - Gray to pinkish porphyritic rhyodacite; includes coarse-grained k-spar megacrysts up to 3 cm long; contains phenocrysts of quartz, k-spar, plagioclase, biotite, hornblende, and clinopyroxene; overlies Tuff of Kawich Caldera (Tkt); maximum thickness about 100 m; uncertain relations to Rhyolite of O'Brian's Knob of Ekren et al. (1971).

TUFF OF KAWICH CALDERA, UNDIVIDED (Tkt) - Undivided of densely to non-welded rhyolitic ash-flow tuff; typically contains phenocrysts of quartz, plagioclase, sanidine, and biotite in a pink to grayish groundmass; contains abundant lithic fragments of sedimentary rocks, lavas, tuffs, and granitic rocks; composed of multiple ash-flow units locally separated by cross-bedded sandstone and shales (probably representing caldera lake deposits); exposed thickness of homogeneous caldera-fill tuff at least 1000 m; includes Tuff of White Blotch Spring of Ekren et al. (1971); where stratigraphic exposure is sufficient, the uppermost units are mapped separately as Clifford Spring (Tk) and the Silicified Tuff of Clifford Spring (Tkb); the tuffs of White Blotch Spring are probably associated with final caldera formation, and aid in delimiting the margins of Kawich Caldera.

TUFF OF CLIFFORD SPRING (Tk) - Youngest unit in Tuff of Kawich Caldera; uppermost

LEHELEN LAKES - Gray to white dome and porphyritic rhyodacite; includes dike east of spring; contains abundant phenocrysts of quartz, plagioclase, biotite, and sparse clinopyroxene; displays up to 30 m of flow-breccia near base; overlies Tuff of Kawich Caldera (Tkt); Tuff of Kawich Peak (Tkr); maximum thickness about 420 m; K-Ar age = 26.4 ± 1.3 m.y. on whole rock (Teledyne); (the younger, whole rock age should be used because of alteration evident in the dacite mass which has probably resulted in yielding a younger date).

OF LONGSTREET RANCH - Gray to pink and sills(?) of porphyritic rhyodacite with phenocrysts of quartz, k-spar, plagioclase, hornblende $\pm$ clinopyroxene; displays flow-breccia near base; overlies Tuffs of Kawich Caldera (Tkt), Tuff of Kawich Peak (Tkr) Northwest of Silverbow (Tpr); maximum thickness about 250(?) m; uncertain relations to O'Brian's Knob of Ekren et al. (1971).

S OF KAWICH PEAK - Gray crystal-rich welded ash-flow tuffs with a pronounced orange; contains abundant fragments and phenocrysts up to 0.5 m across; extremely variable; phenocrysts consist of quartz, plagioclase, biotite, hornblende, $\pm$ clinopyroxene; an intracanyon tuff; overlies Tuff of Kawich Caldera (Tkt) and Rhyodacite Northwest of Silverbow (Tpr); thickness extremely variable; maximum thickness about 300 m.

ST OF SILVERBOW - Gray to pink flows of rhyodacite; includes conspicuous sills up to 3 cm long; contains phenocrysts of quartz, k-spar, plagioclase, biotite, hornblende, clinopyroxene; overlies Tuff of Kawich Peak (Tkr); maximum thickness about 200 m; relations to Rhyolite of O'Brian's Knob of Ekren et al. (1971).

DERA, UNDIVIDED (Tkt) - Undivided unit of non-welded rhyolitic ash-flow tuffs; contains phenocrysts of quartz, plagioclase, and biotite in a pink to gray euclastic; contains abundant lithic fragments; composed of multiple ash flows separated by cross-bedded sandstones and siltstones representing caldera lacustrine deposits; maximum thickness of homogeneous unit at least 1000 m; included in the White Blotch Spring of Ekren et al. (1971); if exposure is sufficient, the units are mapped separately as Tuff of Kawich Peak (Tkr) and the Silicified Tuff-breccia of Silverbow (Tkb); the tuffs of Clifford are probably associated with final caldera stage in delimiting the margins of the

CLIFFORD SPRING (Tk) - Youngest Tuff of Kawich Caldera; upper

Td

DACITE OF REVEILLE VALLEY - Gray to tan flows, domes, and dikes of porphyritic dacite; contains phenocrysts of quartz, plagioclase, biotite, hornblende, and clinopyroxene in variable quantities; locally displays a glassy felted groundmass with microphenocrysts of feldspar; underlies Plagioclase-phyric Basalt (Tpb); maximum exposed thickness about 110 m; included in Lavas of Intermediate Composition of Ekren et al. (1971).

Tpa

ANDESITE OF SOUTHERN REVEILLE VALLEY - Gray to black dome and flows of glassy andesite; contains phenocrysts of plagioclase, clinopyroxene, and orthopyroxene; apparently underlies Plagioclase-phyric Basalt (Tpb); maximum thickness about 80 m; included in Lavas of Intermediate Composition of Ekren et al. (1971).

Tli

LATITE INTRUSIONS - White to gray latite and quartz latite plugs; generally porphyritic with hypabyssal texture; contains abundant phenocrysts of plagioclase, very abundant to sparse quartz, $\pm$ k-spar, $\pm$ biotite; commonly hydrothermally altered to sericite and silica; locally contains fragments of Paleozoic rocks; intrudes Tuffs of Reveille Range (Tt); includes small outcrops of dacite north of Fang Ridge; K-Ar age 18.7 ± 0.8 m.y. on sanidine (Ekren et al., 1973).

Tt

TUFFS OF REVEILLE RANGE, UNDIVIDED - Predominantly densely welded crystal-rich ash-flow tuffs (quartz latitic to rhyolitic); contains fragmental phenocrysts of quartz and plagioclase, $\pm$ biotite; may include resorbed quartz, abundant pumice, and volcanic lithic fragments; commonly hydrothermally altered; may include minor tuffaceous sediments or base-surge deposits near west end and south of Fang Ridge; includes Monotony Tuff, Tuff of Reveille Range and (unnamed) Quartz Latitic Tuffs of Ekren et al. (1973), and Tuff of White Blotch Spring of Ekren et al. (1971); underlies Plagioclase-phyric Basalt (Tpb) and is intruded by Latite Intrusions (Tli); exposed thickness about 700(?) m.

Tss

TERTIARY SEDIMENTARY ROCKS, UNDIVIDED - Buff, yellow and red, fine- to medium-grained quartz-rich sandstone and shale; some conglomeratic sandstone; includes some volcanic breccia and tuffaceous sediments; interbedded with Tuffs of Reveille Range (Tt) and intruded by Latite Intrusions (Tli); maximum exposed thickness about 130 m.

PRE-TERTIARY UNITS

Pu

PALEOZOIC SEDIMENTARY ROCKS, UNDIVIDED - Light gray to black carbonate, shale, and quartzite; largest exposures north of Highway 6 along Warm Springs fault zone; included as small fragments and large blocks several meters across in Tuff of Kawich Caldera (Tkt) near Ben Hur Mine and Cow Canyon; unconformably overlain by the volcanic rocks of Kawich and Reveille Ranges; maximum exposed thickness north of Highway 6 about 400(?) m; may include Antelope Valley Limestone and Fort Union Sandstone of Antelope Valley and Fort Union Sandstone of Antelope Valley and Fort Union Sandstone of Antelope Valley.

CORRELATION of MAP UNITS

DEFINITION of MAP UNITS

INDEX of BASE MAPS
SHOWING AREAS of PRIMARY MAPPING RESPONSIBILITY

PEAS of PRIMARY MAPPING RESPONSIBILITY

A horizontal number line with tick marks. Below the line, the numbers 5 and 10 are labeled, followed by the unit 'km'. Above the line, the numbers 5 and 10 are labeled, followed by the unit 'mi'. This indicates that 5 km is equivalent to 5 mi and 10 km is equivalent to 10 mi.

RESPONSIBILITY

WARM SPGS 15' QUAD

The Bellehelen Lineament cuts through the Kawich Range as the Bellehelen fault zone. The lineament is a previously unrecognized physiographic feature that runs through central Nevada for about 550 km with a northwestern trend. Several hot springs and numerous mining districts, such as those in the Bellehelen fault zone, lie along the length of the lineament. Within the map area the lineament is a major fault zone at least 50 km long, controlling topography and drainage in southern Reveille Valley, disrupting and truncating the Basin and Range faults in Kawich Range, and severing the dacitic-andesitic lava field mentioned above from the Reveille Range. Although no determination of nature and amount of movement on the fault has yet been discerned, the Bellehelen Lineament, because of its length and orientation, would appear to be tectonically related to the Walker Lane Fault Zone. Ekren et al. (1976) describe several east-trending structural lineaments in central Nevada, one of which transects Kawich Range as the Warm Springs fault (see below). Although the Warm Springs Lineament of Ekren et al. (1976) and the Bellehelen Lineament intersect in Stone Cabin Valley, west of Kawich Range, exposures and existing geophysical data do not permit elucidation of their interactions. Ekren et al. (1976) suggest that their east-trending lineaments and the Walker Lane are probably part of a conjugate system, citing the tangential relations of the lineaments with caldera complexes as evidence of the lineaments' deep-seated structural origins. The Bellehelen Lineament, sharing similar tangential relations with the Kawich Caldera and two probable cauldrons in the Monitor Range to the northwest, is probably a deep-seated structural lineament of the same conjugate system.

The Warm Springs fault at the north end of the map area is an anomalous structure that trends east-west, and is part of the Warm Springs Lineament of Ekren et al. (1976). The fault is the structural boundary between the Kawich and Hot Creek ranges, and juxtaposes tuffs of Kawich Caldera with Paleozoic rocks and older Tertiary tuffs.

Field evidence indicates that at least portions of all of the major fault systems in the area have experienced Quaternary movements. At least two uplifted and tilted older Quaternary alluvial surfaces indicate that the northern Kawich Range has undergone uplift twice in the Quaternary. All the fault systems in the map area show a very fresh and prominent geomorphic expression, and Ekren et al. (1973) show Basin and Range faults in Quaternary alluvium in the northern Reveille Range. The Bellehelen fault zone disrupts the trends of and truncates Basin and Range faults. The Bellehelen fault zone and lineament appear to be part of a younger overprint of north-west trending faults on those of the Basin and Range.

Economics: Both the Kawich and Reveille Ranges contain a number of mines and mineral claims; some of the mines are presently active, and some date back at least to the early 1900's. The New Reveille Mine just north of the map area is a currently active gold and silver mine. Ore is mined from faulted Paleozoic rocks and adjacent tuff in a structural horst in the core of the range. Similar geologic environments do not occur in the southern Reveille Range.

Silver and gold ore is, and has been, mined from two geologic environments in the Kawich Range: (1) hydrothermally altered tuff and ring fracture rhyolitic bodies encircling Kawich Caldera; and (2) quartz veins cutting welded tuff in most major fault zones, particularly along the western margin of the range.

Hydrogeology and Water Chemistry: The Reveille Range contains few springs; all surface water drains into Railroad Valley on the east. Kawich Range, which is larger and topographically higher, possesses several creeks that drain the high regions of rhyodacite in the caldera center. The creeks and springs in Kawich Range were flowing as late in the summer as September 1, 1979. In fact, water is so plentiful that several ranches were once established along the creeks of the Kawich Range, and the creeks and springs were used for

Tja

of Ekren et al.
ANDESITE WEST
red cinder
pilotaxitic
sparse plagioclase
pseudomorph
hornblende
intracauldron
about 35
deposits.

Tca

BASALTIC ANDESITE
of basaltic
contains rhyolite
long and rhyolite
pyroxene; glass
pyroxene, and
Basaltic Andesite
(Tad); over
maximum thickness

Tad

BASALTIC ANDESITE
glassy dike
phenocrysts of
pyroxene,
inverted xenocrysts
pyroxene rhyolite
dike of the

Ttl

TUFFACEOUS LACUSTRINE
Interbedded
wackes, in
deposits;
Mine (Tca);

Tga

ANDESITE OF C
phyritic and
blende, and
altered to
fine-grained
(Tk); maximum

Tba

ANDESITE SOUTH
mottled flow
phenocrysts
clinopyroxene
are silica,
lies tuff of
Tuffs (Tot)

Tdi

DACITE INTRUSION
gray to black
of plagioclase
and rare c
intrudes Rhyolite
Rhyolite Intrusion

Tri

RHYOLITE INTRUSION
aphyric to
holocrystalline
crystals of plagioclase
opaque; con
and silica;
Rhyodacite
of Bellehelen
Kawich Peak

of Ekren et al. (1971).

ANDESITE WEST OF JACKSON FALLS SPRING - Vent deposits of red cinders and black glassy flow of hyalopilitic-pilotaxitic andesite; contains microphenocrysts of sparse plagioclase, rare iddingsitized olivine, and pseudomorphs of clinopyroxene and magnetite after hornblende; overlies Tuff of Kawich Caldera (Tkt) and Intracauldron Tuff of Kawich Peak (Tkr); thickness about 35 m, but possibly thicker in intracanyon deposits.

BASALTIC ANDESITE OF CLIFFORD MINE - Black glassy flows of basaltic andesite displaying hackly jointing; contains rare megacrysts of plagioclase up to 2 cm long and rare quartz xenocrysts with rims of clinopyroxene; groundmass consists of plagioclase, clinopyroxene, and glass; similar in field appearance to Basaltic Andesite Dike East of Cap Henry Spring (Tad); overlies Tuffaceous Lacustrine Deposits (Ttl); maximum thickness about 20 m.

BASALTIC ANDESITE DIKE EAST OF CAP HENRY SPRING - Black glassy dike of basaltic andesite containing phenocrysts of large altered olivine euhedra, clinopyroxene, and sieve-textured plagioclase; disseminated xenocrysts (<1 mm) of quartz with clinopyroxene reaction rims; intruded along margins of dike of the Rhyodacite of Bellehelen Lakes (Tbr).

TUFFACEOUS LACUSTRINE DEPOSITS EAST OF CLIFFORD MINE - Interbedded cherts, cherty shales, and arkosic wackes; includes some biotite-bearing air-fall tuff deposits; underlies Basaltic Andesite of Clifford Mine (Tca); maximum exposed thickness 15 m.

ANDESITE OF GOLDEN ARROW - Gray to pink flows of porphyritic andesite with phenocrysts of biotite, hornblende, and plagioclase; generally hydrothermally altered to silica, sericite, chlorite, carbonate, and fine-grained opaques; overlies tuff of Kawich Caldera (Tk); maximum exposed thickness about 60 m.

ANDESITE SOUTH OF BLACK SPRING - Gray to red and green mottled flows of hydrothermally altered andesite; phenocrysts consist of plagioclase, altered clinopyroxene, and rare quartz; alteration products are silica, sericite, chlorite, and carbonate; overlies tuff of Kawich Caldera (Tk) and Older Tertiary Tuffs (Tot); maximum exposed thickness about 40(?) m.

DACITE INTRUSIVE ROCKS NORTHEAST OF STINKING SPRING - gray to black, glassy dacite containing phenocrysts of plagioclase, biotite, clinopyroxene, and quartz, and rare clots of plagioclase plus clinopyroxene; intrudes Rhyodacite Northwest of Silverbow (Tpr) and Rhyolite Intrusions of Kawich Caldera (Tri).

RYHOLITE INTRUSIONS OF KAWICH CALDERA - Gray to white aphyric to porphyritic rhyolites; some may be nearly holocrystalline; generally contain sparse tiny phenocrysts of plagioclase $\pm$ k-spar $\pm$ biotite $\pm$ quartz $\pm$ opaques; commonly hydrothermally altered to sericite and silica; intrudes Tuff of Kawich Caldera (Tkt), Rhyodacite Northwest of Silverbow (Tpr), Rhyodacite of Bellehelen Lakes (Tbr), and Intracauldron Tuffs of Kawich Peak (Tkr); rocks surrounding intrusive bodies

unit in Tuff of Kawich Caldera; upper portions of Tuff of Clifford Spring consist of a thick compound cooling unit of densely welded tuff containing multiple vitrophyres; contains large (up to 20 m diameter) lithic blocks of Paleozoic and Tertiary sedimentary rocks; lower portions are lithologically identical to the upper portions but moderately to non-welded; weathers to characteristically rounded hills caused by disintegration of non-welded pumice; commonly white to tan from extensive hydrothermal alteration; base of unit defined by a 3- to 5-m thick air-fall pumice lapilli tuff; maximum exposed thickness greater than 400 m; apparently included in the Tuff of Kilauea (Quinlivan and Rogers (1974), and Fracture Tuff of Ekren et al. (1971).

SILICIFIED TUFF-BRECCIA OF CLIFFORD SPRING (Tkb) - Maroon, silicified oxidized, and brecciated tuff; cause of brecciation is not known; unit locally includes a basal air-fall tuff less than 3-m thick; overlies Older Tertiary Tuff (Tot) outside the margins of Kawich Caldera; maximum exposed thickness less than 30 m.

Tot

OLDER TERTIARY TUFFS - Gray to dark green, possibly includes some flows north of High undivided unit of variable appearance and minor characterized by the ubiquitous presence of biotite phenocrysts may include combinations of plagioclase, hornblende, or clinopyroxene; most crops hydrothermally altered to sericite, chlorite, carbonate, and silica; underlies the Silicified Tuff-breccia of Clifford Spring of the tuff of Kawich Caldera (Tkb) and Basaltic Andesite of Clifford Mine (Tca); intruded by Rhyolite of Highway 6; maximum exposed thickness about 50 m; probably includes Monotony Tuff, Tuff of Twin Peaks, and of Orange Lichen Creek of Quinlivan and Rogers (1974), and the Rawhide and Italian Springs Tuffs of Cook (1969).

TERTIARY VOLCANIC ROCKS OF THE SOUTHERN REVELLE RANGE

Tpb

PLAGIOCLASE-PHYRIC BASALT - Black flows, dikes, and minor red cinder deposits; generally contains conspicuous phenocrysts of plagioclase up to 3 cm long; may also include conspicuous phenocrysts of clinopyroxene and iddingsitized olivine; groundmass locally diktytaxitic; overlies Dacite of Reveille Valley (Td) and Tuffs of the Reveille Range (Tr); maximum thickness about 100 m; K/Ar age = 5.7 $\pm$ 0.2 m.y. on whole rock (Ekren et al., 1973); also included as Basalt by Ekren et al. (1971).

Tha

HORNBLende ANDESITE OF CEDAR PIPELINE RANCH - Black glassy trachytic, vesicular flows of hornblende andesite; some hydrothermal alteration; contains

CLIFFORD SPRING TUFF (Tks) - Youngest
 in Tuff of Kawich Caldera; upper
 portions of Tuff of Clifford Spring con-
 sist of a thick compound cooling unit of
 closely welded tuff containing multiple
 porphyres; contains large (up to 20 m in
 diameter) lithic blocks of Paleozoic and
 Tertiary sedimentary rocks; lower portions
 lithologically identical to the upper
 portions but moderately to non-welded;
 others to characteristically rounded
 clasts caused by disintegration of non-
 welded pumice; commonly white to tan from
 extensive hydrothermal alteration; base of
 unit defined by a 3- to 5-m thick air-fall
 tuff; lapilli tuff; maximum exposed
 thickness greater than 400 m; apparently
 included in the Tuff of Kiln Canyon of
 Quinlivan and Rogers (1974), and Fraction
 of Ekren et al. (1971).

SILICIFIED TUFF-BRECCIA OF CLIFFORD
SPRING (Tkb) - Maroon, silicified,
 oxidized, and brecciated tuff; cause of
 brecciation is not known; unit locally
 includes a basal air-fall tuff less than
 1 m thick; overlies Older Tertiary Tuffs
 (Tt) outside the margins of Kawich
 Caldera; maximum exposed thickness less
 than 30 m.

CLIFFORD SPRING TUFFS - Gray to dark green tuffs;
 includes some flows north of Highway 6;
 unit of variable appearance and mineralogy
 characterized by the ubiquitous presence of biotite;
 phenocrysts may include combinations of quartz,
 plagioclase, hornblende, or clinopyroxene; most out-
 crops hydrothermally altered to sericite, chlorite,
 epidote, and silica; underlies the Silicified
 Breccia of Clifford Spring of the tuff of Kawich
 (Tkb) and Basaltic Andesite of Clifford Mine
 intruded by Rhyolite of Highway 6 (Thr);
 exposed thickness about 50 m; probably
 Monotony Tuff, Tuff of Twin Peaks, and Tuff
 of Lichen Creek of Quinlivan and Rogers
 and the Rawhide and Italian Springs forma-
 tions (Cook (1969).

ROCKS OF THE SOUTHERN REVEILLE RANGE

PHENOCRYSTIC BASALT - Black flows, dikes, and
 cinder deposits; generally contains con-
 spicuous phenocrysts of plagioclase up to 3 cm long;
 include conspicuous phenocrysts of clino-
 pyroxene and iddingsitized olivine; groundmass
 plagioclase; overlies Dacite of Reveille
 (D) and Tuffs of the Reveille Range (Tt);
 thickness about 100 m; K/Ar age = 5.7 ± 0.2
 Ma (whole rock (Ekren et al., 1973); also
 Basalt by Ekren et al. (1971).

ANDESITE OF CEDAR PIPELINE RANCH - Black
 aphyric, vesicular flows of hornblende
 with some hydrothermal alteration; contains

about 400(?) m; may include Antelope Valley Limestone
 and Eureka Quartzite of Quinlivan and Rogers (1974).

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ACKNOWLEDGMENTS

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 and Mr. Dave Mann for their assistance in word processing, drafting,
 and thin section preparation respectively.

MAJOR UNCONFORMITY

Pu

■ K-Ar DATED UNIT

RECONNAISSANCE GEOLOGY of the NORTHERN KAWICH & SOUTHERN REVEILLE

by J. N. GARDNER, A. C. EDDY & F. E. GOFF at LOS ANGELES
& K. S. GRAFFT at UNIVERSITY of CALIFORNIA

1980

PALEOZOIC

CONNAISSANCE GEOLOGIC MAP
& SOUTHERN REVEILLE RANGES, NYE COUNTY, NEVADA

J. C. EDDY & F. E. GOFF at LOS ALAMOS SCIENTIFIC LABORATORY

S. GRAFFT at UNIVERSITY of CALIFORNIA, DAVIS

1980

LEOZOIC

STINKING SPGS 15' QUAD

SYMBOLS

APPROXIMATE CONTACT

INFERRED CONTACT

FAULT; BALL ON DOWN

INFERRED FAULT

FAULT CONCEALED BY

ORIENTATION OF SHEAR

STRIKE & DIP OF BED

STRIKE & DIP OF PR

STRIKE & DIP OF JO

AIR PHOTO LINEAMENT

VOLCANIC VENT

DIRECTION OF MOVEMENT

SPRING

AP

ES, NYE COUNTY, NEVADA

IENTIFIC LABORATORY

AVIS

STINKING SPGS 15' QUAD

KAWICH PEAK 15' QUAD

REVEILL

SYMBOLS

APPROXIMATE CONTACT

INFERRED CONTACT

FAULT; BALL ON DOWN-DROPPED SIDE; DIP OF FAULT PLANE

INFERRED FAULT

FAULT CONCEALED BY A YOUNGER UNIT

ORIENTATION OF SHEAR ZONE

STRIKE & DIP OF BEDDING

STRIKE & DIP OF PRIMARY IGNEOUS FOLIATION

STRIKE & DIP OF JOINTS

AIR PHOTO LINEAMENT

VOLCANIC VENT

DIRECTION OF MOVEMENT OF LAVA FLOW

SPRING

8

2

H PEAK 15' QUAD

REVEILLE PEAK

15' QUAD

PED SIDE; DIP OF FAULT PLANE

NGER UNIT

NEOUS FOLIATION

LAVA FLOW

major fault systems in the area have experienced Quaternary movements. At least two uplifted and tilted older Quaternary alluvial surfaces indicate that the northern Kawich Range has undergone uplift twice in the Quaternary. All the fault systems in the map area show a very fresh and prominent geomorphic expression, and Ekren et al. (1973) show Basin and Range faults in Quaternary alluvium in the northern Reveille Range. The Bellehelen fault zone disrupts the trends of and truncates Basin and Range faults. The Bellehelen fault zone and lineament appear to be part of a younger overprint of north-west trending faults on those of the Basin and Range.

Tga

Tba

Economics: Both the Kawich and Reveille Ranges contain a number of mines and mineral claims; some of the mines are presently active, and some date back at least to the early 1900's. The New Reveille Mine just north of the map area is a currently active gold and silver mine. Ore is mined from faulted Paleozoic rocks and adjacent tuff in a structural horst in the core of the range. Similar geologic environments do not occur in the southern Reveille Range.

Tdi

Silver and gold ore is, and has been, mined from two geologic environments in the Kawich Range: (1) hydrothermally altered tuff and ring fracture rhyolitic bodies encircling Kawich Caldera; and (2) quartz veins cutting welded tuff in most major fault zones, particularly along the western margin of the range.

Tri

Hydrogeology and Water Chemistry: The Reveille Range contains few springs; all surface water drains into Railroad Valley on the east. Kawich Range, which is larger and topographically higher, possesses several creeks that drain the high regions of rhyodacite in the caldera center. The creeks and springs in Kawich Range were flowing as late in the summer as September 1, 1979. In fact, water is so plentiful that several ranches were once established along the creeks of the Kawich Range, and the creeks and springs support lush meadows that attract stock and game into the mountain canyons. The Bellehelen Lakes lie atop the rhyodacites of the caldera. The lakes are formed from melt water of winter snows, and large snow banks persisted atop the range through late July, 1979. Waters from Kawich drain into Stone Cabin Valley on the west and Reveille Valley on the east.

Thr

Field and isotopic data for several surface waters and one hot spring are shown in Table 1. The isotopes of the cool springs yield a linear trend on a plot of δD versus $\delta^{18}O$ that is parallel to but slightly enriched in ^{18}O relative to the Craig Meteoric line. This shift is common for meteoric waters in regions of high evaporation (Craig et al., 1963). Two sets of values listed for Warm Spring indicate the waters to be meteoric, but suggest a possible enrichment of ^{18}O due to high-temperature rock-water interaction in a geothermal environment (Craig et al., 1956). Warm Spring rises along a fault in shattered Paleozoic rocks, and has been designated a Known Geothermal Resource Area (KGRA). The waters of Warm Spring provide the entire water supply for the community of Warm Springs.

The chemistry of all waters except Warm Spring and Unnamed Spring #223 reveals them to be cool, dilute, and potable (Mariner et al., 1974, 1975; Garside and Schilling, 1979; Goff, unpub. data, 1980). Although the chemistry of Warm Spring is not particularly concentrated, Warm Spring does contain significant fluoride (greater than 3.5 mg/l), relatively high lithium, and has a Li/Na ratio of nearly 0.01 indicating deep circulation at elevated temperature (White, 1957).

fine (Tca); maximum exposed thickness 15 m.

Tga

ANDESITE OF GOLDEN ARROW - Gray to pink flows of porphyritic andesite with phenocrysts of biotite, hornblende, and plagioclase; generally hydrothermally altered to silica, sericite, chlorite, carbonate, and fine-grained opaques; overlies tuff of Kawich Caldera (Tk); maximum exposed thickness about 60 m.

Tba

ANDESITE SOUTH OF BLACK SPRING - Gray to red and green mottled flows of hydrothermally altered andesite; phenocrysts consist of plagioclase, altered clinopyroxene, and rare quartz; alteration products are silica, sericite, chlorite, and carbonate; overlies tuff of Kawich Caldera (Tk) and Older Tertiary Tuffs (Tot); maximum exposed thickness about 40(?) m.

Tdi

DACITE INTRUSIVE ROCKS NORTHEAST OF STINKING SPRING - gray to black, glassy dacite containing phenocrysts of plagioclase, biotite, clinopyroxene, and quartz, and rare clots of plagioclase plus clinopyroxene; intrudes Rhyodacite Northwest of Silverbow (Tpr) and Rhyolite Intrusions of Kawich Caldera (Tri).

Tri

RHYOLITE INTRUSIONS OF KAWICH CALDERA - Gray to white aphyric to porphyritic rhyolites; some may be nearly holocrystalline; generally contain sparse tiny phenocrysts of plagioclase ± k-spar ± biotite ± quartz ± opaques; commonly hydrothermally altered to sericite and silica; intrudes Tuff of Kawich Caldera (Tkt), Rhyodacite Northwest of Silverbow (Tpr), Rhyodacite of Bellehelen Lakes (Tbr), and Intracauldron Tuffs of Kawich Peak (Tkr); rocks surrounding intrusive bodies are generally hydrothermally altered up to hundreds of meters from the intrusion.

Thr

RHYOLITE INTRUSIONS OF HIGHWAY 6 - White hydrothermally altered porphyritic rhyolite containing phenocrysts of quartz, k-spar, and plagioclase; no primary mafic minerals remain; alteration products are sericite, carbonate, opaques, and secondary silica; intrudes Tuff of Kawich Caldera (Tkt and Tk) and Older Tertiary Tuffs (Tot).

Other phenocrysts may include plagioclase, hornblende, or crops hydrothermally altered carbonate, and silica; Tuff-breccia of Clifford S. Caldera (Tkb) and Basaltic (Tca); intruded by Rhyolite maximum exposed thickness includes Monotony Tuff, Tuff of Orange Lichen Creek (1974), and the Rawhide formations of Cook (1969).

TERTIARY VOLCANIC ROCKS OF THE SOUTH

Tpb

PLAGIOCLASE-PHYRIC BASALT - minor red cinder deposits; conspicuous phenocrysts of plagioclase; may also include conspicuous clinopyroxene and iddingsite; locally diktytaxitic; overlies Valley (Td) and Tuffs of Kawich Caldera; maximum thickness about 10 m.y. on whole rock (Ek); included as Basalt by Ekren.

Tha

HORNBLLENDE ANDESITE OF CEDAR CREEK - glassy trachytic, vesicular andesite; some hydrothermally altered phenocrysts of hornblende and plagioclase; glomeroporphyritic zoned volcanic lithic inclusions; maximum thickness about 20(?) m; stratigraphically mapped volcanic units of the late Miocene in age.

...may include combinations of quartz, hornblende, or clinopyroxene; most out-thermally altered to sericite, chlorite, and silica; underlies the Silicified (a) of Clifford Spring of the tuff of Kawich (b) and Basaltic Andesite of Clifford Mine intruded by Rhyolite of Highway 6 (Thr); exposed thickness about 50 m; probably monotonous Tuff, Tuff of Twin Peaks, and Tuff of Lichen Creek of Quinlivan and Rogers and the Rawhide and Italian Springs formations (1969).

ROCKS OF THE SOUTHERN REVEILLE RANGE

HYRIC BASALT - Black flows, dikes, and cinder deposits; generally contains phenocrysts of plagioclase up to 3 cm long; include conspicuous phenocrysts of clinopyroxene and iddingsitized olivine; groundmass microcrystalline; overlies Dacite of Reveille (Tt) and Tuffs of the Reveille Range (Tt); thickness about 100 m; K/Ar age = 5.7 ± 0.2 Ma (Ekren et al., 1973); also Basalt by Ekren et al. (1971).

ANDESITE OF CEDAR PIPELINE RANCH - Black microcrystalline, vesicular flows of hornblende with some hydrothermal alteration; contains some hornblende and clinopyroxene and local phyrritic zoned plagioclase; contains microcrystalline inclusions; maximum exposed thickness about 50 m; stratigraphically unrelated to other units of the Reveille Range; probably older in age.

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1980

RECONNAISSANCE GEOLOGIC MAP

PAWICH & SOUTHERN REVEILLE RANGES, NYE COUNTY, NEVADA

WARDNER, A. C. EDDY & F. E. GOFF at LOS ALAMOS SCIENTIFIC LABORATORY

& K. S. GRAFFT at UNIVERSITY of CALIFORNIA, DAVIS

1980

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ANGES, NYE COUNTY, NEVADA

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ORIENTATION OF

69

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STRIKE & DIP

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STRIKE & DIP

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DIRECTION OF MOVEMENT OF LAVA FLOW

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APPROXIMATE MARGIN OF KAWICH CALDERA

VERTICAL JOINT

INDICATES SAME MAP UNIT ON BOTH SIDES
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OF KAWICH CALDERA

NIT ON BOTH SIDES

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ISSUED: JUNE 1980