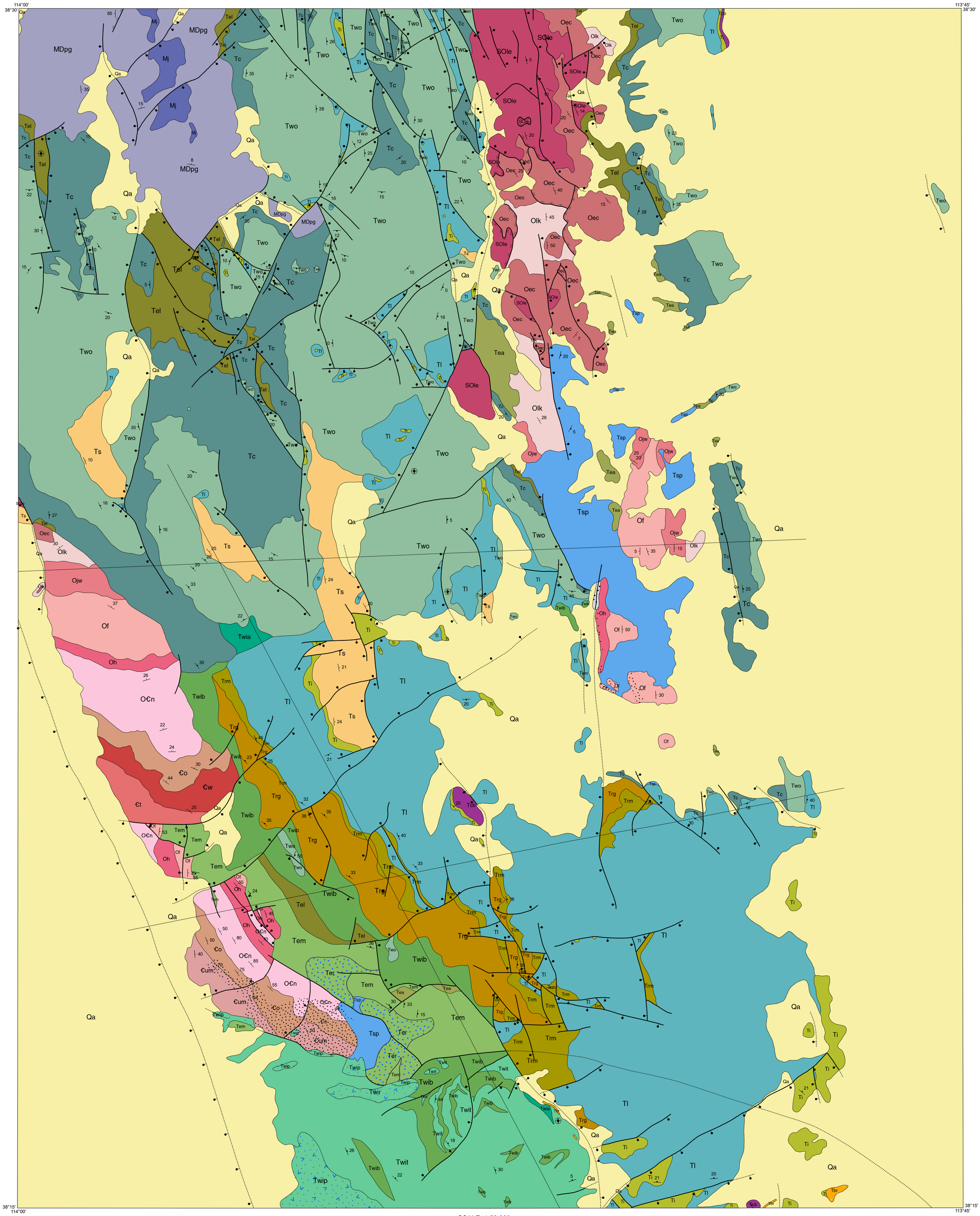


SCALE 1:50,000

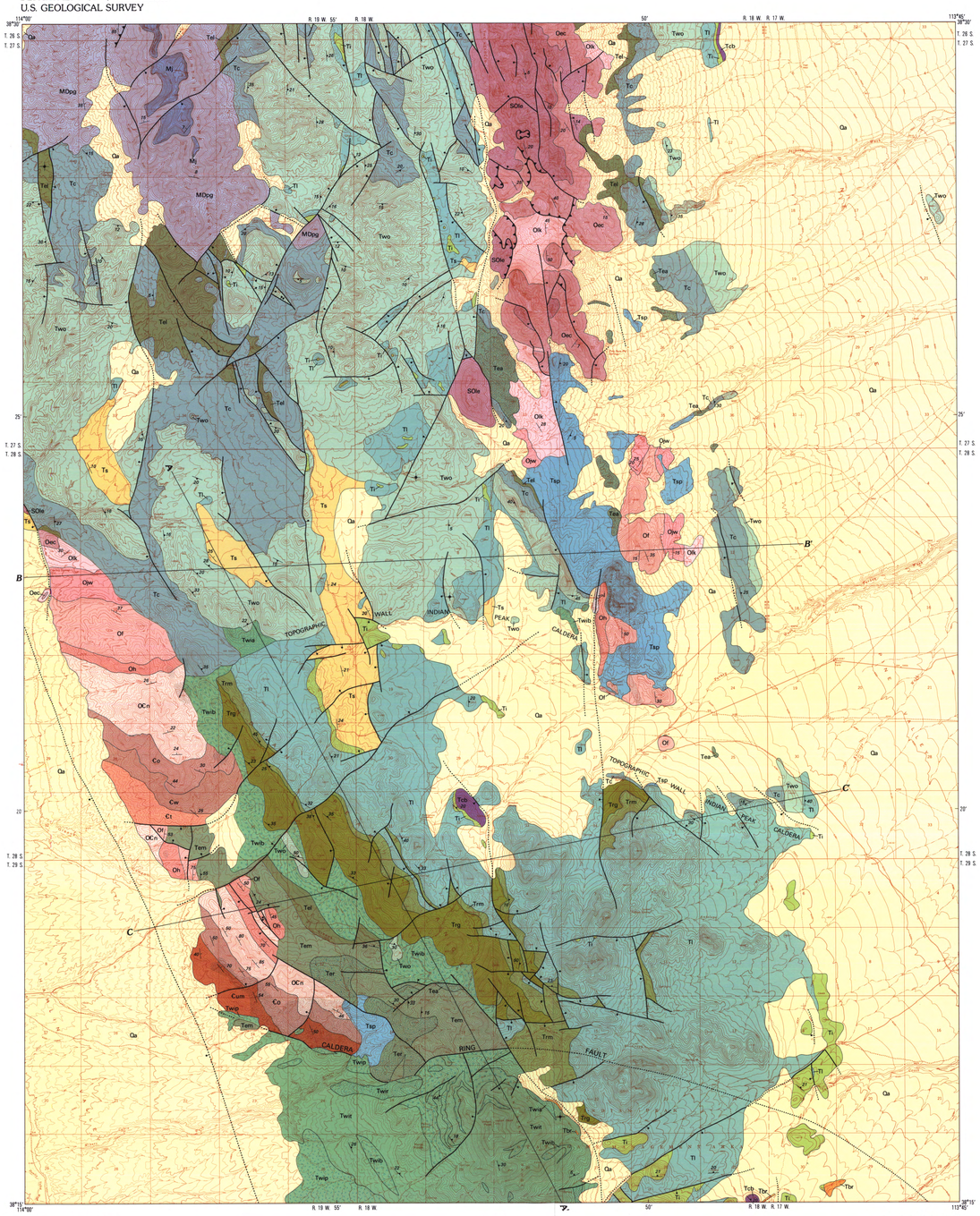
1 0.5 0 1 2 3 4 MILES

3000 0 3000 6000 9000 12000 15000 18000 21000 FEET

1 0.5 0 1 2 3 4 5 KILOMETERS

Utah Geological Survey Open-File Report 673DM

Geologic map of the southern Mountain Home and northern Indian Peak Ranges (central Needle Range), Beaver County, Utah (GIS reproduction of USGS Map I-1796 [1987])



Base from U.S. Geological Survey, 1:24,000
Buckhorn Spring, Lopers Spring,
Miners Cabin Wash, Sawtooth Peak, 1972

APPROXIMATE MEAN DECLINATION, 1987

SCALE 1:50 000

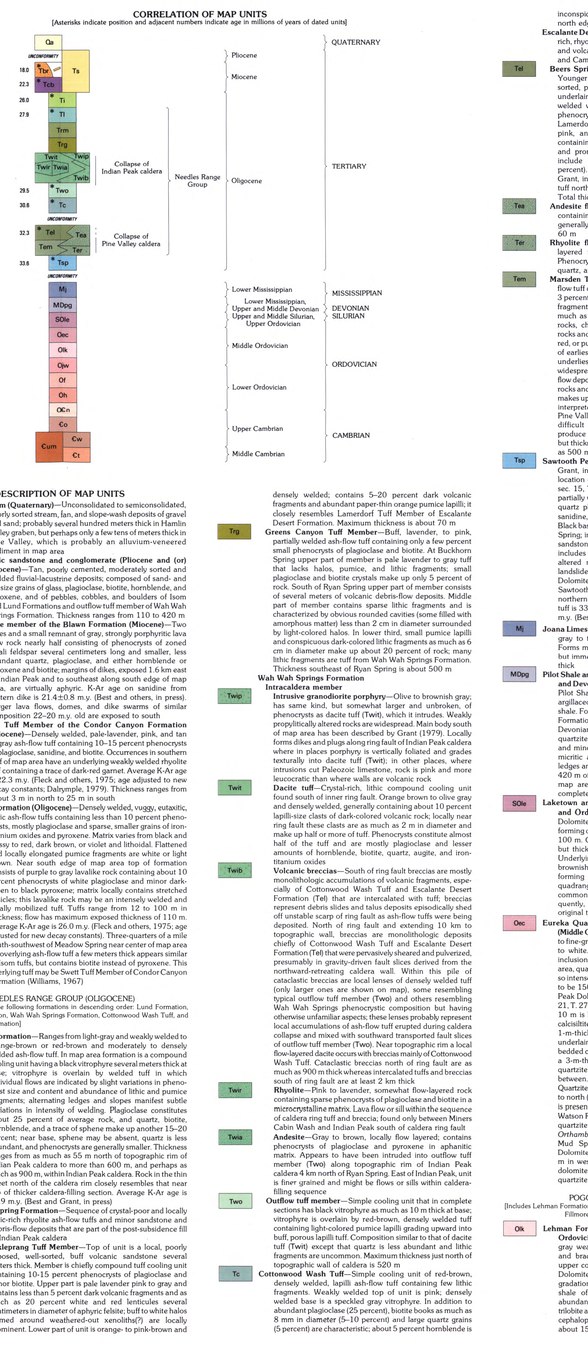
CONTOUR INTERVALS 20 AND 40 FEET
DOTTED LINES REPRESENT 20-FOOT CONTOURS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

MAP LOCATION

Mapped in 1971–72, 1974–75, 1977–79;
modified in part from mapping by students in
Brigham Young University summer geologic
field courses. Compiled from Best (1978),
Best and Hintze (1980a), and Best, Grant, and
Holmes (1979)

CORRELATION OF MAP UNITS

[Asterisks indicate position and adjacent numbers indicate age in millions of years of dated units]



DESCRIPTION OF MAP UNITS

Qa **Alluvium (Quaternary)**—Unconsolidated to semiconsolidated, poorly sorted stream, fan, and slope-wash deposits of gravel and sand; probably several hundred meters thick in Hamlin Valley (subsurface), but perhaps only a few tens of meters thick in Pine Valley, which is probably an alluvium-veneered pediment in map area

Ts **Volcanic sandstone and conglomerate (Pliocene and (or) Miocene)**—Tan, poorly cemented, moderately sorted and bedded fluvial-lacustrine deposits; composed of sand- and fine-size grains of glass, plagioclase, biotite, hornblende, and pyroxene, and of pebbles, cobbles, and boulders of Isom and Lund Formations and outflow tuff member of Wah Wah Springs Formation. Thickness ranges from 110 to 420 m

Tbr **Rhyolite member of the Blawn Formation (Miocene)**—Two dikes and a small remnant of gray, strongly porphyritic lava flow rock nearly half consisting of phenocrysts of zoned alkali feldspar several centimeters long and smaller, less abundant quartz, plagioclase, and either hornblende or pyroxene and biotite; margins of dikes, exposed 1.6 km east of Indian Peak and to southeast along south edge of map area, are vitrically aphyric. K-Ar age on sanidine from eastern dike is 21.4±0.8 m.y. (Best and others, in press). Larger lava flows, domes, and dike swarms of similar composition 22–20 m.y. old are exposed to south

Tcb **Bauers Tuff Member of the Condor Canyon Formation (Miocene)**—Densely welded, pale-lavender, pink, and tan to gray ash-flow tuff containing 10–15 percent phenocrysts of plagioclase, sanidine, and biotite. Occurrences in southern half of map area have an underlying weakly welded rhyolite tuff containing a trace of dark-red garnet. Average K-Ar age is 22.3 m.y. (Fleck and others, 1975; age adjusted to new decay constants; Dalrymple, 1979). Thickness ranges from about 3 m in north to 25 m in south

Ti **Isom Formation (Oligocene)**—Densely welded, vuggy, eutaxitic, vitric ash-flow tuffs containing less than 10 percent phenocrysts, mostly plagioclase and sparse, smaller grains of iron-titanium oxides and pyroxene. Matrix varies from black and glassy to red, dark brown, or violet and lithoidal. Flattened and locally elongated pumice fragments are white or light brown. Near south edge of map area top of formation consists of purple to gray lavalike rock containing about 10 percent phenocrysts of white plagioclase and minor dark-green to black pyroxene; matrix locally contains stretched vesicles; this lavalike rock may be an intensely welded and locally mobilized tuff. Tuffs range from 12 to 100 m in thickness; flow has maximum exposed thickness of 110 m. Average K-Ar age is 26.0 m.y. (Fleck and others, 1975; age adjusted for new decay constants). Three-quarters of a mile south-southeast of Meadow Spring near center of map area an overlying ash-flow tuff a few meters thick appears similar to Isom tuffs, but contains biotite instead of pyroxene. This overlying tuff may be Swett Tuff Member of Condor Canyon Formation (Williams, 1967)

NEEDLES RANGE GROUP (OLIGOCENE)

[This unit includes the following formations in descending order: Lund Formation, Ryan Spring Formation, Wah Wah Springs Formation, Cottonwood Wash Tuff, and Escalante Desert Formation]

Tl **Lund Formation**—Ranges from light-gray and weakly welded to orange-brown or red-brown and moderately to densely welded ash-flow tuff. In map area formation is a compound cooling unit having a black vitrophyre several meters thick at base; vitrophyre is overlain by welded tuff in which individual flows are indicated by slight variations in phenocryst size and content and abundance of lithic and pumice fragments; alternating ledges and slopes manifest subtle variations in intensity of welding. Plagioclase constitutes about 25 percent of average rock, and quartz, biotite, hornblende, and a trace of sphene make up another 15–20 percent; near base, sphene may be absent, quartz is less abundant, and phenocrysts are generally smaller. Thickness ranges from as much as 55 m north of topographic rim of Indian Peak caldera to more than 600 m, and perhaps as much as 900 m, within Indian Peak caldera. Rock in the thin sheet north of the caldera rim closely resembles that near top of thicker caldera-filling section. Average K-Ar age is 27.9 m.y. (Best and Grant, in press)

Ryan Spring Formation—Sequence of crystal-poor and locally lithic-rich rhyolite ash-flow tuffs and minor sandstone and debris-flow deposits that are part of the post-subsidence fill of Indian Peak caldera

Trm **Mackleprang Tuff Member**—Top of unit is a local, poorly exposed, well-sorted, buff volcanic sandstone several meters thick. Member is chiefly compound tuff cooling unit containing 10-15 percent phenocrysts of plagioclase and minor biotite. Upper part is pale lavender pink to gray and contains less than 5 percent dark volcanic fragments and as much as 20 percent white and red lenticules several centimeters in diameter of aphyric felsite; buff to white halos formed around weathered-out xenolith(?) are locally prominent. Lower part of unit is orange- to pink-brown and densely welded; contains 5–20 percent dark volcanic fragments and abundant paper-thin orange pumice lapilli; it closely resembles Lamerdorf Tuff Member of Escalante Desert Formation. Maximum thickness is about 70 m

Trg **Greens Canyon Tuff Member**—Buff, lavender, to pink, partially welded ash-flow tuff containing only a few percent small phenocrysts of plagioclase and biotite. At Buckhorn Spring upper part of member is pale lavender to gray tuff that lacks halos, pumice, and lithic fragments; small plagioclase and biotite crystals make up only 5 percent of rock. South of Ryan Spring upper part of member consists of several meters of volcanic debris-flow deposits. Middle part of member contains sparse lithic fragments and is characterized by obvious rounded cavities (some filled with amorphous matter) less than 2 cm in diameter surrounded by light-colored halos. In lower third, small pumice lapilli and conspicuous dark-colored lithic fragments as much as 6 cm in diameter make up about 20 percent of rock; many lithic fragments are tuff from Wah Wah Springs Formation. Thickness southeast of Ryan Spring is about 500 m

Wah Wah Springs Formation

Intracaldera member

Twip **Intrusive granodiorite porphyry**—Olive to brownish gray; has same kind, but somewhat larger and unbroken, of phenocrysts as dacite tuff (Twit), which it intrudes. Weakly propylitically altered rocks are widespread. Main body south of map area has been described by Grant (1979). Locally forms dikes and plugs along ring fault of Indian Peak caldera; where in places porphyry is vertically foliated and grades texturally into dacite tuff (Twit); in other places, where intrusions cut Paleozoic limestone, rock is pink and more leucocratic than where walls are volcanic rock

Twit **Dacite tuff**—Crystal-rich, lithic compound cooling unit found south of inner ring fault. Orange brown to olive gray and densely welded, generally containing about 10 percent lapilli-size clasts of dark-colored volcanic rock; locally near ring fault these clasts are as much as 2 m in diameter and make up half or more of tuff. Phenocrysts constitute almost half of the tuff and are mostly plagioclase and lesser amounts of hornblende, biotite, quartz, augite, and iron-titanium oxides

Twib **Volcanic breccias**—South of ring fault breccias are mostly monolithologic accumulations of volcanic fragments, especially of Cottonwood Wash Tuff and Escalante Desert Formation (Tel) that are intercalated with tuff; breccias represent debris slides and talus deposits episodically shed off unstable scarp of ring fault as ash-flow tuffs were being deposited. North of ring fault and extending 10 km to topographic wall, breccias are monolithologic deposits chiefly of Cottonwood Wash Tuff and Escalante Desert Formation (Tel) that were pervasively sheared and pulverized, presumably in gravity-driven fault slices derived from the northward-retreating caldera wall. Within this pile of cataclastic breccias are local lenses of densely welded tuff (only larger ones are shown on map), some resembling typical outflow tuff member (Two) and others resembling Wah Wah Springs phenocrystic composition but having otherwise unfamiliar aspects; these lenses probably represent local accumulations of ash-flow tuff erupted during caldera collapse and mixed with southward transported fault slices of outflow tuff member (Two). Near topographic rim a local flow-layered dacite occurs with breccias mainly of Cottonwood Wash Tuff. Cataclastic breccias north of ring fault are as much as 900 m thick whereas intercalated tuffs and breccias south of ring fault are at least 2 km thick

Twir **Rhyolite**—Pink to lavender, somewhat flow-layered rock containing sparse phenocrysts of plagioclase and biotite in a microcrystalline matrix. Lava flow or sill within the sequence of caldera ring tuff and breccia; found only between Miners Cabin Wash and Indian Peak south of caldera ring fault

Twia **Andesite**—Gray to brown, locally flow layered; contains phenocrysts of plagioclase and pyroxene in aphanitic matrix. Appears to have been intruded into outflow tuff member (Two) along topographic rim of Indian Peak caldera 4 km north of Ryan Spring. East of Indian Peak, unit is finer grained and might be flows or sills within caldera-filling sequence

Two **Outflow tuff member**—Simple cooling unit that in complete sections has black vitrophyre as much as 10 m thick at base; vitrophyre is overlain by red-brown, densely welded tuff containing light-colored pumice lapilli grading upward into buff, porous lapilli tuff. Composition similar to that of dacite tuff (Twit) except that quartz is less abundant and lithic fragments are uncommon. Maximum thickness just north of topographic wall of caldera is 520 m

Tc **Cottonwood Wash Tuff**—Simple cooling unit of red-brown, densely welded, lapilli ash-flow tuff containing few lithic fragments. Weakly welded top of unit is pink; densely welded base is a speckled gray vitrophyre. In addition to abundant plagioclase (25 percent), biotite books as much as 8 mm in diameter (5–10 percent) and large quartz grains (5 percent) are characteristic; about 5 percent hornblende is inconspicuous in hand sample. Unit is 305 m thick along north edge of map area

Escalante Desert Formation—Sequence of crystal-poor, lithic-rich, rhyolite ash-flow tuffs, andesite and rhyolite lava flows, and volcanic sandstone described in part by Grant (1978) and Campbell (1978)

Tel **Beers Spring and Lamerdorf Tuff Members, undivided**—Younger Beers Spring Member is discontinuous, well-sorted, poorly bedded, green to brown sandstone that is underlain in northeastern part of map area by partially welded white to pink tuff containing about 15 percent phenocrysts of plagioclase, biotite, and quartz. Underlying Lamerdorf Tuff Member is mottled grayish-brown, purple, pink, and red, densely welded, rhyolite ash-flow tuff containing as much as 20 percent dark volcanic fragments and prominent light-colored pumice lapilli. Phenocrysts include plagioclase (10–15 percent) and biotite (1–3 percent). K-Ar age on biotite is 32.3±1.1 m.y. (Best and Grant, in press). Several meters of conglomerate underlie tuff north of Carney Spring along north edge of map area. Total thickness of unit ranges from 100 to 170 m

Tea **Andesite flow member**—Gray to black andesite lava flows containing local phenocrysts of plagioclase and pyroxene; generally massive and nonvesicular. Thickness is as much as 60 m

Ter **Rhyolite flow member**—White, gray, and lavender flow-layered rhyolite containing autobreccia in upper part. Phenocrysts (less than 1 mm in diameter) of plagioclase, quartz, and biotite make up less than 2 percent of rock

Tem **Marsden Tuff Member**—Light-gray to green, rhyolite ash-flow tuff containing abundant lithic fragments and less than 3 percent minute phenocrysts of quartz and feldspar. Lithic fragments make up as much as one-half of rock and are as much as 15 cm in diameter; these include dark volcanic rocks, chips of green phyllite, gray Paleozoic carbonate rocks and, most characteristic of all, angular pieces of white, red, or purple quartzite, probably derived from thick section of earliest Cambrian and late Precambrian quartzite which underlies southwestern Utah. North of Greens Canyon widespread but poorly exposed lenses of breccia and debris-flow deposits lie within tuff. Clasts are Ordovician sedimentary rocks and matrix is gray-green sandstone. Similar sandstone makes up entire outcrops in some places. These deposits are interpreted to represent debris sloughed off unstable wall of Pine Valley caldera, which was source of unit. Thickness is difficult to ascertain because closely-spaced fractures produce poor exposures and because of possible faulting, but thickness of unit is at least 270 m and possibly as much as 500 m

Tsp **Sawtooth Peak Formation (Oligocene)**—Adopted (Best and Grant, in press) as named by Conrad (1969) except that location of his type section is here clarified as in NE 1/4 sec. 15, T. 28 S., R. 18 W. Most of unit is lavender-gray, partially welded, ash-flow tuff containing about 20 percent quartz phenocrysts and lesser plagioclase, biotite, minor sanidine, and pyroxene. White pumice lapilli are common. Black basal vitrophyre several meters thick occurs near Mud Spring; in several places thin beds of gray-green water-laid sandstone underlie tuff. Northwest of Indian Peak, unit includes massive gray-green sandstone and propylitically altered mafic lava flow at top. South of Mud Spring landslide breccia of Eureka Quartzite and Ely Springs Dolomite underlies tuff. Thickness at least 300 m around Sawtooth Peak and northwest of Indian Peak but thinner in northern part of map area. Fission-track age on zircon from tuff is 33.6±1.8 m.y., and K-Ar age on biotite is 33.5±1.2 m.y. (Best and Grant, in press)

Mj **Joana Limestone (Lower Mississippian)**—Thick-bedded, pale-gray to tan, micritic, locally somewhat cherty limestone. Forms massive cliffs. Maximum thickness is about 100 m, but immediately to north of map area formation is 140 m thick

MDpg **Pilot Shale and Guilmette Formation, undivided (Mississippian and Devonian)**—Lower Mississippian and Upper Devonian Pilot Shale is poorly exposed, interbedded gray to brown argillaceous limestone and gray to olive-drab calcareous shale. Forms gentle slopes below cliffs of Joana Limestone. Formation is 110 m thick. Underlying Upper and Middle Devonian Guilmette Formation is interbedded white to tan quartzite, light- to dark-gray or chocolate-gray dolomite, and minor gray limestone. Carbonate rocks are sugary to micritic and locally laminated. Crops out as alternating ledges and slopes. *Amphipora* are locally abundant. About 420 m of upper part of Guilmette Formation is exposed in map area; formation is about 800 m thick in nearest complete exposures in Confusion Range 60 km to north

SOle **Laketown and Ely Springs Dolomites, undivided (Silurian and Ordovician)**—Upper and Middle Silurian Laketown Dolomite is banded dark-gray and light-brownish-gray, cliff-forming dolomite. Includes some chert, particularly in upper 100 m. Generally brecciated and attenuated in map area, but thickness 20 km to north (Hintze, 1981) is 474 m. Underlying Upper Ordovician Ely Springs Dolomite is dark-brownish-gray, cherty, unfossiliferous, ledge- and cliff-forming dolomite, about 100 m thick in Tunnel Spring quadrangle nearby (Hintze, 1981). Ely Springs Dolomite is commonly brecciated and attenuated in map area; consequently, its structurally altered thickness may be half its original thickness

Oec **Eureka Quartzite and Crystal Peak Dolomite, undivided (Middle Ordovician)**—Eureka Quartzite is light-gray, medium- to fine-grained orthoquartzite that weathers orangish brown to white. Spherical pock holes formed around limonite inclusions are abundant and characterize formation. In map area, quartzite is extensively brecciated and, in some places, so intensely altered as to resemble flint. Thickness estimated to be 150–180 m. Complete section of underlying Crystal Peak Dolomite is exposed on east side of hill (NE 1/4 sec. 21, T. 27 S., R. 18 W.) south of Jackson Wash. There, upper 10 m is light-olive-gray dolomite; next 18 m is dark-gray calcisiltite mottled with light-olive-gray dolomite having a 1-m-thick *Euplicatheria utahia* biostrome at its base; underlain by 21 m of medium-dark-gray, thin- to medium-bedded calcisiltite; basal 24 m is also calcisiltite but includes a 3-m-thick quartzite ledge at its base and a 1-m-thick quartzite ledge at its top and two 1-m-thick quartzite beds in between. Basal 24 m is equivalent to Watson Ranch Quartzite as mapped in adjacent Halfway Summit quadrangle to north (Best and Hintze, 1980a). Nearly complete section is present on east side of hill to north of Mud Spring. Here Watson Ranch equivalent is 25 m thick and has a 4-m-thick quartzite bed at its top and no quartzite beds within it. *Orthambonites perplexus* occurs in middle of formation at Mud Spring locality. Total thickness of Crystal Peak Dolomite is 72 m in northern part of map area, but thins to 8 m in western part where formation consists of dark-gray dolomite underlain by thin-bedded, red-brown dolomitic quartzite

POGONIP GROUP (ORDOVICIAN)

[Includes Lehman Formation, Kanosh Shale, Juab Limestone, Wah Wah Limestone, Fillmore Formation, and House Limestone]

Olk **Lehman Formation and Kanosh Shale, undivided (Middle Ordovician)**—The Lehman Formation consists of bluish-gray weathering, thin-bedded silty limestone; ostracodes and brachiopods are abundant on weathered surfaces; upper contact is placed at basal quartzite of Crystal Peak Dolomite; thickness estimated to be 76 m; lower contact gradational into thin-bedded shaly limestone and olive shale of Kanosh Shale. Fossils in Kanosh Shale are abundant and include orthid brachiopods, ostracodes, trilobite and echinoderm fragments, and occasional orthocone cephalopods; forms slopes and low edges; regional thickness about 150 m

Ojw **Juab and Wah Wah Limestones, undivided (Middle and Lower Ordovician)**—Middle Ordovician Juab Limestone is medium-gray, medium- to thick-bedded silty limestone that weathers same color and forms ledges and slopes. Juab is readily distinguished from similar Wah Wah Limestone by its characteristic fossil, *Orthambonites subalata*. Total thickness is about 60 m. Underlying Lower Ordovician Wah Wah Limestone consists of ledge-forming, yellowish-gray-weathering silty limestone and interbedded thin-bedded limestone and shale; fragmental trilobites common in some beds; *Hesperonomiella minor* coquina in 1-m-thick bed near top; 76 m thick

Of **Fillmore Formation (Lower Ordovician)**—Predominantly intraformational conglomerate, medium-gray, thin-bedded; contains flat pebbles of silty to sandy limestone in a muddy limestone matrix; 30 to 50 percent interbeds of yellowish-gray shale usually poorly exposed. Trilobite fragments are abundant in upper third of formation. About 500 m thick

Oh **House Limestone (Lower Ordovician)**—Medium-bluish-gray, sparsely cherty, finely crystalline, medium- to thick-bedded nonalgal limestone. More massive than overlying Fillmore Formation. 120 m thick

OCn **Notch Peak Formation (Lower Ordovician and Upper Cambrian)**—Limestone and dolomite divisible into three lithologic units. Upper 245 m of thin- to thick-bedded, medium- to bluish-gray, fine-grained limestone containing a small amount of chert, red and brown siltstone laminae about 1 cm thick, and prominent local stromatolitic algal heads. Middle 210 m of coarsely crystalline dolomite alternating light, medium-, and dark-gray in beds as thin as 1 cm, some of which are crossbedded. Lower 150 m of fairly massive beds of medium-gray, fine-grained limestone

Co **Orr Formation (Upper Cambrian)**—Upper third of unit is thinly bedded gray limestone and olive shale generally forming a poorly exposed slope; lower two-thirds is medium- to dark-gray, mottled and striped, locally oolitic or bioclastic limestone containing trilobite hash in some beds; 400 m thick

Cw **Wah Wah Summit Formation of Hintze and Robison (1975) (Upper Cambrian)**—Limestone and dolomite; prominent light-gray laminated limestone makes up upper 50 m and is underlain by about 200 m of medium- to thick-bedded variably gray limestone containing some dolomite

Ct **Trippe Limestone (Middle Cambrian)**—Thinly bedded, shaly, gray limestone underlain by alternating light-gray laminated dolomite and darker dolomitic limestone. Only upper part of formation is exposed

Cum **Upper and Middle Cambrian rocks, undivided**—Wah Wah Summit Formation and Trippe Limestone

Contact—Dashed where inferred on cross sections

Fault—Dotted where concealed. Bar and ball on downthrown side

Younger-on-older attenuation fault—Teeth on overriding plate; many such faults occurring in the SOle unit in northeast quarter of map area are not shown

Strike and dip of beds

Strike and dip of compaction foliation in tuff and flow layering in intrusive bodies

Inclined

Horizontal

Hydrothermally altered rocks—Includes jasperoid (j) formed from volcanic rocks of uncertain stratigraphic identity and from unit Oh(?) west of Sawtooth Peak

GEOLOGY

Rocks exposed in the map area include a nearly complete section of Middle Cambrian through Lower Mississippian sedimentary rocks together with more extensive Oligocene volcanic rocks. The faulted and generally east-tilted rock units are cut on the west by a major basin-range fault concealed beneath the alluvium of Hamlin Valley. On the east side of the range is a sediment-veneered pediment extending a few kilometers into Pine Valley.

Uppermost Ordovician and Silurian rocks in the north-central part of the map area are cut by many attenuation faults subparallel to bedding. These faults (Best and Hintze, 1980b) have attenuated the sedimentary section and represent thin-skinned detachment surfaces formed during the Late Cretaceous Sevier orogeny (Hintze, 1978). Widespread brecciation in the Ordovician Eureka Quartzite appears to be related to the attenuation faulting.

Prolonged erosion following the Sevier orogeny produced a surface of subdued relief, on the order of a few hundreds of meters at most, by the time of inception of intermediate composition calc-alkalic volcanism about 34 m.y. ago. Ash-flow tuffs of the Sawtooth Peak Formation were the first manifestation of volcanism and partly filled paleovalleys northwest of Indian Peak and around Sawtooth Peak. Over the next 6 m.y. ash-flow tuffs of the Needles Range Group were deposited in the map area and spread widely over an area of about 50,000 km² in southwestern Utah and adjacent Nevada; their volume is at least 7,000 km³. The sources of two of these tuffs lay partly within the map area. The elongate perimeter of source calderas shown on figure 1 has been influenced by possibly as much as 40 percent east-west crustal extension during post-Oligocene development of the Basin and Range province. The ash-flow tuffs of the Needles Range Group define two compositional cycles; each cycle began with eruptions of crystal-poor, lithic rhyolite tuff and was succeeded by more voluminous eruption of crystal-rich dacite tuff.

First-cycle rhyolite tuffs (Tern, Tel) of the Escalante Desert Formation were derived from the Pine Valley caldera. This collapse structure is only poorly defined on the basis of thickness, clast content, and alteration of the tuffs. However, an easterly striking fault exposed northwest of Ryan Spring (see cross section *A–A'*) appears to be a segment of the Pine Valley caldera ring fault. Compositionally similar rhyolite lava flows (Ter) were extruded more or less contemporaneously with the tuffs; these were followed by extrusion of andesite lava flows (Tea), and finally, after a brief interval of erosion, sandstone and conglomerate of the youngest member of the Escalante Desert Formation were deposited.

First-cycle crystal-rich dacite tuffs are represented by the 30.6-m.y.-old Cottonwood Wash Tuff and the 29.5-m.y.-old Wah Wah Springs Formation. The former apparently had a source to the northwest of the map area, but there is no definitive evidence of its location. Ash-flow tuffs of the Wah Wah Springs Formation constitute the largest volume, about 4,000 km³, in the Needles Range Group and were derived from the Indian Peak caldera whose northeastern segment is well exposed in the map area. Collapse of this caldera was initiated by eruption of the outflow tuff member (Two), which spread in lobes extending 150 km north, east, and west and 30 km south from the caldera. A more or less equivalent volume of lithic tuff and landslide debris of the intracaldera member (Twit, Twib, Twip, Twir, Twia) emplaced during collapse lies in the deeper inner part of the caldera south of the ring fault, which crosses the range just north of Indian Peak. The topographically enlarged wall and shelf of the caldera were buried beneath as much as 2 km of landslide and fault breccias and post-caldera ash-flow tuffs of the second cycle, but their exact thickness cannot be determined because of subsequent resurgent uplift and erosion.

Second-cycle rhyolitic tuffs of the Ryan Spring Formation are similar in composition to first-cycle rhyolite tuffs. They are confined within the Indian Peak caldera, in which their source must have been located. These tuffs and the overlying more voluminous 27.9-m.y.-old crystal-rich dacite tuff of the Lund Formation thicken and thin south of the map area in a manner suggesting deposition on a block-faulted resurgent uplift within the eastern part of the Indian Peak caldera. The Lund Tuff was derived from the White Rock caldera, which was superposed upon the southern part of the older Indian Peak caldera.

Ash-flow tuffs of the 26.0-m.y.-old Isom Formation cap the Needles Range Group. Overlying the Isom Formation are ash-flow tuffs of the 22.3-m.y.-old Bauers Tuff Member of the Condor Canyon Formation, whose source lay 120 km to the southwest in the Caliente caldron complex (Williams, 1967), and local fluvial sandstones and conglomerates.

REFERENCES CITED

Best, M. G., 1976, Geologic map of the Lopers Spring quadrangle, Beaver County, Utah: U.S. Geological Survey Miscellaneous Field Studies Map MF–739, scale 1:24,000.

Best, M. G., and Grant, S. K., in press, Stratigraphy of the volcanic Oligocene Needles Range Group in southwestern Utah: U.S. Geological Survey Professional Paper.

Best, M. G., Grant S. K., and Holmes, R. D., 1979, Geologic map of the Miners Cabin Wash and Buckhorn Spring quadrangles, Beaver County, Utah: U.S. Geological Survey Open-File Report 79–1612, scale 1:24,000.

Best, M. G., and Hintze, L. F., 1980a, Preliminary geologic map of the Halfway Summit quadrangle, Millard and Beaver Counties, Utah: U.S. Geological Survey Miscellaneous Field Studies Map MF–1153, scale 1:24,000.

_____1980b, Geologic map of the Sawtooth Peak quadrangle, Beaver County, Utah: U.S. Geological Survey Miscellaneous Field Studies Map MF–1152, scale 1:24,000.

Best, M. G., Mehnert, H. H., Keith, J. D., and Naeser, C. W., in press, Miocene magmatism and tectonism in and near the southern Wah Wah Mountains, southwestern Utah: U.S. Geological Survey Professional Paper.

Campbell, D. R., 1978, Stratigraphy of pre-Needles Range Formation ash-flow tuffs in the northern Needle Range and southern Wah Wah Mountains, Beaver County, Utah: Brigham Young University Geology Studies, v. 25, p. 31–46.

Conrad, O. G., 1969, Tertiary volcanic rocks of Needles Range, western Utah: Utah Geological and Mineral Survey Special Study 29, 28 p.

Dalrymple, G. B., 1979, Critical tables for conversion of K-Ar ages from old to new constants: Geology, v. 7, p. 558–560.

Fleck, R. G., Anderson, J. J., and Rowley, P. D., 1975, Chronology of mid-Tertiary volcanism in High Plateaus region of Utah: Geological Society of America Special Paper 160, p. 53–61.

Grant, S. K., 1978, Stratigraphic relations of the Escalante Desert Formation near Lund, Utah: Brigham Young University Geology Studies, v. 25, p. 27–30.

_____1979, Intrusive rocks of the Indian Peak Range, Utah: Rocky Mountain Association of Geologists and Utah Geological Association, Basin and Range Symposium, p. 339–344.

Hintze, L. F., 1978, Sevier orogenic attenuation faulting in the Fish Springs and House Ranges, western Utah: Brigham Young University Geology Studies, v. 25, p. 11–24.

_____1981, Preliminary geologic map of the Tunnel Spring quadrangle, Millard County, Utah: U.S. Geological Survey Miscellaneous Field Studies Map MF–1334, scale 1:24,000.

Hintze, L. F., and Robison, R. A., 1975, Middle Cambrian stratigraphy of the House, Wah Wah, and adjacent ranges in western Utah: Geological Society of America Bulletin, v. 86, no. 7, p. 881–891.

Williams, P. L., 1967, Stratigraphy and petrography of the Quichapa Group, southwestern Utah and southeastern Nevada: Seattle, Wash., University of Washington Ph.D. thesis, 139 p.

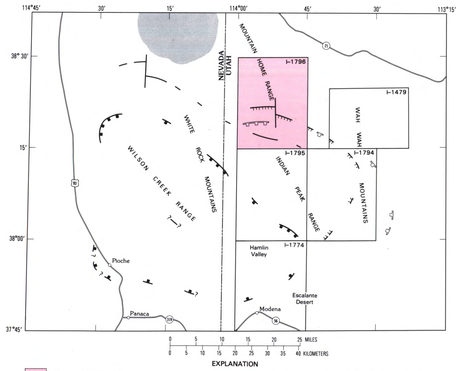
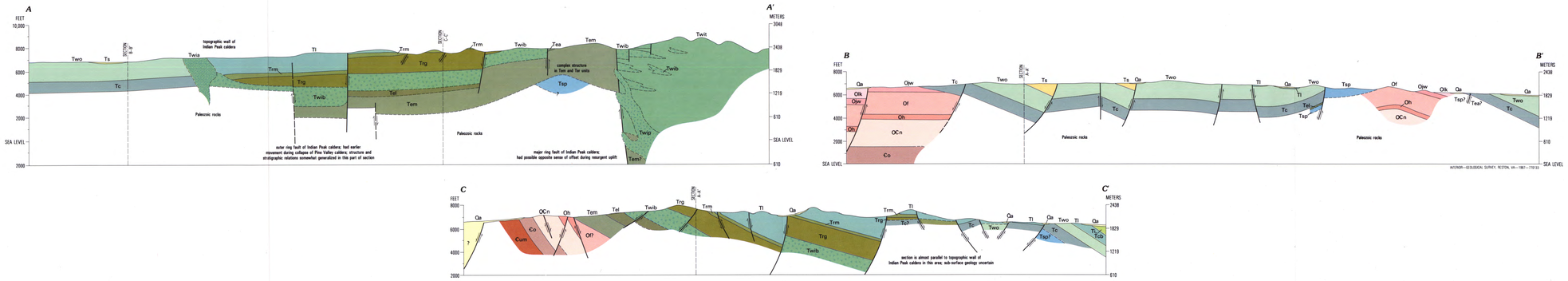


Figure 1.—Map showing location of caldera complexes and recently published geologic maps, Utah and Nevada.



GEOLOGIC MAP OF THE SOUTHERN MOUNTAIN HOME AND NORTHERN INDIAN PEAK RANGES (CENTRAL NEEDLE RANGE), BEAVER COUNTY, UTAH

By
M. G. Best, L. F. Hintze, and R. D. Holmes

1987

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