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Geologic Map of the Miners Cabin Wash and Buckhorn Spring Quadrangles, Beaver County, Utah

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DESCRIPTION OF MAP UNITS

The geology of the Miners Cabin Wash and Buckhorn Spring Quadrangles is dominated by the Indian Peak cauldron and the rocks are described in a time sequence relative to its development. The cauldron formed in response to voluminous eruptions of the Wah Wah Springs Tuff Member, one of several ash-flow sheets that comprise the Needles Range Formation (Best and others, 1973). The Needles Range can be divided into mappable parts. Perhaps it and its parts should be assigned a higher stratigraphic rank.

Qac — ALLUVIUM AND COLLUVIUM (QUATERNARY)--Unconsolidated, poorly sorted stream, fan, and slope-wash deposits of gravel and sand; likely several hundreds of meters thick in Hamblin Valley but no more than 100 m elsewhere

Ts — VOLCANIC SANDSTONE AND CONGLOMERATE (PLIOCENE? AND MIOCENE)--Buff-colored, poorly cemented, massive to moderately well sorted and bedded fluvial-lacustrine deposits; composed of sand- and silt-sized grains of glass, plagioclase, biotite, hornblende, and pyroxenes, and of pebbles, cobbles, and boulders of units Ti, Tl, and Tw. Thickness 420 m

Trc — RHYOLITE OF COTTONWOOD CREEK (MIOCENE)--A thick lava flow of gray, strongly porphyritic rock consisting of nearly half phenocrysts of sanidine several centimeters in diameter with smaller, less abundant quartz, plagioclase, and either hornblende or pyroxene and biotite. Main part of the flow lies 3-5 km to the south in the Pinto Spring Quadrangle

Trcd — Feeder dikes

Tcb — BAUERS TUFF MEMBER OF THE CONDOR CANYON FORMATION (MIOCENE)--Firmly welded, light lavender or brown-gray vitric ash-flow tuff with 10-15 percent small (<2 mm) phenocrysts of sanidine, plagioclase, and minor biotite. Light-colored collapsed pumice lapilli are locally obvious. Nearly one kilometer west of Meadow Spring the unit includes an underlying, weakly welded, pink ash-flow tuff of about the same composition, and along the south margin of the Buckhorn Spring Quadrangle a similar, but gray, weakly welded tuff contains a trace of dark-red euhedral garnet crystals (1-2 mm). Age--22 m.y. (Fleck and others, 1975). Maximum exposed thickness of the member is 100 m

Ti

ISOM FORMATION (OLIGOCENE)--Densely welded, vuggy, eutaxitic, vitric tuff with less than 10 percent phenocrysts, mostly plagioclase with minor and smaller Fe-Ti oxides and pyroxene. Matrix varies from glassy and black to lithoidal and red, dark brown, or violet. Flattened pumice fragments are white or light brown. In the Buckhorn Spring Quadrangle the top of the unit consists of a purple to gray andesite flow with about 10 percent phenocrysts of white plagioclase and minor dark green to black pyroxene; the matrix locally contains stretched vesicles. The ash-flow tuff ranges from 12 to 100 m thick and the andesite flow has a maximum exposed thickness of 110 m. Three-quarters of a mile south-southwest of Meadow Spring an overlying ash-flow tuff a few meters thick appears similar to the Isom tuffs, but contains biotite instead of pyroxene. This overlying tuff may be the Swett Tuff Member of the Condor Canyon Formation. Age--25 m.y. (Fleck and others, 1975)

Ta

ANDESITE (OLIGOCENE)--Gray to brown andesite with phenocrysts of plagioclase, augite, and hypersthene. Weakly flow layered where it is intruded into the Lund, Wah Wah Springs, and Cottonwood Wash Tuff Members along the northern outer wall of the Indian Peak cauldron. East of Indian Peak, this unit is finer grained and might be an older flow within the sequence of breccias and lithic Wah Wah Springs tuff filling the cauldron

Tl

LUND TUFF MEMBER OF NEEDLES RANGE FORMATION (OLIGOCENE)--Ranges from light-gray, weakly welded to orange-brown or red-brown moderately to densely welded ash-flow tuffs. In this area the unit is a multiple ash-flow single cooling unit with a black vitrophyre several meters thick at the base overlain by densely welded tuff in which individual flows are indicated by slight variations in phenocryst size and content and abundance of lithic and pumice fragments. Plagioclase constitutes about one-fourth of the average rock, and quartz, biotite, hornblende, and a trace of sphene comprise as much as another quarter of the rock; near the base, sphene may be absent, quartz is less abundant, and phenocrysts are generally smaller. Thickness ranges from less than 55 m just outside the Indian Peak cauldron near the southern margin of the Lopers Spring Quadrangle to between 700 and 900 m, or more, within the possible moat of the Indian Peak cauldron; the rock in the thin outflow sheet closely resembles that near the top of the thicker moat-filling section. Age--about 29 m.y. (Fleck and others, 1975)

TUFF OF RYAN SPRING (OLIGOCENE)--A sequence of crystal-poor and locally lithic-rich rhyolitic to quartz latitic ash-flow tuffs with minor volcanic sands and debris-flow deposits described by Rauch (1975). The formation takes its name from Ryan Spring near the center of the quadrangle where it underlies the Lund Tuff Member and overlies a complex sequence of landslide breccias which formed in response to caving of the unstable walls of the Indian Peak cauldron. Plagioclase phenocrysts comprise 2-15 percent and biotite 1-2 percent of the tuffs

Trm

Tuff Member of Mackleprang Homestead--Consists of an upper slope forming tuffs and a lower compound cooling unit, which almost everywhere forms a prominent ledge. The upper part of the member is pale-lavender-pink to gray tuff with 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 xenoliths(?) are locally prominent; locally a poorly exposed, well-sorted, buff-colored volcanic sandstone lies at the top of the member. The lower unit is orange- to pink-brown, densely welded, with 5-20 percent dark volcanic fragments and abundant paper-thin collapsed orange pumice lapilli; it closely resembles the Lamerdorf Tuff Member (Tel). Maximum thickness of member is on the order of 200 m

Trg

Tuff member of Greens Canyon--A generally poorly exposed slope-forming sequence of gray to green volcanic sandstones and debris flow deposits at the top of the member is underlain by buff, lavender, and pink moderately welded ash-flow tuffs. The sedimentary deposits in the upper part of the unit are thin or absent in the Buckhorn Spring Quadrangle. In most places the upper tuffs in the lower ash-flow sequence contain very sparse lithic fragments and the rock is chracterized by obvious rounded cavities (some filled with mineral matter) less than 2 cm in diameter surrounded by light-colored halos. At Buckhorn Spring the upper part of the tuff sequence is a pale-lavender to gray, crystal-poor, moderately welded tuff that lacks halos, pumice, and lithic fragments; plagioclase and biotite together comprise only 5 percent of the rock. In the lower third of the tuff sequence, small pumice lapilli and conspicuous dark-colored lithic fragments as much as 6 cm in diameter comprise about 20 percent of the rock; many of the lithic fragments consist of Wah Wah Springs Tuff Member. Thickness of the entire unit southeast of Ryan Spring is 580 m

Tq — QUARTZ TUFF AND LAVA FLOW (OLIGOCENE)--Pink to red, firmly welded, ash-flow tuff overlying gray flow-layered lava; both have a mineralogical composition similar to the Lund Tuff Member

Tr — INTRUSIVE RHYOLITE (OLIGOCENE)--Pink to lavender, somewhat flow-layered rock with phenocrysts of plagioclase and biotite in a felsitic matrix

INTRACAULDRON BRECCIA (OLIGOCENE)--Derived by caving of unstable cauldron wall by rockfalls, landslides, and denudation faulting. The breccias are commonly poorly exposed and generally appear as loose rubble on smooth hills; as a consequence, the contacts shown are commonly generalized and schematic. Breccias of volcanic units north of the inner cauldron ring fault are pervasively mylonitized and locally altered to celadonite(?)

Tbw — Breccia of the outflow unit of the Wah Wah Springs Tuff Member--Breccia derived from the outflow unit (Tw) of the Wah Wah Springs Tuff Member exposed in the outer wall of the Indian Peak cauldron

Tbc — Breccia of Cottonwood Wash Tuff Member--Breccia derived from the Cottonwood Wash Tuff Member exposed in the walls of the Indian Peak cauldron. Although locally somewhat heterolithologic, this unit is typically monolithologic with both clasts and matrix of Cottonwood Wash Tuff Member; locally within this unit the foliated tuff seems intact; in the area west of Ryan Spring this unit locally includes unbrecciated sections of the nonlithic intracauldron unit of the Wah Wah Springs Tuff Member as well as brecciated pyroxene andesite, dacite, and Lamerdorf Tuff Member

Tbb — Breccia of Beers Spring Tuff Member of Escalante Desert Formation--Breccia derived from Beers Spring Tuff Member of Escalante Desert Formation exposed in the outer wall of the Indian Peak cauldron

Tbl — Breccia of Lamerdorf Tuff Member of Escalante Desert Formation--Breccia derived mostly from Lamerdorf Tuff Member of Escalante Desert Formation exposed in the walls of the Indian Peak cauldron

Tbv — Breccia of Oligocene volcanic rocks undivided--Heterolithologic breccia derived from rocks of intermediate to silicic composition exposed in the walls of the Indian Peak cauldron. South of the inner cauldron ring-fault dominant clasts in many lenses are of intrusive rhyolite (Tr), and in some places this rhyolite consists of virtually unbroken flows

Tbe — Breccia of Ordovician Eureka Quartzite--White quartzite landslide-mudflow breccia derived from the Eureka Quartzite exposed in the outer wall of the Indian Peak cauldron or the wall of an earlier cauldron

Tbp — Breccia of Ordovician upper Pogonip Group--Gray to olive-drab limestone and shale landslide-mudflow breccia derived from the upper Pogonip Group (Hintze, 1974) exposed in the outer wall of the Indian Peak cauldron or the wall of an earlier cauldron

Tbh — Breccia of House Limestone--Landslide-mudflow breccia derived from House Limestone exposed in the outer wall of the Indian Peak cauldron or the wall of an earlier cauldron

Tbn — Breccia of Notch Peak Formation--Landslide-mudflow breccia derived from Notch Peak Formation exposed in the outer wall of the Indian Peak cauldron or the wall of an earlier cauldron

Tbs — Breccia of Ordovician sedimentary rocks undivided--Landslide-mudflow breccia derived from undivided Ordovician sedimentary rocks exposed in the outer wall of the Indian Peak cauldron or the wall of an earlier cauldron

WAH WAH SPRINGS TUFF MEMBER OF NEEDLES RANGE FORMATION (OLIGOCENE)--Crystal-rich ash-flow tuff consisting of about 25 percent phenocrysts of plagioclase and 10-15 percent of hornblende and biotite. Age--29 m.y. (Fleck and others, 1975)

Twn — Nonlithic intracauldron unit--Buff to light-gray, firmly welded, crystal-rich ash-flow tuff. Contains no lithic fragments. Phenocrysts are similar to those in the outflow unit, except the intracauldron rocks contain 2-3 percent quartz. Exposed sections have apparently been eroded or tectonically denuded

Twl — Lithic intracauldron unit--Orange-brown to gray, firmly welded ash-flow tuffs which together with landslide breccias fill exposed parts of the Indian Peak cauldron south of its inner ring fault. Fragments as much as 2 m in diameter of unidentified volcanic rocks plus rare Paleozoic carbonate and quartzite rocks locally comprise as much as half of this unit, but ordinarily lithic fragments are only a few centimeters in diameter and constitute only 10 percent of the rock. Intensely flattened pumice lapilli are inconspicuous. The phenocrysts are of about the same size, composition, and proportions as in the outflow unit (Tw) except that quartz is slightly more abundant, 2-3 percent. Exposed thickness is at least 760 m. Above the now concealed inner ring-fault between the Blue Jay Mine and Miners Cabin Wash, vitroclastic fabric is not evident, the foliation is nearly vertical, and the phenocrysts range widely in size and abundance and the rock grades into the intrusive porphyry unit (Twi). These relations suggest that here the magma which formed this unit was at least in part intrusive at the present level of exposure

Twi

Intrusive porphyry unit--Locally along the ring-fault on either side of Miners Cabin Wash the Twl rock-type coarsens gradationally into, or is intruded by, a gray-brown granodioritic porphyry of essentially the same composition, but without lithic fragments. The porphyry is a pink quartz monzonite, northwest and east of the Blue Jay Mine, where it is intrusive into marble and flanked by coarse skarns

Tw

Outflow unit--A simple cooling unit of generally densely welded ash-flow tuff. Complete sections north of the caved outer wall of the Indian Peak cauldron have a black vitrophyre as much as 10 m thick at the base overlain by a stony red-brown rock with no lithic fragments and some light-colored flattened pumice lapilli. Maximum thickness of a complete section of the outflow unit is 520 m just into the adjoining Lopers Spring Quadrangle. All rocks of the outflow member in the northern part of the Buckhorn Spring Quadrangle have slid into the cauldron. An incomplete section of the unit occurs as an unbrecciated fault slice within the sequence of breccias covering the floor of the Indian Peak cauldron south of Ryan Spring

EARLIER ROCKS NOT LOCALIZED WITH RESPECT TO THE PRE-INDIAN PEAK CAULDRON

Tc — COTTONWOOD WASH TUFF MEMBER OF NEEDLES RANGE FORMATION (OLIGOCENE)--Generally red brown, firmly welded ash-flow tuff lacking lithic fragments but locally having compressed white pumice lapilli; pink near top where it is porous and weakly welded and gray near base. In addition to abundant plagioclase (25 percent), biotite books as much as 7 mm in diameter (5-10 percent) and large quartz grains (5 percent) are characteristic; hornblende is present but not conspicuous. Unit is 650 m thick along the north edge of the Miners Cabin Wash Quadrangle

ESCALANTE DESERT FORMATION (OLIGOCENE)--A sequence of crystal-poor, lithic-rich rhyolitic to quartz-latitic ash-flow tuffs, andesitic and rhyolitic lava flows, and volcanic sandstone described by Grant (1978) and Campbell (1978). "The type section for the formation is the northeast flank of hill 6535 (Lund Quadrangle), section 6, T. 32 S., R. 14 W. It includes all lithologies from the first ash-flow above the volcanic conglomerate to the base of the Wah Wah Springs Member of the Needles Range Formation" (Grant, 1978, p. 27). The name is taken from the large flat desert valley which extends into the southeast half of the Lund Quadrangle at the southern end of the Wah Wah Mountains

Tet — Undivided tuffs and volcanic sandstones in the Escalante Desert Formation--Incomplete sections of units Teb, Tel, Tem, and Temc

Teb — Beers Spring Member--Well-sorted, poorly bedded, green to brown volcanic sandstone (Campbell, 1978); about 70 m exposed

Tel — Lamerdorf Tuff Member--Brown, purple, or red densely welded quartz-latitic ash-flow tuff with as much as 20 percent dark-colored volcanic fragments and prominent light-colored collapsed pumice lapilli. Phenocrysts include plagioclase (10-15 percent) and biotite (1-3 percent). H. H. Mehnert, U.S. Geological Survey (written commun., 1978), has obtained a K-Ar age of 32.3±1.1 m.y. on biotite; locally 100 m thick

Tea — Andesite member--Green-brown to gray massive andesite with phenocrysts of pyroxene and plagioclase; propylitically altered near Indian Peak

Tem — Tuff member of Marsden Spring--Light-gray to green or buff, vitric rhyolitic ash-flow tuff with abundant lithic fragments and less than 3 percent phenocrysts of quartz and feldspar. Lithic fragments may comprise as much as one-half of the rock; these include dark-colored volcanic rocks, chips of green phyllite, Paleozoic carbonate rocks and, most characteristic of all, angular pieces of white, red, or purple quartzite, probably from the thick section of earliest Cambrian and late Precambrian quartzites which underlies southwestern Utah. Thickness is difficult to ascertain because of poor outcrop, the unit generally being expressed by rubble-strewn slopes, but is at least 270 m and possibly as much as 1,000 m thick

Ter — Rhyolite member--White, gray, and lavender flow-layered rhyolite with autobreccia in the upper part. Phenocrysts of quartz and biotite comprise less than 2 percent of the rock. Intruded by altered mafic (andesitic) dikes in the northeast corner of sec. 19. Probably an extrusive flow complex as much as 180 m thick

Temc — Member of Miners Cabin Wash--A sequence of gray-green volcanic sandstones and tuffs consisting of plagioclase, quartz, and biotite; apparently overlain by an altered mafic flow; some tuffs may be equivalent to the Sawtooth Peak Formation. At least 180 m thick

Tsp — SAWTOOTH PEAK FORMATION (OLIGOCENE)--Gray to green-gray moderately welded ash-flow tuff with flattened white or pink pumice lapilli; phenocrysts include quartz (20 percent) with biotite, plagioclase, and inconspicuous sanidine and pyroxene constituting an additional 15-30 percent. The formation was first described and formally named by Conrad (1969) for a well-exposed section at Sawtooth Peak just north of Elephant Back in the Sawtooth Peak Quadrangle. Exposed thickness about 120 m

Of — FILLMORE FORMATION (LOWER ORDOVICIAN)--Medium-gray, thin-bedded limestone with interbeds of poorly exposed yellow-brown shale; intraformational conglomerate of flat pebble silty to fine-sandy limestone in a muddy limestone matrix is prominent, especially in the middle and upper portions of the unit; 450 m thick

Oh — HOUSE LIMESTONE (LOWER ORDOVICIAN)--Medium-blue to gray, sparsely cherty limestone in beds about 1 m thick; more massive than overlying Fillmore Formation; 120 m thick

OЄn	NOTCH PEAK FORMATION (LOWER ORDOVICIAN AND UPPER CAMBRIAN)--Limestone and dolomite divisible into three lithologic units: an upper 245 m of thin-bedded medium-gray limestone with a small amount of chert and red and brown siltstone laminae about 1 cm thick and with prominent local algal heads; a middle 210 m of sandy weathering dolomite alternating light-, medium-, and dark-gray in beds as thin as 1 cm, some of which are crossbedded; and a lower 150 m of fairly massive beds of medium-gray, fine-grained limestone
Єo	ORR FORMATION (UPPER CAMBRIAN)--Upper third of unit is thinly bedded gray limestone and olive-colored shale generally forming a poorly exposed slope; lower two-thirds is medium- to dark-gray mottled and striped limestone; 400 m thick
Єw	WAH WAH SUMMIT FORMATION (UPPER CAMBRIAN)--Limestone and dolomite; a prominent light-gray laminated limestone comprises the upper 50 m and is underlain by about 200 m of medium- to thick-bedded variably gray limestone with some dolomite
Єow	ORR AND WAH WAH SUMMIT FORMATIONS UNDIVIDED (UPPER CAMBRIAN)
Єt	TRIPPE LIMESTONE (MIDDLE CAMBRIAN)--Very thinly bedded, shaly, gray limestone underlain by alternating light-gray laminated dolomite and darker dolomitic limestone
Єwt	WAH WAH SUMMIT FORMATION AND TRIPPE LIMESTONE UNDIVIDED (UPPER AND MIDDLE CAMBRIAN)

EXPLANATION OF SYMBOLS

HYDROTHERMALLY ALTERED AND METAMORPHOSED ROCKS--Argillically altered and iron-stained volcanic rocks, and brecciated and intensely silicified carbonate rocks north of Greens Canyon. Recrystallization, ductile flow, and bleaching of carbonate rocks produced marbles and dolo-marbles south of Greens Canyon

DEPOSITIONAL OR INTRUSIVE CONTACT--Dashed where inferred or approximately located

CONTACT OF LANDSLIDE MASS OR DENUDATION FAULT SLICE--Hachured on sole of body; dashed where approximately or schematically located

D / U FAULT--Dashed where inferred or approximately located; dotted where concealed. Bar and ball or "D" on downthrown side

OUTER RING FAULT OF INDIAN PEAK CAULDRON--Dashed where inferred beneath younger deposits; triangle on down-dropped side

INNER RING FAULT OF INDIAN PEAK CAULDRON--Dashed where inferred beneath younger deposits; box on down-dropped side

REFERENCES

Armstrong, R. L., 1970, Geochronology of Tertiary igneous rocks, eastern Basin and Range province, western Utah, eastern Nevada, and vicinity, U.S.A.: Geochimica et Cosmochimica Acta, v. 34, p. 203-232.

Best, M. G., Shuey, R. T., Caskey, C. F., and Grant, S. K., 1973, Stratigraphic relations of members of the Needles Range Formation at type localities in southwestern Utah: Geological Society of America Bulletin, v. 84, p. 3269-3278.

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 Mineralogical Survey, Special Studies 29, 28 p.

Fleck, R. J., 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.

Hintze, L. F., 1974, Preliminary geologic map of the Wah Wah Summit Quadrangle, Millard and Beaver Counties, Utah: U.S. Geological Survey Miscellaneous Field Studies Map MF-637.

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, p. 881-891.

Lipman, P. W., 1976, Caldera-collapse breccias in the western San Juan Mountains, Colorado: Geological Society of America Bulletin, v. 87, p. 1397-1410.

Rauch, P. C., 1975, Tertiary welded tuffs of the Ryan Spring area, Needle Range, Beaver County, Utah: Rolla, University of Missouri, unpublished M.S. thesis.

ROCKS ASSOCIATED WITH THE INDIAN PEAK CAULDRON

Subsidence of the Indian Peak cauldron followed eruption of thousands of cubic kilometers of ash that formed the Wah Wah Springs Tuff Member of the Needles Range Formation which spread widely over southeastern Nevada and southwestern Utah. Episodic subsidence began along an inner ring fault about 1 1/2 km north of Indian Peak as the outflow unit (Tw) of the tuff was being extruded. Volcanic rocks in the exposed wall of the cauldron caved into the depression, producing tongues of landslide-talus breccias that interfinger with a lithic intracauldron unit (Twl) of the Wah Wah Springs Tuff Member, formed by continuing eruption of Wah Wah Springs ash concurrent with subsidence. Apparently, recurrent subsidence created such instability in the wall that massive gravity driven fault slices moved southward toward and into the depression; remnants of these slices are now found as mylonitic volcanic breccias north of the inner ring fault of the cauldron. Eruption of more Wah Wah Springs, the nonlithic unit (Twn) similar to the lithic intracauldron unit but lacking lithic fragments then occurred, but apparently after erosion had removed the upper parts of the fault breccias so that the Twn unit was deposited directly on mylonitic rocks formed deep in the fault masses. The relatively thin but densely welded crytal-rich unit Twn rocks are internally sheared and are overlain by additional mylonitic volcanic breccias which are believed to have been created by cauldron subsidence of at least a kilometer along on an outer ring fault northwest of Ryan Spring. The unit Twn is believed to be significantly thinner than it was when originally deposited; this thinning may have been accomplished either by erosion or by tectonic denudation as the gravity driven fault slices caved from the outer ring fault scarp and moved into the laterally widened and deepened cauldron. Once again, an episode of erosion is postulated to have stripped off the upper parts of these fault breccia deposits before the tuff of Ryan Spring was deposited on them.

The cauldron block was resurgently uplifted along a series of east- to northeast-striking high-angle step faults so that monolithlogic cauldron-filling landslide breccias of Cottonwood Wash and Lamerdorf Tuff Members near Indian Peak now stand topographically a kilometer or so above outcroppings of the source rocks outside the cauldron. Timing of this resurgence is equivocal but the possibility exists that a thick sequence of post-cauldron tuffs (Ryan Spring and Lund) was deposited in a deep moat between the outward flared wall of the cauldron, beyond its outer ring fault, and a resurgently upfaulted block encompassing Indian Peak.

Recurrent displacement on the outer cauldron ring fault west of Ryan Spring appears to have aggregated at least 2 km as measured by offsets of Paleozoic units. Some of this movement may have predated cauldron development and have been contemporaneous with, or earlier than, deposition of Escalante Desert Formation which thickens southward from the fault and is thin or absent to the north in the Lopers Spring quadrangle. The thick section of ash-flow tuffs in the Escalante Desert Formation 2 km north of Indian Peak suggests the possibility of an earlier cauldron filling within the area that later became the Indian Peak cauldron.

An essentially intact, though greatly attenuated, stratigraphic section of internally brecciated Paleozoic rocks rests on Escalante Desert Formation rocks west and south of Ryan Spring. Near the road through Ryan Spring the clasts are mostly of one Paleozoic stratigraphic unit within any given layer and the matrix is of volcanic and comminuted clast material. The clasts in successive layers are in more or less original stratigraphic order. These breccias are crudely stratified with graded bedding and may have formed as mud flows. Northward the breccia units lose their extraneous volcanic matrix and are monolithologic. Whether these breccias formed during subsidence of a possible cauldron related to expulsion of tuffs of the Escalante Desert Formation or during subsidence of the Indian Peak cauldron is not clear.