UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

PRELIMINARY GEOLOGIC MAP OF THE FRISCO QUADRANGLE, BEAVER COUNTY, UTAH

By

D. M. Lemmon and H. T. Morris

U.S. Geological Survey
Open-File Report 79-724
1979

This map is preliminary and has not been edited or reviewed for conformity with Geological Survey standards and nomenclature.

DESCRIPTION OF MAP UNITS

Qa ALLUVIUM (HOLOCENE and PLEISTOCENE)--Unconsolidated talus, stream, and floodplain deposits in the mountains, and Lake Bonneville deposits and semi-consolidated pediment gravel, fanglomerate, and other basin-fill deposits in the valleys. Total thickness locally may exceed 1,000 m

Qt TUFA OF WAH WAH SPRINGS (HOLOCENE AND PLEISTOCENE)--Low mounds of gray, porous, calcareous tufa, possibly deposited when the spring water was somewhat hotter than at present. A maximum of 40 m thick

Td DIABASE PLUG AND DIKE (PLIOCENE?)--Suspected plug in SW 1/4 sec. 15, T. 29 S., R. 13 W. consists of light-brownish-gray, aphanitic rock now reduced to a thick rubble. Dike rock has slightly sugary texture and small phenocrysts of labradorite and chloritized augite

BASALT OF BRIMSTONE RESERVOIR AREA (PLIOCENE?)

Tb Flow member--Black to medium-gray, fine-grained, locally vesicular or amygdular lava flows. Contains small phenocrysts of augite, hornblende, and andesine (or labradorite) in a felted matrix of plagioclase feldspar, glass, and magnetite. May approach augite andesite in composition. Age may be as young as early Pleistocene. Locally is more than 500 m thick

Tbt Basaltic conglomerate and tuff member--Nonresistant unit containing cobbles and boulders of basalt and all older rocks, including quartzite and limestone, in a matrix of calcareous volcanic ash. In areas where it is not capped by flow member, the weathered surface is commonly littered by a residuum of boulders and cobbles of vesicular basalt. Maximum thickness of about 100 m

Tdh RHYOLITE OF DEAD HORSE RESERVOIR OF ROWLEY (1977) (MIOCENE)--Small plutons of white to pink, streaked and banded, alkalic rhyolite. Phenocrysts range from sparse to abundant and consist of quartz, sanidine, oligoclase(?), minor biotite, and opaque minerals. Locally rock is vesicular. Has a K-Ar age of 11.6 m.y. in adjacent Thermo quadrangle (Rowley and others, 1978, p. 181)

RHYOLITE OF WILLOW CREEK AREA (MIOCENE)

Tr Flow member--White to light- brownish- or pinkish-gray, fine-grained, flow-banded porphyry with scattered phenocrysts of clear and smoky quartz, sanidine, biotite, and possibly plagioclase feldspar. Some zones contain incipiently developed lithophysae commonly lined with quartz and rarely, topaz crystals. Locally this volcanic unit is weakly to strongly argillized and is dazzling white. May be as much as 400 m thick

Trt Tuff member--White to light-pinkish-gray fragmental rock ranging from fine-grained tuff to medium-grained tuff-breccia. Locally contains undifferentiated flow units of gray, green, red, or black perlitic vitrophyre, especially near base. Vitrophyre units in southwestern part of quadrangle yielded K-Ar ages of 21.6 m.y. (anorthoclase), 20.8 m.y. (plagioclase), and 22.4 m.y. (biotite) (Lemmon, Silberman, and Kistler, 1973, p. 23). Locally these rocks approach dacite or rhyodacite in composition, and some are strongly argillized. Thickness is probably less than 100 m

Ta ALTERED LAVA AND TUFF (MIOCENE)--Zones of intensely alunitized, argillized, silcified, and iron-stained volcanic rocks chiefly in the area of White Mountain in the southwestern part of the quadrangle and in the general vicinity of Squaw Peak (Stringham, 1963 and 1964). The altered zones are predominantly in the tuff member of the quartz latite of Squaw Peak but locally also extend into the flow member of the same formation and the rhyolite of Willow Creek, which overlie it, and into several of the volcanic formations that underlie it. The altered rocks commonly exhibit intense leaching with conversion of the aluminous minerals to alunite and kaolinite and the local development of jasperoid reefs that commonly are associated with zones of hematitic and limonitic alteration. In the NE 1/4 sec 11, T. 29 S., R. 14 W., uranium minerals occur in argillized tuff resting on limestone, and in the SE 1/4 sec. 11, T. 29 S., R. 14 W., native sulfur crystals occur in tuffs so intensely argillized that they consist of a silica sponge. In the fringe zones of the leached and bleached areas chloritization, zeolitization, and calcitization are common. The geology and geochemistry of the altered zones are described and discussed in detail by Stringham (1963 and 1964) and Brooke (1964)

Tqm QUARTZ MONZONITE PORPHYRY OF SQUAW GULCH AREA (MIOCENE)--Medium- to light-gray, medium-grained, quartz monzonite porphyry containing phenocrysts of quartz, sanidine, andesine, hornblende, and biotite, and many small cognate inclusions. Most exposures exhibit weak argillic alteration

QUARTZ LATITE OF SQUAW PEAK (MIOCENE)

Tsp Flow member--Light-purplish-brown, medium-grained, porphyritic quartz latite with phenocrysts of sanidine, quartz, zoned andesine, brown hornblende, green augite, and rare biotite in a fine-grained groundmass of quartz, orthoclase, and plagioclase. In hand specimen the groundmass is brown, reddish brown, or light grayish brown. Thickness exceeds 200 m near Squaw Peak, where the top has been removed by erosion

Tst Tuff member--Heterogeneous, white, tan, gray, or pink, weakly indurated pyroclastic unit ranging in texture from fine-grained tuff to coarse-grained tuff-breccia with some layers of perlitic vitrophyre near base. This unit is at the expected volcano-stratigraphic position of the Bauers Tuff Member of the Condor Canyon Formation and the Leach Canyon Formation, both of the Quichapa Group, but its great thickness, locally exceeding 300 m, and its compositional similarity and intimate association with the flow member of the quartz latite of Squaw Peak indicate that it is probably of local origin. It is possible, however, that some undifferentiable units of the Quichapa may be present within the tuff member of the quartz latite of Squaw Peak. Lithologically the rock is composed largely of devitrified glass shards containing crystals of quartz, orthoclase, andesine, and biotite, along with many small lithic and vitric fragments

Tstf Latite flow within tuff member--Reddish-brown, medium-grained, porphyritic latite flow unit interlayered with tuff and tuff breccia in the east-central part of Shauntie Hills about 3 km south of Antelope Springs. Under the microscope the rock shows quartz, sanidine, andesine, biotite, and rare hornblende in a fine-grained, locally glassy matrix. The flow is 8-90 m thick, and because of its reddish color, may be confused with the Isom Formation when viewed from a distance

Tfb BASALT OF FRISCO SUMMIT AREA (MIOCENE)--Dark-gray, dense, aphanitic rock that weathers brownish red. Under the microscope, the rock is seen to contain labradorite, pigeonitic augite, and minor magnetite. This rock unit apparently is present only in the general vicinity of the townsite of Frisco, where it overlies the Isom Formation and underlies the tuff member of the quartz latite of Squaw Peak. It is less than 200 m thick

Ti ISOM FORMATION (MIOCENE OR OLIGOCENE)--A single ignimbrite cooling unit consisting of a basal black or dark-reddish-brown vitrophyre 1-2 m thick overlain by a medium- to dark-red, densely welded, vuggy ash-flow tuff 10-15 m thick. The stony-textured upper layer commonly contains small white discoidal inclusions representing collapsed pumice fragments; in cross section these show as distinctive white streaks about 3 cm long and 3 mm thick. Phenocrysts make up only about 10 percent of the vitrophyre and stony-textured welded tuff, and consist of sanidine, andesine, quartz, and biotite. In the Wah Wah Mountains, Best (written commun., 1978) reports three separate cooling units of unequal thickness with an aggregate thickness of 28 m. Throughout the

southern part of the quadrangle the Isom overlies the Needles Range Formation, but in the vicinity of Frisco it rests directly on the Horn Silver Andesite of Stringham (1967). The isotopic age of sanidine from the Isom Formation near Frisco is 21.9 m.y. (Lemmon, Silberman, and Kistler, 1973, p. 23); Armstrong (1963) reported a date of 25.7 m.y. According to Anderson and Rowley (1975) the Isom Formation of the general Milford area probably is the Baldhills Member of Mackin (1960) and an underlying unnamed member of similar rock of Mackin (1960)

Tbp BRECCIA PIPES (OLIGOCENE)--Pipelike bodies of breccia consisting of angular to rounded fragments of adjacent country rock embedded in a matrix of rock powder. The pipes near Frisco townsite are alunitized and silicified, and the pipes near the Cactus mine are mineralized with copper and iron sulfides and other minerals. Only the larger breccia pipes are shown

Tgp GRANODIORITE PORPHYRY PLUGS AND DIKES (OLIGOCENE)--Small plutons of greenish- to pinkish-gray granodiorite porphyry in or near the contact zone of the Cactus stock and the Horn Silver Andesite of Stringham (1967) near Frisco townsite. Except for their distinctly porphyritic texture, these rocks are mineralogically similar to the granodiorite of the Cactus stock, but they are younger bodies because some of them distinctly crosscut the rocks of the stock

Tgd GRANODIORITE (OLIGOCENE)--Pinkish- or lavender-gray, medium-grained granitic rock, mostly granodiorite but ranging from quartz monzonite to quartz diorite, containing phenocrysts, some 5 mm in length, of perthitic orthoclase, oligoclase-andesine, quartz, hornblende, biotite, and locally, diopsidic augite. This rock forms the Cactus stock, a pluton about 2 km in diameter with several apophyses and a few dikes, in the southern part of the San Francisco Mountains. Under the microscope the rock shows a distinct hypidiomorphic-granular texture, and accessory apatite, zircon, sphene, rutile, and abundant magnetite in addition to the above-listed major constituents. Biotite from the Cactus stock, according to Lemmon, Silberman, and Kistler (1973, p. 24), has yielded a K-Ar age of 28.0 m.y. which is about 1.3 m.y. younger than the Needles Range Formation. The youngest rock known to be cut by the granodiorite, however, is the Horn Silver Andesite of Stringham (1967)

Tnr NEEDLES RANGE FORMATION (OLIGOCENE)--Includes four undifferentiated members of moderately resistant pink, light-reddish-purple, or light-gray, moderately welded, crystal-rich, dacitic ash-flow tuff. These members are the Cottonwood Wash, Wah Wah Springs, Lund, and Wallaces Peak (Best and others, 1973). All members contain small- to medium-sized phenocrysts of biotite and andesine, both of which are abundant, hornblende, quartz, and minor sanidine, sphene, and magnetite. White pumice lapilli are common in some units. The aggregate thickness of the four members in the western part of the quadrangle exceeds 1,100 m but abrupt variations in thickness are common due to the uneven surface on which the

formation was deposited

The age of the Needles Range Formation is well established at about 29.3 m.y. by Armstrong (1970) and other geochronologists. In the Frisco quadrangle (SE 1/4 sec. 14, T. 29 S., R. 13 W.) the K-Ar age of biotite from the Needles Range was determined to be 29.3 m.y. and hornblende 29.2 m.y. (Lemmon, Silberman, and Kistler, 1973, p. 24)

TUFF OF ESCALANTE DESERT (OLIGOCENE)--Underlying the Needles Range Formation in the southwestern part of the Frisco quadrangle is a series of volcanic rocks that are well exposed in the adjacent Lamerdorf Peak quadrangle and other parts of the Wah Wah Mountains. In the Lamerdorf Peak quadrangle these rocks have been subdivided into the tuff of Marsden Spring, the tuff of Lamerdorf (containing an intercalated andesite flow unit), and the Beers Spring Formation of Conrad (1969). Of these, only the tuff of Lamerdorf is apparently exposed in the Frisco quadrangle

Tel Tuff of Lamerdorf--Variegated brown, pinkish-brown, and lavender, fine-grained, porphyritic, densely welded ash-flow tuff containing phenocrysts of plagioclase and minor biotite, and trace amounts of quartz, sanidine, hornblende, and accessory minerals. Angular fragments of brown, or lavender aphanitic volcanic rock locally make up one-fourth of the rock. In many beds thoroughly flattened pumice fragments are common. About 80 m thick

Telf Flow unit in tuff of Lamerdorf--Black to dark-grayish-brown, porphyritic andesite containing phenocryts of plagioclase and pyroxene in a glassy to fine-grained matrix. About 15 m thick

Ths HORN SILVER ANDESITE OF STRINGHAM (1967) (OLIGOCENE)--Heterogeneous, medium-gray to reddish-, purplish-, or greenish-gray, medium-grained porphyritic eruptive rocks ranging in composition from andesite to dacite and quartz latite; the greater part of the formation consists of medium- to thick-bedded flow units, but discontinuous layers of intraformational tuff, breccia, and cognate agglomerate are common. Some tuff beds have been quarried for building stone. Under the microscope, the flow units are seen to consist of andesine, quartz, conspicuous hornblende, biotite, augite, and abundant magnetite in a glassy to very fine grained matrix. In general, the formation is predominantly a dacite. In the area north of the Horn Silver mine, some of these rocks have been propylitized, argillized, and silicified (Stringham, 1967). The thickness of the Horn Silver Andesite near Squaw Peak is reported by East (1956), who separated it into two units, to be 572 m. The age of the andesite is uncertain. Stringham (1967, p. 13-14) reported that it depositionally overlies the Needles Range Formation in Squaw Gulch, but this relationship was not confirmed during the present study. The supposed Needles Range appears instead to be coeval tuff-breccia units interlayered within the dark dacite flow units, and south of Squaw Springs the Horn Silver Andesite of Stringham (1967) directly overlies Paleozoic limestone with no intervening Needles Range. According to Lemmon, Silberman, and Kistler (1973, p. 24-25), minerals from a sample of

porphyritic pyroxene-hornblende-biotite "andesite" vitrophyre from the southwestern corner of the Beaver Lake Mountain quadrangle, about 3.2 km north-northeast of the Horn Silver mine, and presumed to be the Horn Silver Andesite of Stringham (1967), yielded isotopic ages of 30.8 m.y. (plagioclase) and 34.1 m.y. (hornblende). If these rocks are continuous with the type Horn Silver Andesite near the Horn Silver mine, as they seem to be, the Horn Silver Andesite of Stringham (1967) is distinctly older than the Needles Range Formation

Thst Basal tuff member--Light-gray, pink-weathering, fine-grained, air-fall tuff here interpreted to be the basal tuff of the Horn Silver Andesite of Stringham (1967), but possibly an exposure of the tuff member of the quartz Latite of Squaw Peak. Unit is poorly exposed

Tsh DACITE OF SHAUNTIE HILLS (OLIGOCENE)--Dark-greenish- to brownish-gray, medim-grained, porphyritic to dense, flow rocks with some local fragmental and agglomeratic layers. In thin section the flow rock is seen to contain phenocrysts of andesine, quartz, chloritized augite, hornblende, and biotite in a glassy to very fine grained matrix. Magnetite is abundant. In the southeastern part of the Frisco quadrangle this unit is overlain by both the Needles Range Formation and the quartz latite of Squaw Peak, and probably is equivalent to the Horn Silver Andesite of Stringham (1967). Its total thickness is unknown, but probably exceeds 600 m

Thr CONGLOMERATE OF HIGH ROCK PASS AREA (OLICOGENE?)--Disorganized conglomerate containing pebbles, cobbles, and boulders of limestone, quartzite, and other sedimentary rocks in a red-weathering, fine-grained matrix of sandy siltstone or shale. This unit represents the soil and rubble zone that overlay the sedimentary rocks at the time of the first volcanic eruptions in the Frisco area, and it compositionally reflects the lithologic character of these rocks. Named from exposures near High Rock Pass in the adjacent Beaver Lake Mountain quadrangle. Thickness irregular

Pk KAIBAB LIMESTONE (PERMIAN)--Dark-gray, medium-bedded, fossiliferous limestone. Gray chert nodules and layers are common in some beds. Top eroded in the Frisco quadrangle, but complete sections in adjacent quadrangles are 60-200 m thick

Pto TOROWEAP LIMESTONE (PERMIAN)--Medium- to dark-blue-gray, medium-bedded, cherty limestone and subordinate dolomite. In the lower part of the section the beds are silty, dolomitic, and commonly cherty. In the middle of the section they are light gray and locally phosphatic. The upper part of the formation contains much silty and sandy limestone, some limy sandstone, and at least one bed of gypsum that is typically leached away at the surface. Complete sections are 115-225 m thick

Pta TALISMAN QUARTZITE (PERMIAN)--Massive, crossbedded, gray to pink orthoquartzite that weathers dark reddish brown; commonly it is highly fractured and develops thick accumulations of talus. Locally contains lenses and beds of limestone and gypsum at base and near the middle of the formation. Complete sections are 70-325-m thick

PPpc PAKOON(?) DOLOMITE OF WELSH (1973) AND CALLVILLE LIMESTONE (PERMIAN AND PENNSYLVANIAN)--Cyclicly bedded limestone, dolomite, and sandstone or orthoquartzite; locally mostly cherty dolomite in upper part. Limestone units are medium to light gray and streaked with silt and sand; dolomite units are darker gray, commonly cherty, and somewhat thinner bedded; arenaceous beds are gray to light brown, fine grained, and commonly crossbedded. Permian fossils have been reported in adjacent quadrangles from some of the upper cherty dolomite beds, and this part of the section has been identified as Pakoon Dolomite; such beds have been described from sec. 34, T. 27 S., R. 13 W., by Welsh (1973, p. 11). Complete sections of Callville Limestone and undifferentiated Pakoon(?) Dolomite are 150-450-m thick

Mr REDWALL LIMESTONE (MISSISSIPPIAN)--Medium- to dark-gray, commonly thick-bedded to massive, partly cherty dolomite and limestone; brown-weathering, gray sandstone beds locally are common in lower part of the upper one-third of formation. Most of the limestone beds and some of the dolomite beds are abundantly fossiliferous. In adjacent quadrangles the Redwall may be subdivided into five members that are correlated with at least parts of the Fitchville, Gardison, Deseret, Humbug, and Great Blue Formations of the East

Tintic Moutains, Utah, or with the Dawn Limestone, Anchor Limestone, Bullion Dolomite, Arrowhead Limestone, and Yellowpine Limestone Members of the Monte Christo Limestone of the Spring Mountains, Nev. Complete sections are about 400 m thick

Dp PINYON PEAK LIMESTONE (DEVONIAN)--The lower 40-50 m is medium-gray, thin-bedded, argillaceous limestone and the upper 50-70 m is dark gray, medium- to thin-bedded, argillaceous limestone and dolomite. According to Welsh (1973, p. 11) the lower part of this unit is equivalent to the Crystal Pass Limestone Member of the Sultan Limestone. Total thickness is about 100 m

Dsi SIMONSON DOLOMITE (DEVONIAN)--Medium- to dark-brownish-gray, medium-bedded, sugary textured dolomite containing a few thin beds and one thick bed of gray to brown quartzitic sandstone. Locally in the general Frisco area these rocks have been designated the Guilmette Formation by several geologists (cf. Baer, 1962, p. 32), but the brownish color, striped appearance, and abundance of dark dolomite beds containing Amphipora all serve to identify it as Simonson, and indicate a significant unconformity at the top of the formation. Complete sections are 120-220 m thick

Dse SEVY DOLOMITE (DEVONIAN)--Medium- to light-gray, medium-bedded, dense to faintly laminated dolomite. Complete, unaltered sections of this formation are not exposed in the general area of the Frisco quadrangle, but the thickness is assumed to be about 150 m

Go ORR FORMATION (CAMBRIAN)--Incomplete section of medium- to dark-gray, medium-bedded, dolomitic limestone irregularly bleached and streaked within the contact zone of the Cactus stock. The exposed beds are 335 m thick

——— CONTACT--Dashed where approximately located

—D/U—— HIGH-ANGLE FAULT--Dotted where concealed; D, downthrown side; U, upthrown side

—▲—▲— THRUST FAULT--Dotted where concealed; sawteeth on upper plate

⊥50 STRIKE AND DIP OF BEDS

NOTE: A printed list of commonly used geologic map symbols is available on request from the U.S. Geological Survey

Lemmon, D. M., Silberman, M. L., and Kistler, R. W., 1973, Some K-Ar ages of extrusive and intrusive rocks of the San Francisco and Wah Wah Mountains, Utah, in Geology of the Milford area, 1973: Utah Geological Association Publication 3, p. 23-26.

Mackin, J. H., 1960, Structural significance of Tertiary volcanic rocks in southwestern Utah: American Journal of Science, v. 258, p. 81-131.

Rowley, P. D., 1977, Preliminary geologic map of the Thermo 15-minute quadrangle, Beaver and Iron Counties, Utah: U.S. Geological Survey Open-File Report 77-508, 36 p.

Rowley, P. D., Lipman, P. W., Mehnert, H. H., Lindsey, D. A., and Anderson, J. J., 1978, Blue Ribbon lineament, an east-trending structural zone within the Pioche mineral belt of southwestern Utah and eastern Nevada: U.S. Geological Survey Journal of Research, v. 6, no. 2, p. 175-192.

Stringham, B. F., 1963, Hydrothermal alteration in the southeast part of the Frisco quadrangle, Beaver County, Utah: Utah Geological and Mineralogical Survey Special Studies 4, 21 p.

_____1964, Alteration area south of the Horn Silver mine, Beaver County, Utah: Utah Geological and Mineralogical Survey Special Studies 9, 18 p.

_____1967, Hydrothermal alteration near the Horn Silver mine, Beaver County, Utah: Utah Geological and Mineralogical Survey Special Studies 16, 35 p.

Welsh, J. E., 1973, Paleozoic and Mesozoic stratigraphy of the Milford area, Beaver County, Utah, in Geology of the Milford area, 1973: Utah Geological Association Publication 3, p. 9-12.