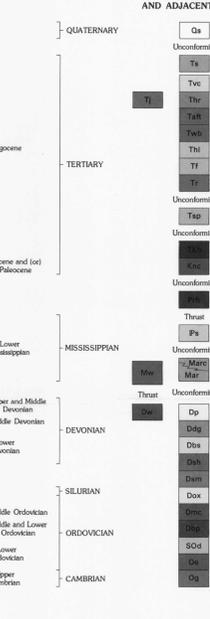


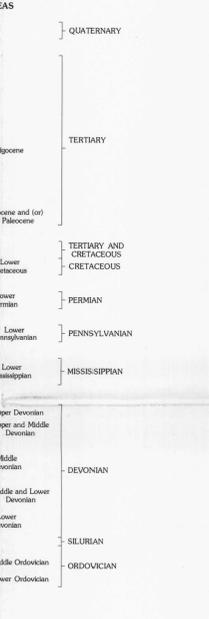
CORRELATION OF MAP UNITS



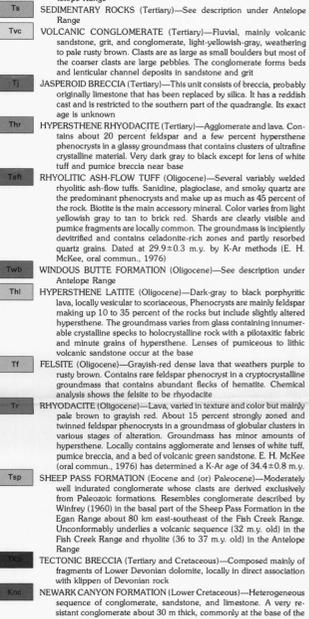
FISH CREEK RANGE AND ADJACENT AREAS



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NOTES ON THE STRUCTURAL GEOLOGY

In the Cockburn Wash quadrangle, about 32 mi south-southeast of Eureka, Nev., there are a number of significant contrasts in the Paleozoic section between the Antelope Range in the western part of the quadrangle and the Fish Creek Range in the central part as well as between ranges and areas beyond the quadrangle. These contrasts are thought to result from telescoping on thrust faults but may result in part from rapid facies changes. Many structures can be mapped in the field but the rest are interpreted largely on the basis of these contrasts, which form the substance of this map note.

DESCRIPTION OF MAP UNITS

Qs SEDIMENTARY DEPOSITS (Quaternary)—Diverse unconsolidated deposits including landslide, slope wash, and alluvial debris and thick soil on pediments.
Ts SEDIMENTARY ROCKS (Tertiary)—Varied lake and pond deposits, including altered clayey air-fall tuff; limestone containing abundant white chert; dense white limestone; light-colored tuff; and abundant conglomerate whose clasts were derived mainly from the volcanic terranes of the Antelope Range but also from Paleozoic units.
Tbm BATES MOUNTAIN TUFF (Oligocene)—Vitic ash-flow tuff, resistant, massive, stony, brick-red to orange, welded. The groundmass consists mostly of slightly deformed shreds. Flattened pumice clasts and exotic zones are common. Biotite is sparse. The rock contains scattered rounded to 1.5 cm across.
Tcw TUFF OF CRESTED WHEAT RIDGE OF DIXON AND OTHERS (1972) (Oligocene)—Welded rhyolite ash-flow tuff. The basal unit is densely welded and consists of deformed shreds and about 10 percent feldspar phenocrysts. The next higher unit, a few meters thick, is a brick-red weathering crystalline welded tuff with a groundmass of deformed shreds. The topmost unit, also a few meters thick, is brick-red to brown stony tuff made up largely of deformed shreds with fairly abundant flattened pumice fragments, about 10 percent feldspar phenocrysts.
Twb WINDOUS BUTTE FORMATION (Oligocene)—Banded or laminated black, pink, and white rhyolite ash-flow tuff. Feldspar phenocrysts make up more than half the rock. Biotite is a common accessory. Smoky to yellowish quartz is abundant. Exotic zones are present. In places, the formation consists of two or more cooling units that vary widely in degree of welding. Best developed in the southern Antelope Range. In the southeastern part of the Fish Creek Range, the main welded ash flow intertongues northward with a sequence of very light yellowish-gray air-fall tuff, tuffaceous claystone, and limestone, about 1 km south of Cockburn Wash. Boulders and blocks derived from Paleozoic carbonate formations are incorporated in the air-fall tuff. Included in the formation are some lenses of conglomerate. K-Ar ages of 32.1±0.3 m.y. for the Antelope Range and 32.5±0.8 m.y. for the Fish Creek Range were determined by E. H. McKee (written commun., 1976).

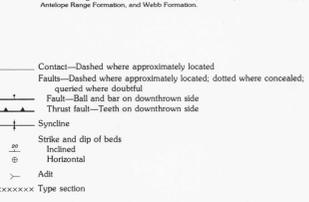
DESCRIPTION OF MAP UNITS

Tpa PANCAKE SUMMIT TUFF (Oligocene)—Light yellowish-gray ash-flow tuff. Unit is 20 to 30 percent phenocrysts, mostly quartz, with lesser amounts of feldspar and sparse biotite. The groundmass is finely deformed. Most of the unit is poorly welded but it is extrusive just north of the north fork of Snowball Creek.
Tph DACTYL FORBYTTE (Oligocene)—Thin, pale red to pink, and white tuffaceous dacite tuff, pale red to medium gray with brown overtones. Feldspar phenocrysts, 20 to 50 percent of the rock, are large, strongly zoned, twinned, and corroded with micrite laminae. The tuff is a common accessory. The groundmass consists of abundant ultrafine crystalline material in a glassy matrix. The unit is remarkably uniform and serves as an excellent mapping datum in the southwestern part of the map area.

DESCRIPTION OF MAP UNITS

Th HYPERSTHENE RHYODACITE (Tertiary)—Agglomerate and lava. Contains about 20 percent feldspar and a few percent hypersthene phenocrysts in a glassy groundmass that contains clusters of ultrafine crystalline material. Very dark gray to black except for lens of white tuff and pumice breccia near base.
Tha RHYOLITIC ASH-FLOW TUFF (Oligocene)—Several variably welded rhyolite ash-flow tuffs. Sandstone, plagioclase, and microcline quartz are the predominant phenocrysts and make up as much as 45 percent of the rock. Biotite is the main accessory mineral. Color varies from light yellowish gray to tan to brick red. Shards are clearly visible and pumice fragments are locally common. The groundmass is finely deformed and contains calcite-rich zones and partly reworked quartz grains. Dated at 29.9±0.3 m.y. by K-Ar methods (E. H. McKee, oral commun., 1976).
Thb WINDOUS BUTTE FORMATION (Oligocene)—See description under Antelope Range.
Thc HYPERSTHENE LATITE (Oligocene)—Dark gray to black porphyritic lava, locally vesicular to scoriaceous. Phenocrysts are mainly feldspar making up 10 to 25 percent of the rocks but include slightly altered hypersthene. The groundmass varies from glass containing innumerable crystalline specks to holocrystalline rock with a plagioclase fabric and minute grains of hypersthene. Lenses of pumiceous to lilac volcanic sandstone occur at the base.
Thd FELSITE (Oligocene)—Grayish-red dense lava that weathers purple to rusty brown. Contains rare feldspar phenocryst in a cryptocrystalline groundmass that contains abundant flecks of hematite. Chemical analysis shows the feldspar to be rhodochase.
Thf RHYODACITE (Oligocene)—Lava, varied in texture and color but mainly pale brown to grayish red. About 15 percent strongly zoned and twinned feldspar phenocrysts in a glassy to doleritic matrix in various stages of alteration. Groundmass has minor amounts of hypersthene. Locally contains agglomerate and lenses of white tuff, pumice breccia, and a bed of volcanic green sandstone. E. H. McKee (oral commun., 1976) has determined a K-Ar age of 34.4±0.8 m.y. for the Sheep Pass Formation (Eocene and/or Paleocene). Moderately well indurated conglomerate whose clasts are derived exclusively from Paleozoic formations. Resembles conglomerate described by Whitney (1960) in the basal part of the Sheep Pass Formation in the Egan Range about 80 km east-southeast of the Fish Creek Range. Unconformably underlies a volcanic sequence (32 m.y. old) in the Fish Creek Range and rhyolite (36 to 37 m.y. old) in the Antelope Range.
Tm TEONIC BRECCIA (Tertiary and Cretaceous)—Composed mainly of fragments of Lower Devonian dolomite, locally in direct association with klippen of Devonian rock.
Tn NEWARK CANYON FORMATION (Lower Cretaceous)—Heterogeneous sequence of conglomerate, sandstone, and limestone. A very resistant conglomerate about 30 m thick, commonly at the base of the formation, well-rounded pebbles to cobbles, mainly of chert from the western facies of the Ordovician Valley Formation and of quartzite from the Ordovician Valley Formation with lesser proportions of Paleozoic carbonate clasts. The conglomerate is overlain by about 65 m of fine to medium-grained sandstone that includes some lenses of conglomerate. The upper part of the Newark Canyon consists of light yellowish-gray to white fine grained limestone with matrix claystone interbeds more than 90 m thick. An overlying reddish mudstone 15 m thick may belong to this formation. The Newark Canyon Formation lies unconformably on Devonian and Pennsylvanian rocks and is unconformably overlain by the Sheep Pass Formation and younger units. Fossils from various parts of the Newark Canyon, including ostracods, pollen and spores, and freshwater mollusks, indicate an Early Cretaceous age.
Tr RIB HILL SANDSTONE (Lower Permian)—Calcaceous yellowish-gray very fine grained sandstone to siltstone, forms one small outcrop near Willow Creek. Yields conodonts considered by Bruce Wardlaw (written commun., 1976) as probably Permian to Triassic. The unit is considered by Calvin Stevens (oral commun., 1976) to be equivalent in age to those in the Rib Hill elsewhere.
Ps SEDIMENTARY ROCKS (Lower Pennsylvanian)—Coarse-textured organic detrital limestone with abundant terrigenous chert and quartz grains of sand to grit size. Confined to two small outcrops between Cottonwood Creek and the north-northeast corner of the Fish Creek Range. Probably deposited on the Antelope Range Formation but too poorly exposed to interpret with certainty. Conodonts considered by A. G. Harris (oral commun., 1977) as Mississippian (Osagean) formers. Also identified by A. K. Armstrong (written commun., 1976). A thin chert from a higher zone in the unit yielded radiocarbon considered by B. K. Holdsworth (written commun., 1978) as late Osagean. Unit is allochthonous.
Mar ANTELOPE RANGE FORMATION (Lower Mississippian)—Dark yellowish-orange medium- to coarse-grained sandstone in the lower part, succeeded by olive-gray to medium-gray silt shale with lenticular beds of sandstone and grit, some of which is conglomeratic, unit rests unconformably upon the Devonian Devils Gate Limestone in the northern part of the quadrangle and probably on the Pilot Shale farther south in the southern Fish Creek Range. Includes, in upper part of formation:
Conglomerate—Pebbles, cobbles, and boulders in a poorly sorted and poorly indurated matrix. The largest clasts are mainly of quartzite from the Valley Formation but some are of Devonian carbonate rocks. Unit also includes chert clasts from Mississippian rocks of the Biondi claims. The conglomerate intertongues with silt shale in the upper part of the Antelope Range Formation and rests unconformably upon other parts of the formation and the Mississippian siliceous rocks of Biondi claims. Conglomerate crops out only in the Fish Creek Range, where its outcrop pattern suggests a large fan deposit.
Md WEBB FORMATION (Lower Mississippian)—Pale yellow-brown organic detrital limestone containing quartz and chert grains locally interbedded with and succeeded upward by light-colored siliceous mudstone, siltstone, and claystone. Includes some thin lenses of siliceous sandstone and grit. Limestone in the basal part contains a siliceous detrital limestone (Kanderhookian) conodont fauna (A. G. Harris, oral commun., 1977) and Mississippian (Osagean) formers. Also identified by A. K. Armstrong (written commun., 1976), etc. A thin chert from a higher zone in the unit yielded radiocarbon considered by B. K. Holdsworth (written commun., 1978) as late Osagean. Unit is allochthonous.
Md WOODRUFF FORMATION (Upper Devonian)—Siliceous mudstone, gray siltstone, and chert that are dark brown to medium gray in fresh fracture and weather to light pastel colors. These rocks are carbonaceous to kerogenaceous and contain high concentrations of vanadium, zinc, selenium, molybdenum, and several other metals. Conodonts identified by C. A. Sandberg (oral commun., 1981) are of late Devonian age. Unit is allochthonous.
Dp LOWER PART OF PILOT SHALE (Upper Devonian)—Slightly siliceous, somewhat dolomitic pale yellow to pale yellow-gray silty siltstone and (or) mudstone. Includes pebble-conglomerate limestone at its northernmost outcrop. Contains *Aspidograptus* identified by J. M. Berdan (oral commun., 1978), early Famennian conodonts (A. G. Harris, oral commun., 1979), late Devonian radiolarians (B. K. Holdsworth, oral commun., 1978), and *Aspidograptus*.
Dm DEVILS GATE LIMESTONE (Upper and Middle Devonian)—Medium-light gray to medium-micrite, faintly laminated in part. Contains abundant bioherms of *Angulopora* and large spheroidal stromatoporoids that form resistant ledges as much as 3 m thick. Unit is 125 to 150 m thick where overlain by the Antelope Range Formation in the northern part of the quadrangle but probably is thicker in the southern part of the quadrangle where it is overlain by the Pilot Shale.
Dbs BAY STATE DOLOMITE (Middle Devonian)—Medium to coarse-grained biostromal dolomite in resistant beds as much as 2 m thick. Includes some interbeds of micritic medium-gray limestone. Exposed thickness is more than 150 m. Base not exposed. Graduated into the Devils Gate Limestone.
Dpb SOUTH HILL SANDSTONE (Middle Devonian)—Well-indurated medium-grained quartzite. Limited to two small outcrops, one in the northwest part of the Fish Creek Range, the other 1 km southeast of Eightmile Well.
Dm SENTINEL MOUNTAIN(?) DOLOMITE (Middle Devonian)—Light yellowish-gray sugary dolomite and brownish-gray dolomite, thickness estimated to be about 100 m.
Dox OYOKE CANYON SANDSTONE (Middle and Lower Devonian)—Unit is mainly in fault blocks and consists of medium-grained well-indurated light yellowish-brown quartz sandstone.
Dn MCCOLLEY CANYON FORMATION (Lower Devonian)—See description under Antelope Range.
Dp BEACON PEAK DOLOMITE (Lower Devonian)—See description under Antelope Range.
Sd DOLOMITE (Silurian)—Brownish-gray medium-grained dolomite and light yellowish-gray sugary dolomite. Contains conodonts considered latest Early Silurian by A. G. Harris (written commun., 1977). Believed approximately equivalent to the Laketown Dolomite of area to the east.
Dq EUREKA QUARTZITE (Middle Ordovician)—See description under Antelope Range.
Go GOODWIN LIMESTONE (Lower Ordovician)—See description under Antelope Range.

The Cockburn Wash Formation (Merritt, 1973) is here abandoned; the rocks here designated as the Devils Gate Limestone, Pilot Shale, Woodruff Formation, Antelope Range Formation, and Webb Formation.



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DOLOMITE