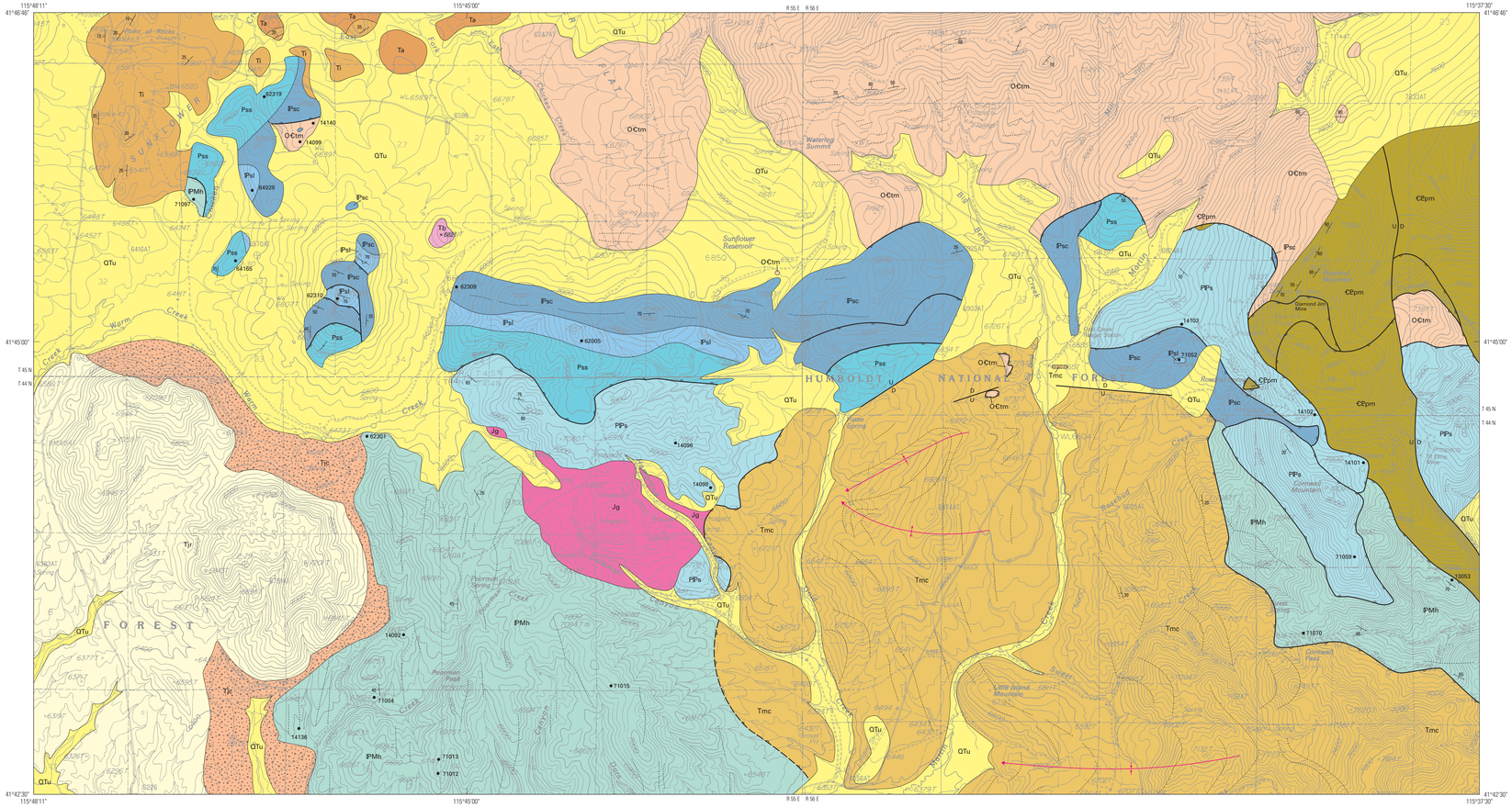
U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

SCIENTIFIC INVESTIGATIONS MAP 2992
Version 1.0



Base from U.S. Geological Survey, Merritt Mountain, 1986; Tennessee Mountain, 1986; Wild Horse, 1986; Cornwell Mountain, 1986

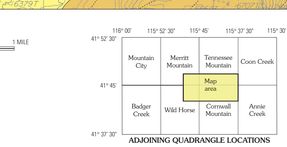
Universal Transverse Mercator projection, zone 11
Nevada State Plane coordinate system, east zone

APPROXIMATE MEAN DECLINATION, 2001

SCALE 1:24 000

1 0 1 MILE
1 .5 0 1 KILOMETER

CONTOUR INTERVAL 40 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929



ADJOINING QUADRANGLE LOCATIONS

MAP LOCATION

Geology by K.B. Ketner, 1995–2001
Digital cartography by Springfield and Springfield
Edited by L.J. Binder,
Denver Publishing Service Center
Manuscript approved for publication September 9, 2007

CORRELATION OF MAP UNITS

QTu			QUATERNARY
Tjr		Middle Miocene	
Tc			TERTIARY
Tb			
Unconformity			
Tmc	Ti	Ta	upper Eocene?
Jg		Late Jurassic	JURASSIC
Intrusive contact			
Pss	PPs	Lower Permian	PERMIAN
PPsl		Upper and upper Middle Pennsylvanian	
PPsc			PENNSYLVANIAN
Fault			
PMh		lower Middle and Lower Pennsylvanian	
		Upper Mississippian	MISSISSIPPIAN
Fault			
OCtm		Lower Ordovician	ORDOVICIAN
			CAMBRIAN
CEpm			PROTEROZOIC (?)

DESCRIPTION OF MAP UNITS

QTu **Unconsolidated sand and gravel (Quaternary and late Tertiary)**—Sand and gravel along streams; soil, colluvium, talus, landslides, quartzite-boulder gravel

Tjr **Jarbidge Rhyolite (middle Miocene)**—Rhyolite characterized by abundant, large phenocrysts of quartz and unaltered feldspar. Potassium-Argon dating indicates a middle Miocene age (Coats, 1987; Evernden and others, 1964). Except for high-angle faults, the Jarbidge Rhyolite is nearly undeformed tectonically in contrast with the distinctly folded Eocene Martin Creek sequence

Tc **Conglomerate (Miocene?)**—Loosely consolidated conglomerate, gravel, and tuffaceous, sandy deposits locally underlying the Jarbidge Rhyolite

Tb **Basalt (Tertiary)**—A single exposure of basaltic rock on a hill just northeast of Jenkins Peaks (elevation of hill, 6821 ft.); composed of an upper unit of basalt flows and an underlying unit of tuffaceous sandstone and gravel; basalt characterized by very large phenocrysts of unaltered plagioclase. Plagioclase from the tuffaceous part of a similar basaltic unit at Rough Mountain, 8 km to the west, was K-Ar dated at 22.9±3 my, near the Miocene-Oligocene boundary (Coats and others, 1984; McKee and others, 1976). Correlated with the Seventy Six Basalt by Coats and others (1984)

Tmc **Martin Creek sequence (upper Eocene?)**—Interlayered ignimbrite, lahar deposits, volcanic ash, alluvial conglomerate, and sandstone. Lahar deposits, consisting mainly of clasts of ignimbrite (Ti), some of which are 2 m or more in diameter, are prominently exposed just southeast of Fuzzie Spring. The thickness of the exposed part of the Martin Creek sequence is estimated to be many hundreds of meters. The age of the sequence in the Gold Creek area was not determined but it is correlated, on the basis of general lithologic features, with the upper Eocene Meadow Fork Formation and Dead Horse Tuff (Coats, 1964, 1987), and with upper Eocene units in the Bull Run Mountains area (Ehman, 1985)

Ti **Ignimbrite (upper Eocene?)**—Relatively undeformed layered tuff composed of highly altered devitrified glass matrix and abundant phenocrysts of plagioclase entirely altered to clay; lesser amounts of quartz and biotite. Weathered outcrops are characterized by pink color and large lenticular voids parallel to layering. The ignimbrite is prominently exposed at Point of Rocks in the northwest part of the map area. It is identical to some strata and some large clasts of the Martin Creek sequence

Ta **Andesite (upper Eocene?)**—Relatively undeformed, thinly layered, gray-weathering andesite consisting of devitrified glass, biotite, abundant euhedral crystals and fragments of unaltered plagioclase, and somewhat less abundant quartz; lithologically similar to the upper Eocene Dead Horse Tuff of Coats (1964, 1987). It was named Bieroth Andesite by Bushnell (1967) but the same name was applied to rocks of other types by Coats and others (1984)

Jg **Gold Creek pluton (Late Jurassic)**—Ranges from quartz diorite to quartz monzonite; contains distinctive poikilitic biotite (Coats, 1987). It occupies the contact zone between the allochthonous Sunflower Formation and the allochthonous Havallah sequence and it produced contact metamorphic deposits along its margin in both units. Contacts with autochthonous rocks are not exposed. A drill hole in the pluton bottomed at 457 m in the pluton (David Greenan, Aur Resources Inc., written commun., 1997)

PPs **Sunflower Formation (Permian to upper Middle Pennsylvanian)**—Informally designated members are mapped separately in places. Unit was named by Coash (1967) and Bushnell (1967). Conodonts, fusulinids, and bivalves from the middle and upper members in the Gold Creek area indicate that the Sunflower's age is within the Permian to late Middle Pennsylvanian interval

Pss **Upper member**—Siltstone, chert, and limestone; A relatively deep-water deposit

PPsl **Middle member**—Abundantly fossiliferous limestone, oolitic in places; A shallow-water deposit

PPsc **Lower member**—Conglomerate and sandstone; A shallow-water deposit. Clasts of the lower member are mainly chert and quartzite derived from lower Paleozoic deep-water or western facies rocks. The microscopic texture of the quartzite cobbles is similar to that of quartzite beds in the Ordovician Valmy Formation but different from that of the Prospect Mountain Quartzite. Based on the age of the overlying middle member and regional-stratigraphic relations, the age of the lower member is probably late Middle Pennsylvanian. The depositional substrate of the Sunflower Formation is not exposed in the Gold Creek area but relations nearby are clear: lithic and temporal equivalents of the Sunflower in the Mount Ichabod area were deposited unconformably on lower Paleozoic western facies units (Ketner and others, 1996). A correlative sequence in the Independence Mountains was deposited unconformably on rocks equivalent to the Tennessee Mountain Formation (Miller and others, 1984)

PMh **Havallah sequence (lower Middle Pennsylvanian to Upper Mississippian)**—Allochthonous mass of siliceous deposits. Commonly in Nevada, the name Havallah is given to allochthonous, deep-water deposits of Late Devonian to Permian age. The name "Schoonover," which was applied to a similar sequence in the Independence Mountains (Miller and others, 1984), is a local term for equivalent strata. In the Gold Creek map area, the Havallah consists of siltstone and lesser amounts of bedded chert, argillite, limestone, sandstone, conglomerate, and greenstone. Beds of richly phosphatic rock are present in the Mississippian strata. Fossils of Late Pennsylvanian to Permian age were not found in the Gold Creek area but are common in the Havallah sequence of the Mt. Ichabod area (Ketner and others, 1996). The depositional base of the Havallah is not exposed in the map area but in the Rowland-Bearpaw Mountain area (Ketner and others, 1995) and at Schoonover Creek, in the Independence Mountains (Miller and others, 1984; Ketner, 1998), it disconformably overlies the Ordovician Valmy Formation

OCtm **Tennessee Mountain Formation (Ordovician and Cambrian)**—This formation, named by Bushnell (1967), is a distal turbidite composed mainly of thinly laminated, fine-grained limestone with interbeds of calcareous shale, silty or sandy beds, and sparse greenstone. Bedded chert is present near the top at its gradational contact with the Ordovician Valmy Formation in the Rowland-Bearpaw Mountain area (Ketner and others, 1995). The lowermost beds near its sedimentary contact with the underlying Prospect Mountain Quartzite on the west side of Rosebud Mountain are composed mostly of brown, sandy, phyllitic shale with lenticular, distinctively blue beds. These shaly beds are similar to the Cambrian Edgemont Formation described by Ehman (1985) in the Bull Run Mountains. In the map area, however, the thin, poorly exposed shale grades upward into the Tennessee Mountain Formation and is included here in that formation

CEpm **Prospect Mountain Quartzite (Cambrian and Proterozoic?)**—Cross-bedded quartzite, correlated lithologically and stratigraphically with the Prospect Mountain Quartzite which is exposed widely in Nevada

- Contact
- Normal fault—D, downthrown; U, upthrown side
- Low-angle fault (Unknown or unspecified sense of slip)—Identity and existence certain; dashed where approximately located or inferred. Half-circles on upper plate
- Trend-line of bedding—From surface exposures and aerial photographs

Strike and dip of bedding

- 30 Inclined
- Vertical
- 70 Overturned
- Anticline—Showing axis and direction of plunge
- Syncline—Showing axis and direction of plunge
- 71015 Locality and field number of fossil collection—See table 1 for more information on fossil collection

CONVERSION FACTORS

Multiply	By	To obtain
inches (in)	2.54	centimeters (cm)
feet (ft)	0.3048	meters (m)
miles (mi)	1.609	kilometers (km)

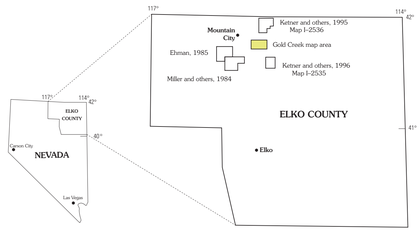


Figure 1. Index map of Nevada showing the location of the Gold Creek map area, and the locations of geologic maps of other areas that are referenced in this investigation.

STRUCTURAL FEATURES AND MINERAL DEPOSITS

Autochthonous Sequence

The Prospect Mountain Quartzite, and the overlying Tennessee Mountain Formation in the Gold Creek area are considered to be essentially autochthonous, although this is assumed. Strata composing the autochthon within and adjacent to the map area form a north- to northwest-facing sequence with variable but generally steep dips. The upper part of this sequence, which is separated from the lower part by large granitic stocks just north of the map area, is exposed in the Rowland-Bear Paw Mountain area (Ketner and others, 1995; see fig. 1). There, it includes the Ordovician Valmy Formation and disconformably overlying Mississippian rocks. The steep dips in the autochthon could be the result of tilting in an extensional environment or could represent the northwest limb of a large contractional anticline.

Allochthonous Structural Plates

Each of the pre-Miocene stratigraphic units overlying the autochthon constitutes a distinct structural plate. In general, exposures in the Gold Creek gold district do not permit precise measurement of bedding attitudes, but the trend lines of bedding, observed on the ground and on aerial photographs, indicate that in all of the allochthonous plates, the bedding dips are generally steep and the strikes differ from those of other plates. Restoration of the bedding in each of these plates to the horizontal would result in structurally improbable reorientation of the autochthon or of underlying allochthonous plates. This is the principal basis for classifying the plates as allochthonous. The local evidence that would determine whether the allochthonous plates were emplaced under contractional or extensional stress conditions is inconsistent or inconclusive and resolution of the ambiguity awaits regional studies.

The Havallah sequence appears to be either isoclinally folded on north-south-trending axes or to be cut by faults nearly parallel to bedding. Bedding trends are consistently steep as indicated by their pattern in relation to topography, and the east-west alternation of Mississippian and Pennsylvanian strata within and south of the map area indicates the presence of folds or faults. The Havallah plate is regarded as allochthonous because its internal structure is incompatible with that of the autochthon. The younger-on-older relation of this plate to the autochthon suggests emplacement by extensional means, but the unit extends continuously to the Mount Ichabod area (south of the map area), where it overlies Triassic rocks on a low-angle contractional fault (Ketner and others, 1996).

The Sunflower Formation displays near-vertical east-west bedding trends in the area just south of Sunflower Reservoir, and the sequence faces south. It is cut by internal low-angle faults there as well as in other exposures. The plate is regarded as allochthonous because (1) its structure is incompatible with that of the underlying autochthon, (2) clasts comprising the conglomerate member do not reflect the composition of the underlying autochthon and, (3) the conglomeratic member is not consistently at the base of the plate. The fault underlying the Sunflower plate is a younger-on-older fault which suggests extensional conditions. However, at Jenkins Peaks, the members are tectonically repeated, normally the result of thrust faulting.

The Martin Creek sequence is locally strongly folded as can be observed in exposures and very clearly on aerial photographs. Dips on exposed sedimentary strata near the mouth of Gold Creek are more than 60 degrees. Elsewhere, poor exposures do not permit measurement of attitudes, but dips estimated from bedding traces on aerial photographs appear to be equally steep. Except for the area of sharp folds in northern exposures, bedding strikes trend generally north to northwest and dips are to the west. Assuming it is upright, the sequence faces west. The plate is regarded as allochthonous because its structure is incompatible with that of the autochthon and of the other plates. Whether the underlying low-angle fault, and the folds of the Martin Creek plate are the result of contractional or extensional stress is indeterminate from the local evidence. The younger-on-older nature of the fault suggests extension, but the strong folding suggests contraction.

Ages of Deformation

The Havallah and Sunflower plates were emplaced during the Jurassic or earlier. The Gold Creek pluton of Late Jurassic age (Coats and McKee, 1972) intruded both the Havallah sequence and the Sunflower Formation, producing contact alteration in both units. A hole drilled into the pluton bottomed at 457 m in plutonic rock (David Greenan, Aur Resources Inc., written commun., 1997), which suggests that the pluton is probably not underlain by low-angle faults that reach the surface nearby. Therefore, the pluton pins the Havallah and Sunflower plates to the autochthon.

The detachment and folding of the Martin Creek sequence must have taken place between the upper Eocene, the age of the unit, and the middle Miocene, the age of the undeformed and nonfolded Jarbidge Rhyolite.

Gold deposits

Placers along the lower part of Gold Creek and its tributaries in Coleman and Hammond Canyons were the source of almost all of the gold produced in the district. Most production was in the years immediately following discovery in 1873, but subsequent efforts to revive production continued sporadically into the 1990s. Minor production was from veins in the Gold Creek pluton and its wall rocks. It seems likely that the source of at least some of the placer gold was the pluton which is upstream from the placers; however, a contribution from other sources cannot be ruled out from the scanty information available. The principal source of information on the placers is Johnson (1973) and references therein.

Other Mineral Deposits

Claims in the upper reaches of Big Bend Creek produced small quantities of lead, zinc, antimony, and tungsten from small pockets in the Tennessee Mountain Formation. The Diamond Jim mine on Rosebud Mountain produced significant quantities of lead and small amounts of copper, silver, and gold from the phyllitic shale at the base of the Tennessee Mountain Formation. Other claims on the mountain produced minor amounts of lead, silver, and gold. The source of information on these deposits is Bushnell (1967) and references therein.

ACKNOWLEDGMENTS

The geologic maps by Bushnell (1967), Coash (1967), and Coats and others (1984) served as a useful introduction to the area. Fossils were identified by R.C. Douglass, Mackenzie Gordon, Jr., J.W. Huddle, C.R. Sandberg, J.R. Repetski, and B.R. Wardlaw, all of the U.S. Geological Survey.

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Table 1. *Age ranges of fossil collections from the Gold Creek map area.*

Field no.[1]	USGS no.	Fossil type	Age range of collection	Paleontologist
Sunflower sequence				
62005	24600	Conodonts	Late? Pennsylvanian	J.W. Huddle
62309	21597	Brachiopods	Late Pennsylvanian to Permian	MacKenzie Gordon, Jr.
62310	21598	Brachiopods	Late Pennsylvanian to Permian	MacKenzie Gordon, Jr.
62319	21587	Brachiopods	Permian	MacKenzie Gordon, Jr.
64028	23845	Fusilinids	Late Pennsylvanian	R.C. Douglas
64165	23781	Brachiopods	Late Pennsylvanian to Permian	MacKenzie Gordon, Jr.
71052	24816	Conodonts	Pennsylvanian to Permian	J.W. Huddle
71059	24877	Conodonts	Early Permian	B.R. Wardlaw
14096	n/a	Conodonts	Permian, Leonardian	B.R. Wardlaw
14098	n/a	Conodonts	Late Middle Pennsylvanian through Permian	B.R. Wardlaw
14101	n/a	Conodonts	Permian, Leonardian	B.R. Wardlaw
14102	n/a	Conodonts	Earliest Permian	B.R. Wardlaw
14103	n/a	Conodonts	Earliest Permian	B.R. Wardlaw
Havallah sequence				
62301	24602	Conodonts	Late Mississippian	J.W. Huddle
71004	24810	Conodonts	Early Pennsylvanian	J.W. Huddle
71012	24811	Conodonts	Late Mississippian	J.W. Huddle
71013	24863	Brachiopods	Mississippian	MacKenzie Gordon, Jr.
71015	24818	Conodonts	Pennsylvanian to Permian	J.W. Huddle
71070	24819	Conodonts	Early Pennsylvanian	J.W. Huddle
71097	24821	Conodonts	Late Mississippian	J.W. Huddle
13053	n/a	Conodonts	Early-Middle Pennsylvanian	B.R. Wardlaw
14092	n/a	Conodonts	Late Mississippian, Chesterian	B.R. Wardlaw
14136	n/a	Conodonts	Late Mississippian, Chesterian	C.A. Sandberg
Tennessee Mountain Formation				
14099	11905	Conodonts	Middle to early Late Cambrian	J.R. Repetski
14140	11906	Conodonts	Middle to early Late Cambrian	J.R. Repetski
Havallah sequence within six km. south of the map area				
71011	25084	Brachiopods	Mississippian	MacKenzie Gordon, Jr.
71021	24812	Conodonts	Late Mississippian to early Pennsylvanian	J.W. Huddle
71022	24813	Conodonts	Late Mississippian	J.W. Huddle
71024	24814	Conodonts	Late Mississippian	J.W. Huddle
71027	24815	Conodonts	Pennsylvanian to Permian	J.W. Huddle
72035	24996	Conodonts	Early Pennsylvanian	J.W. Huddle
72037	24997	Conodonts	Early Pennsylvanian	J.W. Huddle
72040	24999	Conodonts	Early Pennsylvanian	J.W. Huddle
72043	25000	Conodonts	Early Pennsylvanian	J.W. Huddle
72151	25084	Conodonts	Middle Pennsylvanian	J.W. Huddle

[1] Samples numbered 62005–72151 were collected by R.R. Coats from 1962 to 1972 (Coats, 1986)
n/a, no USGS sample number

GEOLOGIC MAP OF THE GOLD CREEK GOLD DISTRICT, ELKO COUNTY, NEVADA

By
Keith B. Ketner

2007

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