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Mining District File Summary Sheet

DISTRICT	Elko County General
DIST_NO	0050
COUNTY If different from written on document	Elko
TITLE If not obvious	Tectonic Review of Elko County
AUTHOR	
DATE OF DOC(S)	1978
MULTI_DIST Y / (N?) Additional Dist_Nos:	
QUAD_NAME	
P_M_C_NAME (mine, claim & company names)	
COMMODITY If not obvious	
NOTES	Tectonic review; geology; Coats donation 13p

Keep docs at about 250 pages if no oversized maps attached
(for every 1 oversized page (>11x17) with text reduce
the amount of pages by ~25)

Revised: 1/22/08

	Initials	Date
SS:	DD	12/15/08
DB:		
SCANNED:	MT	1,05,10

obsolete

In reviewing the tectonic history of Elko County, it is well to remember the great areal spread of the area under consideration; approximately 2 degrees in latitude and 3 degrees in longitude. Several events that left a conspicuous record in one part of the area often had little visible effect in another. As in every extensive area with a long history the younger deposits both permit the dating of the earlier events and also obscure the evidence in many places. In Elko County the earlier tectonic events affected chiefly the Paleozoic rocks and the younger sediments of the Mesozoic are very limited in their distribution so that the dating of the events which are prior to the beginning of the Mesozoic is very uncertain.

Early Cambrian or Precambrian orogeny

Evidence for tectonism between the period of deposition of the Prospect Mountain (in a restricted sense) Formation and the underlying Precambrian Z rocks of the McCoy Creek group is sparse in Elko County, because of the very limited areas of exposure. Woodward (1963, 1965) and Misch and Hazard (1962) have described a disconformity between the Lower Cambrian Prospect Mountain Quartzite in the Egan Range and the Snake Range in Nevada, and the Deep Creek Range of Utah on the one hand and the McCoy Creek on the other.

In the Shell Creek and southern Snake Ranges Misch and Hazard (1962) have found a weak regional metamorphism thought by them to be Mesozoic in age extending upward through the Lower Cambrian shale. In the Ruby Range Kistler and Wilden (1969) have found a strong angular unconformity between the Precambrian schist, metamorphosed in the silimite zone about 550 m.y. years ago and overlying Prospect Mountain Quartzite, metamorphosed

only to the biotite grain. In the Jarbidge and Rowland quadrangle, and in the Mt. Velma quadrangle Coats (1964) recognized only a slight disconformity between quartzite, assigned to the Prospect Mountain Quartzite, and underlying mica schist assigned to the McCoy Creek group. The differences in metamorphic grade are slight and are confused by later thermal metamorphism, attributed to Cretaceous Coffeepot stock (Bushnell, 1965, 1967).

In the Mt. Velma quadrangle, small amounts of yellowish and reddish phyllite resting on the Prospect Mountain Quartzite, but not separately mapped, may be correlative with the shale and may by the degree of metamorphism suggest that the post Lower Cambrian orogenic episode affected these rocks.

In the Rowland quadrangle, Bushnell (1967) recognized a formation of Cambrian or Ordovician age, the Tennessee Mountain Formation, which is unconformably overlain by rocks equivalent to Strathearn. The western part of the belt of Tennessee Mountain Formation is phyllitic and is higher in degree of metamorphism than the allochthonous Ordovician rock of the Valmy which are present not far away. It is possible that the metamorphism of the Tennessee Mountain Formation which does not affect the overlying Strathearn is to be attributed to this late Ordovician tectonic disturbance, the Ruby disturbance but the significance of that for this area is rendered somewhat doubtful by the fact that the Tennessee Mountain Formation is probably parautochthonous and has been brought into the Rowland quadrangle as a major thrust plate though the extend of movement on this thrust plate is impossible to state because of the direction of movement

is to the south and is unclear how far the rocks have been moved. The source area is probably covered by the lavas in the Snake River plain.

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Cambrian orogeny

In the Schell Creek and southern Snake Ranges, Misch and Hazzard (1962) have found a weak regional metamorphism, thought by them to be Mesozoic extending upward through the Lower Cambrian shale.

In the Ruby Range, Kistler and Willden (1969) have found a strong angular unconformity between Precambrian schist, metamorphosed in the silliminite zone, about 550 m.y. ago and the overlying Prospect Mountain Quartzite metamorphosed only to the biotite zone.

In the Jarbidge, Rowland and Mt. Velma quadrangles, Coats (1964) recognized only a slight disconformity between quartzite, assigned to the Prospect Mountain Quartzite and the underlying mica schist assigned to the Precambrian McCoy Creek group. Differences in metamorphic grade are slight but are confused by later thermal metamorphism attributed to the Cretaceous Coffeepot stock (Bushnell, 1965, 1967).

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Ruby disturbance

In the Elk Mountains [7] Matthias (1959) mapped Eureka Quartzite in contact with the Cambrian limestones, which according to Michael Taylor (oral commun., 1977) are correlative with the Cambrian Windfall Formation. If the contact is not a thrust fault, which might be as young as Mesozoic then all the Lower Ordovician has been eliminated by deformation and erosion.

Post-Oligocene thrusting

The concept of post-Oligocene thrusting in Elko County has had its most persuasive advocate in Willden (Willden and others, 1967). He and his associates have published a map showing three klippen on the Ruby Range for which a post-Oligocene age is advocated. These klippen are from south to north the Overlin Pass klippe, the Michael Creek klippe, and the Cedar Mountain klippe. Willden and others (1967, p. 1352) based the fostulation of a thrust klippe on a facies contrast between the beds of the klippe and the autochthonous Devonian and Mississippian rocks of the same age as those on the klippe on either side of the high angle faults that form the north boundary of the lkippe. The hypothesized basal thrust was not found by Hose and Blake (1976, pl. 1) and the facies contrast does not exist according to Hose (oral commun., 1978). The evidence for the dating

of the Mitchell Creek klippe the next north is the presence of thermal metamorphism in the underlying Cambrian rocks, and its absence in the rocks in the upper plate. The discrepency in degree of metamorphism may be best explained by tectonic movement of the Mitchell Creek klippe but it does not follow that this necessarily results from compressional tectonics. A possible gravity slide origin is preferred here as in the case of the Cedar Mountain klippe.

The Cedar Mountain klippe (Willden and others, 1967) is a displaced block of unmetamorphosed Devonian rock resting on a surface that is underlain by a brecciated phase of the Harrison Pass Granodiorite, an Oligocene pluton. The tectonic emplacement of the klippe in post early Oligocene time in undoubted, but the direction of emplacement has not been ascertained. Field examination of the klippe in 1978 revealed internal structures suggestive of westward rather than eastward movement, as suggested by Willden and others. These include subsidiary east-dipping thrusts within the klippe and gash fractures having a S-shaped cross section looking southward with the steeper part wider than the flatter portion and the flatter portions being nearly parallel with the underlying thrust. Perhaps the most telling argument against the episode of thrusting suggested by Willden and others, however, is the general absence in surrounding areas of any post-Oligocene compressional features. The exhaustive study of Smith and Ketner (1977) record no such tectonic event in an area just to the west of the southern Ruby Mountains. Early Tertiary volcanic rocks are widespread. Similar arguments would negate the post-15 m.y. thrusting offered by Snoke (in press) as an explanation for exposures in the Secret Pass area, between

the Ruby and East Humboldt Ranges where late Paleozoic sediments overlie tectonicly rhyolite which is correlated with the Jarbidge Rhyolite of this report. This occurence here is regarded as an example of gravity tectonics (and this section). The exposure and rocks of this unit has not been seen elsewhere in the same stratigraphic position. Another unit is the rhyodacitic tuff of Harris Gulch in the Mountain City quadrangle on which an age of 30.1 m.y. was determined by J. C. Von Essen (written commun., 1969) The hydrothermal alteration of these tuffs suggest that the gold-silver veins of the Mountain City mining district ( ) are post-30 m.y. but just how much later they are than the volcanics is not clear. A general coincidence in trend between these volcanics of Harris Gulch and the veins suggest that they may be genetically connected. Near the southern edge of the Mountain City quadrangle in the valley of Allegheny Creek is a sequence of tuffs and associated sediments which are light creamy to pale green in color and locally biotitic as small lenses of fine gravel and tuffaceous gravel. Some of these gravel lenses contain a vertebrate fauna of Arikareean or middle Miocene age according to C. A. Repenning (oral commun., 1965) and the description of the tuff of Allegheny Creek. In the Mt. Velma quadrangle and in some of the quadrangle to the east as far east of the Charleston reservoir and Marys River Basin northwest quadrangles, the early Tertiary tuffs are overlain unconformably by a sequence of ignimbrites which are generally dacitic to rhyodacitic in composition and have phenocryst combinations ranging from hornblende and biotite plus the sanidine and plagioclase and quartz to plagioclase with or without quartz and hornblende plus hypersthene and many samples of augite. Most of these rocks are

nearly flat lying or show gentle sag basin type of deformation. The total thickness is on the order of perhaps as much as 3 or 4 hundred feet.

Mid-Tertiary tuffs

In the Willow Creek Reservoir quadrangle and in the hills to the north of it and east to the valley of Rock Creek there is a sequence of tuffs and ignimbrites most of which are pale pinkish gray to gray in color and are sympathic and are actually probably biotite rhyolite and have phenocrysts or quartz sanidine and biotite. The individual units may be as much as 200 feet thick and these are well exposed in the valley of Willow Creek near the damsite for the Willow Creek Reservoir and westward in the valley of Willow Creek where they dip steeply eastward as some repetition. The total thickness suggested by the width of exposure would be several thousands of feet but there probably seen some repetition by strike faulting. These rocks have been dated by E. H. McKee as 32.1 m.y. old and thus fall in our mid-Tertiary unit. They rest upon a sequence of sediments which includes many coarse poorly consolidated gravels with minor amounts of tuff and upward they grade into andesites.

Tuffs and sedimentary rocks.

In the Mountain City district in a poorly exposed bassanitic tuff which is arkosic in carbonaceous near the base and has small amounts of malignite in it overlying a quartz monzonite or granodiorite of Cretaceous age. On Creek a tributary of the south fork of California Creek in sec. 35, T. 45 N., R. 54 E. (projected) these were briefly described by Garside (1973, p. 42). Malignites in this deposit yielded a substantial pollen fauna which is determined by Estella Leopold, see filed number 62NC91 paleobatonical locality D3985. Leopold determined that these were

probably of Oligocene age.

A sequence of pebble and cobble gravel and tuffs and pumiceous tuff occurs west of the Falcon mine between north of Rock Creek and south of Rock Creek in the valley of the south fork of Rock Creek and of To Jam Creek, a tributary of Rock Creek and this have been informally referred to as the Jo Jam Creek tuffs and gravels. Two evidences of the age of this formation are available. It was determined by Estella Leopold, see field number 71NC290, as being possibly pre-Miocene or also possible Miocene. The K-Ar date determined by E. H. McKee, however, was on biotite extracted from rhyolite pumice in a pyroclastic flow interbedded with gravels which are thought to be part of the same formation although the area is disjunct from that of the outcrop that furnished the pollen was published in McKee and others (1976) as a date number 34, p. 23. The date given by McKee is 33.6 1.6 m.y. which would place this rather early in the Oligocene.

Late Tertiary rocks

Jarbidge Rhyolite

The Jarbidge Rhyolite is one of the most distinctive and widespread volcanic units in northern Elko County. It was originally first described in detail by Schrader (1923, p. 17) and was named by Coats (1964, p. m10). The rhyolite includes flows, tuffs, and welded tuffs of rhyolitic composition, small amounts of coaly material are locally interbedded. A few dikes and some small necks of vitrophyre are also present. Flows seem to far outweigh in volume and areal extend the welded tuffs and tuffs but because of prevasive recrystallization hydrothermal ash alteration in much of the area it is difficult to differentiate welded tuffs from flows but

judging from all the frequency in the thin sections examined the products of coal ash falls are commoner than welded tuffs but well-bedded fine-grained tuffs are rare. A rhyolite ranges from pale bluish gray to yellowish gray and oxides in shades of brown and gray. Locally greenish and purplish tints are seen. The fresh glassy rocks are black to dark gray. The rocks are characterized by a large proportion of quartz phenocrysts as much as 5 mm in diameter but are mostly rounded or corroded but are in part euhedral by sanidine crystals which are slightly smaller and less numerous and by somewhat rarer phenocrysts of oligoclase-andesine. The rarely recognizable clinopyroxene is pigeonitic but bastite psudomorphs after pyroxene(?) are common. Biotite and hornblende are recognizable psudomorphs after them are extremely rare. Accessories includes zircon, apatite, ilminite, magnetite, and pale-pink garnet. A single occurrence of apparently secondary topaz is found in the Jarbidge quadrangle. Locally the Jarbidge Rhyolite has been altered porphyritically with the development of epidote and clorite but more commonly in the Jarbidge mining district the groundmass, plagioclase and sanidine phenocrysts have been replaced by adularia and, locally, by clay minerals. The thickness of the Jarbidge Rhyolite has not been precisely determined because it is sliced by numerous high-angle faults and easily mappable marker beds have not been found. It is certainly in excess of 2,000 feet but probably not more than that figure. Most of the dips in the Jarbidge Rhyolite where they can be measured on interbedded tuffs are very low. The age of the Jarbidge Rhyolite is dependent upon two potassium-argon dates one of which is on a sample collected by D. I. Axelrod and determined by Geocron, Inc. on Middle Creek

of the Rowland quadrangle which gives an age of 16.8±0.5 m.y. Another sample collected by Coats and determined by Evernden, Savage, Curtis, and James (1964) was from a basal vitrophyre in the Jarbidge Rhyolite just northeast of the Wild Horse Reservoir and this gave a date of 15.4 m.y. The samples collected by The Jarbidge Rhyolite is quite widespread. It has been recognized in the Mountain City quadrangle, in the eastern and southern parts of the Mountain City quadrangle, in the Rowland quadrangle, western part of the Rowland quadrangle and the northern part of the Wild Horse quadrangle where masses are continuous into the Mountain City quadrangle, in the Jarbidge quadrangle, and the Marys River Basin quadrangle south of the Jarbidge quadrangle in the Elk Mountains up to the east of the Jarbidge quadrangle and extensively in the quadrangles south of the Marys River Basin quadrangle. The isolated occurrences of what appears to be the same unit are present in quadrangles east of U.S. 95 and north of Interstate 80 and also at the extreme north end of the East Humboldt Range and in Secret Pass between East Humboldt Range and the Ruby Mountains. It is widespread also east of the north fork of the Humboldt and North Fork quadrangle and the Mahalla Creek East quadrangle and in the Devils Armchair quadrangle to the east of these. Several other masses in many cases disected by erosion, resemble the Jarbidge Rhyolite very closely but most of these have been mapped as undifferentiated late Tertiary Rhyolite. One of these is quite widespread south and west of Windover, Utah, and Elko County and was described as a tridymite rhyolite by Armstrong (1970) whose sample 90 it was, and this sandine from this rock was dated by Armstrong as being 11.6±0.4 m.y. as

differing significantly from the Jarbidge Rhyolite. It differs from the Jarbidge Rhyolite in having not only a ferroan clinopyroxene but also ferroan olivine probably and theralite.

Another Tertiary rhyolite is the rhyolite of Cold Spring Mountain in the Jarbidge quadrangle which makes up several prominent mountain peaks Cold Springs Mountain, Rough Mountain, and Gentleman Peak. This rhyolite differs very substantially from the Jarbidge Rhyolite in addition to the usual phenocrysts, rhyolite, quartz plagioclase and sanadine, it contains a hornblende which is dark brown to dark green and in many sections a biotite as well and nearly every section shows small amounts of rare earth accessory called periorite. The sanidine from one of these masses was dated by the Geological Survey at 14.6 0.9 m.y. This date was published by E. H. McKee and others in 1976 (p. 21, date number 17). This unit also includes an extensive series of rhyolitic volcanic rocks in the wouthwestern part of the quadrangle in the Midas district which was mapped and have been described by R. C. Green (written commun., 1973). The rocks are generally resistent and they outcrop well on the steep fault scarps and canyon walls and are especially well exposed on the Owyhee bluffs which are on the north side of the Midas depression. The maximum thickness of the unit was probably over 2,000 feet. They are mostly rhyolite and rhyodacite with minor dacite. These rocks have aphanitic groundmasses of various colors of grayish to pale red, grayish to pale brown, light brownish gray predominating. Locally vitrophyres are uniformly black in color and may be streaked with pale red. Rhyolites containing from 5 to 25 percent alkali feldspar phenocrysts and 0.5 percent quartz phenocrysts. Many contain

very small amounts of hornblende or iron-rich olivine. Fewer contain traces of biotite or augite. Mafic minerals are generally peripherally oxidized. The refractive indices range from a few beads range from 1.485 to 1.492 corresponding to 76 to 73 SiO_2. The rhyodacites contain 2 to 10 percent sanadine, less than 1 to 5 percent of plagioclase and 0 to 2 percent quartz phenocrysts. Some contain small amounts of altered mafic minerals. The rhyodacites samples have furnished a few beads of indices ranging from 1.492 to 1.501 corresponding to 73 to 70 percent of silica.

Late Tertiary landslide deposits

Tertiary landslide deposits have been recognized in only a few places though many more may be present but two criteria in general was used for assigning a Tertiary age to landslide deposits. One is their presence at high level on divides well above present stream channels and the other is their being overlain by rocks that are known to be of Tertiary age. Landslide deposits second catagory are found in the Wild Cat guard station just south of the Jarbidge Wilderness. Landslide deposits of the first age catagory are found in the Mountain City quadrangle in a few places. Gravels of late Tertiary have been mapped in a few places. One conspicuous unit was mapped in the Jarbidge quadrangle (Coats, 1964, p. m12) as the Slide Creek gravel which rests unconformably on the Jarbidge Rhyolite. It is poorly sorted and unconsolidated and boulders as much as 4 feet across, some of which are rounded and some subangular. The gravel is not deformed except by faulting and is overlain unconformably by the Jenny Creek tuff which is here mapped with the Cougar Point welded tuff.

In the Rowland quadrangle Bushnell (1967, p. 23) mapped a unit which he referred to as the Young America gravel.