Road Log 2 for the Ten Mile Graben Area

(Originally created by Dick Dayvault in 2004; modified slightly by Hood and Cole)

At Exit 175 on I-70, turn off highway. At stop sign, turn left (south) onto Grand County Road 147 (also called the Floy Wash Road). Proceed across I-70 and off the pavement to an open area on the right. This is **Stop 4**. We will reconvene here and have an overview talk. Set your trip odometer to 0 at the stop sign. *(On Hatch Mesa 7.5' tope quad).* Initially, we will be driving on the Ruby Ranch Road, then on the Salt Wash Road. These roads can be very dusty, thus, visibility will be an issue. Also, this area is popular for off-road enthusiasts. Drivers, please keep a lookout for various forms of fast-moving recreational vehicles, plus slow-moving vehicles towing trailers. Large semi-trucks are also possible. Since we are in the San Rafael Desert, vegetation is sparce. No outhouses are present along our route! Depending on time and conditions, some of the stops may not be visited. Participants can bale out at any time, but please inform a trip leader before doing so.

0.2 Cattle guard.

0.4 Large gravel pit on the left.

1.0 Small gravel pits to east (left) of road are in thin terrace deposits overlying Mancos Shale.

2.9 Cross Little Grand Wash, which drains west to the Green River. Upper Cretaceous Mancos Shale crops out in the wash and dips about 4^{o} northeast.

3.0 Cattle guard.

4.3 Road junction, continue straight ahead. Blue Hills Road (Grand County Road 138) is to the east (left). *(We are now on the Dee Pass 7.5' topo quad).*

4.4 Pass under large power lines. Cuesta on left is formed by the Ferron Sandstone Member of the Mancos Shale. It is about 50 ft. thick.

4.5 Pipeline service facility approximately 0.3 mi. t the east (left). From this point southward for several miles there will be a pipeline parallel to the road on the right.

Sidebar on pipeline facility. The facility to the east consists of two components under different ownership. The structure on the surface is known as the Greentown facility and is currently owned and operated by Zephyr. It processes natural gas from Zephyr's nearby wells before inserting the gas into a 16-inch diameter pipeline. The pipeline is owned and operated by Enbridge Gas and transmits natural gas from to and from a large Williams Company pipeline at Moab. Gas in the system is transported via a smaller pipeline from here to the town of Green River. Both the surface facility and the pipeline system have undergone several ownership changes over the years and it is a bit hard to keep track of who owns or operates what.

5.0 Crossing a flat area underlain by the Tununk Shale Member (lowermost member) of Mancos Shale. The Henry Mountains are visible in the distance.

5.1 Sandstones outcrops nearby to west (right) are the upper part of the Lower Cretaceous Cedar Mountain Formation. This formation caps many cuestas in this area and has produced large amounts of fossil wood, including cycad trunks.

5.2 Calcrete forms brown nodular concretions in Cedar Mountain Formation to right.

5.5 Tan sandstone at 2:00 is the base of the Cedar Mountain Formation. Varicolored shales in the slope below are the Upper Jurassic Brushy Basin Member of the Morrison Formation.

5.8 Oil well on right.

5.9 Road Junction; continue on main road to right. Road to left goes south about 1.5 miles to Dee Pass.

6.2 **Stop 5.**

6.3 Tan sandstone from 9:00 to 2:00 is top of Salt Wash Member of the Morrison Formation. Mesa to west is capped by Cedar Mountain Formation with slopes of Brushy Basin. Fossil wood and agate are found in the Brushy Basin in this area.

6.4 Road is on Salt Wash Member of the Morrison Formation.

6.8 Crossing the north bounding fault of Ten Mile Graben onto a down-dropped block (**Stop 5C**). View to the east shows Salt Wash Sandstones on the north (upthrown side) and Brushy Basin on the south (downthrown side). In this area of the eastern part of the graben, the structure is complex with several bounding faults and several sub-grabens.

7.5 Cattle guard and road junction. Take the road to the right, the Salt Wash Road. Road to left is the continuation of the Ruby Ranch Road and goes to the Little Grand manganese field, the Ruby Ranch and some sand dunes. (We have included a short paper and a road log the manganese deposits). Gray to purple mudstone in this immediate area is probably the Tidwell Member of the Morrison Formation, which lies just beneath the Salt Wash Member.

Proceed westward through and along the Ten Mile – Salt Wash Graben, named by Edwin McKinght in USGS Bulletin 908 in 1940. McKnight originally named the Tenmile Graben as that part of the graben extending from this area eastward for about 7 miles to Tenmile Wash. He called the graben structure extending about 10 miles westward from this point the Salt Wash Graben. In the 1990s, Hellmut Doelling (Utah Geologic Survey) in his mapping of the western Grand County, collectively referred to the related grabens as the Tenmile Graben. This terminology was followed in 2015 Utah Geological Survey map of the San Rafael Desert (Doelling et al. 2015). However, most of the recent publications refer to the graben structure that we will follow as the Salt Wash Graben.

From this area westward, the graben is about 2,400 feet wide and displacement on the north bounding fault(s) is up to 1,050 feet and that on the south bounding fault(s) is about 800 feet.

7.8 Rocks on the hill to the right of the road are sandstones of the Salt Wash Member, which lie above the Tidwell Member mudstones at road level, both of the Morrison Formation.

8.3 Cross step-fault along north side of graben. Road is on shales of the Brushy Basin Member and soon passes over the main north bounding fault of the graben and onto rocks (covered here) of the Jurassic Curtis Formation. Views ahead to northwest on steep slopes of mesa are well-layered rocks of the Curtis Formation overlain by the Jurassic Summerville Formation.

8.8 Corral to right at base of mesa. Curtis Formation sandstones above corral are capped by red, layered siltstones and sandstones of the Summerville Formation. At 9:00 are resistant hogbacks of sandstone in the Brushy Basin Member in the narrow, step-faulted segment paralleling the north border of the graben.

9.4 Small outcrop area to left is the earthy member of Entrada Sandstone, which is just north of the north boundary fault of the graben. Small hills just south of the Entrada outcrop are formed on sandstones in the Brushy Basin Member in the step-faulted segment along the north edge of the graben. In the mesa to the right, lower slopes are in the Curtis Formation. The cliffs and upper slope are formed in the Summerville Formation, and the upper cliff and top are composed of the Tidwell Member of the Morrison Formation.

9.6 Road is on the upper part of the Entrada Formation.

9.8 **Stop 6.** Dark gray sandstone lens is asphaltic, oil-saturated sandstone. If not removed by grading, the layer is sometimes visible in the road. Oil saturation here occurs in several thin sandstone layers in the upper part of the Entrada Formation. The petroleum likely was generated in deeper, Pennsylvanian-age rocks and migrated upward along the nearby graben faults and into the porous zones in the Entrada.

9.9 Road junction. Continue west (left) on the Salt Wash Road.

10.4 At 10:00, hogbacks of south-dipping sandstones of the Cedar Mountain Formation are in the step-faulted segment along the north part of the graben.

10.8 Road crosses the north boundary fault of the graben. This is near **Stop 7**.

10.9 Road crosses gray slopes formed on mudstones of the Cedar Mountain Formation.

11.2 Road crosses/follows Salt Wash drainage west-northwest along the center of the graben. Colorful chert and chalcedony fragments are abundant int wash alluvium. Gray-green calcareous mudstone and siltstone of the Cedar Mountain Formation just north of the wash dip steeply southward.

11.3 To the south about 0.25 mile are north-dipping sandstones and mudstones of the Cedar Mountain Formation that have dropped down along the south edge of the graben. Rocks just south of the graben ae those of the Tidwell and Salt Wash Members of the Morrison Formation.

11.4 Torrey's Spring, a mineral spring, is up this wash to the right along the north boundary fault of the graben.

11.7 Road crosses north boundary fault of the graben.

11.9 To right about 150 feet north of the road is the abandoned oil test of Pacific Western Oil Corp., Sharp State Unit 1. Rock underlying eolian cover here is the Slick Rock and earthy members of the Entrada Sandstone.

12.3 Reddish massive sandstone to the right is the Entrada.

12.4 To left at 9:00 the fault along the north edge of the graben passes along the hillside. Cedar Mountain Formation is south of the fault. To right at 3:00 is a slump structure in the Entrada, reflecting movement near the graben margin.

12.5 At 11:00, low hills of Cedar Mountain Formation are just inside the north edge of the graben.

12.8 **Stop 8**. Deformed sandstone and siltstone beds are displaced at an outlier at 2:00. When viewed from the southwest, this feature is nicknamed "Elephant Butt Butte." Red, massive sandstone in the lower part of the "butte" may be the earthy member of the Entrada Sandstone. Siltstone draped over the sandstone may be the Curtis Formation. If so, this would mark the J-3 unconformity.

12.9 Fork in road; stay to right. Hill at 9:00, just to the south, is formed on the earthy member of the Entrada and is slightly north of the bounding graben fault.

13.0 Mesa about 0.5 mile to the north (right) has lower slopes of Curtis Formation, cliffs of red, even-bedded Summerville Formation, upper slopes of Tidwell Member and a cap of tan sandstone of the Salt Wash Member of the Morrison Formation.

13.1 White, slobby material interbedded with the Entrada Sandstone in the small hill off the right side of the road is travertine. Also, travertine occurs as light-colored dikes in this area. The travertine is composed of aragonite, a calcium carbonate mineral deposited from carbon dioxide-charged water migrating upward and laterally along the north bounding fault(s) of the graben.

13.2 Road junction. Turn left on the spur road that leads to the Tenmile Geyser. We will return to this junction later after visiting **Stop 9**.

13.3 At 9:00, the northern boundary fault of the graben goes through the hill.

13.5 10:00 near the top of small hill are thin layers of travertine in the uppermost part of the Entrada Sandstone. At 3:00 are steeply-dipping, light-colored bands of travertine deposited from CO_2-charged waters.

14.0 Junction of faint road to the south (left). Turn left and proceed across flat area toward the 100-foot-high butte formed on Entrada Sandstone. The base of the butte is white (presumably leached by CO_2-charged water) and the upper part is red.

14.1 Low, rounded mound of white tufa is the site of a small spring pool of cold, effervescent water. This pool is along the north flank of the butte. Proceed left around the east end of the b butte.

14.15 The light -colored spire at the east end of the butte is called the Redcap, from its red (unaltered and presumably more resistant) cap of Entrata Sandstone. Proceed southward.

14.2 **Stop 9**. Stop at the flat area of travertine northeast of the Salt Wash drainage. This site is on the north bounding fault of Tenmile graben. North of the fault is the Entrada Sandstone and south in the graben is the Cedar Mountain Formation. Visible on the ridge about 0.25 mile to the west-northwest along the fault is a quarry developed on mining claims in the travertine deposits that were planned to be marketed as “honeycomb marble” in 2004. The small Tenmile Geyser is about 100 yards south up the drainage of Salt Wash. The geyser erupts at irregular intervals from a drill casing to heights of 4 to 6 feet above the ground. After locating the geyser and inspecting the travertine deposits, retrace our route back to milage 13.2 and turn north (left) and continue on Salt Wash Road. Reset milage to 0.

Route to Stop 10

0.0 Proceed northward. Road is on reddish sandstones of the Entrada.

0.3 Road climbs onto bench formed in the lower part of the Curtis Formation.

0.8 Road junction. Continue straight ahead. Unimproved 4-wheel drive road to the right goes to the north and after approximately 5 miles connects with the road to Crystal Geyser, Grand County Road 150. View of mesa at 12:00 exposes Curtis Formation up to and including the thin dark red layer. Above the Curtis is the light red Summerville Formation, above which are the green-gray beds of the Tidwell Member of the Morrison Formation. Doelling (2001) measured the following thicknesses in this area: Curtis Formation 167 feet, Summerville Formation 75 feet and Tidwell Member 66 feet. Tan sandstones of the Salt Wash Member cap the mesa.

0.9 Cross an unnamed drainage, which is a tributary to Salt Wash.

1.2 Abundant colorful chalcedony occurs to the north (right) on lower slopes of the mesa in red siltstone beds of the upper part of the Curtis Formation. Rockhounds call the red chalcedony "Walker agate" and the yellowish chalcedony "Sanchez agate." Higher up, the dark red ledge marks the contact with the basal Summerville Formation above.

1.6 Parking location for foot traverse to **Stop 10**. Please do not block the road. One-way walking distance to **Stop 10** is about 1,150 feet over an irregular surface (no trail). Elevation difference between the road and **Stop 10** is about 50 feet.

Stop 10 is on a prominent ledge overlooking Big Bubbly Spring, which is 6 to 8 feet in diameter. A safety issue is present here! Do not get too close to the lip of the ledge; a fall could be fatal! We will not descend to the spring. The stream of bubbles emanating from Big Bubbly Spring are CO_2 gas. A large area of travertine extends east and west of the spring. This spring is 200 to 300 yards north of the north bounding fault of the graben. About 150 yards southeast of the stop in a small tributary canyon, there are excellent pseudohexagonal crystals of aragonite up to 1 cm in diameter, sometimes forming clusters of many crystals. The crystals represent sixling twins of this orthorhombic mineral. Return to the vehicles and retrace route back to the Salt Wash Road, turn east (left) and return to I-70 (~15.3 miles) via Salt Wash Road and Ruby Ranch Road.

Note: For anyone interested in actually visiting the spring, there is a washed-out road a short distance beyond the paring area. Follow it down to the drainage, then walk about 150 yards eastward to the spring.

END OF ROAD LOG 2. Turn around and retrace route back to I-70. The distance is approximately 15.3 miles.

Road log to the El Grand manganese mine.

We did not consider there to be enough interesting exposures to merit this being a part of the trip, but we include this road log and a brief paper on the manganese district in case someone wants to explore the area. There is little to see of the mine itself. This road log begins at mile 7.5 on the main road log. The road that you will follow ends at the Ruby Ranch on the Green River.

0.0 Junction of Ruby Road and Salt Wash Road.

0.2 Cross Salt Wash, which drains west within the Ten Mile graben to the Green River.

0.5 View west-northwest at 2:00 is along strike of south edge of Salt Wash graben. South of the graben, sandstone of the Salt Wash Member of the Morrison Formation dips gently to the north. At roughly this point, the road crosses into the Green River SE 7.5' quad.

0.85 Remains of an old stock pond on the right. The road is on sandstones of the Salt Wash Member for almost 2 miles. The Salt Wash Sandstone Member was named by Charles Lipton in 1914 in USGS Bulletin 541 for exposures of gray, coarse-grained sandstone in the McElmo Formation. The McElmo has been replaced by the Morrison and Cedar Mountain Formations. The type section of the McElmo was 164 feet thick and is about 3 miles southeast of here.

2.3 Rusty-red and gray siltstones in the low area to the right are the Tidwell Member, the lowermost member of the Morrison Formation.

2.6 Just left of the road is the contact of the Salt Wash and Tidwell Members.

2.7 The road passes through patented mining claims for the next mile.

3.3 Road is on reddish sandstone and siltstone of the Jurassic-age Summerville Formation. View to the left (southeast) is into the Salt Wash valley and its sand dunes, derived mostly from the Slick Rock Member of the Entrada Formation.

3.4 Black lag material is manganese ore minerals that replaced thin limestone or limy lenses in the upper part of the Summerville Formation.

3.45 Oil well west of road is the CF&I 42-16 in the Salt Wash Oil Field. This well, and one about 0.3 mile ahead (CF&I 22-16) have produced about 700,000 barrels of oil, which is most of the production of this field. The field is on a small dome discovered by seismic exploration in 1961 that produces from vuggy porosity in the Leadville Limestone of Mississippian age at a depth of about 8500 feet.

3.6 Oil well on the bench to the south is State 1-16A. The Green Rive is visible about 4 miles to the south and the Ruby Ranch is along the floodplain.

3.7 Road to the right leads to the oil storage tank complex for the Salt Wash Oil Field. Sandstones of the Glenn Canyon group of Jurassic age are exposed in the "reef," visible

on the east side of the San Rafael Swell about 20 miles to the west. Turn around and backtrack a few hundred feet to a pull-offs on the right side. This leads to large, scraped-off area that was formerly part of the manganese mine. The other part is across the road. There is little to see, but if you venture over the edge of the point, you can find some golf-ball or larger pieces of ore. Smaller pieces are abundantly scattered on the surface as you start back toward the highway. The mineralized lenses were generally only a few inches thick. The ore minerals are pyrolusite and manganite. The deposits were worked in 1901-1906 and during the WW1 years of 1915 to 1918 on claims owned by the Colorado Fuel and Iron Company (CF&I). There was some minor mining activity again during the Korean Conflict. For more information, see the section on the Little Grand Manganese District.

End of log.