117°18.000' W   117°16.000' W   117°14.000' W   117°12.000' W   117°10.000' W   WGS84 117°07.000' W

37°49.000' N

31

POWERLINE

6

36   31

1

6

37°47.000' N

1550

1600

1650

1750

37°45.000' N

Canyon

1750

RAILROAD GRADE

WT

Mc Mahon Ridge   Black Butte

13   12

16   14

Gemfield

Water Tank

Gemfield   15

Ruby Hills   1750

Tognoni Springs

10   8   11

4WD

1807

Corral

95

17   Columbia Mtn

1851

Vindicator Mtn

9

Banner Mtn   7

West Spring

Landing Strip

Silver Pick Mine

3   36

5   6

West Spring

Cem

31

Nevada Eagle Mine

Slaughterhouse Spring   Well

Florence Mine

4   2

6

Espina Hill

Willow Spring

Spring

Goldfield

1

Rabbit Spring

Preble Mtn

Blackcap Mtn   1750

1950

WT Well

Myers Mtn

1800

Malpais Mesa

Poco Can

Mira Mtn

Meda Pass

Chispa Hills

4WD

1950

4WD

1850

Mine

1750

AQUEDUCT

1749

GRADE

1750

1850

1750

36   31

1600

H I L L S

37°43.000' N

37°41.000' N

37°39.000' N

TN /MN
14½°

0.0   0.5   1.0   1.5   2.0   2.5   3.0   3.5 miles
0   1   2   3   4   5 km

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0.00 **Stop 1:** In Goldfield, meet in the parking lot of the **Metallic Ventures office** located one block south of the old fire station No. 1 (corner of highway 95 and Euclid). The MGI office is a trailer house on the NE corner of Myers and Euclid. Next proceed to the Merger for introduction and orientation.

Return to highway 95 and turn right. Left turn on Bellevue. Proceed one block and make a right turn then travel easterly on a good graveled road leading out of town.

Traveling easterly, the route between Goldfield and the Merger site enters the Goldfield mining district from the southwest side and passes just south of the very rich **Florence mine** and large wooden headframe, **Little Florence Hill** (just south of the large Florence shaft and white house) and the **Red King shaft** (smaller wooden headframe located next to the gravel road on the left-hand or north side). Note also the yellow head frame and warehouse on the left. This is Lode Star Gold's facility located on the **February-Premiere shaft**.

Most of the recorded 4.2 million ounces of gold produced in the Goldfield district has come from the area extending from the Red King shaft on the south to foot of **Columbia Mountain** on the north. Columbia Mountain is located approximately 1 mile north of the road and is easily recognized by the large white "G" on the southwest side of the peak.

The less productive mines of the **Red Hills** area are located south and east of the road while passing the Florence and Red King mines.

1.30 **Left turn.** At this point there is a good view of the mines of the **C.O.D. Ridge** area. In this area mainly from the **Gold Bar** and **Victor** mines which are recognized by the two larger mine dumps located on the south flank of C.O.D. Ridge. The deepest workings of the Goldfield district are located on the north side of C.O.D. ridge accessed by the **Deep Mines shaft** which reportedly was sunk to the 2,150 foot level (vertical distance below the collar). Proceed northerly approaching Merger shaft.

1.60 **Merger gate (green locked gate).**

1.80 **Stop 2: Introduction and district orientation:** This area is MGI's sample storage facility located on the **St. Ives** mineral patent and site of the **Merger shaft** and headframe. Topics such as mining history, geology, geochemistry, geophysics, remote sensing, hydrothermal alteration and mineralization will be discussed.

Goldfield Main District Tour from Merger storage facility

0.00 **Reset the trip odometer in the yard at the Merger shaft.** Enter the Main district from the Merger facility by traveling northerly and then westerly around head frame of the Merger shaft.

0.20 Pass the **Grizzly Bear shaft** (located on the right), and continue down the road through the right-hand curve.

0.45 The remains of the ore bin and shaft collar of the **Clermont shaft** can be seen on the right. The north end of the **Jumbo pit** can be seen back to the left (look south towards the Florence shaft and mine buildings). On the left, several foundations and skeleton of an old steel and concrete building can be seen. These ruins mark the site of the famous and very rich **Mohawk mine**.

0.50   Take right turn at intersection and travel northerly along the high wall and east side of the Red Top open pit.

0.70   The large headframe of the **Laguna shaft** is on the right.

0.90   **Stop 3: Locked green gate** at entrance to the **Red Top pit**. <u>**THIS IS A HARD HAT AREA.**</u> A brief look at the altered and mineralized rhyodacite/dacite host rocks will be made at the bottom of the Red Top pit. Proceed with caution and drive to last turn before reaching the bottom of the open pit. Park vehicles and walk to the lower benches of the mine. **Watch out for falling rock.**

The Red Top open pit was completed in the early 1990's by a number of mining companies including: Dexter Mines, Red Rock Mining, American Resources Inc., and Rhea Gold Inc. Gold mineralization in the Red Top mine is hosted in a northwest-striking and northeast-dipping structural zone which some authors have referred to as the **Columbia Mountain Fault Zone**.

The fault zone exposed in the Red Top pit is approximately 100 feet wide and can be recognized in the south pit wall by the approximately -50° northeasterly dipping structural foliation. The geometry of this fault zone is listric in character and the up-facing, concave, curviplanar-dip of the fault flattens significantly at depth to the east. (Based on current thinking, the southeast strike of this fault zone suggests that it may actually be part of the **intrusive related ring fracture zone** at this location rather than the north-south striking Columbia Mountain Fault.)

Typical of most ore bodies in the Main district, gold mineralization in the Red Top pit is hosted in silicified, faulted, and sheared rhyodacite and/or dacite porphyry. This rock package is locally referred to as the "**Main district dacite.**" This lithologic unit appears to be an eroded remnant of a large volcanic flow dome complex that is similar in age to the **Milltown Andesite (~21.5 m.y.)** which is another important volcanic host rock sequence in the Goldfield district.

In terms of ore host rock, the rhyodacite/dacite flow dome sequence in the Main district is by far the most productive in the Goldfield district. The Main district dacite is underlain by generally unproductive **latite** flows and tuff. A portion of the latite flow unit is exposed in the northwest wall of the Red Top open pit. While there is some recorded gold production from latite, as for example at depth in the Clermont mine, and even though the latite is often noted to be extremely clay altered and pyritic in drill cuttings, very little gold has been produced from this lithologic unit in the Goldfield district. (It is important to note, however, that much of the hydrothermally altered latite that occurs in the central part of the Goldfield district is little explored.)

Free gold in the Goldfield district is generally associated with **quartz, dickite, and alunite** gangue. In addition, particularly in the Main district, gold is commonly found to be associated with a variety of sulfide mineral species typical of high-sulfidation type copper-gold hydrothermal systems. Sulfidic ore in Goldfield always includes **pyrite**, but other common sulfide species include: **marcasite, famatinite, enargite,** and **bismuthinite.** (A more complete list of the mineralogy of Goldfield ores and alteration suite is presented in an attachment to this handout.) Minor gold and silver **tellurides and selenides** have also been noted in some Goldfield ores.

The geology of the Red Top mine illustrates very well the importance of structure, and in particular structural intersections, to the localization of hydrothermal alteration and mineralization. In detail, ore deposition in the Main district is strongly influenced by the intersection of the East Goldfield structural zone and the Columbia Mountain fault system.

When leaving the Red Top pit, evidence of **post-mineral faulting** can be observed in the west pit wall where younger alluvial gravels of the **Pozo Formation** and/or **Siebert Formation** have been down-dropped in contact with the older Main district dacite. A brief stop can also be made at the southwest end of the pit to observe an exposure of **argillized latite** which is footwall to the altered and mineralized dacitic host rocks.

Reset odometer at the gated entrance to the Red Top pit.

0.00   Gate at entrance to Red Top Pit. Turn left, and follow the road around the north and west side of the Red Top open pit.

0.10   **South end of Columbia Mountain:** The two bumps on the southeast flank of Columbia Mountain represent the footwall (on the left—west) and hanging wall (on the right—east) contacts of the actual north-south striking and east dipping Columbia Mountain fault zone. Rock units in the footwall of this fault are composed of Jurassic quartz monzonite (light colored dump and outcrops) and Ordovician Palmetto Formation slate (black outcrops). The hanging wall of the fault is Main district dacite and/or Milltown Andesite (further to the north).

0.30   Proceed straight through the road intersection toward the **Combination open pit.**

0.40   Take left fork in road. The large Silver Pick mine dump and shaft is located just ahead on the right.

0.60   At 9:00 o'clock to the vehicle direction (on the left), the old stone building foundation and wall are located at the site of the historic Mohawk mine. The Great Stope in the Mohawk mine produced 250,000 ounces of gold from an ore shoot that was about ~75 feet long, ~14 feet wide, and ~150 feet down dip. The ore averaged $400 per ton at $20.67 per ounce (~20 oz/ton). One famous lot of ore from the Mohawk mine weighed a little over 47 tons and paid almost $575,000 (~600 oz/ton).

0.70   **Stop 4:** The **Combination open pit** is on the right, and the shaft, headframe and mine buildings of the very productive Florence mine lie straight ahead atop the large dump in the foreground to the southeast. At this location, more typical Goldfield-style silica ledges are exposed in the north and southeast pit walls. Coming from the direction of the Florence mine, the main production zone in the Combination mine enters the pit area on the southeast limb of the crescent shaped open pit, travels northwesterly to the collapsed workings of the January shaft, then the zone more or less turns sharply to the northeast and heads toward the workings of the Mohawk mine. The Combination Main shaft, which is no longer visible having been consumed by the open pit mining, is located about midway along the southeast trending lower bench of the open pit. Note that the caved shaft may reopen again sometime in the future so proceed along this bench with caution.

Contemplating this peculiar geometry, one might suspect a fault intersection in the area of the January shaft in order to explain the hook shaped geometry of the combined Combination and January ledges. While this is still a possibility, the underground plan maps of the ledge, however, do not suggest that this interpretation is correct. Instead, the plan of the ledge and drifts indicate that the structure is truly curvilinear in form, and the ledge zone seems to be continuous and unbroken around the rather sharp bend changing from a southwesterly heading to southeasterly.

The complex geometry of the Combination ledge is a good example of the irregular and generally unpredictable character of the strike and dip of any given ledge zone in the Goldfield district. Similarly, although at times even more dramatic, gold mineralization is also very unpredictable in distribution and ore-grade gold mineralization seems to start and then abruptly stop for no apparent reason. It is just this

scenario that makes gold exploration extremely difficult, drilling intensive, and, more often than not, very frustrating. The massive ledges exposed in the walls of the Combination open pit exhibit how these silicified structures, either dike- and/or breccia-filled, descend from surface outcrop to ore zones along curved, fault-controlled, hydrothermal fluid passageways.

Finally, note the young, post-mineral fault scarps which have tilted and down-dropped various blocks of younger alluvial gravels and tuffaceous sediments of the **Pozo** and/or **Siebert Formations** exposed in the northwest wall of the Combination open pit. Note that the wooden headframe once on site above the Combination shaft has been relocated next to the Santa Fe Saloon for posterity's sake.

Return to vehicles and proceed ahead on road toward the Florence shaft.

The area southeast of the Combination mine hosted several rich ore bodies along this part of the main ledge system; these include the **Riley** on the northwest end, closest to the Combination mine, and the **Sweeny stope** of the Florence mine on the southeast end. Also note that the Florence mine, like the Sweeny stope had a number of other rich gold ore bodies that radiate out from the central shaft location on several headings. The Sweeny stope began near the Florence shaft and continued about 200 feet to the northwest towards the Riley Lease and Combination mine. Other ore splay headings trend northerly toward the Jumbo mine and others trend southeasterly toward Little Florence Hill and the Red King shaft. Ore bodies between the Combination shaft and the Florence were generally hosted in Main district dacite porphyry and ended at or above the footwall contact with the underlying and generally barren latite flow unit. South of the Florence shaft, beneath Florence hill and the Red King mine, rich gold ore bodies are hosted in Milltown Andesite.

The large silver-colored metal building on the east side of the Florence shaft is a mill facility constructed by Newmont in the late 1940's to process gold ore from a small ore body located to the southwest about midway between the Florence shaft and the town of Goldfield.

0.80   Left turn at the Baby Florence shaft and small wooden headframe; the road climbs the low hill on the west edge of the **Jumbo open pit mine.**

0.85   **Stop 5: Jumbo Open pit overview:** The very productive north-northwest striking ledge system exposed in the Jumbo open pit is well exposed in the walls and floor of the open pit. The Jumbo ledge system is a steep, east-dipping structure in the hanging wall of the ring fracture zone and Columbia Mountain fault zone. The ledge generally strikes north-northwest along the long axis of the pit, but note that the main ledge zone is offset slightly in a number of locations by steep northeasterly trending cross faults. In some cases the northeast structures are ledge filled and mineralized; however, some of these cross structures are post-mineral in age and generally off-set mineralization slightly. Several splays of the Jumbo structure make their way back to the Florence shaft and several of these had some significant recorded gold production. Note the intense argillic alteration envelope developed in dacite porphyry wall rocks which host the silica ledges and gold ore shoots.

0.90   From this point on the west side of the Jumbo Pit continue northerly back toward the right turn which will eventually pass the Clermont, Grizzly Bear, and Merger shafts. This route will back track to the Merger storage area.

1.15   **Grizzly Bear** headframe on left.

1.30   **Merger shaft on right.**

1.55   **Merger entrance, locked green gate.** Exit the Merger shaft area and turn left after passing through the green gate. Travel north toward Vindicator Mountain and stop briefly at the Spearhead shaft.

1.75   Four o'clock to vehicle direction the large dump on the south side of the east-trending gulch marks the site of the Deep mines shaft which was sunk to the 2,150-foot level (vertical distance below the shaft collar). This shaft passed through the base of the Tertiary volcanic section and into Jurassic quartz monzonite at about 1,400 feet below surface. A drift was then driven back to the west at the bottom of shaft to intersect the down-dip projection of the Main district mineralized zone, but apparently no ore was encountered in these workings.

2.25   **Stop 6:** After passing the sharp bend in the road with the large waste dump on the left and the historic **Spearhead mine** dump on the right, turn off the road to the right at the top of the hill and proceed back southeasterly a short distance to the large Spearhead mine dump. Proceed on to the dump surface as far as the fence around the caved shaft collar of the Spearhead mine. On the south side of the shaft collar there is a scattered pile of sulfide-bearing Palmetto Formation. This "ore" generally runs fairly high in copper (+1% and also carries some gold values (+0.1 opt). The fairly oxidized, dark steel gray to black copper-bearing mineral is likely famatinite and/or enargite. If bismuthinite is present it can be recognized as bright silvery needlelike crystals. Free gold is sparse, but may be found by the experienced (or lucky) hand lens operator. The upper lift of the dump consists of Palmetto black shale, argillite, and Jurassic quartz monzonite is also common. The quartz monzonite on this dump exhibits the effects of an intrusive-related advanced argillic hydrothermal alteration event, and this mineral assemblage includes mainly quartz, pyrophyllite, and diaspor, and possibly some alunite. Bright white, finely crystalline, dickite may be observed in vugs in the sulfide-bearing rock on the scattered ore pile.

0.00   **Return to the main road from the Spearhead shaft and turn right. Reset the trip odometer to 0.0 once on the main road.**

0.10   Columbia Mountain is at 9 o'clock to the vehicle direction. Vindicator Mountain (Jqm) is straight ahead.

0.30   **Large road intersection, turn right onto the Kawich road.** The black outcrop area on the left (southwest flank of Vindicator Mountain) is a **roof pendant** of Ordovician Palmetto argillite hosted in Jurassic quartz monzonite. The high flat topped peak of Vindicator Mountain is capped with **Vindicator rhyolite (Tvr)** which rests on Jurassic quartz monzonite and as far as it is known this contact represents the base of the Tertiary volcanic stratigraphic section in the Goldfield mining district.

0.70   **Fork in road keep right and continue easterly on the Kawich road.**

0.80   The high peak on the horizon at 1 o'clock is **Preble Mountain** which is underlain by a Tertiary dacite porphyry intrusion hosted in Tertiary Milltown Andesite. Much of the dacite porphyry has been pervasively altered to quartz-alunite, and pyrophyllite has been noted to occur locally around the margins of the intrusive. Minor gold occurrences have been identified in generally east-west trending structures which contain quartz and hypogene crystalline alunite veins and veinlets. Preble Mountain has been the focus of a number of exploration drilling programs over the past 40 years for both porphyry copper-molybdenum and gold mineralization. All of these exploration ventures have been unsuccessful in locating significant economic mineralization of any type. The geographic location of Preble Mountain has likely been determined by the intersection of the inferred intrusive-related ring fracture zone and the East Goldfield structural belt (west-northwest/east-southeast trending).

0.85 **Mine dump on the left near top of hill:** the light gray rock on the mine dump is argillized, pyritic latite flow rock. The dark gray knob to the east (right) of this dump is a relatively fresh, but perhaps weakly propylitized, dacite porphyry (Td) plug.

1.35 **Banner Mountain on left:** Banner Mountain largely consists of argillized and locally silicified latite flows (Tl) and tuff (Tlt). Banner Mountain is located at the geographic center of the inferred ring fracture zone.

1.50 **Small patches of Jqm in road and on slope to left:** the Tertiary volcanic package is very thin in the core of the district presumably due to uplift and erosion which have completely removed any outcrop evidence of younger volcanic units.

1.80 **Brownie Mountain:** small hill on the right. The Mayflower patent which covers **"Pyrophyllite Hill"** is located on the north (left) side of the road.

1.90 **Left turn** onto the two track road located at the beginning of the left-hand curve in the Kawich Road.

2.00 **Stop 7: Arrive at the top of Pyrophyllite Hill.** Collect sparingly since we are nearing the mined-out state at this locality.

0.00 **Return to the Kawich road and reset the trip odometer to zero.** The gray rock across the road at this intersection is part of the latite flow unit (Tl). **Turn right onto the Kawich road and backtrack toward Vindicator Mountain.**

0.80 **Vindicator Mountain** can be seen on the horizon at 1 o'clock.

1.15 **Sharp right turn onto the Diamondfield road.**

1.70 Vindicator Mountain (Jurassic quartz monzonite-Jqm) on left—Banner Mountain (Tlt and Tl) on right.

1.90 **Right turn at fork in road onto two-track road.** The large reddish-brown outcrop straight ahead is a west dipping flow of **Vindicator Rhyolite** (the outcrop is on the left side of the two-track road).

2.20 Jqm outcrop located on the west bank of the drainage next to the road.

2.65 **Stop 8:** Drainage crossing: walk a short distance to the propylitized Latite Tuff (Tlt) outcrop located west (left side) of the road. **Caution: Soft sand in drainage bottom. Drivers turn the empty vehicles around on firmer ground across the drainage (north side).**

0.00 **Reset trip odometer to zero at drainage crossing:** proceed a short distance ahead (southerly) to sharp left turn.

0.15 **Stop 9:** The two-track road leads a short distance to the east to a **yellow-green sulfidic dump and prospect pit** located on the left side of road. Examine sulfidic **Tertiary Diamondfield Formation (Ashley's Tsf_1)** on the dump of the prospect pit. The pyritic thin-bedded shale and tuffaceous interbeds are currently interpreted to represent moat sediments which were deposited for the most part in a subsiding basin in the interior portion of the inferred ring fracture zone. The rocks here are weathered and oxidized, and perhaps some of the pyrite, and a small degree of argillic hydrothermal alteration may also have affected these rocks.

Drivers turn vehicles around being careful not to run over the tire-piercing sage and rabbit brush.

1.00   Backtrack to the Diamondfield road and turn right.

1.20 Continue along the Diamondfield road to the north. The next series of hills on the left, north of Vindicator Mountain are referred to as the **Ruby Hills**. A small outcrop of Jurassic quartz monzonite (Jqm) is exposed at the base of the hill on the north side of the canyon between Vindicator and the south end of the Ruby hills. The lighter colored band above the quartz monzonite outcrop is **Vindicator Tuff (Tvt)** which in turn is overlain by **Vindicator rhyolite (Tvr).** These two genetically related rock types probably represent a small flow dome sequence. The Vindicator Rhyolite in the Ruby Hills is often strongly affected by quartz-alunite alteration. The denser rhyolite outcrops at the top of the hill are pervasively silicified and often contain finely meshed needles of crystalline pink alunite throughout the matrix and phenocryst sites.

Continue up the main road along the southeast flank of the Ruby Hills. The rocks on both sides of the road are Jurassic quartz monzonite. Higher on the ridge to the right (east), the bed rock is mainly latite tuff which is then capped locally by a few sparse exposures of Vindicator rhyolite. On the left the Ruby Hills consist of quartz-alunite altered Vindicator tuff and rhyolite.

1.50   Left turn onto two track road which climbs to the top of the Ruby Hills. Exposures of altered Vindicator tuff and rhyolite can be seen as you drive up this short but rather rough jeep road.

1.60   View through the gap to the north provides a first look at McMahon Ridge to the north.

1.75   Stop 10: Top of Ruby Hills and Overview of the northwestern part of the inferred, but by now famous if not infamous, ring fracture zone.

Looking west toward Columbia Mountain and **Morena Ridge** the mine workings from south to north include the **Henry Clay** (small dump south of a large silicified outcrop on the north extension of the Columbia Mountain fault zone), **Cracker Jack mine** (dozed white dump), **Kruger mine area** (just over the ridge behind the Cracker Jack mine, the **Sandstorm mine** dump behind the Kruger, the **Kendall mine** north of the Sandstorm (last large mine dump on the hill below the horizon), and the **Adams open pit mine** recognized by the low waste dumps in the low ground in front of the Kendall mine.

North of the Adams pit area the ring fracture zone is less productive, but can easily be traced around to the northeast by less intense, but more or less continuous, clay altered and locally silicified outcrops of Milltown Andesite. This bend area also is characterized by a number of small plugs and flows of less altered andesite referred to by MGI as the **upper member of the Milltown Andesite (Tmau)**. Continuing around the bend towards **McMahon Ridge**, prospecting activity picks up in the **Red Butte, Virginia,** and **Rabbits Foot** patented claims area. From the drainage cut at the lower west end of McMahon Ridge to the east end of that prominent ridgeline, an area recognized by recent drilling activity, the strike length of known gold mineralization is approximately 3,500 feet. Significant drill intercepts up to (0.5 oz/ton gold) extend a vertical distance below the small peak situated about midway along the ridge is 800 feet. The Belmont fault zone is located at the east end of McMahon Ridge, and Black Butte is the prominent black knob located a short distance east of McMahon Ridge proper. The rounded barren hill between the east end of McMahon Ridge and Black Butte is a slightly younger flow dome composed of rhyodacite/andesite porphyry which is the source of a pronounced magnetic high anomaly at this location. The dome was originally mapped by both Ransom and Ashley as Milltown Andesite, but these rocks have sparse quartz phenocrysts and sparse biotite which suggests a slightly more felsic composition than typically found in the Milltown Andesite sequence.

Of particular interest here is the order and thickness of the volcanic stratigraphy exposed between the Ruby Hills and the inferred ring fracture zone centered on McMahon Ridge. Descending the slope of the Ruby Hills (to the north), the volcanic stratigraphy becomes progressively younger. The base of the Tertiary volcanic section begins with the **Vindicator tuff (Tvt)** which lies on the **Jurassic quartz monzonite (Jqm)** outcrop in the canyon to the south, then **Vindicator rhyolite (Tvr)** at this location. The stratigraphic sequence then passes sequentially up through the **latite tuff (Tlt)** and **latite flow (Tl) units**, a thin layer of **Kendall tuff (Tkt)**, then **unit one of Ashley's Sandstorm formation (Tsf$_1$**--which MGI refers to as the **Diamondfield Formation Tdf)**, the **Milltown Andesite (Tma)**, and finally the **upper Milltown Andesite (Tmau)** which is exposed on the low hills at the base of the south slope of McMahon Ridge.

It is important to describe the character of the Ashley's Sandstorm Formation Tsf$_1$ at this time. Within the interior of the ring fracture zone the **Tsf$_1$ (a.k.a. Diamondfield Formation Tdf)** unit is notably different than the **Tsf$_2$ (Tsr—Sandstorm Rhyolite)** which is the host formation for the gold deposits in the Gemfield, Kendall and Kruger mine areas which, by the way, are also located outside of the inferred ring fracture zone **(Ashley's Tsf$_2$ = fluidal (very finely laminated, flow-banded rhyolite)**.

Tsf$_1$ (a.k.a. Tdf) is for the most part a very thin bedded, carbonaceous, pyritic, black shale unit which locally contains thin partings of tuffaceous material (particularly near the base and probably latitic in composition), tuffaceous sandstone, and pebble conglomerate (common near the top of the unit). This shallow water sedimentary unit is for the most part restricted to the northern half of the inferred ring fracture zone. The Tsf$_1$ unit has been found to vary greatly in thickness between the core of the district where it is fairly thin (tens of feet or less—perhaps partly affected by erosion) and the hanging wall of the ring fracture zone where it has been found to be up to ~500 feet thick. It is speculated that the ring fracture zone may have acted somewhat like that of a typical growth fault in that the water depth of the lagoonal basin never was very deep at any given time, and though no fossil plant evidence has been found, the hydrologic character may have been stagnant, probably acidic, and subject to reducing conditions.

In as much as the Tsf$_1$ unit (1) represents an intravolcanic period characterized by the deposition of a clastic sedimentary sequence that occurred between the eruption of the Kendall tuff and/or the older latitic volcanic sequence and the Milltown Andesite, (2) is clearly a very fine-grained detrital sedimentary unit that appears to have been deposited in a generally shallow restricted basin under reducing conditions based on the presence of common to abundant diagenetic pyrite throughout, (3) has a very limited and well-defined distribution (i.e. the interior of the northern ring fracture zone), (4) the sediments of this unit tend to have coarser-grained, higher energy components that have so far been found to be limited to the flanks of the core area, and (5) as mentioned above, is now known to thicken dramatically from the central domed core of the district where it may be only several tens of feet thick, up to 500 thick just inboard of the ring fracture zone on the south flank of McMahon Ridge (based on drill hole data MCM-292 and MCM-294), MGI believes that this formation represents a moat sediment deposited within a volcanic depression bound by the ring fracture system.

So in the northern part of the Goldfield district it is apparent that structural subsidence appears to have taken place along the ring fracture zone during and after the eruption of the older latitic and Kendall Tuff volcanic sequence. Subsequently, the core area of the volcanic depression was being uplifted and eroded as the result of the emplacement of a younger complex intrusive center of intermediate (andesitic **Tma**) to slightly felsic (**dacite-rhyodacite Td**-and minor rhyolite—**Morena Rhyolite Tmr**). The fact that the shales contain a higher percentage of interbedded tuffaceous material at its base, and a coarser-grained sandy and conglomeratic component at the top suggests a more rapid doming event in the core

area just prior to the eruption of the Milltown Andesite. It is further surmised that the rate of subsidence was fairly well matched by the infilling of the moat so that water depths remained shallow.

The fact that the Tsf_1 unit is absent to the south suggests that either less subsidence took place along the ring fracture zone in the southern half of the district, or the presence of the East Goldfield structural belt may have complicated the depositional environment in this region during the intravolcanic period bound by the eruptions of the latite (Tl/Tlt ~33 m.y.) and later andesite (Tma ~21.5 m.y.).

Finally, to further characterize the relationship between Tsf_1 (Tdf) and Tsf_2 (Tsr) it is apparent from drilling results in the Adams mine area that the fluidal rhyolite of Ashley (Tsf_2) is essentially equivalent in age to that of Tsf_1. However, most drill holes in this area where the two depositional basins overlap slightly, that the depositional period for Tsf_1 was significantly longer since the rhyolite is in fact sandwiched between an upper and lower shale sequence. In the Adams area, particularly outside of the ring fracture zone, the Tsf units are underlain by a thick tuff sequence referred to by Ransom as the **Kendall tuff (Tkt)**. Drilling results support this stratigraphic relationship very well. As noted by Ransom the Kendall tuff is a complex intertongued series of tuff units that display a variety of lithologic characteristics the most notable of which is the highly variable quartz-phenocryst content of a particular tuff member. All members of this group contain euhedral biotite crystals, but crystal and pumice contents, like that of quartz phenocrysts, vary significantly.

The fluidal **Sandstorm Rhyolite (Tsf_2/Tsr)** is the very important host rock formation in the Gemfield gold deposit. This rock unit is for the most part uniquely unmistakable (even in rotary drill cuttings) due to its very finely or delicately flow banded, generally glassy to devitrified character. The base of the **Sandstorm Rhyolite** is marked by a thick **vitrophyre (Tsv)** which is locally found to be hydrothermally altered to some degree, particularly at the base of the Gemfield gold deposit where it is variably sulfidic and clay altered. Where the basal vitrophyre is found to be less altered it generally varies in color from green, to gray, or brown. In addition to the glass at the base of the formation some vitrophyre has also been noted at various stratigraphic positions above the base of the unit as well.

The Kendall Tuff and the Sandstorm Rhyolite (Tsf_2/Tsr) are considered to be closely related in time and sequence of deposition since both units have been found in unison throughout the northwest part of the Goldfield district. Furthermore, the Kendall Tuff has been observed to lie on a mappable erosion surface and can be underlain by latite, quartz monzonite, or Palmetto Formation.

Based on the aerial distribution of the Sandstorm Rhyolite and Kendall Tuff, it is apparent that these volcanic rocks probably erupted from vent source located in the vicinity of the Sandstorm and Kendall mines prior to the beginning of Milltown volcanism. These units are noted to be either considerably thinner or absent inside of the ring fracture zone, but lithologic equivalents of the Sandstorm Rhyolite have been noted along the northeastern part of the ring fracture zone in the Tognoni Springs area, and rhyolite has been found beneath the Milltown Andesite in the Tom Keane area in the southeastern part of the Goldfield district.

As noted above, for the sake of simplifying terminology as well as to emphasize the difference in lithologic character between Ashley's Sandstorm Formation members, MGI personnel have substituted Diamondfield Formation (Tdf) for Tsf_1 and Sandstorm Rhyolite (Tsr) for Tsf_2.

0.00   **Return to the Diamondfield road and reset the trip odometer to zero at the intersection. Make a left turn and head north to the Diamondfield town site.**

0.40   View of **McMahon Ridge** straight ahead.

0.65 **Diamondfield town site and intersection:** sharp right turn on two track road past iron pipe and benchmark marking the corner of the Diamondfield post office erected in the early 1900's. (At this intersection a sharp left turn heads toward the Adams pit area and/or the west side of Vindicator Mountain. Straight ahead or left fork of the main road leads to McMahon Ridge. The right fork of the main road leads to Black Butte which is not a scheduled stop on this trip due to current mining activity and property ownership. Black Butte is the site of a small dacite porphyry stock which is apparently localized along the northern segment of the ring fracture zone. It also is the site of minor historic gold production).

Drive to the foot of the prominent ridge northeast of Banner Mountain in the north central part of the Goldfield district where sedimentary rocks of the Sandstorm Formation have been silicified and later overprinted with late-stage advanced argillic alteration mineral assemblages related to the older, deeper portions of the Goldfield hydrothermal system.

0.90 **Take right fork in road and continue southeasterly on two-track road.**

1.25 **Stop 11: Crystalline diaspore, Tsf$_1$/Tdf conglomerate outcrops, and small abandoned heap leach pad with gold ore reportedly from the Adams open pit mine area.**

Note black shale fragments on dump of small shaft next to the abandoned heap leach pad. Next, walk along the drainage to the south to the small outcrops of tuffaceous sandstone and conglomerate located on the right side of the drainage. If it is a sunny day, note the sparkling crystal growths on fractures in the silicified outcrops. Note diaspore often occurs in silicified rocks, but diaspore is not in equilibrium with quartz.

Return to vehicles and backtrack to Diamondfield.

1.80 **Diamondfield intersection:** make a right turn onto the left fork of the main road and head toward the low saddle at the top of the ridge.

2.25 **Keep left on the main road just before reaching the low saddle on the ridge.** The barren hill on the right is the young dacite/andesite (magnetic high) flow dome that is localized on the northern ring fracture zone between McMahon Ridge and Black Butte. Continue up the main road onto the northeast end of McMahon Ridge. Gold mineralization is hosted in massive silica ledges and thin clay zones which in turn are hosted in Milltown Andesite.

2.35 **Belmont fault zone:** The Belmont fault is a northeast trending normal fault that dips at about -60° to the northwest. The large barren area on the right side of the road is the former site of the **Old Daisy mine** shaft which produced some high grade ore mainly from shallow ore bodies hosted in the Belmont fault zone. The dump was hauled away and processed for gold and silver at some point probably during the late 1970's or early 1980's. The large dump approximately 1200 feet to the northeast marks the site of the **Belmont mine shaft.** A number of multi-ounce dump samples of gold-bearing quartz vein material have been collected from the Belmont mine dump. Ordinary translucent quartz vein material found in drill cuttings and outcrops on McMahon Ridge generally are barren and presumed to be late stage genetically. Conversely, milky white quartz vein material almost always contains microcrystalline dickite and usually contains gold mineralization on McMahon Ridge. A number of specimens of this type of quartz vein have even been found to contain specks of visible gold. **Dickite** is a common alteration clay mineral that is almost always present with gold in Goldfield ores found throughout the district.

The silica ledge on the north side of McMahon Ridge at this location is referred to as the **North Ledge** which strikes nearly east-west and dips steeply to the south.

2.40 Several prominent silica ledges can be seen on the left (south) side of the road. Contrary to most of the structures on McMahon Ridge these have a steep northerly dip and based on the number of shallow workings, these ledges appear to have some minor gold production.

The **Main Ledge** on McMahon Ridge strikes essentially east-west and dips at an average of about -70° to the south. The main ledge at this location has been referred to historically as the **Camp Vein**. The Camp Vein is strongly brecciated and contains fragments of silica ledge and white-colored quartz vein material. Here the ledge is also notably coated with heavy iron oxides on fracture surfaces. The Main Ledge system on McMahon Ridge has a known strike length of about 3,500 feet not counting the northeast trending Belmont fault zone which accounts for about another 1,300 feet of strike length. In all, as many as seven ledge splays have been identified in exploration drill holes along strike on McMahon Ridge. To date, however, most of the ore grade gold values have been fount in the Main Ledge while most of the other splays exhibit either very low gold grades or are essentially barren.

Also of interest at this location is the fact that thin beds of Tsf_1/Tdf have been encountered below the Milltown Andesite in a number of drill holes. These intercepts contain significant gold values (e.g. 20 feet @ 0.1 oz/ton).

2.50 **Stop 12: Fork in road, take left fork and stop at the toe of the mine dump on the right:** The mine dump on the right side of the road is the site of the **Detch-Brewer mine**. Note the fragmental character of the Milltown Andesite (lahar?) on the dump. The Milltown Andesite displays numerous rock textures throughout the Goldfield district. On McMahon this fragmental texture is common. In the main district flow textures seem to more common. Elsewhere tuffaceous and even sedimentary epiclastic textures can be found.

2.55 **Fork in road, take the high road to the right and stop at the top of the rise** which is the top of the dump surface of the **Lutz-McMahon shaft**.

2.60 **Stop 13:** Note the strong argillic alteration developed in the Milltown Andesite in the hanging wall of the Main Ledge. The typical alteration sequence found on McMahon Ridge begins with propylitic alteration in the Milltown Andesite in the more distal parts of the hanging wall block. Argillic alteration progressively increases toward the ledge contact. Finally, a very intense clay zone from 5 to ~25 feet thick occurs on the hanging wall contact of the Main Ledge. The Main Ledge at the surface may be more than 100 feet thick but ledge thickness gradually decreases at depth. At depth, a second intense clay alteration zone occurs on the footwall contact of the Main Ledge. The thickness of this zone is similarly between ~5 and ~25 feet thick. Below the footwall clay zone hydrothermal alteration in the Milltown Andesite quickly passes from argillic to propylitic.

Gold mineralization on McMahon Ridge generally seems to occur as clay plus free (probably very finely disseminated) gold (+/-tellurides) and is commonly associated with dickite. The silver to gold ratio is generally low and may be on average about 2:1. Some copper-arsenic-antimony-sulfides have been observed in ore piles on McMahon Ridge, but most multielement analyses have not shown significant copper grades in the McMahon Ridge deposit to date.

Significant gold mineralization has been found in a number of depositional sites on McMahon Ridge. First of all, it is important to note that the silica ledges are not always mineralized, and good gold grades

have been found in both the hanging wall and footwall clay zones adjacent to the Main Ledge. Furthermore, significant gold grades that occur within the silica ledge often times are associated with sizable clay seams which are surrounded by or enclosed in massive silica ledge material. Finally, some significant gold mineralization again associated with clay has been identified in propylitic alteration zones in the Milltown Andesite host rock.

The significance of these occurrences suggests that the primary gold mineralizing event occurred after the initial emplacement of the massive silica ledges and propylitic alteration envelope developed in the Milltown Andesite. Furthermore, it appears that after emplacement of the massive silica ledges McMahon Ridge was subjected to another significant structural event(s) which included significant degrees of faulting and fracturing of both the wall rocks and massive silica ledges. This advanced stage of structural preparation may have also been accompanied or followed by a strong hydrothermal acid leaching and clay alteration event which further prepared the ground for the main gold depositional event. In the end it is certain that much more detailed information regarding the nature of the McMahon Ridge gold mineralizing event will be gathered during the mining of this deposit.

2.70   **Sharp right turn and cross over the east-west axis of McMahon Ridge on the Thanksgiving Gift patented claim.**

2.80   **Make a left turn at the next intersection and proceed around and down the northwest flank of McMahon Ridge to the Great Bend mine area.**

2.90   **Continue down the south flank of McMahon Ridge through the next two road intersections.**

3.00   **Take the left fork in the road, and proceed down and around the large dump of the Great Bend mine shaft.** The low hills ahead and across the narrow drainage to the south are capped with upper member of the Milltown Andesite.

3.10   **Take the right fork in the road and travel southwesterly to the next intersection.**

3.15   **Take the right turn at the next road intersection and travel westerly along the base of the south slope of McMahon Ridge.**

3.30   **Gap in the silicified outcrop of the ring fracture zone and apparent west end of significant gold mineralization on McMahon Ridge. Take the left fork in the road and cross to the south side of the drainage and continue westerly around the ring fracture zone.**

3.45   **Stay left at the next three-way road intersection.**

3.60   **Stay on the main two-track road and continue traveling westerly.**

4.00   **Keep left, traveling westerly around the ring fracture zone.** Note the small stocks of upper Milltown Andesite apparently localized along the northwest part of the ring fracture zone.

4.15   The main strand of the ring fracture zone is located on the south side of the small andesite stock south of the road. Spotty patches of silicification in this area on the north side of the ring fracture zone are hosted in Tsf_1/Tdf and/or Tsf_2/Tsr.

4.40   Recent drilling in this area tests shallow, west dipping beds and flows of Tsf_1/Tdf and Tsf_2/Tsr.

4.60   **Keep left at the fork in the road.**

4.80   **Keep left at the fork in road, enter northeast end of Adams open pit mine area at the site of the historic Conqueror mine.**

4.90   **Northeast end of the Adams open pit mine area.** A thin wedge of Tsf_1/Tdf is in contact with Kendall Tuff (Tkt) in the west highwall of the open pit at this location. The rocks are strongly silicified and contain fine crystalline alunite and barite locally. Milltown Andesite is exposed in the east pit wall and represents the hanging wall assemblage of the ring fracture zone.

5.05   Keep right and enter the main open pit of the Adams mine. Unpublished production notes indicate that ~40,000 tons of gold ore were removed from this mine in the early 1980's (~4,000 ounces of production).

5.15   **Stop 14: Claim post marker, Adams pit overview.**

5.20   **Stop 14a: Time permitting a brief walking tour can be made of the highwall along the west side of the open pit.** Altered Tsf_1/Tdf is exposed along the west pit wall and the trace of the ring fracture zone can be seen in the north pit wall.

0.00   **Reset the trip odometer to zero at the main road intersection located at the south end of the Adams open pit mine.**

0.10   **Take left fork at next intersection to access the Kendall-Sandstorm-Kruger mine area. Keep left and proceed southwesterly.**

0.15   **Stay left.** The large mine dump ahead is the location of the **Kendall mine** shaft. The medium-sized dump to the south is the **Sandstorm mine**. Stay left and enter the small open pit mine on the **Kruger mine** Patent. Gold was first discovered in the soils in the vicinity of the Kendall and Sandstorm mines in December 1902 by William Marsh and Harry Stimler. The two prospectors from Tonopah were reportedly led to this area by a Native American by the name of Tom Fisherman.

0.35   **Stop 15: Kruger open pit and ledge system.** View silicified and mineralized Sandstorm Rhyolite exposures believed similar in character to mineralization contained in the Gemfield deposit. The large dark silica ledge on the hill to the east exhibits barite crystals in vugs and classic leached outcrop cavities after barite mainly at the north end of the ledge outcrop.

Turn vehicles around in the Kruger pit area and back track to the north.

0.45   **Take left fork in road and proceed north.**

0.65   **Main road intersections: make a left turn and proceed northwesterly.** Note the outcrops of silicified cap rock on Kendall Mountain on the north side of the road. Host rocks are Milltown Andesite. To date, no significant gold mineralization has been found to be associated with this apparently high level silica cap.

0.90   **Stop 16: Silicified outcrop of Sandstorm Rhyolite on left.** A brief stop can be made at this outcrop if time permits. Some crystalline barite may be found in rocks on the dumps of several small pits at the top of the hill to south.

1.30   **Silicified outcrops of Milltown Andesite on hill top south of the road.** Recent exploration drilling tests west-dipping Sandstorm Rhyolite at depth beneath the Milltown Andesite.

1.40   **Cross drainage and make a left turn to the south at the next intersection.**

1.45   **Road intersection, left turn.**

1.90   Low hill on left is capped with upper Milltown Andesite (Tmau). The lower slopes of the hill are interpreted to be Milltown Andesite (Tma). **Continue on main road to the south.**

2.40   The Goldfield Consolidated Mines Company mill foundation was constructed in 1909 and closed on December 31, 1918. The mill housed 100 stamps and the town of Goldfield reportedly shook whenever the mill was operating. Bedrock in the low light colored hills below and along the ridges to the north and south of the mill is west-dipping Sandstorm Rhyolite.

2.60   **Continue straight following the main road to the south which passes through several road intersections.**

   Approaching the west flank of Columbia Mountain: Columbia Mountain is capped in part with a thin fault sliver of locally silicified and alunitized **Sandstorm Rhyolite (Tsr)**. The upper slopes on the west flank of Columbia Mountain are generally underlain by a thin wedge of west-dipping layers of quartz phenocryst-rich **Kendall Tuff (Tkt)**. A working hypothesis currently believed by some suggests that the lower contact of the Kendall Tuff is cut by a strand of the ring fracture zone. The ring fracture zone, if present, has been intruded by a relatively thick dike-like mass of **Morena Rhyolite (Tmr)**. A number of obvious prospect pits have been dug along the lower contact of the inferred intrusive mass of Morena Rhyolite. Beds of the **Ordovician Palmetto Formation (Op)** occur in the footwall of the ring fracture zone beneath the intrusive contact of Morena Rhyolite, mainly on the southwest flank of Columbia Mountain. Further north along the west flank of Morena Ridge, the Kendall Tuff unit occupies the footwall of the ring fracture zone, but intrusive Morena Rhyolite still marks the position of the ring fracture above the sole of the fault. Many of the rocks along the crest of Columbia Mountain and Morena ridge are intensely altered most exhibit classic examples of quartz-alunite alteration. The alunite in this area is generally found to occur as delicate pink crystals which fill vugs and fractures in a fine mesh-like fashion.

2.90   **Stop 17:** Left turn toward an old stone building foundation where exposures of **Sandstorm Rhyolite vitrophyre (Tsv)** can be observed.

End of Tour

Goldfield District Detailed Stratigraphy

Quaternary

    Q, Qp Alluvial and colluvial deposits, pediment surfaces

Tertiary

Middle Miocene

Tmb	Malpais Basalt and Rabbit Spring Formation (~7 m.y.)
Tts	Spearhead Member of the Thirsty Canyon Tuff (~7 m.y.)
Tp	Pozo Formation
Tb	Basalt north of Tognoni Mountain (10.4 ±1.4 m.y.)
Trct	Rhyolite of Cactus Peak (11.2 ±0.2 m.y.)
Tb	Basalt southwest of Mud Lake (12.0 ±0.5 m.y.)
Tb	Basalt of Black Cap Mountain (12.9 ±1.2 to 10.4 ±1.3 m.y.)
Tb	Basalt north of Kendall Mountain (13.5 ±3 m.y.)
Tmib	Mira Basalt
Ts	Siebert Tuff (16.0 ±0.3 to 12.7 ±0.3 m.y.)
Tst	Silic vitric air fall tuff commonly with pumice lapilli
Tm	Meda Rhyolite (17.8 ±0.4 m.y.)

Lower Miocene

Ta	Andesite flows

Goldfield hydrothermal event (20 to 21.5 m.y. approximate timing based on field evidence)

Tc	Chispa Andesite (20.8 ±0.4)?
Trw	Rhyolite of Willow Springs (or Wildhorse Spring?--21.2 ± 0.4 to 20.3 ±0.8 m.y.)
Trwt	Rhyolite lapilli tuffs associated with rhyolite flows
Tct	Tuff of Chispa Hills (21.1 ±0.3)
Te	Espiña Breccia (22.2 ±1.4 m.y.)
Tab	Andesite Megabreccia (possible landslide deposits)
Td	Porphyritic Rhyodacite/Dacite (23.2 ±1.6 to 19.8 ±1.4 m.y.) *hosts most gold*
Tdb	Rhyodacite flow breccia, tuff breccia, and conglomerate
Tql	Porphyritic Quartz Latite-Rhyolite
Tas	Sedimentary Rocks composed of Milltown Andesite clasts
Tma	Milltown andesite (21.5 ±0.5 m.y.)
Trt	Silicic Tuff and Ash Flow Tuff
Tdt	Rhyodacite Ash Flow Tuff
Tmd	Porphyritic Rhyodacite

Oligocene

Tmr	Morena Rhyolite
Tsr	Sandstorm Rhyolite (Tsf₂ of Ashley) *-good host rock for disseminated ore*
Tsv	Sandstorm Rhyolite vitrophyre
Tdf	Diamondfield Formation (Tsf₁ of Ashley) Black shale with tuffaceous interbeds

(moat sediment)

Tkt   Kendall Tuff of Ransome (locally very quartz phenocryst rich, 33.2 ±2.6 to 31.1 ±3.5 m.y.)

Tl   Quartz Latite (~33 m.y.)

Tlt   Compacted quartz latite tuff and lapilli tuff with plagioclase

Tvr   Vindicator Rhyolite (~33 m.y.)

Tvt   Vindicator Tuff (~33 m.y.)

Jurassic

Jqm   Quartz monzonite (Alaskite of Ransome,173 -147 m.y.)

Ordovician

Op   Palmetto Formation (500 - 435 m.y.)

Qp	PEDIMENT GRAVEL (Quaternary)—Gravel-bearing gobbles and boulders. Locally contains layers cemented by abundant limonite
Tmb	MALPAIS BASALT AND RABBIT SPRING FORMATIOM (Miocene or Pliocene)—Malpais Basalt; porphyritic, highly aluminous basalt with plagioclase and olivine phenocrysts, 7.8+-0.8 m.y. (average of four age determinations, Armstrong and others, 1972; Ashley and Silberman, 197). Rabbit Spring Formation (Ransome, 1909); local fluvial gravels underlying the basalt flow
Tts	SPEARHEAD MEMBER OF THIRSTY CANYON TUFF (Miocene or Pliocene)—Sodic rhyolite ash-flow tuff containing sanidine phenocrysts. Densely welded and crystallized. Average of four age determinations is 7.0+-0.4 m.y. (Armstrong and others, 1972; Ashley and Silberman, 197 ; Kistler, 1968; Noble and others, 1964)
Tp	POZO FORMATION (upper Miocene)—Fluvial conglomerate. Probably more widespread than shown, generally indistinguishable from conglomerate of the Siebert Tuff
Trct	RHYOLITE OF CACTUS PEAK (Miocene)—Rhyolite tuff and tuff breccia associated with rhyolite flows exposed extensively to north and east of mapped area. Age is 11.2+-0.2 m.y. (Ashley and Silberman, 197)
Ts	SIEBERT TUFF (Miocene)—Includes andesite breccia of Ransome (1909). Four age determinations range from 12.7+-0.3 m.y. to 16.0+-0.3 m.y. (Ashley and Silberman, 197 ; Silberman and McKee, (1972). Volcanic conglomerate and sandstone; tuffaceous conglomerate, sandstone, and shale
Tst	Silicic vitric air fall commonly with pumice lapilli
Tb	BASALT OF BLACKCAP MOUNTAIN (Miocene)—Aphanitic aluminous olivine basalt flows and dikes. Locally bedded scoria deposits at base of flows. Six age determinations range from 10.4+ 1.4 m.y. to 13.5+-3.0 m.y. (Armstrong and others, 1972; Ashley and Silberman, 197)
Tmib	MIRA BASALT (middle Miocene)—Porphyritic olivine basalt with plagioclase phenocrysts and conspicuous quartz xenocrysts
Tm	MEDA RHYOLITE (middle Miocene)—Rhyolite ash-flow tuff, moderately crystal-rich, containing sanidine, quartz, and biotite phenocrysts. Densely welded and crystallized. Age is 17.8+ 0.4 m.y. (Silberman and McKee, 1972)
Ta	ANDESITE FLOWS (lower Miocene)—Porphyritic trachyandesite with small plagioclase, pyroxene, and hornblende phenocrysts, and rhyodacite with small plagioclase, pyroxene, hornblende, and biotite phenocrysts
Te	ESPINA BRECCIA (lower Miocene)—Rhyolite tuff breccia locally with lapilli tuff interbeds, forming a pumice cone deposit (area 2). Aphanitic spherulitic rhyolite flow (area 7). Age is 22.2+ 1.4 m.y. (Ashley and Silberman, 197)
Tc	CHISPA ANDESITE (lower Miocene)—Trachyandesite flow(s) and dikes with small Plagioclase and large augite phenocrysts. Includes andesite dikes of Ransome (1909). Age is 20.8+-0.4 m.y. (Ashley and Silberman, 197)
Trw	RHYOLITE OF WILDHORSE SPRING (lower Miocene)—Porphyritic rhyolite flows and flow breccias, locally vitrophyric near base. Consists of at least two flows containing quartz, sanidine, and biotite phenocrysts,
Trwt	Rhyolite lapilli tuffs associated with rhyolite flows. Locally compacted and partly welded beneath overlying flow
Tct	TUFF OF CHISPA HILLS (lower Miocene)—Dacite vitrophyre of Ransome (1909). Rhyodacite-quartz latite ash-flow tuff. Contains moderately abundant to abundant plagioclase, quartz, and biotite phenocrysts. Age is 21.1+-0.3 m.y. (Kistler, 1968)
Tab	ANDESITE MEGABRECCIA (lower Miocene)—Jumbled blocks from units Tma, Td, and Tdb. Probably represents landslide deposits
Td	PORPHYRITIC RHYODACITE (lower Miocene)—Dacite of Ransome (1909). Average of eight age determinations is 21.2+-0.8 m.y. (Albers and Stewart, 1972; Ashley, 1973; Ashley and Silberman, 197 ; Silberman and Ashley, 1970). Several rhyodacite flows containing plagioclase phenocrysts and varying proportions of hornblende, biotite, and hypersthene phenocrysts. Some flows contain scattered corroded quartz phenocrysts. Forms flow-dome complexes
Tdb	Rhyodacite flow breccia, tuff breccia, and conglomerate representing water-reworked ejecta. Tma accidental fragments abundant in lower part and scarce in upper part
Tql	PORPHYRITIC QUARTZ LATITE-RHYOLITE (lower Miocene)—Contains abundant quartz, sanidine, plagioclase, biotite, and hornblende phenocrysts. Locally vitrophyric
Tas	SEDIMENTARY ROCKS COMPOSED OF MILLTOWN ANDESITE CLASTS (lower Miocene)—Fluvial sandstone and conglomerate. Uppermost conglomerate contains scarce ejecta blocks of porphyritic rhyodacite(Td)
Tma	MILLTOWN ANDESITE (lower Miocene)—Flows and tuffs, including pyroxene-hornblende and pyroxene trachyandesite, pyroxene-hornblende and hornblende-biotite rhyodacite, and minor quartz latite and basalt. Finely porphyritic or aphanitic. Age is 21.5+-0.5 m.y. (Albers and Stewart, 1972)
Trt	SILICIC TUFF AND ASH FLOW TUFF (lower Miocene)—Associated with Milltown Andesite(Tma)
Tdt	RHYODACITE ASH FLOW TUFF (lower Miocene)—Moderately densely welded, crystallized tuff containing abundant plagioclase and biotite phenocrysts
Tmd	PORPHYRITIC RHYODACITE (lower Miocene)—Flow-banded rhyodacite containing abundant plagioclase, hornblende, and biotite phenocrysts, and scarce large rounded feldspar phenocrysts
Tmr	Moderately crystal rich to crystal-rich ash-flow tuff containing plagioclase, sanidine, quartz, biotite, and scarce hornblende phenocrysts. Morena Rhyolite of former usage (Albers and Stewart, 1972; Ransome, 1909)
Tsf2/Tsr	SANDSTORM FORMATION (Oligocene)—Sandstorm rhyolite of Ransome (1909). Fluidal rhyolite bearing small sanidine and quartz phenocrysts. Age is 28.6+-3.2 m.y. (Ashley and Silberman, 197)
Tsf1/Tdf	Silicic tuff, lapilli tuff, and tuff breccia characterized by abundant lithic fragments. Locally conglomerate, sandstone, and tuffaceous shale at base of unit
Tl	QUARTZ LATITE (Oligocene)—Latite and Kendall Tuff of Ransome (1909). Average of four age determinations

	is 32.9+-1.0 m.y. (Ashley, 1973; Ashley and Silberman, 197). Fluidal porphyritic quartz latite with plagioclase, biotite, and hornblende phenocrysts. Included in unit mapped by Ransome as "latite"
Tlt	Compacted quartz latite tuff and lappilli tuff with plagioclase, biotite, hornblende, and scarce quartz phenocrysts. Includes Kendall Tuff of Ransome in area 1. In area 2, included in unit mapped by Ransome as "latite"
Tvr	VINDICATOR RHYOLITE (Oligocene)—Four age determinations range from 24.4+-0.5 m.y. to 33.0+-2.0 m.y. (Ashley, 1973; Ashley and Silberman, 197). Fluidal rhyolite and rhyolite flow breccia bearing quartz phenocrysts
Tvt	Rhyolite ash flow tuff bearing quartz and sanidine phenocrysts, crystal-poor to moderately crystal-rich
Jqm	QUARTZ MONZONITE (Jurassic)—Alaskite of Ransome (1909). Age is 170±13 m.y. by fission-track determination on sphene (Ashley, 1973). Two biotite age determinations and one muscovite age determination by K-Ar range from 147±3 m.y. to 173±3 m.y. (Ashley and Silberman, 1137 ; Edwards and McLaughlin, 1972). Leuco-quartz monzonite and quartz monzonite, mostly medium-grained, with a few aplite dikes and mafic inclusions
Op	PALMETTO FORMATION (Ordovician)—Siliceous shale, siliceous argillite, and minor limestone

GOLDFIELD

- Goldfield is one of Nevada's premier gold producing mining districts. Recorded historic production for the main district from 1903 to 1960 includes: 4,190,133 oz. gold, 1,450,258 oz. silver, 7,669,666 lbs. copper, and 51,744 lbs. of lead from 7,740,154 tons of ore (mathematical ave. grade = 0.541 oz/ton gold and 0.99% copper). Albers and Stewart (1972, NBNG Bull. 78) state that the recorded production for the main district, historically speaking, valued almost $90 million dollars. However, "allowing for the large amount of high grading by miners, total production may be as much as $100 million." Most of the production in this district was completed during the years 1904 and 1915.

- Outside of the main district there has been little recorded production, but there is strong evidence that the productive character of the hydrothermal system extends well beyond the limits of the main district. For example, Albers and Stewart (1972) state that "the total recorded production of the Diamondfield district (McMahon Ridge) is $52,305, but actual production may be as much as $1 to $2 million." By inspection, and considering the grades of ore samples collected from numerous workings around McMahon Ridge and Black Butte, it is appears likely that much more gold has been extracted from this part of the Goldfield hydrothermal system than is reported. Likewise, based on the extent of existing mine workings and gold geochemistry from dump samples, we know that gold was produced from several mines in the Tognoni Spring and East Goldfield district located in Nye County.

- Metallic Ventures has acquired a large land position in the Goldfield district which consists of both patented and unpatented land that covers a total of approximately 20,620 acres or 32.2 square miles of prospective land.

- The Goldfield district is somewhat of an anomaly in the United States in terms of the geologic character of this plus one million-ounce, volcanic-hosted copper-gold system. While there is evidence for the existence of this type of system elsewhere in Nevada and the western U.S., the Goldfield hydrothermal system is unique in its very large order of magnitude.

- The geologic character of the Goldfield district is very similar to the Andean- and southwest Pacific Rim-style of high-sulfur, copper-gold systems such as the deposits in the El Indio and Maricunga-belts, Chile; Lepanto, Philippines; Chinkuashih, Taiwan; and Yanacocha, Cerro de Pasco, Ccahuarso, and Julcani, Peru.

- In the main district, the largest producers belonged to the Goldfield Consolidated Mines Company. The most important of these mines include the Red Top, Mohawk, Jumbo, Combination, and January.

- Gold grades in the main Goldfield district are spectacular. For example:

  - Ransome (1909) reports, that the main ore shoot in the **Red Top mine** was opened in February of 1905. The total gross production of this mine by October 31,1907, was $509,541.11 (~24,651 oz.). Average grade figures are not known for this mine but a sample of oxidized ore from the Red Top pay shoot assayed $12,500 to the ton (@ $20.67 per oz., the ore grade is 604.741 oz. gold per ton).

  - Another example, the great stope in the **Mohawk mine** "produced in round figures $5,000,000 (~241,896 oz) from ore averaging $400 (~19.352 oz.) a ton. Ore in the great stope "extends from near the 245-foot level to the bottom of the oxidized ground, a vertical distance of nearly 150 feet. The length of the stope was about 75 feet." Widths of the ledge varied dramatically, but overall the shoot was probably fairly narrow; <50 ft. and maybe 6-10 ft. on average.

  - According to Ransome, "Ore shipments (from the **Combination mine**) began in November 1903, the first car averaging $160 per ton (~7.741 oz.)--the lowest in grade that was ever sent out according to Mr. Edgar A. Collins" (former superintendent of the property). By the end of the year in 1904, "1,166 tons of ore had been shipped, with an average value of $419 per ton, or a total gross value of $489,209. The average contents of this ore were 20.22 ounces of gold and 2.68 ounces of silver per ton. The average gross value of the ore shipped up to

May, 1905, when milling began, was $404 (~19.545 oz.) per ton."

- Also in 1904, a lease on the **January mine** is reported to have produced 1,000 tons of high-grade ore, yielding $199,489 (~9,651 oz.) and $286,000 (~13,836 oz.) worth of ore, ranging in grade from $30 (~1.451 oz.) to $100 (~4.838 oz.) per ton.
- The **Jumbo Mining Company** was organized in March 1904, "and during the following Spring (a month or two later) leases were let to six or more different sets of lessees. Most of the lease blocks extended for 100 feet along the lode, although the northernmost, or Ridge-Curtis lease, was 300 feet in length. The lessees soon found ore and the ledge became an object of great activity, each block having its own shaft. The daily output from all leases in August of 1904 was estimated at $10,000 a day (~484 oz). The total gross production from these leases to their expiration early in 1905 was approximately $1,100,000 (53,217 oz. extracted in less than one years time). The most productive single lease was the Bowes-Kernick, near the middle of the claim, which expired October 31, 1904, after a net production of $258,000 (12,482 oz.). The royalty paid by the lessees to the company was 20 per cent of the gross output."

- Since 1996, Romarco and MVI geologists have conducted geologic mapping and geochemical sampling throughout the district. The MVI geochemical database includes the results for 8,000 rock chip samples from outcrops, dumps, and underground mine workings. The soil geochemical database contains the results for 6,000 samples. Two rock samples of note come from the Black Butte and Tognoni Springs area: Sample RG-6 collected from the dump of the Bull Dog Fraction returned 18.728 oz. per ton Au, 14.8 oz. per ton Ag, 463 ppm As, >1000 ppm Sb, 30 ppm Bi, 0.23% Cu, and 0.18% Pb. Samples TOG-7 & 8 were collected from the dump of the Excelsior patent at the north end of the Nevada Gold and Casino (NVG&C) lease. These samples returned the following results: 5.341 oz. per ton Au and 17.20 oz. per ton Ag; and 10.409 oz. per ton Au and 54.30 oz. per ton Ag, respectively. There is no doubt that these workings pass through the barren near surface, acid leached alteration layer and encountered high grade mineralization at depth.

- In addition to geochemistry and geophysics, some new techniques must be employed at Goldfield in order to be successful in finding more high-grade ore. Romarco and Metallic Ventures have been compiling clay mineral, hydrothermal alteration data at Goldfield since 1996. More than 4,000 samples have been analyzed, in-house, in an attempt to map and understand the clay alteration fingerprint related to the gold ores found throughout the district. Certain individuals, who shall remain nameless at this time, feel that there is potential for at least doubling the recorded production figures of this poorly understood and under-explored, world class mining district.

Important Characteristics of the Goldfield Mining District According to Frederic Leslie Ransome 1909

Quotations from Professional Paper 66

Age of Mineralization: The time of deposition of the ores is not definitely known, but was probably Pliocene [*5-2 Ma; however, more recent studies have determined that the mineralizing event occurred in early Miocene time, between 21 and 20 Ma*]. They were deposited from acidified solutions and the deposits now exposed are believed to have been at no time covered by more than 1,000 feet (305 meters) of rock.

Ore Host Rocks: The most important ore bodies thus far found are in dacite, although some small, very rich pay shoots have been discovered in the Milltown andesite, Sandstorm Formation, Palmetto Formation, Latite, and quartz monzonite.

Character of the Ore Bodies: The most notable features of these ore bodies are their remarkable richness and their equally remarkable irregularity. The ores are almost without exception associated with craggy outcrops of silicified volcanic rock, although only a very small proportion of these outcrops, which are extraordinarily numerous and constitute the most striking superficial features of the district, have been found productive (*Yet*). Associated with the silicification other processes of locally intense alteration, especially the formation of alunite, have also been active, producing in many cases a softening of the rock affected, and thus serving to accentuate the silicified portions under the selective action of erosion. The deposits have formed along zones of fissuring, which for the most part are very irregular in trend, are rarely traceable in any one direction for more than half a mile, and are not planes of notable faulting. Branching and intersection are very common. Many of the outcrops show no linear character, being mere irregular knobs of siliceous and alunitic material. Some of these probably represent intense alteration at the point of intersection of two or more inconspicuous approximately vertical fissures. Others are erosion remnants of nearly horizontal silicified zones and, as in the case of Black Butte, merely cap the hills whose summits they form.

Ledges: The Goldfield deposits, in all that pertains to the genesis of the ore, are most closely allied to metasomatic fissure veins. Yet they can scarcely be included within that class. They are intimately related to fissuring, but only a small part of the ore has actually filled fractures (spaces of discission). These fractures, moreover, rarely show that regularity in form and that persistency in strike and depth which are connoted with the term 'vein' or 'vein fissure.' Structurally the deposits are irregular masses of altered and mineralized rock traversed by multitudes of small, irregularly intersecting fractures, such fracturing passing in many places into thorough brecciation. There are exceptions to this character. Certain deposits exhibit in part more regularity of form and there is reason to suppose that at depths greater than those now reached such approaches to lode-like form may become more numerous. But within the mass of rock extending from the surface to a depth of 600 feet (183 meters), a mass which includes all the ore bodies thus far exploited, the deposits can not be called lodes or veins with-out giving to these words unusual meanings or without tacitly ascribing to the mineralized bodies a tabular form that they rarely possess.

In view of these considerations, the word 'ledge,' already in use by miners in a less definite sense than 'vein,' will be employed in this report to designate the masses of silicified or otherwise altered rock in which the ore bodies are found. This word, although suggested by the outcrops of such material, will be applied at all depths where any distinction is possible between an alteration intimately associated with the ores and a more extensive alteration of country rock. It will be applied, moreover, to rock which has undergone alteration of the kind characteristic of the immediate vicinity of ore bodies, whether or not ore is known to be present.

The actual ore bodies or pay shoots occur within, but are seldom coextensive with the ledges or ledge matter.

The proposed usage of ledge is not intended to restrict the word to a special technical meaning but rather to avoid the use of vein and lode, which, while broadly used by miners, are employed with some definiteness in scientific writing.

Oxide Ores: Oxidized ores have supplied a large part of the gold produced during the first two or three years of exploitation, and some mines, particularly the Sandstorm and Kendall, which are in rhyolite, no sulphide ores are as yet known. As a rule the oxidized ore is a soft, shattered, more or less earthy material, usually stained brown by oxide of iron. Fragments of rusty porous quartz are mingled with kaolin, alunite, gypsum, alum, oxide of iron, and various earthy mixtures of no definite mineral composition. Some of the rich ore, as in the Sandstorm mine, is a nearly white, impure kaolin, gritty from the presence of minute crystals or grains of quartz, and containing all through it abundant specks of free gold. Barite, in crystals up to an inch (25 millimeters) in length, is abundant in this ore. In the January and Combination mines some of the most characteristic rich ore consists of porous rusty quartz (silicified dacite), in which the pores and crevices are partly filled with yellow, earthy limonite and tiny pearly scales of bismite, the oxide of bismuth. In some specimens these scales form pseudomorphs after bismuthinite. They are usually a sign of rich ore, but are occasionally found in low-grade or barren material. In the mines at Black Butte the richest oxidized ore usually shows little greenish-yellow specks of a ferric tellurite, either emmonsite or durdenite, and tellurite, the oxide of tellurium, was noted in a partly oxidized telluride ore from the Goldfield-Belmont mine near Black Butte. Melanterite (hydrous ferrous sulphate), in some cases mixed with a very little chalcanthite (hydrous copper sulphate), occurs in the partly oxidized ore of the Combination and Florence mines.

The valuable constituent of the oxidized ores is native gold. Native silver or halogen compounds of silver are not common.

Sulfide Ores: The sulfide ores of the Goldfield district are of complex mineralogical character, native gold and pyrite being accompanied by minerals containing copper, silver, antimony, arsenic, bismuth, tellurium, and other elements. In some ores the gold occurs free in fine particles, which as a rule are so closely crowded together in the characteristic flinty quartz gangue as to form yellow bands or blotches. The associated minerals are pyrite, marcasite, bismuthinite, a reddish gray cupriferous mineral which appears to correspond more nearly to famatinite than to any other known species, and a new cupric sulphantimonite, which has been named goldfieldite. A concentric crustification is highly characteristic of the richest ores, fragments of silicified, alunitized, and pyritized rock being covered by shells of gold and sulfides.

Ore Mineralogy:

Native elements:	gold	Au	[yellow gold (Mohawk), reddish gold]
	sulfur	S	
Sulfides:	bismuthinite	Bi_2S_3	
	galena	PbS	
	sphalerite	ZnS	
	wurtzite	ZnS	
	Tennantite	$(Cu,Fe)_{12}As_4S_{13}$	
	cinnabar	HgS	
	chalcopyrite	$CuFeS_2$	

	pyrite	FeS_2
	marcasite	FeS_2
	goldfieldite	$Cu_{12}(Te,Sb,As)_4S_{13}$
	enargite	Cu_3AsS_4
	famatinite	Cu_3SbS_4
	luzonite	Cu_3AsS4
Tellurides:	petzite	Ag_3AuTe_2
	hessite	Ag_2Te
	sylvanite	$(Au,Ag)_2Te_4$
Oxides:	quartz	SiO_2
	chalcedony	SiO_2
	zircon	$ZrSiO_4$
	bismite	Bi_2O_3
	tellurite	TeO_2
	massicot	PbO
	hematite	Fe_2O3
	limonite	mixture of hydrous iron oxides
	goethite	$Fe^{3+}O(OH)$
Sulfates:	alunite	$KAl_3(SO_4)_2(OH)_6$
	natro-alunite	$NaAl_3(SO_4)_2(OH)_6$
	huangite	$Ca_{0.5[]0.5}Al_3(SO_4)_2(OH)_6$
	alunogen	$Al_2(SO_4)_3 \cdot 17H_2O$
	jarosite	$KFe_3(SO_4)_2(OH)_6$
	barite	$BaSO_4$
	gypsum	$CaSO_4 \cdot 2H_2O$
	melanterite	$Fe^{2+}SO_4 \cdot 7H_2O$
	halotrichite	$Fe^{2+}Al_2(SO_4)_4 \cdot 22H_2O$
Clays, etc.	Illite, sericite	$(K,H_3O)(Al,Mg,Fe)_2(Si,Al)_4O_{10}[(OH)_2,H_2O]$
	kaolinite	$Al_2Si_2O_5(OH)_4$
	montmorillonite	$X_{0.3}Y_{2-3}Z_4O_{10}(OH)_2 \cdot nH_2O$
	pyrophyllite	$Al_2Si_4O_{10}(OH)_2$
	diaspore	$AlO(OH)$
	epidote	$Ca_2(Fe^{3+},Al)_3(Si_2O_7)(SiO_4)(O,OH)_2$
	chlorite	$(Mg,Fe,Al,Li,Mn,Ni)_{4-6}(Si,Al,B,Fe)_4O_{10}(OH,O)_8$
	emmonsite	$Fe^{3+}_2Te^{4+}_3O_9 \cdot 2H_2O$
	durdenite	$Fe_2O_3 \cdot 3TeO_2 \cdot 4H_2O$
	zunyite	$Al_{13}Si_5O_{20}(OH,F)_{18}Cl$