KEYSTONE MAPPING REPORT 2019

Thomas Chapin, June 15, 2019

This report covers activities from the 2017 mapping season to the present, with a discussion of the geochemistry, petrology and petrography of the igneous and stratigraphic units. It presents a study of the dikes on the property and their relationship to target areas.

Many of the map products and diagram shown in the report are compressed. On computer versions they can be made larger by expanding the scale.

Comus Limestone from Greenstone Gulch

INTRODUCTION

This document is an update from the 2017 **2016 Keystone Mapping Report.** Mapping in 2017 commenced shortly after the first writing was finished and continued into 2018. The objective was to finish the original Keystone area and then the 12 square kilometers south of Potato Canyon that were added during 2017-18. The completed map is presented in the structural section of this report. Since the first document, several new formations were added to the upper plate stratigraphy. These are the Devonian Slaven, the Silurian Elder and outcrops of Cambrian early Ordovician Comus Formation. Also the possibility of late Devonian to Permian flysch is proposed.

New work on the igneous complex was conducted by the author and by Gabriel Aliaga who did a master's thesis titled **Igneous Geology of the Keystone Window, Simpson Park Mountains, Eureka County, Nevada: Age, Distribution, Composition, and Relationship to Carlin-Style Gold Mineralization.** The thesis is referenced within the text of this report. The 2017-18 mapping added many units to the extrusive portion of the complex and a new rhyolite intrusion. Some late fieldwork in the alluvium on the east side of the property has provided insight into the denudation history of the area and put some constraints on the age data provided in the thesis.

Also new, is work we have done on the dikes that crop out on the property and an extensive study was conducted by the author to see if there is one type of dike which is most associated with the Carlin Style deposits. The main conclusion is that type A dikes, which are mafic, are found in areas that we have elevated gold and Carlin Style Geochemistry. However, heavily altered type D dikes are associated with hydrothermal alteration of the host rocks. Whether this is an indicator of a Carlin System or a base-metal system is unclear.

The main part of the work discussed in this document is the mapping shown at several scales including 1:12,000 and 1:6,000 editions. The maps are in three versions; the original outcrop data, the alteration, and the interpretation. These may be considered as appendices to the report. Also supplied is a sample location map, and a fossil map showing the age date data with color coded symbols that are displayed on the interpreted geology. Seven 5 kilometer wide cross-sections were made across the map area from north to south.

Extensive thin section work was done particularly on the igneous rocks. Whole rock data was collected in conjunction with the thin sections. The thin sections are presented as brief summaries in the appendices as Power Point presentations. The whole rock data was analyzed using petrology diagrams and the pertinent data is discussed in this report. A table of the data is also provided.

Though the author was not involved in the day to day drilling, work did involve some relogging to provide consensus within the group. Furthermore, thin section and whole rock data were analyzed to help identify the stratigraphy of selected problematic intervals, and the author provided guidance in the use of geochemistry for the recognition of strata, particularly the differentiation of Comus from Lower Plate rocks. The geochemistry section of this report covers this latter effort. Finally targeting is discussed with relationship with the recognition of similarities in the Keystone Drill intercepts and those of the Cortez Mining District.

OUTLINE

LIST OF ILLUSTRATIONS

APPENDICES

The appendices are placed in a file labelled Chapin Mapping Project 2019

Keystone Interpretive Geology Map Products

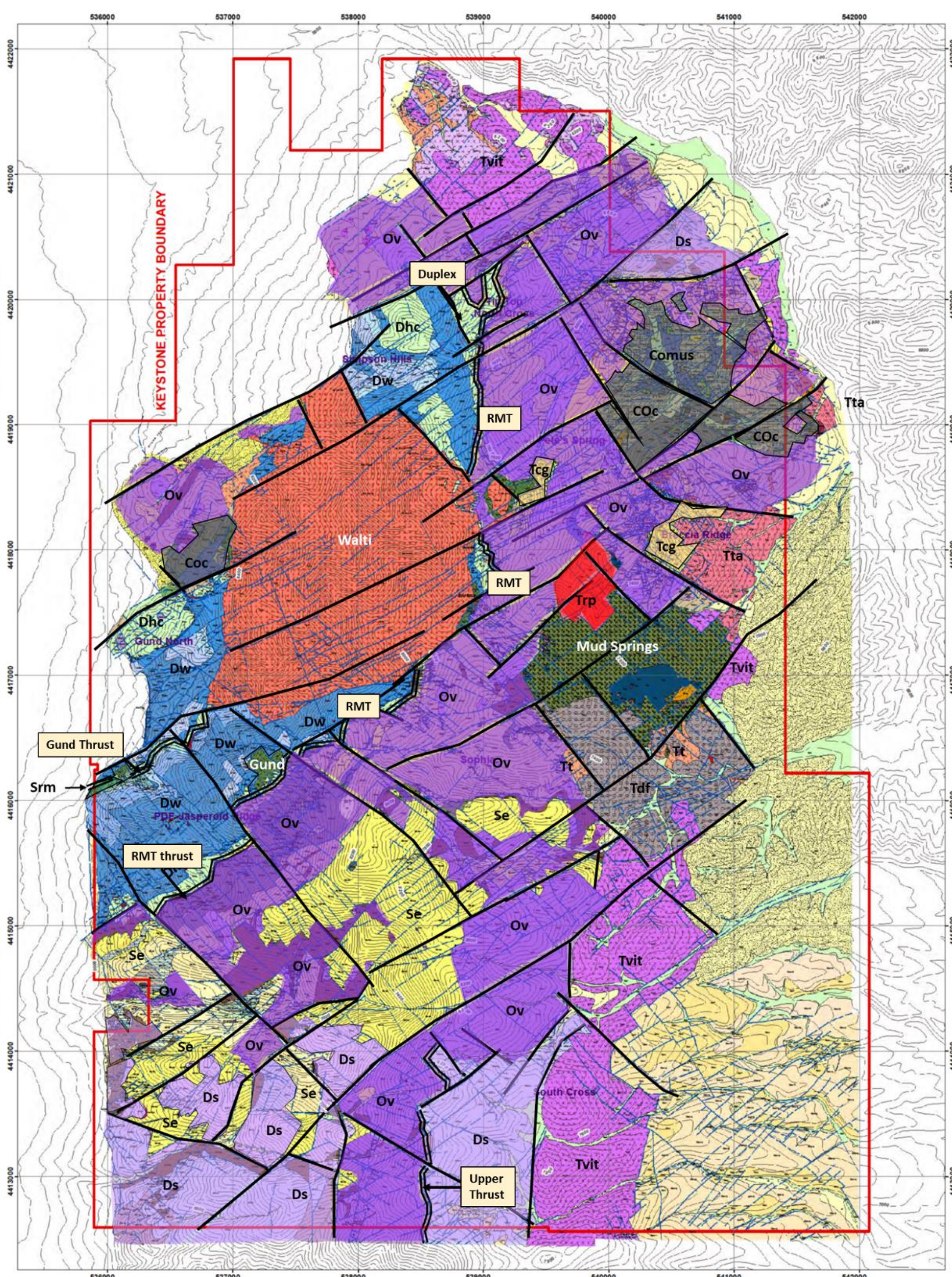
Keystone Explanation

Keystone Cross-Sections

Fossil Data File

Whole Rock Data: master file csv

2019 Thin Section Power Points: photos of six boxes of slides with brief explanations.



Map M-1: The map has been simplified by overlaying major upper plate elements with colors as follows; brown gray indicates Comus, dark purple is Valmy, bright yellow is Elder, and light lavender is Slaven. The fields are consistent with faunal dating. The more important faults have been highlighted. The double barred lines are thrust faults.

U.S. GOLD CORP
Keystone Project, Eureka Co., Nevada

KEYSTONE PROJECT - EUREKA COUNTY, NV
INTERPRETIVE GEOLOGY MAP
By Tom Chapin 2018

CONCLUSIONS

The Keystone Project has four main target areas, the Tip Top area, the Sophia Zone, the Lonesome Dove Target and the Blue Lagoon (Breccia Ridge) area. These lie either on the axis or on the flank of the Keystone Arch which is cored by the Walti intrusion and exposes a window of lower plate carbonate along its westward flank. Since the Simpson Park Mountains are tilted to the east within the northern part of the range, the apex of the Keystone Arch may be slightly east of the Tip Top to Lonesome Dove targets. However, these two areas expose the Lower Plate. The projection of the Arch passes through the Greenstone Gulch area which has carbonate rocks at the surface. The Sophia Target and the Blue Lagoon lie east of the axis but both should have lower plate within a 1000'.

Many of the drill holes have drilled calcareous Comus formation above the lower plate. Often there is a barren looking flysch between the Comus and the Lower Plate. At Sophia this has overlain cave deposits indicating collapse breccias formed in the Horse Canyon Formation by hydrothermal fluids. Drill Hole Key 1809r encountered strong Carlin Indicators at this contact that should be pursued. The dip of the Lower Plate appears to be 30^{o} from the axial plane and it can be encountered 1000' at least one kilometer away from the exposures of lower plate. Topography should be considered in making this calculation.

The thickness of the Horse Canyon is still in debate. Geochemistry should be used in conjunction with visual logging. The Horse Canyon is a calcareous siltstone and the carbonate clasts are usually dolomite shaped. Thin, plane laminar pin striping is common and the percent Ca is on the order of 9-12%. Titanium levels over 0.5% are too high for the Horse Canyon as are elevated vanadium numbers. If the silt is largely quartz or upper plate sand grains, the formation is not the Horse Canyon. The present geochemical method we are using is insufficient for delineating stratigraphy. MeMs 43 is recommended for stratigraphic use, particularly the titanium percent. The Cross-Sections show the Horse Canyon as less than 200' to absent. Outcrop mapping has never shown it to be thicker than 100'.

The mineralized target zones show that type A type mafic dikes are associated with Carlin Style mineralization. They are encountered beneath Tip Top, Lonesome Dove and the Sophia zone. The dikes are also associated with jasperoid outcrops.

There is an association of old NW structures with mineralization, particularly in the Sophia and Lonesome Dove area. In the Lonesome Dove area there is a secondary NW structural grain that cuts the lower plate and daylights into Grass Valley. It is associated with jasperoids and visible alteration. NE striking structures are probably Tertiary. They parallel the axis of the Keystone Arch and may be formed in part as axial plane faults. As such they would have been active during the doming formed by the Walti pluton. The doming would also form tension gashes perpendicular to the arch. This would result in both NE and the older NW fault sets being open. The intersection of the structures is a classic setting for pipe like deposits and increased fluid flow. Low angle thrusts within the lower plate such as the Gund Thrust and favorable stratigraphic horizons such as Wenban 5, the Horse Canyon and the Comus calc-arenites provide sites for large size blanket deposits. At the Cortez Hills deposit, chimneys feed into thrust faults and favorable stratigraphic horizons to form ore bodies.

The north south structures are Miocene Basin and Range faults and postdate the Carlin System which is displaced significantly downward into Grass Valley and Antelope Valley.

RECOMMENDATIONS

The following are a couple of practical recommendations. Drilling should be perpendicular to bedding to encounter the maximum stratigraphic depth per food drilled. This would effectively explore the NE structures. NW structures, once properly identified, should be drilled across strike. The Greenstone Gulch or south end of the Blue Lagoon dike swarm is untested. Drilling along the Blue Lagoon Ridge near the quartzite outcrops should cross both the dike swarm and encounter the Comus at fairly shallow depth. The Gulch itself looked less appealing due to the lack of strong alteration.

The drilling on top of Tip Top Ridge should be to the NW perpendicular to the Keystone adit fault and the identified Type A dike in the area.

Mapping south of Potato Canyon revealed Devonian Slaven chert and argillite. It would seem that without any interesting geochem, at least the 1km strip along the southern border could be dropped. The lower plate is generally over 2000' from the surface. Though there are some ferrocrete occurrences and barite bearing structures in the southern area, they are geochemically barren.

A simplified Keystone Map is provided below. It is recommended that Joe Laravie create the simple version for presentation use.

HISTORICAL SETTING

The 2017 Keystone report dealt extensively with the exploration history and geologic setting of the Keystone Project area. For a detailed account to the sedimentary history the reader is asked to read page 5 of that report. However, a brief review of the paleo geology is presented prior to entering into the stratigraphic and igneous details that follow.

During the late Cambrian to early Ordovician the west margin of the Laurentian (North America) continent was split apart forming the Pacific Ocean. The rift margin is modelled like the modern rift that separates Africa from Asia along the Red Sea. Here a series of tilted listric block faults extend out into the sea which is floored by upwelling primitive lava (tholeiites) or OIB ocean island basalt. The islands are bounded by basins filled with continental cratonic material as well as basaltic lava flows and dikes (greenstone). The late Cambrian Comus Formation is formed in this setting. As rifting matured, the continental margin rebounds and material on the continent is shed rapidly into the basin forming siltstone and sandstone deposits that intermix with Ordovician age greenstone and associated carbonate, (lower Valmy). In the middle to late Ordovician, the craton is further eroded denuding the Eureka Quartzite to form the Valmy Ovq orthoquartzite.

In the Silurian, a prograding carbonate platform is building away from the coast line to form the Roberts Mt formation (Lower Plate). The Roberts is a thin bedded quartz sand bearing limestone. In deeper water to the west, the Silurian Elder formation is deposited largely below the carbonate dissolution depth and it is primarily a fine sandstone without much carbonate. The platform continues to prograde and regress in pulses during the Devonian depositing the Wenban Formation. The alternating depth cycles start with several turbidite pulses Wenban 1 and 2 as the water shallowed. This was followed by the quiescent platform Wenban 3 and 4, and finally active shallower times in the late Middle Devonian that formed turbidite beds seen in Wenban 5, 6 and the slumped Wenban 7. The formation is capped by deep water Wenban 8. Meanwhile off shore, the deep water facies of the Devonian form three general units, the Lower Slaven Chert, Middle Slaven argillite and siltstone, and the Upper Slaven Chert.

In the late Middle Devonian, forces in the west begin to make the oceanic sediments rise and bulge much like the Chilean coastal range or the Front Range in California. East of the range, close to the bulge, the oceanic western facies are shed eastward forming flysch deposits. The starved basin between the bulge and the western shelf receives reworked carbonate material from the continent and pulses of grit from the western facies which is diagenetically silicified to form black bands in the Horse Canyon Formation. The flysch from the west (Blue Hill) is pushed over the Horse Canyon by the Antler Orogeny and eventually is itself overridden by the obducting Upper Plate along the RMT Roberts Mountain Thrust which puts the western facies over the eastern facies.

Though a lot of Mesozoic sedimentation occurred on the continent, there is none mapped in the district. In the early Tertiary, the continent had been quiescent for a long time and erosion formed a large peneplain covered with gravel and conglomerate deposits. This is the Tcg unit found at Breccia Ridge. Extension in the Eocene triggered 35ma magmatism that first deposited extrusive lavas and tuff deposits. The magma chambers rose to the surface slowly doming the area to form the Keystone Arch. The arch creates extension and reactivates old faults that provide pathways for the ascending magmas as dikes and more importantly for the hydrothermal fluids that carry gold.

In the Miocene 12ma, Nevada is broken into north-south trending block faults that form most of the topography we see today.

The rest of the report is organized as follows.

The target section is not really a discrete chapter since targeting is dealt with in relation to structure and later in relation to the dike study and finally in the geochemistry of hole Key 1809r.

UPPER PLATE STRATIGRAPHY

Cambrian Comus Formation- Cc

The Comus Formation is also known as the Harmony Formation depending on which mining camp is relevant to the area. The Comus is a Cambro – Ordovician package deposited on the rifted margin of the Continent which has a geometry of horsts and graben that parallel the continent. Volcanism associated with the rifting created a series of volcanic edifices that shed lava and debris flows into the basins. The uplifted blocks had fringing reefs of limestone which also shed into the basins. At Turquoise Ridge, the Comus strata include abundant thick debris flow conglomerate that is a mix of carbonate and basaltic lava clasts that, along with carbonate bearing siltstone, form the main hosts of the Turquoise Ridge gold deposit.

The Comus was first recognized at Keystone in Drill Hole Key 1605c where mixed greenstone carbonate debris flows were encountered. At that time the results of conodont collections had not been received. However, we now know that the lowermost 400' of the drill hole is late Ibexian (early Ordovician) consistent with the age of the debris flows at Turquoise Ridge. Also, drilling at Pipeline some 20 miles to the north encountered sea mount facies that contained late Cambrian algal mat material underneath the open pit.

The new mapping in this report shows that there are exposures of greenstone, epiclastic siltstone, silty limestone and carbonate debris flows exposed in the Greenstone Gulch area north of the Blue Lagoon. These plot as basanites or OIBs similar to the Turquoise ridge Comus basalt. The debris flow is from Key 1605c are slightly less primitive than typical OIBs, probably due to mixing of igneous material with chemical and continental sediments and plot as more evolved.

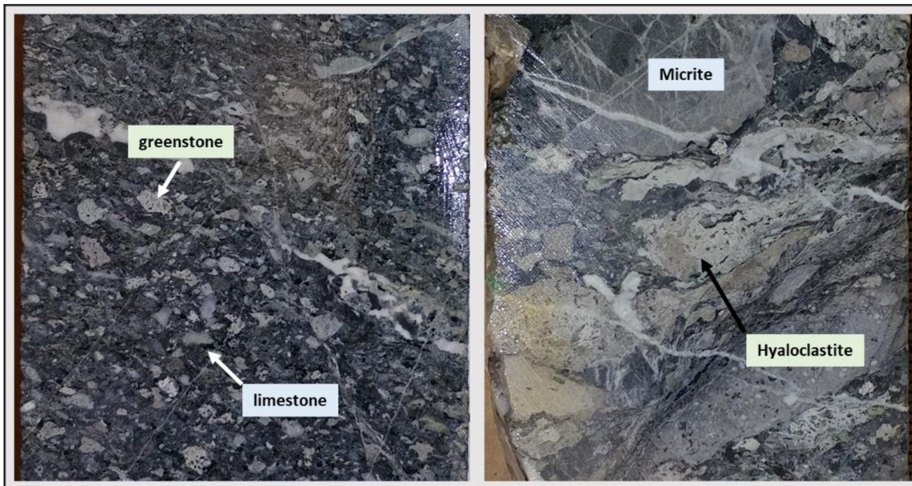
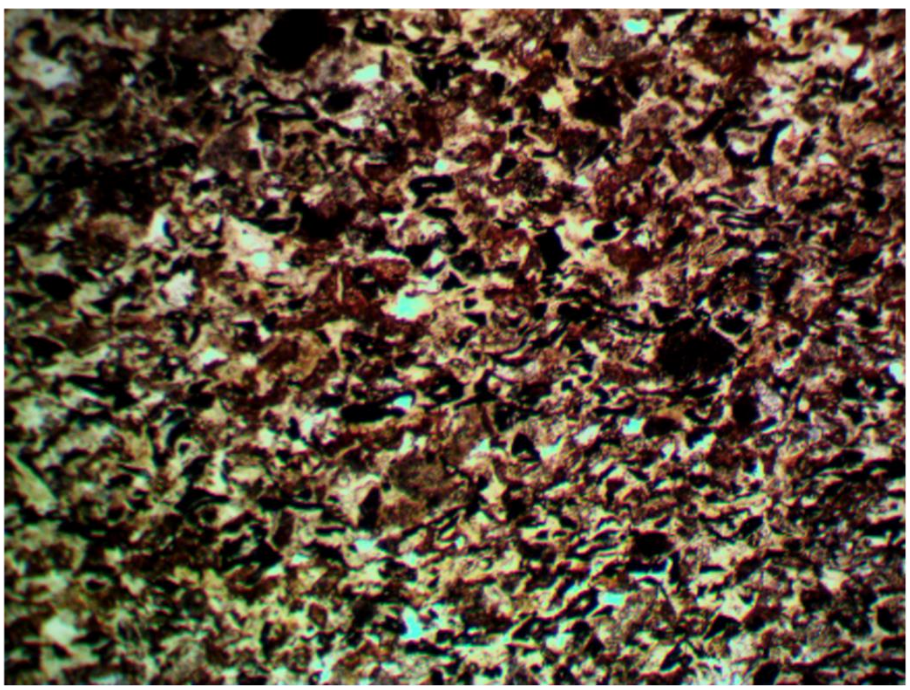


Figure 1: Comus like volcaniclastic debris flows made up of limestone and greenstone clasts. Greenstone is amygdaloidal scoria made of soft easily stretched clasts due to heat and the limestone is derived from exposed reefs that surround a seamount. This facies is seen at Turquoise Ridge and Twin Creeks. Actual size.

The photo above shows some of the typical shredded textures seen in Drill Hole Key 1605. The photomicrograph below comes from Greenstone Gulch and is remarkably similar to the drill sample.

Several carbonate debris flows were found in the Greenstone Gulch area. Two photographs below show different kinds of early Ordovician carbonate occurrences. The first photo shows a slightly strained limestone cobble conglomerate. The insert is from another outcrop on the Blue Lagoon Ridge. The black clasts are unoxidized argillite while the oxidized limestone was deposited in shallow water. This fact shows the typical turbidite mixing of oxidized strata from the near surface environment with deep water anoxic facies.



KTC 460: 4X pl: Greenstone tuff from the north wall of Greenstone Gulch. Shattered glass bubbles are black. The groundmass is a mixture of chlorite, feathery quartz and clay. Part of the outcrop looked like pillow lava, this sample may come from the shattered vesicular material between pillows or from the top surface of the flow.

The lower photograph shows load casted carbonate sandwiched between greenstone pillow basalts. It is likely that the carbonate is partly derived by the interaction of the calcium bearing mafic rock with seawater (Saussuritization).

Figure 2: Debris flows in the Greenstone Gulch area. The image on right shows the classic dark and light mixture of oxidized and unoxidized clasts.

Both images are found near greenstone exposures. This type of sedimentation is common to the Comus Formation

Figure 3: This image is located near the top of the Comus formation. The limestone is very silty and has load casts. It is located between two pillow basalt flows. Much of the material stratigraphically above this unit is a calcareous sandstone with epiclastic greenstone grains and carbonate grains in quartz silt.

The environment of the Comus is highly variable due to its derivation from sea mounts and block faulted scarps. Therefore, it is difficult to predict where favorable horizons can be found.

Ordovician Valmy Formation - Ov

The Valmy type section is located in the Northern Shoshone Mountains. Mapping by the author in the range north of Pipeline reveals that the Valmy is largely a clastic formation deposited off the slope of the continent. It consists of several coarsening upward sequences that have fine shaley mudstone and greenstone at the base. The sequence is followed by wake siltstone and polymict siltstone with channel sandstone beds merging upward into thin plane bedded quartz siltstone that is capped by a thick sequence of orthoquartzite. The Cherry Springs chert is deposited on top of the uppermost sequence of sandstone. North of Pipeline the above described stratigraphy overlies a 10' quartzite bed which presumably also overlies another sedimentary cycle.

Detailed mapping and drill logs at Keystone suggest that the Valmy can be subdivided into four sedimentary cycles or '**system tracts'.** The stratigraphic section provided shows that the first cycle **Tract 1** transitions from the Comus greenstone limestone section into a coarsening upward sequence that starts with mixed siltstone and sandstone beds typically 10 cm thick. The sediments are a combination of epiclastic reworked greenstone, reworked carbonate detritus and quartz grains. Some thin greenstones are found within the package. Upward the greenstone derived material and limestone clasts are less common and the package is quartz silt to sand with calcareous, quartz or clay cement depending on location. The top of the sequence is a 10' bed of orthoquartzite typical of the Valmy. The lower sequence is approximately 300' thick.

Figure 4: Typical polymict siltstone of the Valmy Fm.

Tract 2 is a similar 300' coarsening upward sequence capped by the orthoquartzite located just under Breccia Ridge. Drill hole Key 1813r shows that the second tract from 100' to 450' begins with a deep water chert followed by cherty mudstone and the 'varved' arkosic black and white striped, very fine sandstone. The 3 meter thick quartzite was not noted in the log which saw quartz siltstone. It is either absent or the grab sample used for logging missed the unit. Quartzite is found above Key 1601c on the surface of Tip Top as float and small beds in a section of quartz siltstone. Presumably the quartzite underlies the 40’ chert unit that crops out northeast of the Key 1601 drill collar.

Tract 3 begins with the deep water chert found at 100’ in Key 1813r and under the Key 1601c drill collar. The chert is dated as Katian or Upper Ordovician. Most of the tract is exposed above and below the Burma Road where the tract is decidedly heterolithic, ranging from thick chert beds found on the road (late Darwillian to Katian radiolaria) to mudstone, siltstone, greenstone and associated limestone at the top that yielded middle Ordovician to Silurian conodonts.

A similar exposure is located under the Tip Top ridge in the Northern Cross area. Here the section overlies 700’ of Ordovician clastics of Tract I and Tract 2. **Tract 3** begins above sheared chert that demonstrates low angle deformation. Greenstone sits on the fault followed

Figure 5: This outcrop is from the north end of Breccia Ridge. It overlies the Ovq orthoquartzite. Typical Ordovician ribbon chert beds. Insert shows the rhythmic banding of argillite and chert that has been metamorphosed to hornfels. Radiolaria from this outcrop produced Katian Upper Middle Ordovician fauna. Tract 3.

by channel sands, packstone, grainstone, and channel limestone deposits. The section is cut out by a fault but it is probably 200’ thick.

Tract 4 is exposed above the Sophia Zone from the above the chert at Sophia Wash to the McClusky ridge where it is overlain by the Cherry Springs unit. It is plane bedded polymict sandstone and siltstone with a few chert beds and some black argillite beds. The Tract is

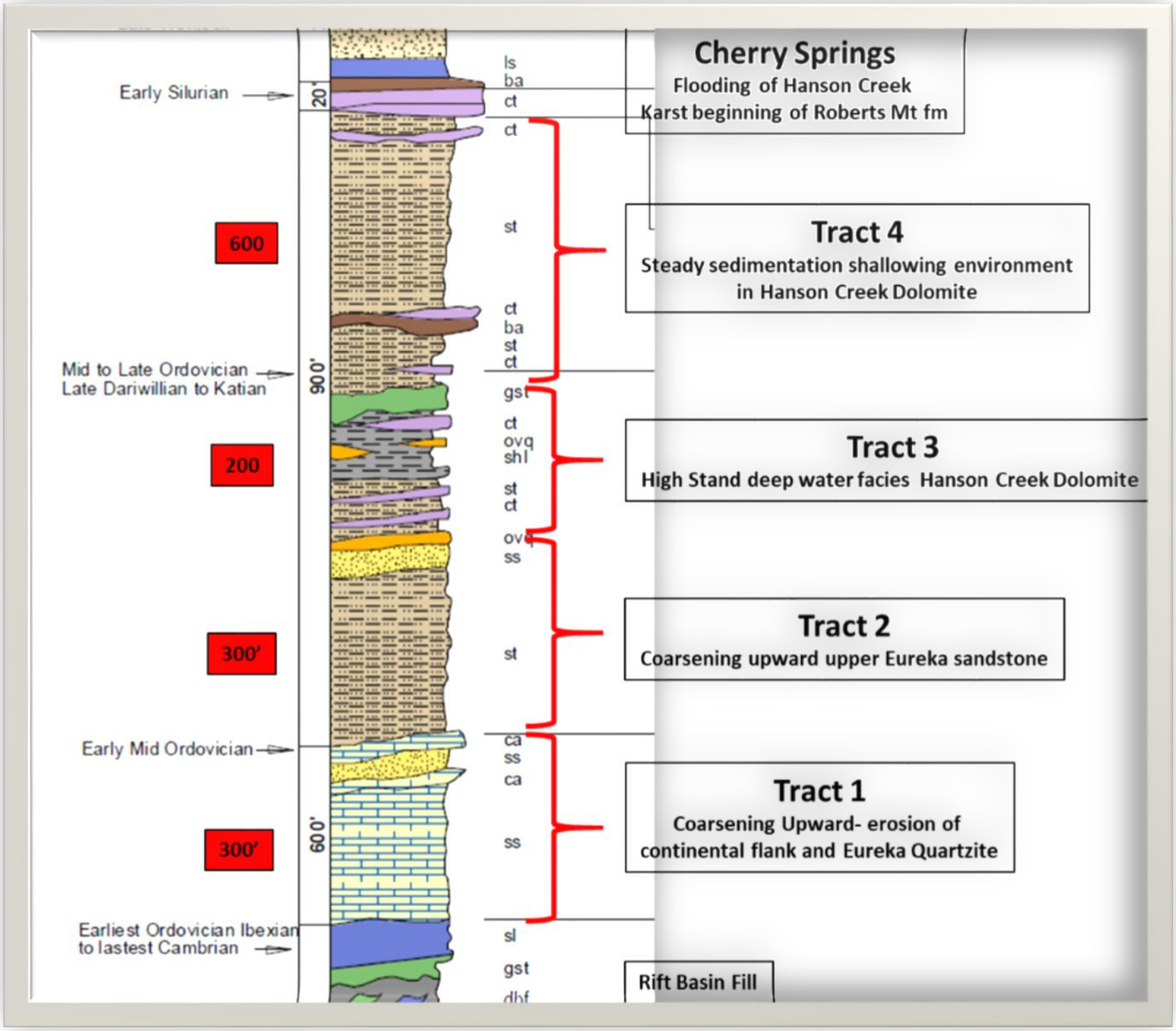


Figure 6: Ordovician Stratigraphic Section. The Tracts are identified and compared to the contemporaneous activity on the continental shelf.

The photograph below is located east of the Northern Cross and is from Tract 3. It overlies Tract 2.

Figure 7: This outcrop is located below and north west of Tip Top ridge in the Northern Cross area. The section here has greenstone, some orthoquartzite, messy packstone limestone and polymict siltstone. It is probably Valmy since it resembles the Upper Middle Ordovician System Tract 3 dated elsewhere. Strata beneath this assemblage resembles coarsening upward System Tract 2 of largely platy quartz siltstone beds found on the western slopes of the Northern Cross area that are capped by orthoquartzite.

Early Silurian Cherry Springs Member - Scs

Fossil data collected in the Keystone area at the top of McClusky ridge and down to Potato Canyon show that the Cherry Springs Member is early Silurian, Llandovery. It consists of 20-60' of shiny black argillite and boudinaged white chert. Plane bedded, waxy green chert beds located east of the headwall of Potato Canyon also are dated as Llandoverian. The Cherry Springs unit overlies a variety of clastic sediments that are part of the Valmy. These include arkosic sandstone, wake siltstone mudstone and chert. In terms of sequence stratigraphy, the unit signals an abrupt change from clastic sedimentation to deep water colloidal deposition.

The Elder Formation that is deposited on top of the Cherry Springs is a shallow water deposit. There is a close relationship between the sedimentary processes occurring on the continental shelf and the processes in the ocean basin and formation boundaries on the continent should have the same relative timing as similar events in the ocean basin. The deposition of the Silurian Roberts Mountain formation started in the early Wenlockian – Scheinwoodian. The Roberts is a plane laminated silty limestone with significant quartz silt components. Thin sections have revealed that the quartz silt is similar in size and character as the quartz grains in the Elder Formation. Therefore, the author has put the Cherry Springs as part of the Valmy and assigned the Elder (very difficult to date) to Wenlockian to early Devonian, a similar quiescent time period as the Roberts.

Silurian Elder Formation - Se

The Elder Formation overlies the Llandovery Cherry Springs unit of the Valmy. It represents a deep water equivalent of the Roberts Mountain Formation which is largely monotonous plane laminated quartz bearing limestone deposited during a tectonically quiet setting. Consequently, the Elder also was deposited in a quiescent setting with little change in the style or source of deposition. Its type section is Elder Creek in the Shoshone Range. It is very difficult to get age data from the formation since it is largely fine grained sandstone. However, the Silurian Elder is considered to span from late Llandovery to early Devonian. Mapping by the author in the type area shows that there is a carbonate debris flow at the base which is overlain by mudstone and siltstone beds. At Keystone, the majority of the Elder has fine grained, subround quartz grains 80% in a clay or carbonate matrix with minor carbonate grains, feldspar grains and detrital white mica. There is some muddy looking chert which is probably diagenetic in origin. One of the main characteristics of the Elder is that it is a yellow weathering, plane bedded sandstone with some graded beds, turbidites and cross-bedding.

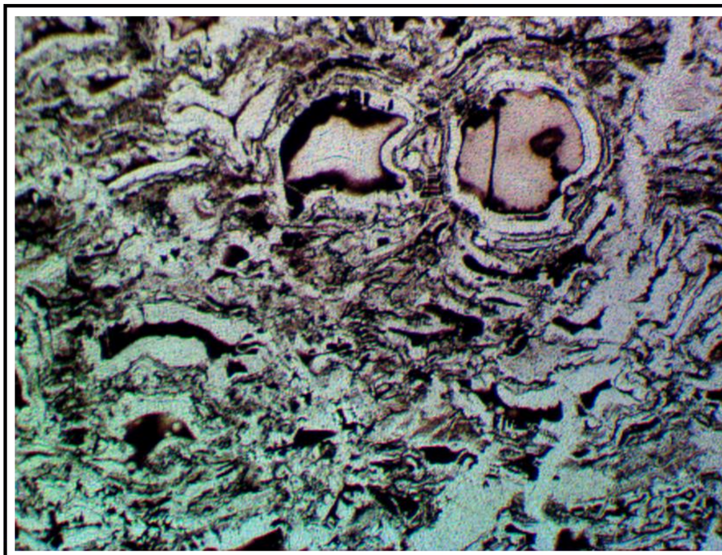
Figure 8: The photo above shows typical Elder sandstone turbidites with channel scoured bottoms. The yellow material is graded sandstone that fills the scours and overlies the dark gray finer muddy siltstone.

The Elder formation is found on the south flank of McClusky peak and it dips south forming a dip slope down into Potato Canyon. Since there is abundant structure, the thickness of the unit cannot be accurately measured but it is graphically estimated to be 200' thick.

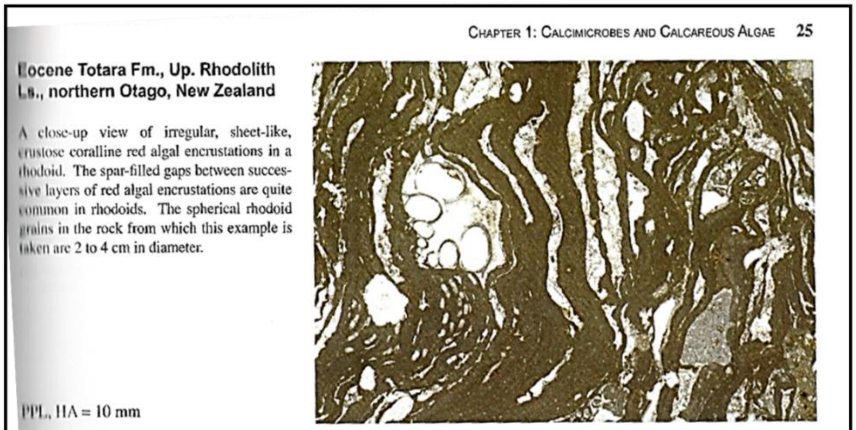
Devonian Slaven Chert - Ds

The type section of the Slaven Chert is Slaven Canyon located in the Northern Shoshone Range. In the type section, the formation is divided into a lower member that consists of thick beds of chert and glassy black argillite. The middle member is largely plane bedded black silt and argillite beds and the upper member is described as ribbon chert. The Slaven is largely radiolarian chert and consequently dating in the unit is quite easy. Thirteen dates spanning from Early Devonian to the Carboniferous were recovered from radiolaria in the south part of the Keystone property. The author believes that Late Famennian is the upper limit of the formation. This is supported by the fact that the upper age of the Horse Canyon Fm. is Famennian and represents a change of depositional style from largely carbonate to more clastic facies. There is approximately 600' of the formation located south of Potato Canyon.

At the base of the Slaven formation there is a widespread 1 meter thick marker bed of silicified algal material which manifests itself as fine vesicular chalcedony. Thin sections of the bed reveals that it is an algal mat. As such, the bed indicates a shallow water low stand and the bed should be included in the Slaven Formation. The overlying radiolarian chert is a high stand deep water facies. Similarly, in the Shoshone range, the base of the Slaven is marked by a debris flow that contains large clasts of greenstone and limestone indicating a low stand tract. See the two photomicrographs below.



KTC 097: 4X pl. This slide also comes from south of Potato Canyon. It is an algal mat.



Eocene Totara Fm., Up. Rhodolith Ls., northern Otago, New Zealand

A close-up view of irregular, sheet-like, crustose coralline red algal encrustations in a rhodoid. The spar-filled gaps between successive layers of red algal encrustations are quite common in rhodoids. The spherical rhodoid grains in the rock from which this example is taken are 2 to 4 cm in diameter.

PPL, HA = 10 mm

Photomicrograph from AAPG Memoir 77, A Color Guide to the Petrography of Carbonate Rocks: Peter A Scholle, Dana S. Ulmer-Scholle. 2003

Above the algal mat, the Lower Slaven member is thick bedded light gray chert that weathers to a pale honey brown. Also present are thick beds of black shiny argillite (BA on outcrop maps). The chert contains a few radiolaria that yield Early Devonian or younger dates. Some of the difficulty in more precise dating is due to tectonic erosion caused by folding. The lowermost beds of the Slaven can be strongly folded and demonstrate crenulation cleavage, recumbent folds and boudins. Boudinage and large load casts on the top surface make precise attitude measurements difficult. Tectonic unconformities between the Basal unit and older members are present. Luckily the algal mat marker bed can be confidently tracked across the southern portion of the Keystone Property.

Figure 9: Typical Lower Slaven chert beds. Note the light gray color and tan weathering. The thick bedded and folded nature is common above the Slaven – Elder contact.

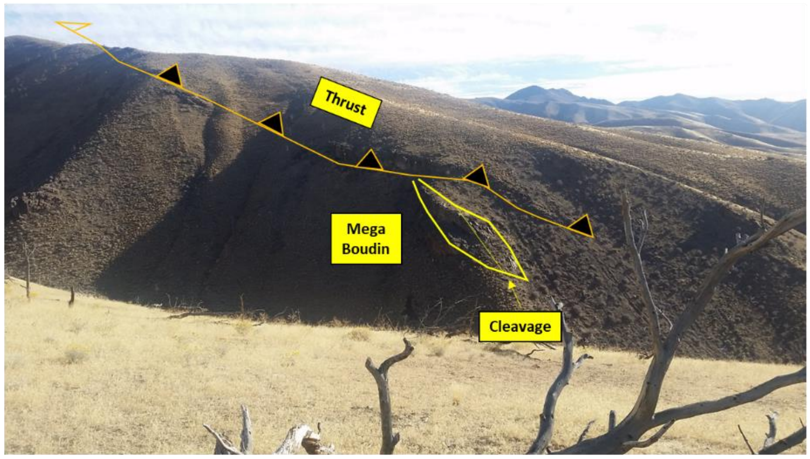


Figure 10: Photo looking at the southern margin of the Keystone Property. Here the Slaven is thrust over Slaven. Several mega boudins can be seen under the thrust which is a structural unconformity. Note the Cleavage in the boudin.

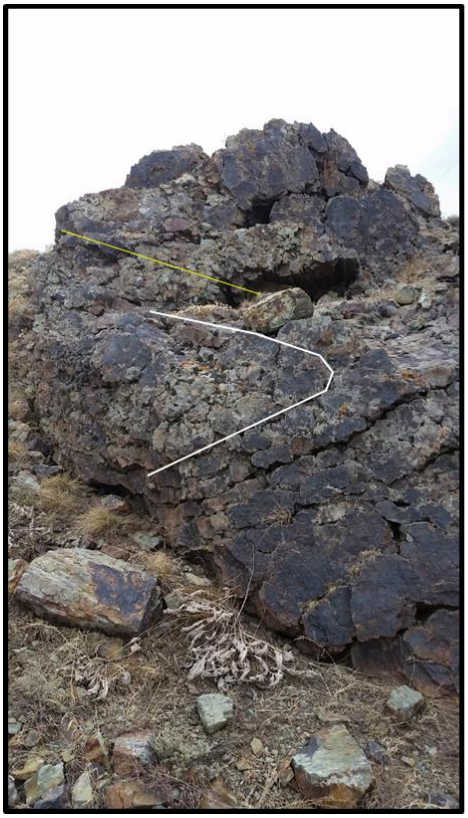


Figure 11: South of Potato Canyon. This is another view of the Lower Slaven showing the interaction of cleavage, boudins and folding. Thickness and attitude measurements are meaningless in this type of material. Note the yellow line showing the cleavage direction. The fold is shown in white.

At the extreme SW edge of the property the Middle Slaven is exposed in a narrow twisted canyon. Here thin bedded chert and argillite beds with shale partings have chevron and cylindrical folds. The unit appears to be more recessive than the thicker chert beds above and below it and it may be hidden under the Upper Slaven slope wash.

The Upper Slaven is exposed on both the east and west flanks of the southern part of the property. Four radiolaria dates from the east flank of the range yielded late Famennian ages. The Upper Slaven is largely medium to thin bedded green or white colored chert with small intervals of siltstone found on the east flank of Barite Ridge. Radiolaria from chert beds within the sandy siltstone are late Famennian. The green chert pieces found in Three Bar Valley are most likely Slaven chert and not part of the Cherry Springs, which is pale waxy green or light gray. Barite prospects are found within the Upper Slaven hence the name Barite Ridge.

Flysch (Blue Hill?) Dbh

US Gold drilled one hole in Antelope Valley between Keystone and the Three Bar ranch. The chips from GBN 1701c revealed 500' of Valmy sitting on top of 700 to 800' of Comus similar to the facies encountered in Key 1605c. Two conodont samples from the Comus yielded dates consistent with the Ordovician Cambrian boundary. At 1300' a completely different facies was encountered consisting of 500' of clean angular quartz flysch. This unit cannot be dated due to the lack of in situ biota. Therefore ascribing the flysch to a particular time period is problematic.

A similar looking unit was noted in the Cortez Range both in the Dry Hills at the southern end of the Cortez Range and in Horse Canyon where it overlies the Goldrush deposit. In The Dry Hills, the section begins with gray angular clastic grit deposited on the Slaven chert. It coarsens up to polymict reworked upper plate siltstone, sandstone and conglomerate. In Horse Canyon, the Blue Hill unit overlies the Horse Canyon Formation. Here the lower exposures are gray angular upper plate derived flysch which grades upward into plane bedded polymict silt and sandstone derived from upper plate material. It is overridden by the RMT and Comus age carbonate and greenstone. Similar material is also present in the Shoshone Range where gray immature flysch overlies the Slaven. This occurrence is down dip from the Battle Conglomerate mapped by Gilluly and Gates and is presumably equivalent.

The significance of this observation is that the unit may overlie both upper and lower plate rocks and it may prove a useful marker bed. Several occurrences of flysch have been identified in drilling, particularly in the Sophia area. Key 1706r drilled through the Comus into what appears to be flysch and was stopped due to excessive drill depth. Nearby holes on the other hand, went directly from the Comus into the Lower Plate. The fact that the occurrences are variable is due to the fact that the Roberts Mountain Thrust is truncating the Blue Hill unit.

Since the Chainman Formation is also present locally it could be similar to the Blue Hill. However, the westward limit of the Chainman Formation is considered to be Devil's Gate much further east than the Keystone area. Furthermore, it as well as the Webb Fm, is a much more heterolithic unit, consisting of black shale, claystone and siltstone interbedded with sandstone and some chert. Drill Hole GBN 1701c shows that the unit is 100% angular clast sandstone and hence very different from the type section of Chainman and completely lacks most of the facies described in the Chainman type section. Similarly, the flysch has no similarity to the Woodruff which is largely plane laminated, thin bedded coarse silt.

LOWER PLATE CARBONATE ROCKS

The Keystone Window is a 5 kilometer wide exposure of Lower Plate slope carbonate rocks that form steep slopes on the west side of the Keystone property. No additional field work was done by the author in the Lower Plate rocks since the 2017 report. However, there has been an evolution in the understanding of what constitutes the Horse Canyon Formation, leading to the more restricted exposures shown in the interpreted map, **figure S-1**. One can see that the pale green **Dhc** Horse Canyon Formation forms a thin unit above the Wenban Formation that is truncated by the Roberts Mountain Thrust.

The details of the Lower Plate are shown in the stratigraphic section provided below. Drilling surrounding the window has shown that the Lower Plate dips steeply around an arch flanked by Upper Plate rocks. Key 1801r drilled 1km south of the window hit the lower plate at 300m indicating a 30^0 dip. This elevation is at variance with the current log because the calcium levels above the Wenban contact in Key 1801r averages less than 4% which is too low for the Horse Canyon Fm. and consequently the contact of the Lower Plate is deeper. Also the vanadium levels from 515' to 570' are similar to the vanadium in the greenstone logged at 420-450'. The titanium percent is worthless as a guide since the geochemical method is not appropriate.

3,000' due west of the RMT Key 1703r was drilled in the Sophia Zone. It hit the Horse Canyon at 850' for an average dip of 30^0. Northwest of the window, Key 1812r did not encounter the Lower Plate because drilling became problematic 1,100'. This would indicate a dip greater than 35^0. However, these dip indicators are simplistic since they do not reflect high angle structural movements either up or down of the lower plate.

Drill data also has revealed that there is a zone of caving at the contact with the lower plate. Specifically, the drills pass through the RMT and find a zone of caving associated with the Horse Canyon Formation. This would indicate that the Horse Canyon is particularly prone to dissolution. The area of caves is located in the Sophia zone and is discussed in the dike study in association with mafic dikes. At Goldrush in the Cortez Range, the best gold mineralization was below a widespread zone of caving that often had mafic lamprophyre dikes. The caves are a form of collapse breccia and are considered an important vector for Carlin Systems.

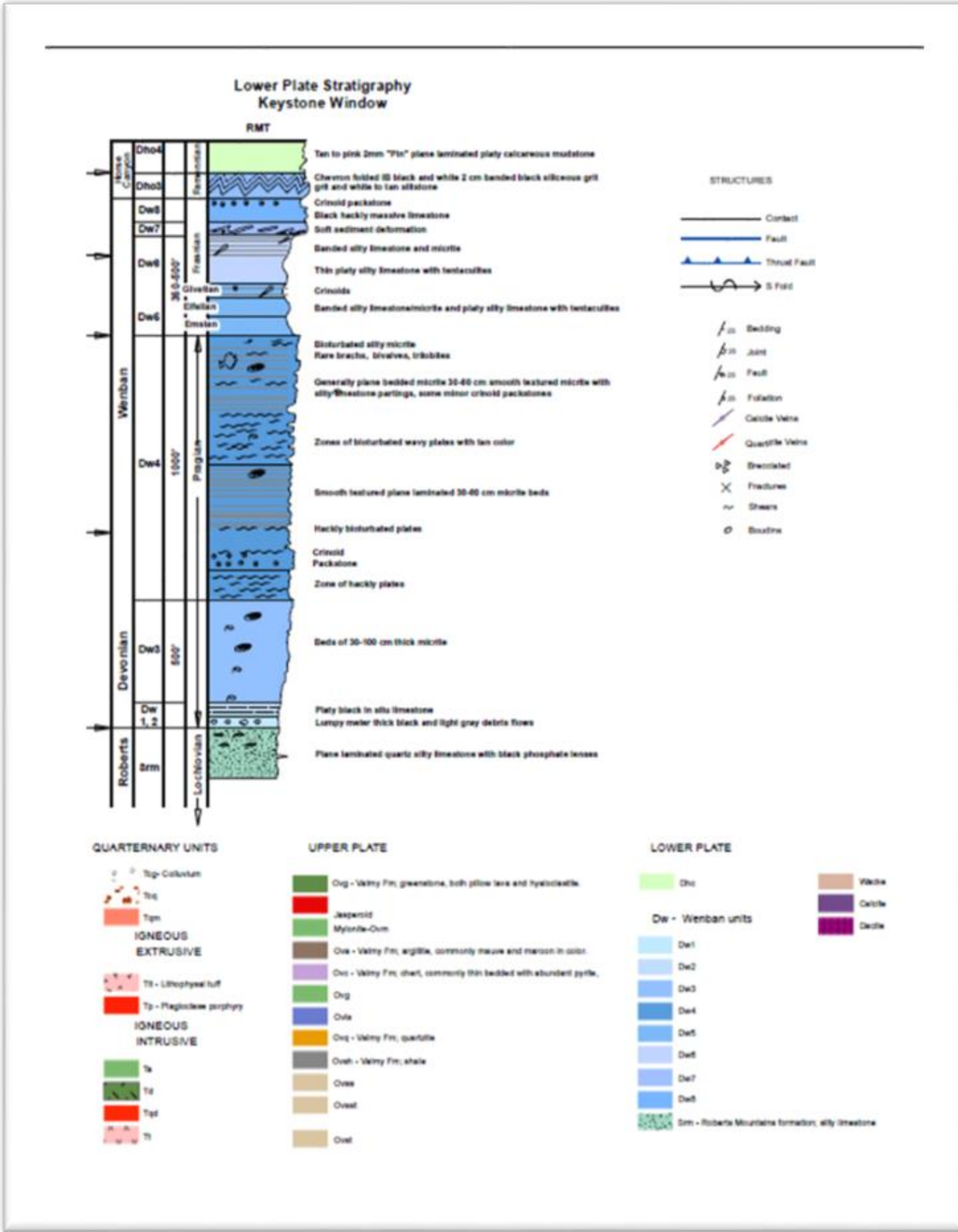


Figure 12: This figure is an excerpt from the Explanation that accompanies the map products. It is meant as a guide only.

TERTIARY SEDIMENTS

There are two mapped elements believed to be Tertiary; Tertiary conglomerate **Tcg** and Tertiary limestone **Tls**.

The Tertiary conglomerate is discussed in the Extrusive Rocks section since it uses the diagrams generated for the volcanics. The conglomerate was deposited on the Tertiary Peneplain and has been dated as 35.62 +/- 0.32 Ma by Gabe Aliaga, figure 67, p108 and 109 in his Master's Thesis. Four occurrences have been noted. The largest occurrence is found on **figure D-x** which provides a map of the Blue Lagoon area. The conglomerate is a 60' sequence of well-rounded, brown weathering, cobble conglomerate containing Paleozoic clasts. **Figure E-1** is located over breccia ridge where finer bedded pebble to small cobble conglomerate underlies the aphyric tuff. Here the conglomerate is strongly altered to jarosite, chalcedony and minor variscite. The total thickness in the area is probably 40' or less. On the west side, a small outcrop of conglomerate underlies aphyric tuff seen if **Figure E-2.** On the north side of the property, there is a bake zone that underlies aphyric tuff and consequently must be considered part of the peneplain.

The tertiary limestone is found on the top and flanking the Mud Springs Pluton. Its provenance is controversial with Dr. Mike Ressel and Gabe Aliaga considering the deposit to be Paleozoic roof pendant of the Mud Springs intrusion and the author considering it to be a tertiary lake deposit related to the Tertiary peneplain. In either case, the limestone is altered to a punky marble by the intrusion. Steve Moore and the author mapped a similar occurrence in Horse Canyon south of the SSZ zone where punky, chalk white, lumpy bedded material overlay Caetano intrusive material. The outcrops at Mud Spring are similar in texture. Furthermore, the marble does not resemble the typical lower plate metamorphic assemblage that has calc silicates such as tremolite, idocrase or talc. No calc silicates were found in the limestone.

Metamorphic Ordovician quartzite also surrounds the Mud Springs pluton but is not found on the top or sides of the intrusion. These outcrops were probably cooked by the heat of the intrusion, but since the encapsulating host rock is Valmy, the quartzite need not have moved significantly.

TERTIARY TO QUATERNARY ALLUVIUM

Generally, alluvial deposits are not considered with as much care as older rocks. However, in this case two sections to the SE of the property were selected for additional study due to some favorable geochemistry. The approach was to see if the mineralized interval could be sourced back to a particular underlying structure or horizon. To do so, details of the clast parent were noted and their percentages and a proposed denudation sequence was developed.

The oldest alluvial deposit is 100% reworked upper plate and does not contain any Tertiary volcanic clasts. It was mapped as **Qau** (older alluvium). The **Qauq** unit is a quartzite boulder apron found on the east side of Vitrophyre Ridge that is derived from similar boulder field found west of the ridge. The Vitrophyre Ridge is made of 100% andesite flows that have no alluvial deposits on the top or flanks of the ridge indicating that it was emplaced after the **Qauq** was deposited since it forms a effective topographic barrier**.** The quartzite boulder conglomerate mapped in the western part of **Figure xxx** lies on top of ferrocrete deposits of reworked upper plate. This may well be another example of the Tertiary Peneplain as it dips to the east semi-parallel to the dip of the andesite.

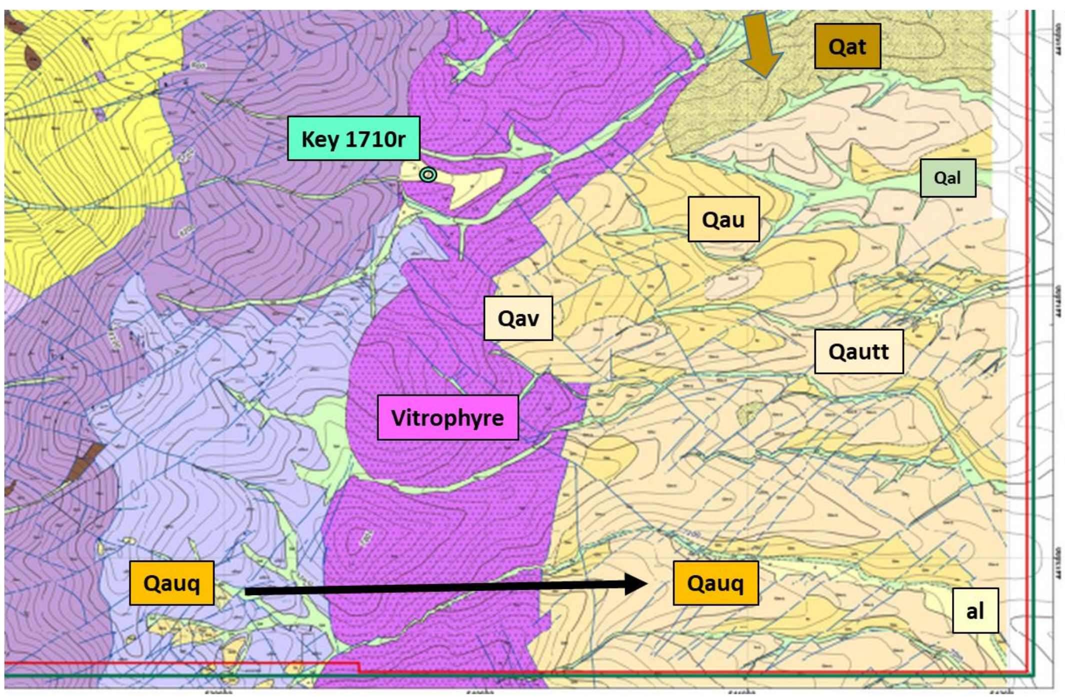


Figure 13: The image is from the SE corner of the property. The **Qau** is the oldest alluvium pre the Tertiary Volcanics. The **Qauq** unit is reworked quartzite boulder conglomerate that has bypassed the barrier formed by the Vitrophyre ridge and hence is older. The **Qat** is provenanced from the north and contains a significant portion of aphyric tuff clasts. It becomes mixed with reworked **Qau** to form **Qatt. Qav** is young reworked vitrophyre. The **Qal** delineates the stream beds, the **al** in this image is a bench. The streams follow the general dip of the valley to the east. NE structure is quite young.

The older alluvium is covered by the **Qat** which is a white aphyric tuff bearing fan deposit. The **Qat** is younger than the aphyric tuff that is dated at 35.6ma, but probably formed almost immediately after the emplacement of the tuff. The **Qat** fan tapers off to the south to form a mixed deposit containing much more upper plate material. This is recognized at the **Qautt** unit.   The **Qav** unit is found next to the vitrophyre ridge and probably some of the loose boulders on top of the unit. It is deemed the youngest of the alluvial units exclusive of quaternary colluvium, and stream benches mapped as **al** and stream beds **Qal**.

The study provides further evidence that the age of the vitrophyric andesite is younger than the dates provided in the thesis since it apparently formed after the tertiary paleosurface. Presumably the older alluvial units underlie the andesite. Furthermore, **Qau**, **Qat** and **Qautt** units are not found overlying the vitrophyre, though some post Miocene deposits from the eastward tilt of the Simpson Park Range can overly the lava flow. The observation is consistent with Drill Hole Key 1710r, which encountered 400' of tuff under the andesite. The alluvial data accurately reflect the denudation sequence with the andesite forming later than the aphyric tuff. A Miocene age for the unit must be considered.

FOSSIL AGE DATING

Conodonts and Radiolaria samples were collected from the Upper and Lower Plate strata to confirm that the field picks were accurate. In all 95 samples from drilling and the surface were sent for analysis with a 50% success rate. The importance of the sampling was to separate the Horse Canyon siltstone facies from Valmy siltstone packages, Comus limestone from Lower Plate limestone and Valmy Chert from Slaven chert. The result is that the final geology map is tightly constrained by fossil data.

Joe Laravie has taken the fossil data and overlaid it over the final map geologic map. This file is in the appendix as Fossil Geology Map. The scale of the map precludes putting a copy here.

STRUCTURE

The Keystone 2017 Chapin Report dealt with the structure of the Keystone Window. This chapter will mainly deal with aspects not previously discussed. The section called **Historical Setting** discussed the formation of a NS trending rift margin during the late Cambrian early Ordovician that formed fault block basins and highlands off the coast of Laurentia. The continental margin experienced isostatic rebound and rose up resulting in the erosion of 4,000' of section that are missing between the Hamburg Dolomite and the Eureka Quartzite. This margin formed a formidable barrier the obduction of the Upper Plate over the Lower Plate carbonate platform.

The onset of the Antler Orogeny in late Devonian to early Mississippian first developed a foreland bulge west of the continental margin similar to the Coast Range in California, and then as the orogeny progressed brought the oceanic western facies onboard, over the platform margin. The compression resulted first in extremely deformed upper plate rocks in the bulge, and subsequently more passive thrusting as the margin was loaded, depressed and made into a more planar feature. The compression in the lower plate carbonate rocks is expressed by asymmetric folds that are cored by blind thrusts. Cross-section **E-E'** demonstrates this feature. These thrusts are known to be present in the Pipeline Pit, the Cortez Hills underground Lower Zone and Lower-Lower Zone, The Horse Canyon Pit, and at Goldrush. The Gund Thrust is a similar feature that places the Roberts Mt Fm. over the Horse Canyon formation.

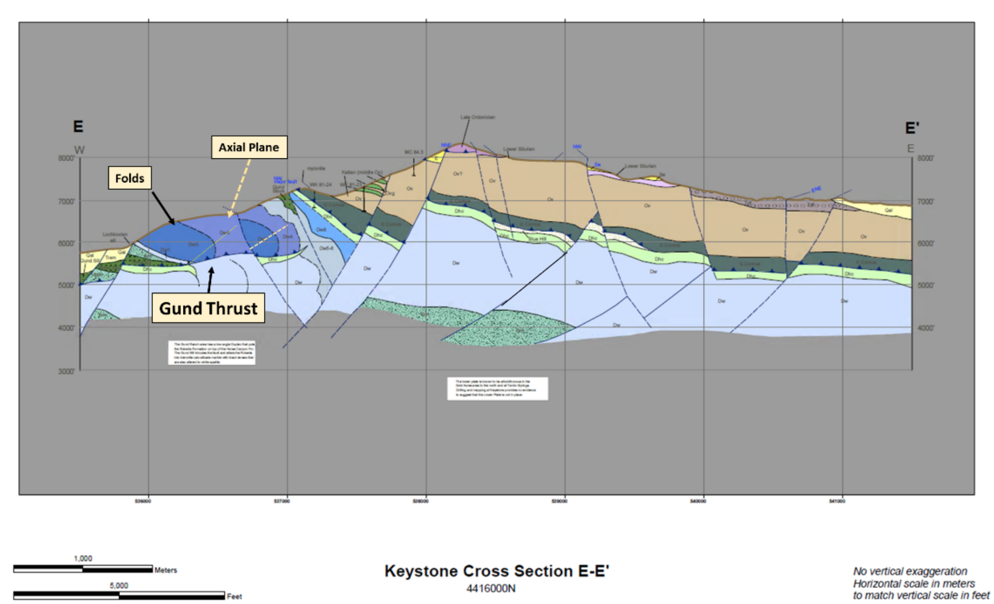


Figure S-1: The cross section shows the deformation with the lower plate **generated** by the Antler Orogeny. East vergent folds are cored by blind thrusts. The architecture is found throughout the Cortez and Shoshone mountains. The Gund Thrust has put the Roberts Mt Fm and Wenban over the Horse Canyon Fm. The thrusts are commonly the locus of mineralization both along the thrust plane and in the axial plane cleavage formed by the folding.

Cross Section **F-F'** shows the Upper Thrust, seen on **Map S-1.** The architecture of the lower plate on the section was developed to explain drill hole GBN 1701r located in the eastern valley that drilled exposures of Valmy and then 1,200' of Comus Formation above a thick section of flysch. Though I have named the flysch the Blue Hill unit using the convention of the Cortez Mountains, it has other names regionally. The importance is that the flysch is known to overlie the Horse Canyon and Wenban Formations. Since Cross Section **F-F**' shows an anticline coring the Simpson Park Range, the valley to the east should be a syncline and filled by Tertiary and Quaternary facies. This is not the case as drilling revealed Cambrian age rocks. The tilting in the east portion of the cross-section would explain the over thickening of the Comus and flysch. The Paleozoic upper and lower plate rocks are folded by eastward verging thrusts which were formed while overriding the continental margin. Once the thrust has passed over the margin, the folds and thrusts relax as the thrust sheet spreads eastward by gravity sliding away from the foreland welt. This results the reactivation of steep thrusts into low angle extension features modelled in the cross section. Furthermore, the cross-section copies both small and meso-scale structures within the Pipeline Pit.

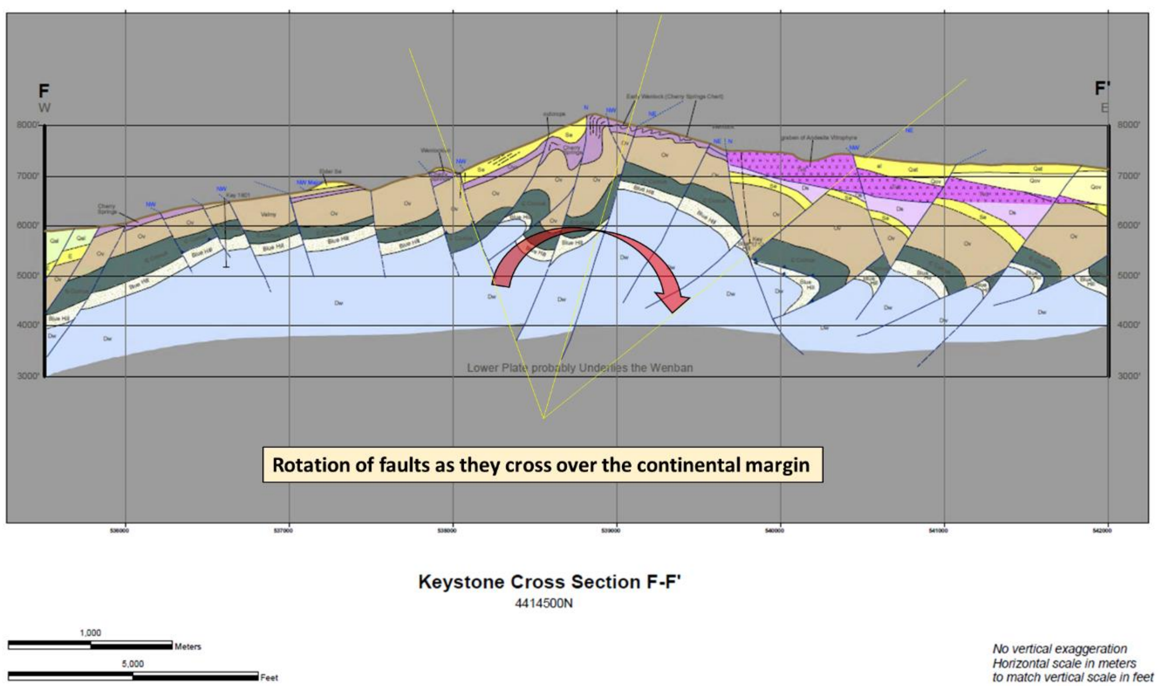


Figure S-2: The figure shows the rotation of the thrust architecture as the foreland welt is pushed up against the continental margin and then collapses once it has crossed up and over the continental edge. The lower plate is also affected by the thrusting and is probably allochthonous, much like the Gold Acres Window. The Antler Orogeny should be considered a continuum lasting from Late Devonian to late Permian.

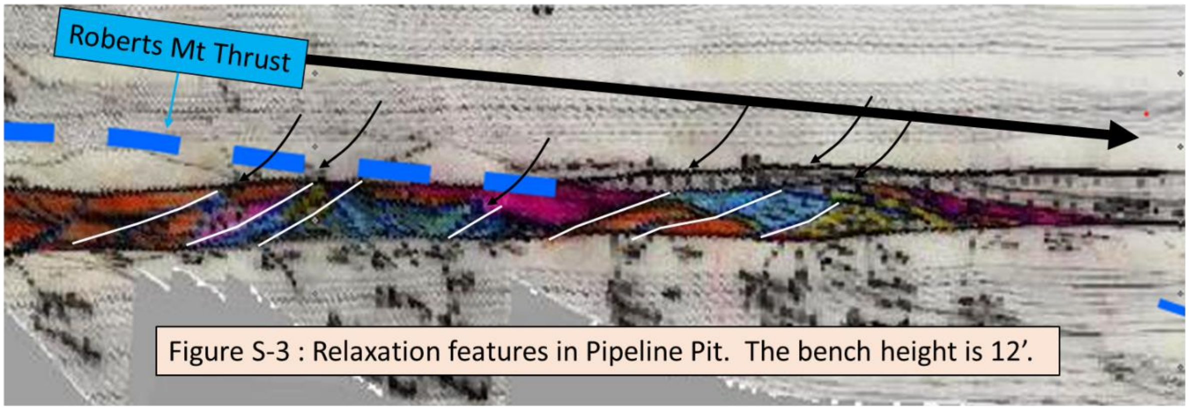


Figure S-3 : Relaxation features in Pipeline Pit. The bench height is 12'.

The drawing above comes from the Pipeline Pit map. It demonstrates the architecture in cross-section **F-F'**. The overthrusting of the Upper Plate rolls the structures outlined in white to the east forming what appears to be extensional features. However, the detachment like features are actually formed by compressional rotation.

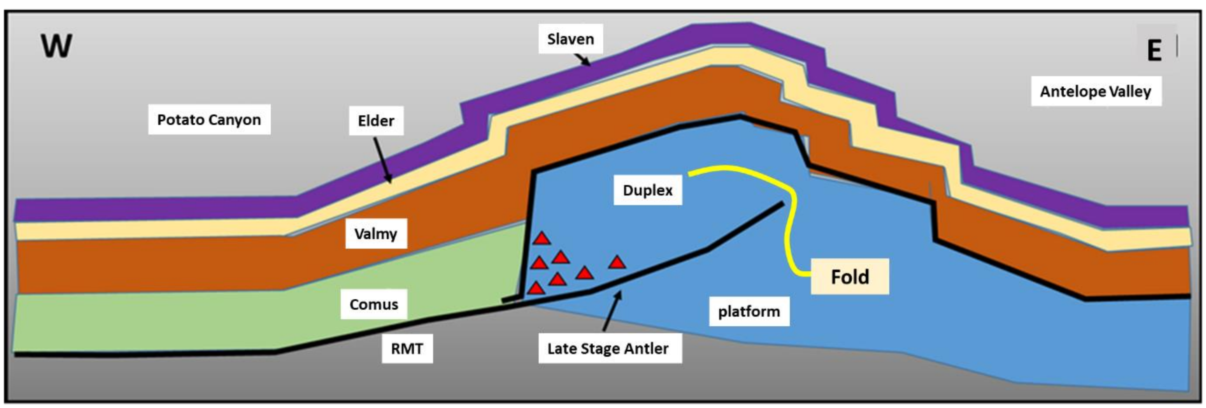


Figure S-3a: This sketch shows that thrusting from the west results in breakage in the lower plate forming a structural target. The buttress shown can scrape off some of the upper plate as seen at Pipeline, but this is not necessary. Small step folds on the east side of the antiform are located 200m west of Drill Hole Key 1710r. The vertical strata on the west side are mapped features south of Potato Canyon. Pipeline drilling penetrated the Valmy into the Wenban which formed an eastward vergent fold cored by the Roberts, Hanson Creek and Eureka. Drilling in the bottom of Pipeline Pit showed that the lower plate strata overlay the Valmy including the Ovq unit, and a greenstone seamount dated as late Cambrian.

Figure 3a above is a sketch demonstrating the effect that the eastward verging thrust has on the Lower Plate. In the sketch the upper part of the duplex would form a high either as an anticline or as in the case of the Gold Acres Window, a disassociated block within the Upper Plate strata. The small scale folds shown in this diagram are reflecting mapped features found on the transect through Potato Canyon to Drill Hole Key 1710r.

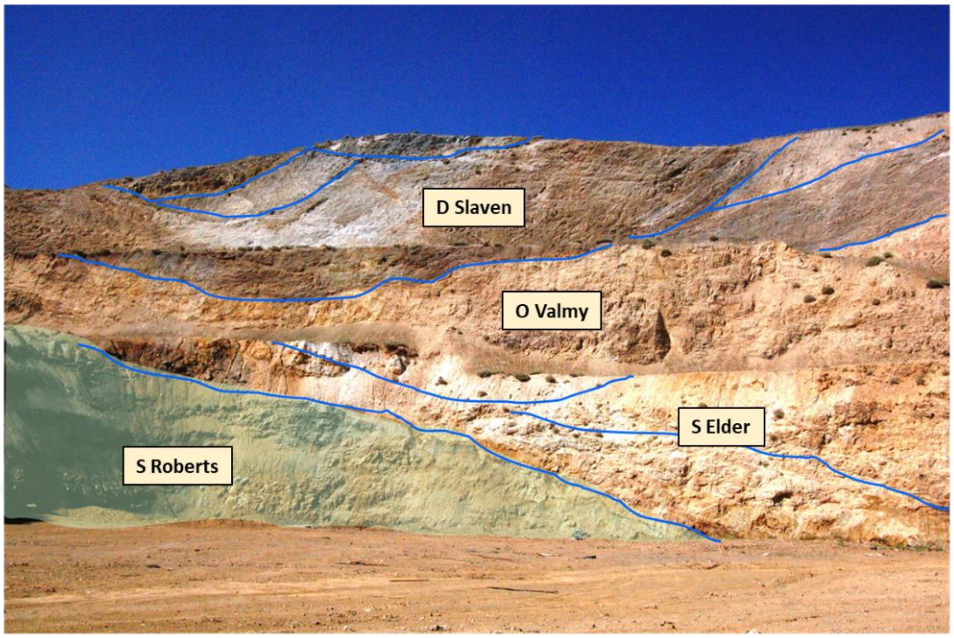


Figure S4: This slide from Gold Acres shows meso-scale shovel shaped thrusts that shuffle major upper plate stratigraphic units along the RMT. The purpose of the slide is to emphasize that one cannot reliably predict which unit will underlie the exposures of Comus seen in Greenstone Gulch.

The two figures above emphasize the unpredictability of Upper Plate stratigraphy. There are several examples on the property where the stratigraphy is out of order. For example, the Northern Cross area appears to have a duplex which is seen exposed north of Tip Top beneath the ridge. Here Comus like rocks underlie the Horse Canyon Formation. Drill hole Key 1605c encountered the Wenban (Famennian) at 1000' beneath a thick shear zone, probably the RMT. However, at 1,120' the rock changed into typical Comus debris flow facies dated as late Ibexian. These strata resemble the greenstone limestone underlying Tip Top. Similarly, Key 1705r hit 100' of Horse Canyon and Wenban at 800' but then drilled 100' of Valmy Ovq facies before going into the Wenban at 1000'. Arguably Key 1704r also hit an upside down sequence of Wenban over Horse Canyon at 600', hit mineralized jasperoid at 1000' and then entered and enigmatic zone that was logged as jasperoid but is not hard enough. Examination of this lower mudstone section shows that it has very low strontium and high titanium from 1250' to 1375' similar to levels experienced in rocks logged as Comus. Therefore, the section of mixed carbonate and mudstone could be the Comus. Below 1400' the strontium rises to levels more suitable for the Wenban. One may argue that the decreased strontium could be due to decalcification but the titanium data are difficult to explain. The point of this discussion is to show the difficulty of predicting what may underlie a specific stratum.

Cross Section **G-G’** strikes NW and is perpendicular to the proposed arch. Regional map **Map M-2** has the major structure elements highlighted. One can see that the dip symbols delineate an anticline with a NE strike and plunge of 20 degrees to the NE. The strata are highly dissected by NW and NE structures but the general form is evident. The bright green line outlines the Ovq Ordovician quartzite outcrops that were deposited above the Comus Formation. The NE end of the property is clearly an anticline. The SW end of the anticline is truncated by Miocene N-S striking range front faults. The southern end is also cored by the Walti Pluton which has brought up the lower plate. Three sides of the pluton are in normal contact with lower plate sediments since the contacts are skarn. The northwest margin is a post Eocene fault that jogs Grass Valley to the NE.

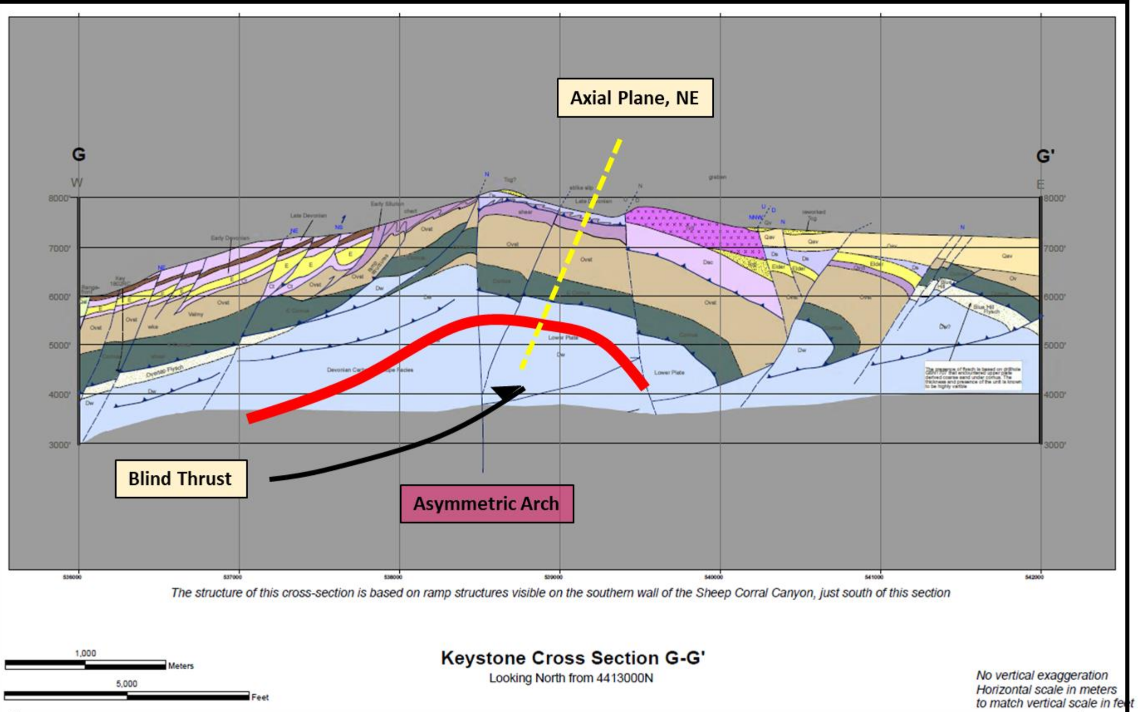
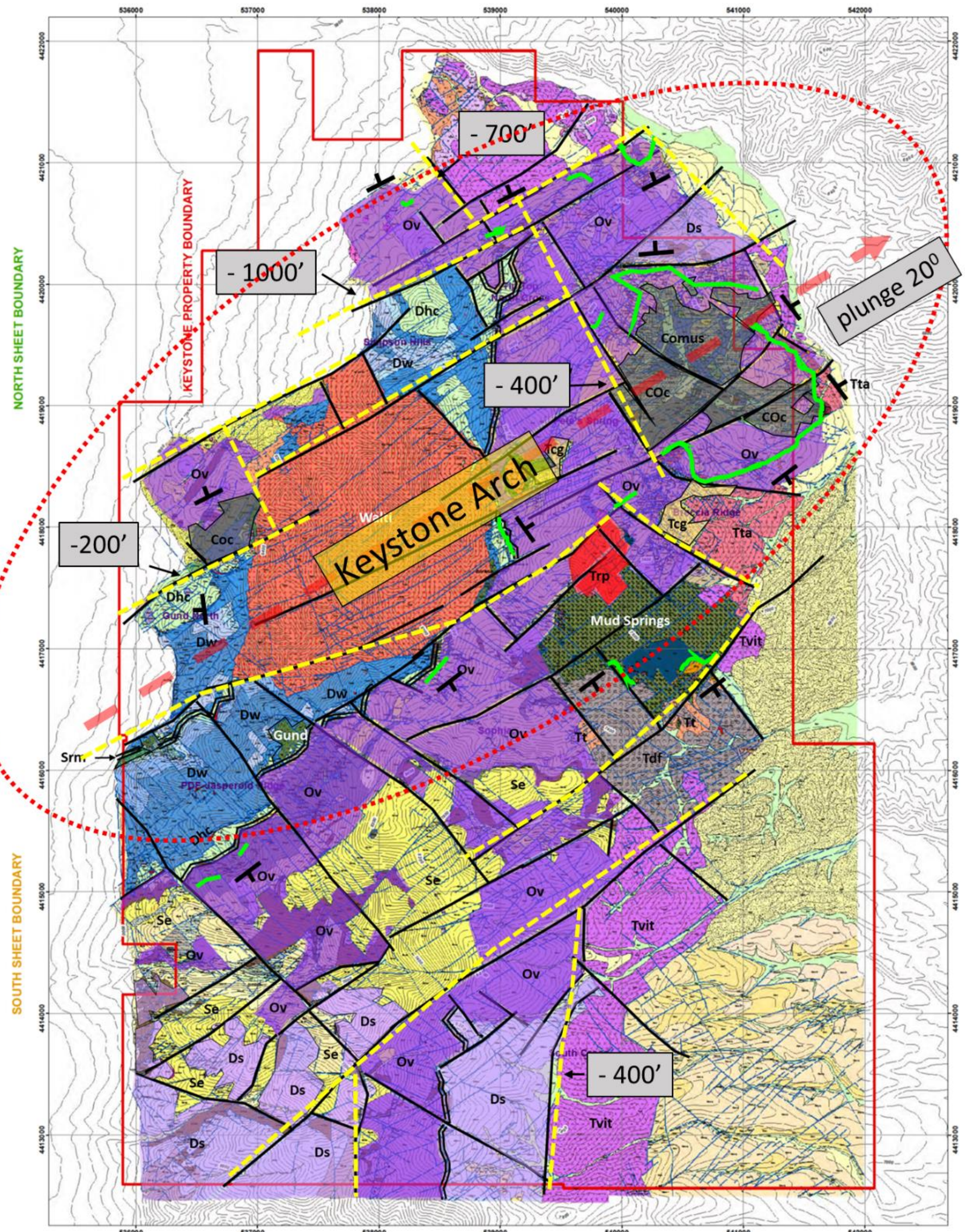


Figure S-5: This figure shows the Keystone Arch that may have been intruded and domed by the intrusion of the Tertiary Walti Pluton. The fold axis strikes approximately NE. The doming will reactivate older structures such as the thrusts Antler thrusts and regional NW structure. Some NE structures may be axial plane features related to the arch. Antiforms form traps for ascending fluids

The arch may have been formed by late Antler thrusting which was somewhat southeast vergent. However, it could be caused by the Walti Pluton. The lack of metamorphism along the NE part of the axis would argue against the pluton underlying the northern end of the anticline. Also, B and C type dikes become less common beyond the NW trending fault that separates the Comus exposures from the chert argillite dominated Katian Valmy facies. Note that the NE fault



Map M-2: The map has selected the major structures in yellow. The dip symbols show an elongate dome with a NE strike. The quartzite outcrops are highlighted in green. Note the quartzite outcrops surrounding the Mud Springs Pluton.

U.S. GOLD CORP
Keystone Project, Eureka Co., Nevada
KEYSTONE PROJECT - EUREKA COUNTY, NV
INTERPRETIVE GEOLOGY MAP
By Tom Chapin 2018

labelled 400’ on **Map S-2** truncates the orthoquartzite. The NW faulting is probably Pre-Tertiary with similar strike to the Mexico-Sonora megashear, the Walker Lane, the Eureka Battle Mountain Trend and the Carlin Trend that are major structures cutting the continental crust and also the locus for gold mineralization. The NW structures are therefore crosscut and displaced by all younger faults and consequently the individual strands cannot be traced for any great distance. If some of the NE faults are formed by the formation of the arch either by thrusting or Tertiary doming, then the intrusion of the Walti Pluton and Mud Springs Pluton would result in the reactivation of both fault systems. The intersection of NE with NW faults coupled with an anticlinal axis makes an intriguing target model.

The most favorable area structurally would be the Blue Lagoon Dike swarm area. The dike study discusses targeting and the geochemistry of the Blue Lagoon Dikes. Altered B type dikes appear to be related to strong argillic alteration and the deposition of some minor variscite. It is felt that the phosphate is a telethermal mineral overlying a higher temperature hydrothermal deposit. Drill hole Key 1813r is the closest hole to this target area. The lower plate was encountered at 750’. Due to the dip of the strata, one would expect the contact to be somewhat deeper in the dike area. However, across the NW 400’ fault, the Comus is exposed. Comus strata are near surface. Four hundred feet of throw has been proposed for the NW fault that bounds the Katian chert from the Valmy quartzite. However, the suggested depth is highly speculative due to the unpredictability of the various Antler thrust sheets, **See Figure S-4.**

IGNEOUS ROCKS – PALEOZOIC AND TERTIARY

Greenstone Samples

Seventeen samples were identified as greenstone species within the upper plate. They include spilites, pillow basalts, possible sills, debris flows containing soft basalt clasts and one sample is a dunite xenolith. All the samples are alkaline to sub alkaline basalt and plot in the OIB ocean island basalt field which is consistent with the model that rifting began in the Cambrian and persisted into the lower Ordovician. The purpose of the petrologic study was to see if there is a geochemical discriminant between Cambrian Comus or early rift basalts and younger presumably more evolved basalts found in the Middle Ordovician of the Valmy formation. What the geochemistry discovered, however is that though there are two discrete clusters of data, the data seem more affected by the manner of depositional mixing than the differentiation of the basalt itself. Therefore, pillow basalts, sills and the xenolith are basanite

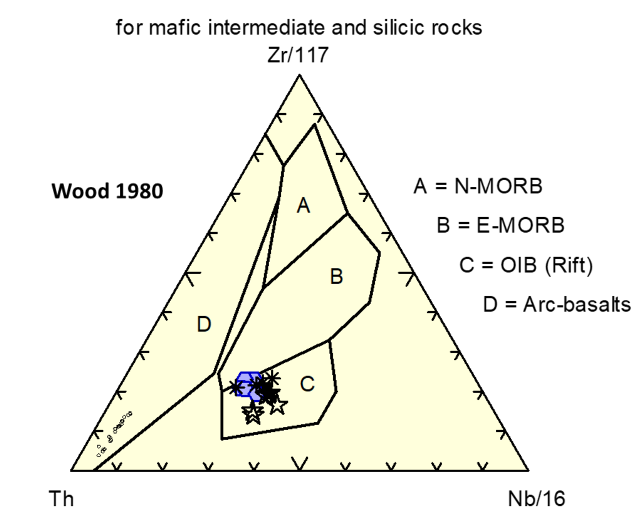


Figure D-1: All the material identified as Upper Plate igneous plot as OIB primitive basalt.

nephelinites and the spilites, tuffs and mixed greenstone carbonate debris flows form a different slightly more evolved alkaline basalt. The diagram above (as well as several other permutations) show that the upper plate greenstone rocks are clearly oceanic rift basalt.

Sample types: Spilites are identified by their mixed textures of lava, seawater alteration and mixing with surrounding sediments. One sample collected from the Greenstone Gulch area is an underwater tuff made up of palagonite shards that plots with other spilites in the alkali basalt field.

Basalts were tentatively called upper plate lamprophyres due to their euhedral biotite laths. However, geochemically these rocks plot near basanite to nephelinite basalt field in diagram 1.

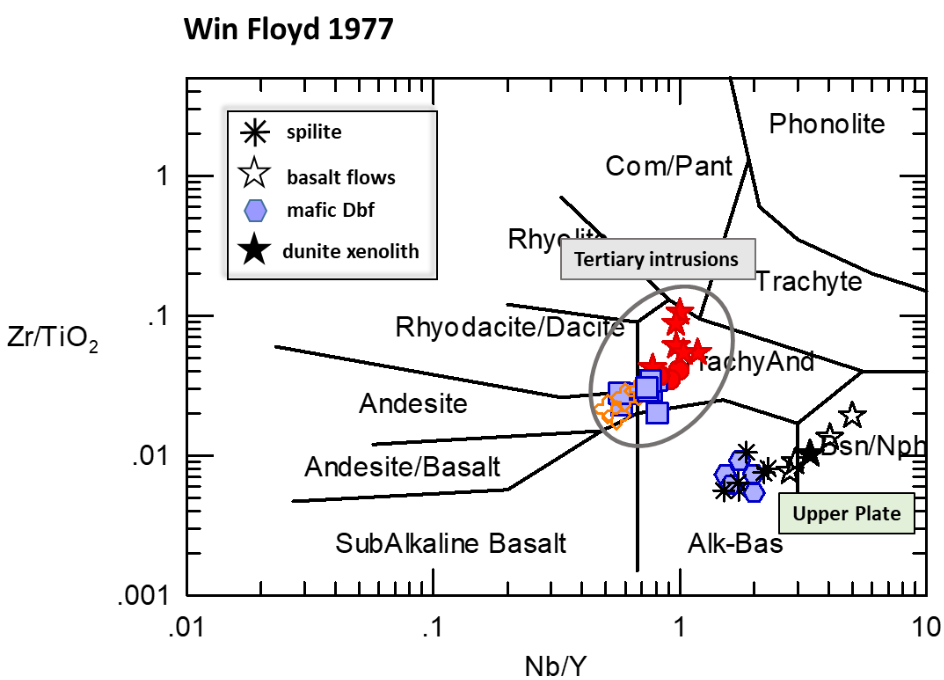


Figure D-2: The Winn Floyd diagram shows clearly that the Upper Plate has higher titanium and yttrium than the Tertiary intrusions. It also groups the spilite and the greenstone carbonate and siltstone debris flows together. The basalt flows and possible sills are basanites similar to the dunite 100% olivine sample.

The dunite (peridodite) sample (black star) was collected from a wash draining from the Walti Pluton and presumably it is a xenolith entrained from the stock. It is 100% olivine. It plots as an OIB which is unsurprising in a rock that is essentially mantle material.

The greenstone bearing debris flows were collected from drill hole Key 1605 on the extreme west side of the property and from GBN 1701 located southwest of Keystone midway to the Gold Bar area. The samples come from strata that yielded Cambrian to early Ordovician ages consistent with debris flows within the Comus formation. It is surprising that mixed facies of greenstone, silty limestone and oceanic mudstone should plot so tightly with material that was collected as largely greenstone. This fact shows the viability of using the immobile elements to do such comparisons.

The Win Floyd diagram compares the Zr/TiO2 ratio with the Nb/Y ratio which is the most useful rock type discriminant. The Tertiary igneous plutons are circled in red and are a completely distinct family from the ocean rift derived basalt flows of the Comus and Valmy. Looking at the mafic species only, there are alkali basalts and basanite basalts. The open stars are flows and sills which form a continuum from nephenilitic basalt to alkaline basalt. One simple explanation is that these samples are more pure and less mixed with seawater and sedimentary debris.

The diagrams below were designed to spread the data. P2O5 was used on the Y axis since it is normally enriched in OIB basalt. Note that the samples considered more primitive and unmixed have the higher P2O5 values. The immobile elements Nb and Ta show the same pattern with the spilites and debris flows being considerably lower in these elements. Since they are immobile why do the two groups differ? This would indicate that dilution may be a factor. The mobile element Th also sows the same general pattern. The CaO data is very scattered showing a large variability compared to the other clusters. In part this demonstrates that the basanites are more pure samples since they come from the center of pillows and sills. The spilites and debris flows are mixed either by saussuritization, the explosive interaction with seawater, or the sedimentary component of the debris flows.

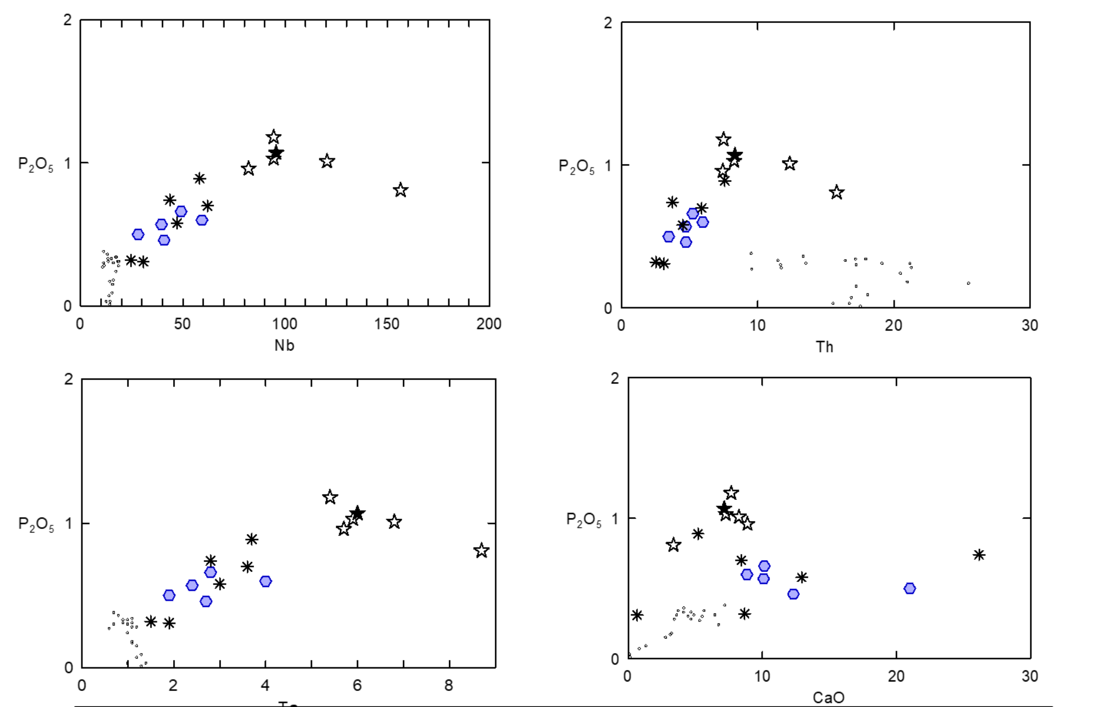


Diagram D-3: These diagrams show that the basanite and dunite persist in clustering tightly with regards to the immobile elements Nb and Ta whereas the spilites and debris flows are depleted (by mixing) The mobile elements thorium and P2O5 are also depleted, possibly by mixing. The CaO diagram shows a high variability in calcium due to the presence of calcite found in amygdales and surrounding limestone that is mixed into the sample in spilites and limy sediments.

Tertiary Igneous Intrusions

The Igneous rocks have been discussed both in the Chapin 2017 report and in Gabe Aliaga's Thesis. The following is a brief summary of the major intrusions that are used to compare the dike and extrusive families which are discussed at length further in the report. The figure below shows the four main intrusive species. The Gund Sills (35.87ma) are found on the west side of the property both underneath the RMT and along the range front. They are the most mafic Tertiary intrusions on the property. The Mud Springs diorite (35.82ma) is located north of the Sophia zone and was shallowly emplaced. The Walti Monzonite (35.51ma) is the main cliff forming intrusion seen on the west side of Keystone. It forms metal bearing skarn deposits and probably most of the hornfels alteration seen in the upper plate. The Rhyolite Porphyry (35.43ma) is located next to the Mud Springs diorite and is the youngest of the intrusions. The dates come from Gabe's thesis.

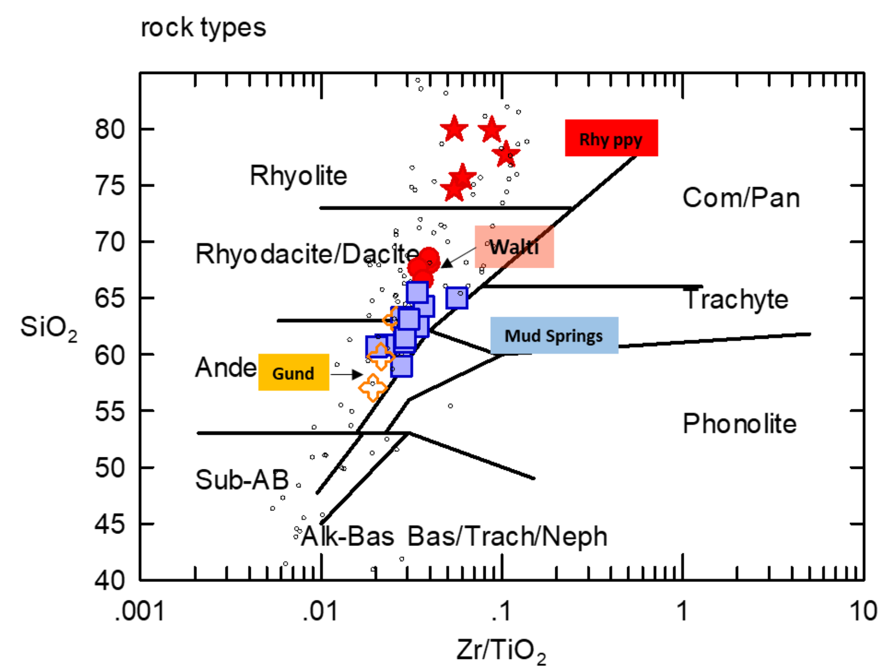


Diagram D-4: The diagram shows a normal differentiation sequence with the Gund sills as the most mafic rocks, followed by the Mud Springs, Walti and the quartz rich Rhyolite Porphyry.

For the purposes of the **Dike Study** portion of this report, the data from the intrusions was simplified to one typical sample of each species; Gund, Mud Springs, Walti and the Rhyolite Porphyry.

Gund Sill

The outcrops of the Gund Sill opposite the Gund Ranch intruded a low angle thrust fault (Gund Thrust) that carried Silurian Roberts Mt Formation and the complete Devonian Wenban and Horse Canyon Formations over the Devonian Wenban and Horse Canyon rocks, thus doubling the Lower Plate section. The sill formed a metamorphic halo altering the Horse Canyon below to epidote and making tremolite calc-silicate marble in the Roberts Mountain formation above the thrust. Similarly, the exposure underneath the RMT at Jasperoid Ridge formed marble, diopside skarn in the Lower Plate carbonates, and hornfels pyrite alteration in the Upper Plate rocks. The upper plate greenstones behaved like carbonates and have diopside and epidote alteration.

It has been proposed that the vitrophyric andesite flows (McClusky Andesite) are related to the Gund Sills, but field evidence suggests that the McClusky andesite is one of the youngest igneous rocks on the property.

Mud Springs Diorite

The diorite is a shallow intrusion with a possible mushroom shape. The evidence for a shallow depth of intrusion are the lithophysal gas cavities found on all three flanks and the top of the intrusion. Additionally, the calcite outcrops that lie on top and ring the flanks of the Mud Springs intrusion are only slightly thermally altered. Typical contact metamorphism of a carbonate would create marble and calc silicates such as diopside. None is present in the outcrops directly in contact with the intrusion suggesting that the magma was already fairly cool when encountering the limestone deposit. A very minor sphalerite prospect is found at the top of the plug. Since the Mud Springs is unnaturally cool relative to its size, it is logical to suggest that the magma body is small, possibly sill like or lopolithic. Note that the Gund must have been emplaced at a deeper depth since it was apparently quite hot, regardless of its small size.

Walti Pluton

One of the most interesting aspects of the Walti Pluton is that it shows evidence of magma mixing. Gabe Aliaga shows photographs of mafic liquid magma mixing into the quartz monzonite. Mafic facies associated with the top of the Walti pluton are mapped around the Keystone Mine. They are also found intruding the Tertiary conglomerate and near other contact rocks. The A type dikes discussed in the subsequent chapter could be related to this magma rather than the Mud Springs Pluton as proposed.

Rhyolite Porphyry A small plug of quartz eye rhyolite intrudes the west margin of the Mud Springs stock. The border between the two intrusions shows some intermixing and propylitic alteration within the Mud Springs. The plug is late stage and has very high silica ranging up to 80% SiO_2.

Tertiary Dikes

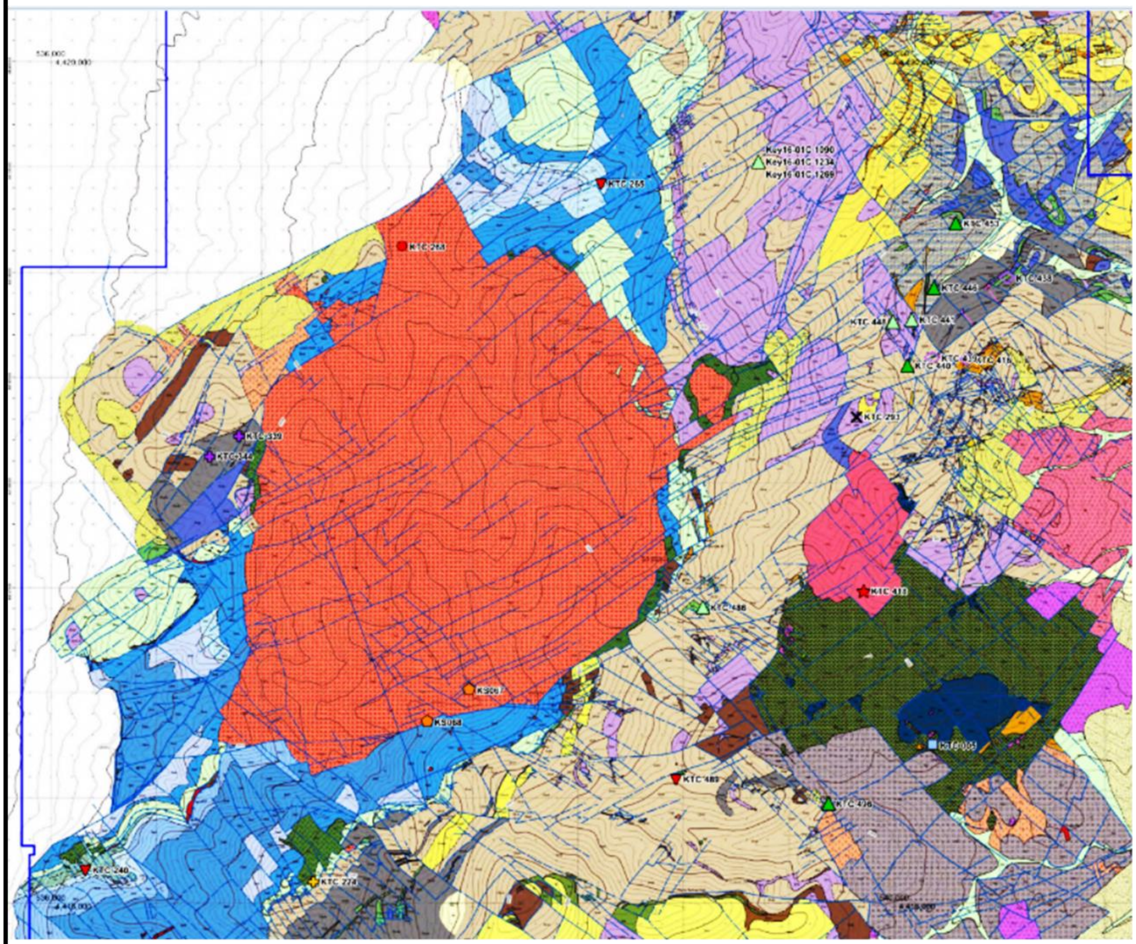
.

The following is an intensive study of the geochemistry of the various dikes on the property. It is important to understand the Tertiary dikes since they occupy structures that must have been open during the Tertiary hydrothermal event. Dikes usually are not rich in metals or pathfinder elements since they easily alter to clay and become aquitards. Indeed, our dike data show that the pathfinder elements are generally low to absent. A few exceptions exist but are not consistent with the identified rock types.

The table **Keystone Dike Groups** discriminates the various dikes into groups using petrography and petrology. Many of the samples are highly altered. Consequently, the thin section work involved some guess work, but a general grouping was possible using textures such as trachytic, glomeroporphyritic, clean cut simple oblong feldspars, the presence of hornblende or pyroxene shapes etc. The groups were then analyzed by whole rock data and resorted using chemistry. The result is a fairly consistent pattern which is shown in the table. The table consists of the sample identity, its group, its plot symbol (see symbol chart), a brief description, its location, its major elements and finally any association to matallogeny.

The table is divided into six groups. The upper plate **UP** tholeiite dikes were used as a control. **Group A** dikes are fairly mafic with a holocrystalline trachytic groundmass and have plagioclase, pyroxene and hornblende phenocrysts. **Group B** dikes include Key 1601c dikes and have a glomeroporphyritic texture and are generally completely altered to quartz sericite. **Group C** have simple plagioclase phenocrysts and mafics are not identified. **Group D** have a variety of textures and vary from Group C dikes by having lower Zircon, Vanadium, and MnO. The latter variance could easily be due to alteration. **Group Uncl** is not really a group, but are altered samples that plot all over the show. KTC 247 is contaminated by lithic inclusions including sedimentary host rock. KTC 265 could well belong to **Group A** and KTC 293 plots near **Group B.**

A location map with the various dikes identified by species was made by Joe Laravie. It is found as Dike Map.jpg and provided as an addendum to this report. The symbols are changed somewhat due to constraints between the Petrology program and the GIS program. The light colored green triangles of **Group B** are the open green triangles in the petrography diagrams, and the dark green triangles are the solid green triangles of **Group C.**



Map M-3: Excerpt of map created by Joe Laravie showing the location of the pertinent dike samples. The scale can be blown up on the computer to make the sample numbers legible.

This is an excerpt from the Dike map. The resolution is pretty poor but it can be blown up to make the sample numbers legible.

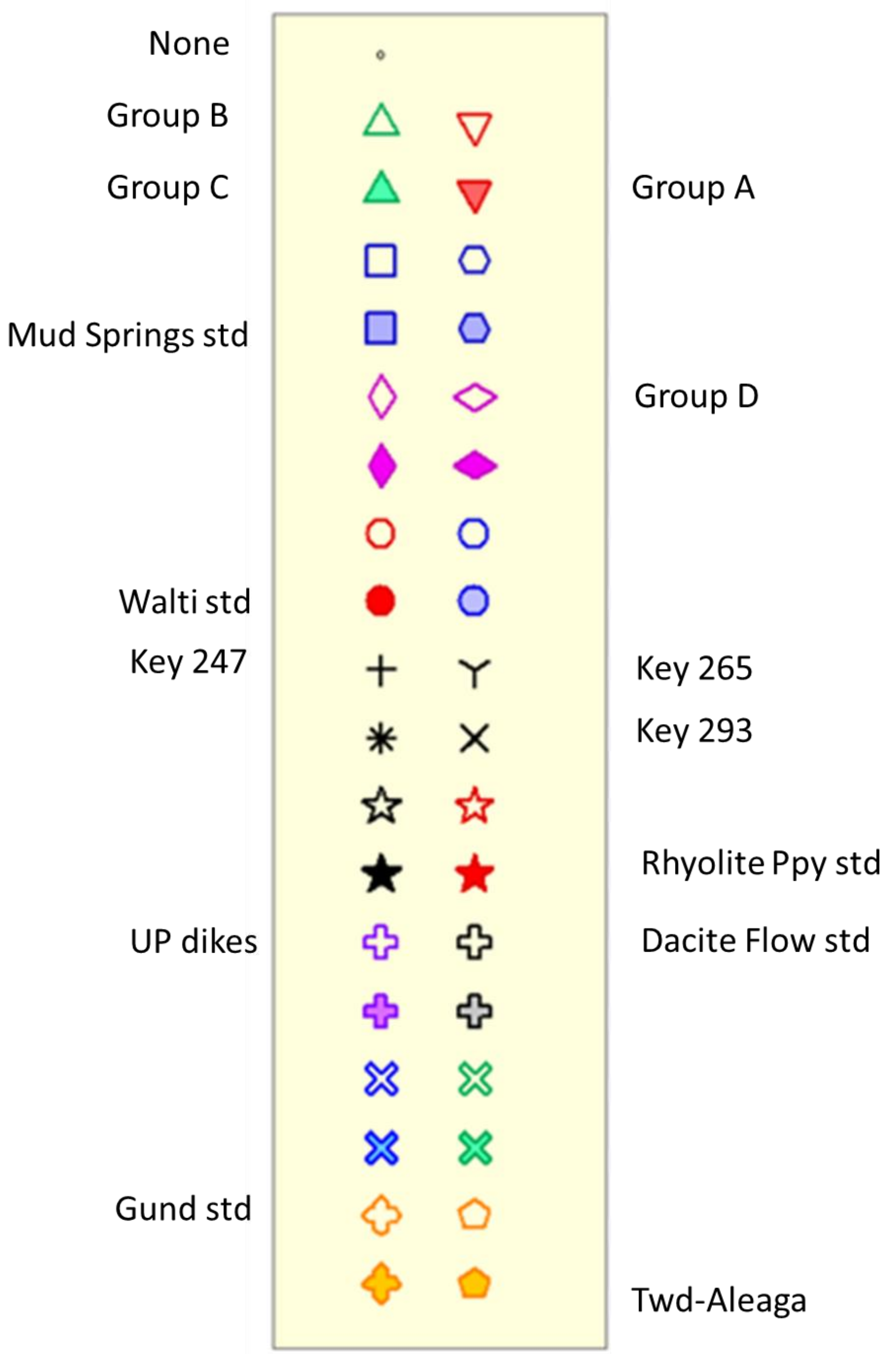
Table 1: Tertiary Dike Data with Symbol and Location

SAMPLE	Rock Name	Type	Symbol	DESCRIPTION AND SETTING	LOCATION	Titanium	P2O5	Zircon	Vanadium	MnO	Arsenic	Thallium	Silver	Zinc	Lead	Copper
KTC 339	trachi-andesite	UP	purple +	both samples are hosted in upper plate rocks and plot as OIB basalts. They are a control.	Lower West Flank Keystone north of Gund Ranch	hi	hi	lo	hi	hi	mod	10		mod		
KTC 344	trachi-andesite	UP	purple +	both samples are hosted in upper plate rocks and plot as OIB basalts. They are a control.	Lower West Flank Keystone north of Gund Ranch	hi	hi	lo	hi	hi				mod		
KTC 240	trachi-andesite	A	triangle V	plagioclase laths and chlorite alteration, phenos Plag Hbl Aughite	Lower central West flank touching Gund Sill	hi	hi	lo	hi	v hi				mod		
KTC 489	trachi-andesite	A	triangle V	plagioclase laths and chlorite alteration, Plag hbl and augite phenos	Sophia near Key 1706	hi	hi	lo	hi	v hi	some	10	some	mod		
Key 1601 1090	Dacite	B	triangle A	**plot as related to Mud Springs** but trending toward Walti. Recognized by glomeroporphyritic mix mafic plag	Tip top	avg	avg	avg	avg	avg	some	10		mod		some
Key 1601 1234	Dacite	B	triangle A	glomeroporphitic	Tip top	avg	avg	avg	avg	avg			some			
Key 1601 1269	Dacite	B	triangle A	crouded porphyry andesite	Tip top	avg	avg	avg	avg	avg	high					
KTC 441	Dacite	B	triangle A	glomeroporphitic plag mafic clusters and isolated Hbl. Chlorite sericite mnox alteration +/- quartz	Blue Lagoon E Wash between BX ridge & spring	avg	avg	avg	avg	avg				mod		
KTC 448	Dacite	B	triangle A	glomeroporphyritic very altered mafics to chl and chalcedony; plag to sericite and calcite	Blue Lagoon ridge crest north	avg	avg	avg	avg	avg	some	10		mod		
KTC 486	Dacite	B	triangle A	1cm 30% ppy glomeroporphyritic plag mafic clumps biot hbl px alt chl accessory apalitie	Sophia N near Blue Lagoon headwall of E Wash	avg	avg	avg	avg	avg			some	mod	some	
KTC 440	Rhyo-dacite	C	triangle A	**Plot as associated to Walti** Heavily altered 30 ppy some glom, sericite, qz and chlorite, amyg, zircon, ap	Blue Lagoon East Wash	lo	lo	v hi	hi	lo		10				
KTC 446	Rhyo-dacite	C	triangle A	plucked plag 30% ppy heavy alteration sere, chl, qz and py, mica after mica has zircons glomero alt to chl and se	Blue Lagoon East Wash	lo	lo	v hi	hi	lo						
KTC 453	Rhyo-dacite	C	triangle A	0.5cm plag 30% ppy feldspar and glomero less altered than above, matrix is qz and dirty mica phlogo? alt hbl	Blue Lagoon N end of Ridge	lo	lo	v hi	hi	lo					some	
KTC 496	Rhyo-dacite	C	triangle A	1cm plag ppy alt to chl, epi, sericite calcite + accessory apatite, glomero, holoxlene groundmass with quartz	Sophia road east nose of ridge	lo	lo	v hi	hi	lo			some			
KTC 416	Altered andesite	D	diamond	**Plot as Rhyolite but not :** higher TiO2 than Walti or Rhy ppy. Devit hypabissal ser alt oblong feld ppy	N end of Breccia Ridge	lo	lo	avg	lo	v lo	some		some	lo		mod
KTC 438	Altered andesite	D	diamond	40% 1cm andesite pyroxene hbl porphyry, penetrative twin plag, qz ser alteration	NW flank Breccia Ridge	lo	lo	avg	lo	v lo	some			lo		mod
KTC 439	Altered andesite	D	diamond	heavily altered plag possibly glomeroporphyritic, alt qz ser illite chl hem and limo	SW flank Breccia Ridge	lo	lo	avg	lo	v lo	mod	10		lo		mod
KTC 247	Rhyodacite ??	Uncl	black +	**All Over The Show**: Extremely altered samples, lithic possibly contaminated, hbl biot plag ppy, rhyocacite	Northern Cross	avg	lo	lo	hi	avg	high					
KTC 265	unclassified	Uncl	black Y	highly altered plag ppy with strongly resorbed quartz eye possibly xenocryst no alkalis at all	Keystone Window north of Keystone Mine	hi	hi	avg	hi	v lo	v high					some
KTC 293	Rhyodacite ??	Uncl	black X	plots with Mud Springs but high Silica, plag hornblende in altered glass, py jarosite sericite	Blue Lagoon South of spring	avg	lo	avg	v hi	v lo		10			mod	mod

The table was made in excel and the symbols are approximations.

The petrologic approach was to compare the various dikes with the major intrusions to track the evolution of the magma from dikes to the intrusion of the plutons.

Symbols used in Dike Study



The Wood diagram below compares SiO2 to the Zr/TiO2 (continental/mantle) ratio. It identifies the rock name used in this report.

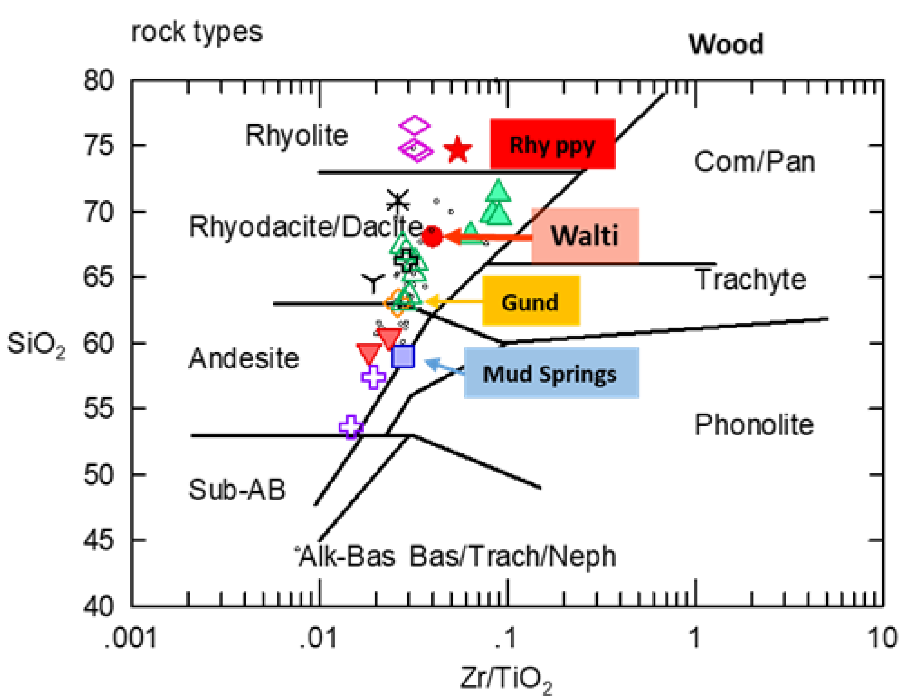


Diagram D-5: The diagram plots silica against the Zr/tiO2 ratio. The rocks generally follow a differentiation trend from mafic to acidic. The dike species show a similar trend.

UP -The Paleozoic upper plate dikes are tholeiitic andesite.

A- Tertiary andesite, precursor to Mud Springs.

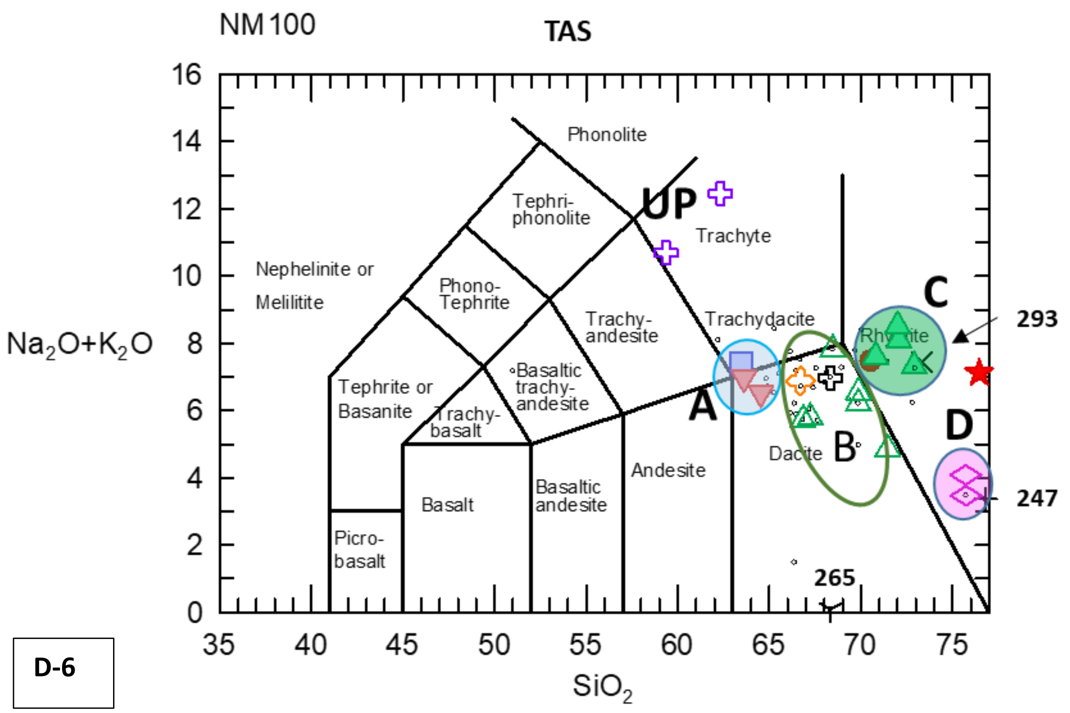
B- Dacite to Daci-andesite, precursor of Walti? Plots with Dacite Flows (vitrophyre) open black Plus + sign.

C- Rhyodacite precursor of the Rhyolite Porphyry

D- Heavily altered dikes determined to belong to **Group B**

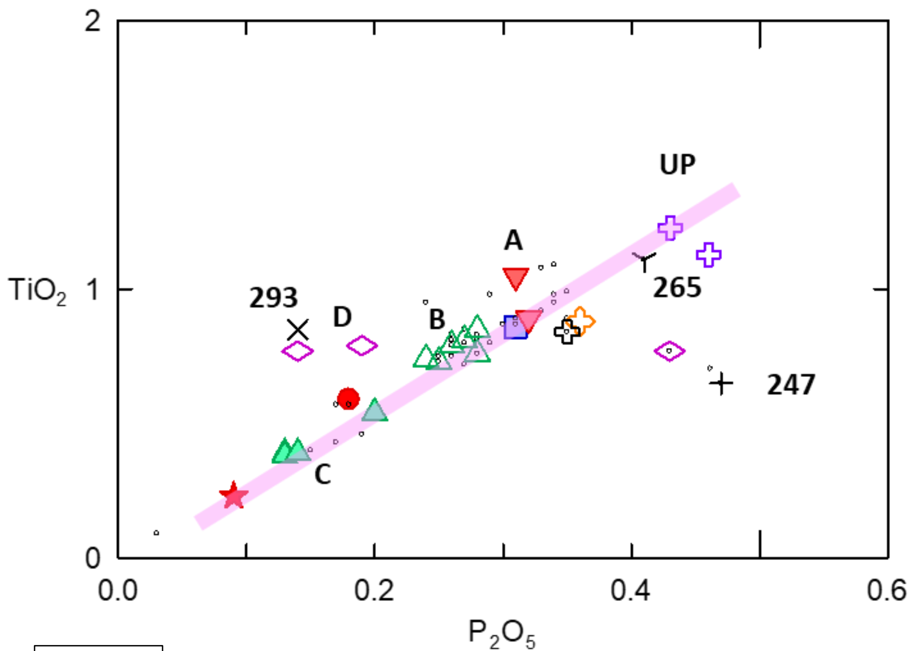
U-Unknown**-** Here shown as Dacite and Rhyodacite but study associates them to groups **A, B and C.**

The TAS diagram below is another classification system that compares Alkalis to SiO2. The alkalis are affected by alteration and group **D** is shifted away from the Rhyolite Porphyry field. Likewise two of the **U** samples have low to no alkalis. Sample KTC 265 is devoid of any alkalis. This is surprising since the sample is clearly a quartz plagioclase porphyry with abundant clay; probably kaolinite due to the lack of alkalis. The sample lies north of the Keystone mine in the jasperoid zone. It is the only dike showing large quartz eyes. One would suspect that it is related to the quartz eye porphyry intrusion that has slightly resorbed quartz phenocrysts. However the sample has much more TiO2 than the porphyry so it is not related. In KTC 265 the quartz eye is highly resorbed and the crystal may be a xenocryst.



TAS Diagram : The dikes are shown as groups. The **A** group associates with Mud Springs, **B** with Gund and vitrophyre flows, **C** with the Walti, and **D** with the Rhyolite Porphyry. The alkalis are easily removed so Group **D** is probably altered. The **U** samples are labelled. 265 is clearly completely depleted in alkalis, whereas 293 is not.

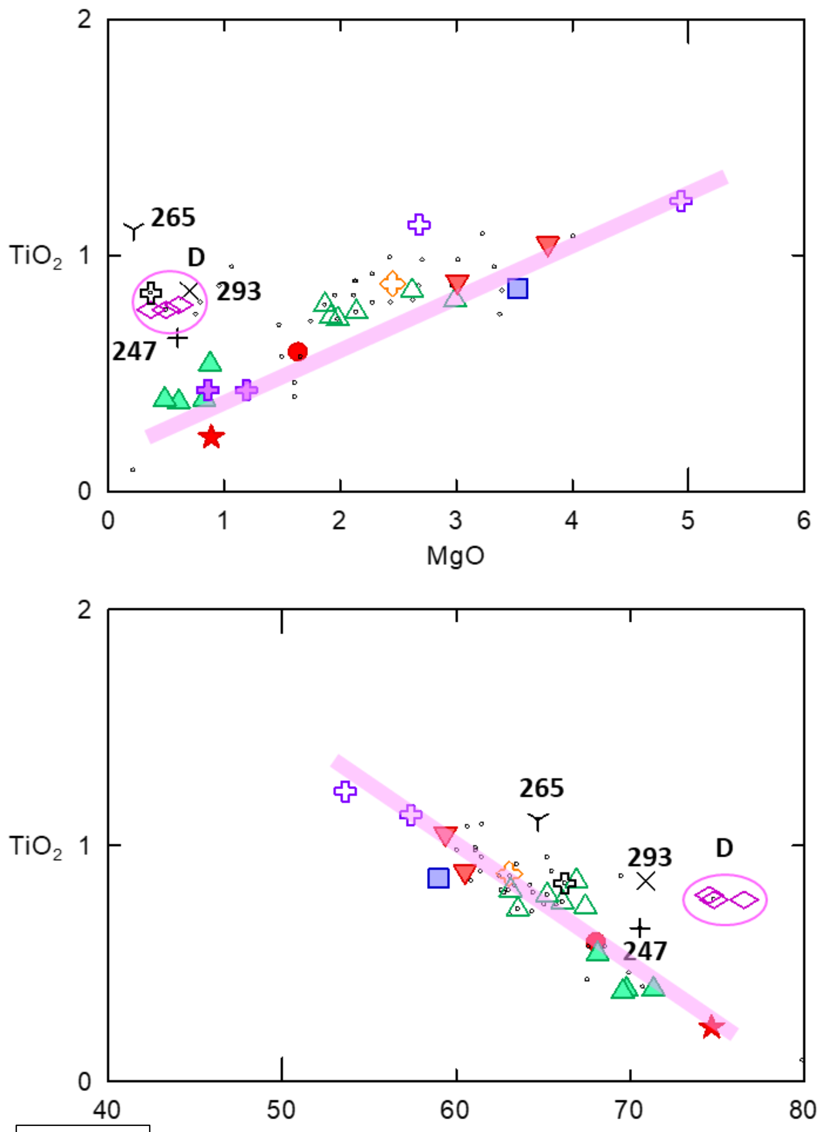
The following diagrams examine the dikes and related intrusions with respect to TiO2 which was chosen for the Y axis because it is immobile and discriminates the various groups by spreading the data. P2O4 is enriched in mantle derived material and therefore an indicator of how much the sample is differentiated. It is not surprising then that the control, trachyandesite upper plate dikes have high Titanium and Phosphorous. The Rhyolite quartz eye porphyry is the youngest and most evolved rock and it plots with the least of these elements. A pink line shows the differentiation trend between the two end members and both the Walti and Mud Springs plutons lie on the line. The Gund sills however, deviate from the trend but are considered to be closely related to the Mud Springs pluton. Note that KTC 265 lies at the mafic end of this chart whereas the quartz eye porphyry intrusion lies at the other end.



D-7: P2O5 is high in mantle derived rocks, the intrusions and dikes follow a normal differentiation trend with the Rhyolite PPY having the least P2O5. samples that stray from the line significantly are altered.

Two other diagrams of major oxides are compared to TiO2. They show that the **D** and **U** samples have added silica and depleted magnesium relative to the trend line. This is undoubtedly due to hydrothermal alteration. Thin sections show that **Group D** samples are highly altered to quartz and sericite. The **U** group also are strongly altered by quartz and sericite. To which igneous species and whether these samples are altered specimens of either **Group A, B, or C** is problematic. Looking at TiO2, **Group D** is most similar to **Group B** as is sample 293. Sample 247 may belong to **Group C** and sample 265 to **Group A**. These associations are clearly evident on the TiO2 – MgO diagram where MgO, which is highly mobile, is depleted in all the dike samples moving them to the left of the pink line linking the various plutons. The major groups are also pulled slightly to the left. **Group D** and the **U**nidentified group are much further left indicating that the original MgO has been largely removed. The puzzle in this diagram is why the Dacite Vitrophyre flow sample, gray plus sign, is depleted in

MgO? An examination of the rest of the data reveals that the MgO within the vitrophyre flows is highly variable, this sample is the lowest at 0.36% whereas some have over 2% MgO.



D-8: These two plots compare TiO2 with the major oxides of MgO and SiO2. The important thing to note is that group D and **U** group plot off the trend, they have more TiO2 and silica than they should.

In the TiO2 – SiO2 diagram one can see that Group D and Group U are pulled right of the line indicating added silica. Thin sections describe the samples as quartz sericite altered.

Immobile elements are unaffected by alteration. Therefore they are useful for comparing the dikes to the parent unaltered magma. In the Sc – TiO2 diagram below one can see that groups **A, B** and **C** lie close to the pink trend line. Sample KTC 265 however does not match the differentiation trend at all but it has the same Scandium level as the Mud Springs and Gund sills, but much more TiO2. The Northern Cross sample KTC 247, though highly altered, seems to lie fairly close to the intermediate rocks, regardless of lithic contaminants. KTC 293 on the other hand has Scandium levels similar to Group A.

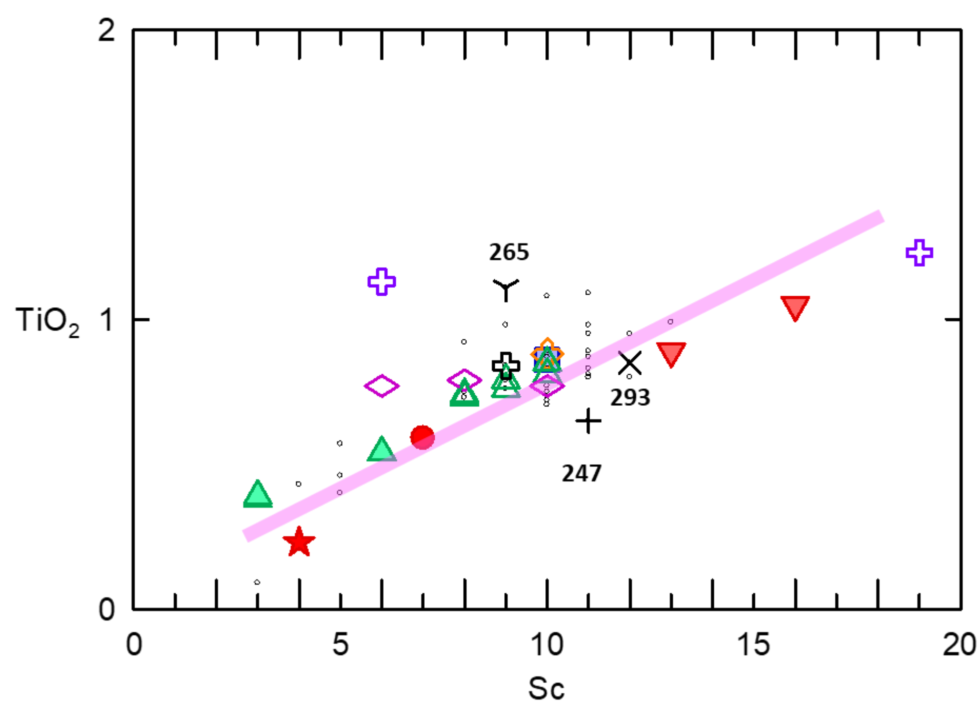


Diagram D-9: This diagram demonstrates that the highly altered rocks do not vary far from the trend line. It suggests a relationship between Group A and Group D as half way between the Mud Springs and Walti pluton. Key 265 and Key 247 have Sc levels similar to the Gund and Mud Springs, and KTC 293 is more mafic.

The Hafnium and Tantalum diagrams below show similar trends. Sample KTC 265 is associated with the more mafic minerals suggesting magma mixing with respect to Hafnium. **Group C** is distinctly enriched in Hf but lies near the Walti pluton trend line with Ta. Apparently Hafnium is no longer compatible with respect to the high silica Rhyolite Porphyry whereas Ta remained in the magma. The zircon data show the same trend.

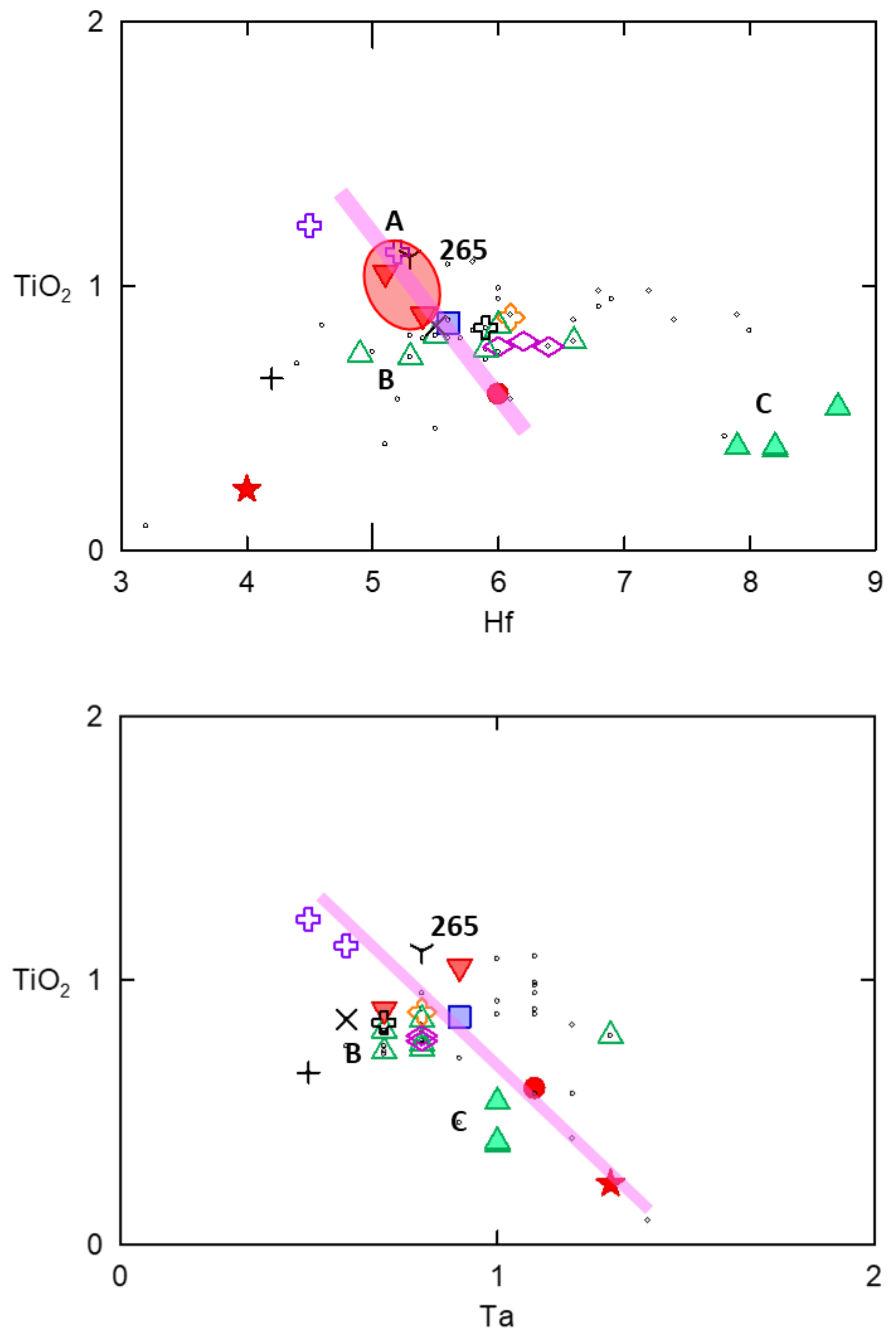


Diagram D-10: The immobile elements Hafnium and Tantalum show that Group A is more mafic as is sample KTC 265, Group B is in intermediate and group C is enriched in Hf while the rhyolite porphyry is depleted. But compared to Tantalum, Group C and the Rhyolite Ppy lie on the trend line. Presumably Hf is acting like Zr.

The Zircon diagram below is similar to the Hf data with respect to **Group C** and the Rhyolite Porphyry. Also note that Sample KTC 293 plots with the early precursors of the Mud Springs and Gund plutons.

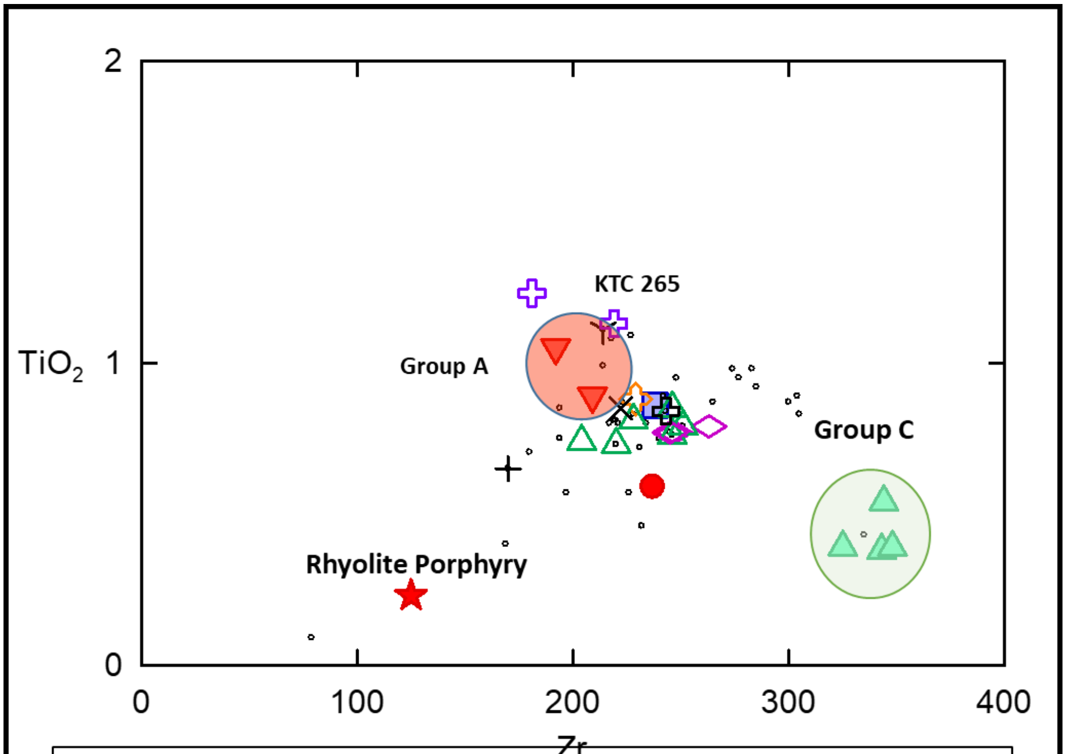


Diagram D-11: The zircon diagram shows that group **C** is completely different than the rest of the data. Since Group D is also highly altered, it is unlikely that alteration is the cause. Thin sections did not indicate significant zircon. The Rhyolite Porphyry is also strongly anomalous with less zircon than expected in a rhyolite.

Several questions arise from this diagram. **Group C** seems enriched in Zircon compared to the other species. Presumably additional Zircon crystallized prior to the emplacement of the high silica Rhyolite Porphyry because Zircon becomes immiscible at high silica levels (see the SiO2 diagram). Consequently **Group C** acquired the additional Zircon. Therefore **Group C** is geochemically distinct and can be identified by its Zircon TiO2 ratio quite easily. Group A can also be fairly easily distinguished using the Zr and Hf data.

The intermediate rocks **Groups A and B** are more complicated with respect to the immobile elements, but the P2O4 levels seem fairly reliable as is the MgO data. However, the immobile TiO2 must be used in conjunction with these oxides since they are fairly mobile and therefore affected by hydrothermal alteration.

A Group + KTC 265

Turning to the **U Group** samples, can we associate them with any of the main groups? KTC 265 shows evidence of magma mixing since it has resorbed quartz eyes. Gabe Aliaga shows photographs of the Walti pluton with zones of more mafic magma mixed into the quartz monzonite of the main Walti magma. The mafic phase has similar resorbed quartz phenocrysts indicating that during the crystallization of CPX, the quartz was removed. Since **Group A** dikes plot as precursors of the Mud Springs pluton they could be related to the mafic phase. The immobile elements indicate that Sample 265 plots with **Group A.** It is located in the heart of the Keystone jasperoids below Tip Top which suggests that **Group A** dikes are important to the Carlin System. The recognition of these dikes and the structures they occupy could be a vector for exploration. KTC 489, in **Group A** is located in the Sophia Zone and KTC 240 is located touching the Gund Sill in the South Keystone Window.

An examination of Gabriel Aliaga's data shows that the geochemistry of the **A** group samples most resembles rocks identified as Twd (tertiary Walti diorite) which I call the mafic carapace. This would suggest that **Group A** samples are related to the mafic facies mixed into the Walti pluton. However, though Gabe's sample KS 067 plots within Group A. KS 068, identified as a carapace rock, plots exactly like the representative Mud Springs Pluton sample KTC 005 with respect to TiO2, P2O5, Hf, Ta and Zr. Gabe supplies two thin section photos of the Twd samples that have resorbed quartz crystals. Perhaps there is a labelling problem with the KS 068 whole rock data?

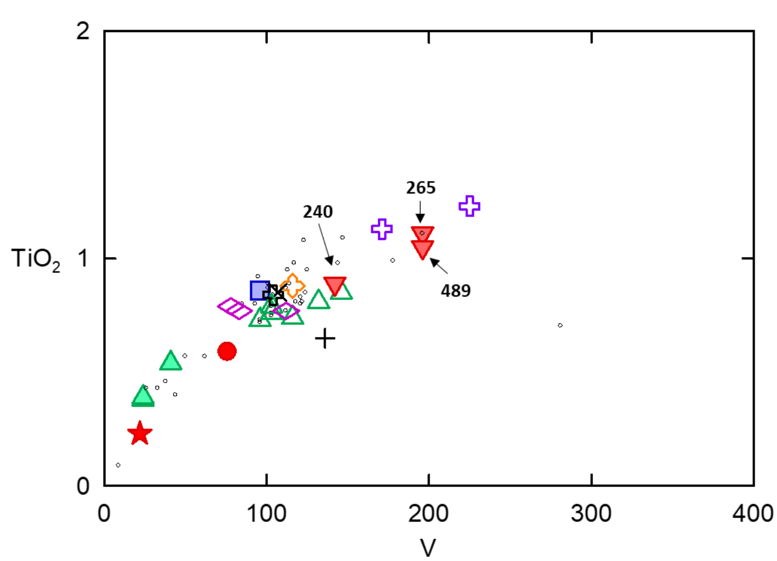
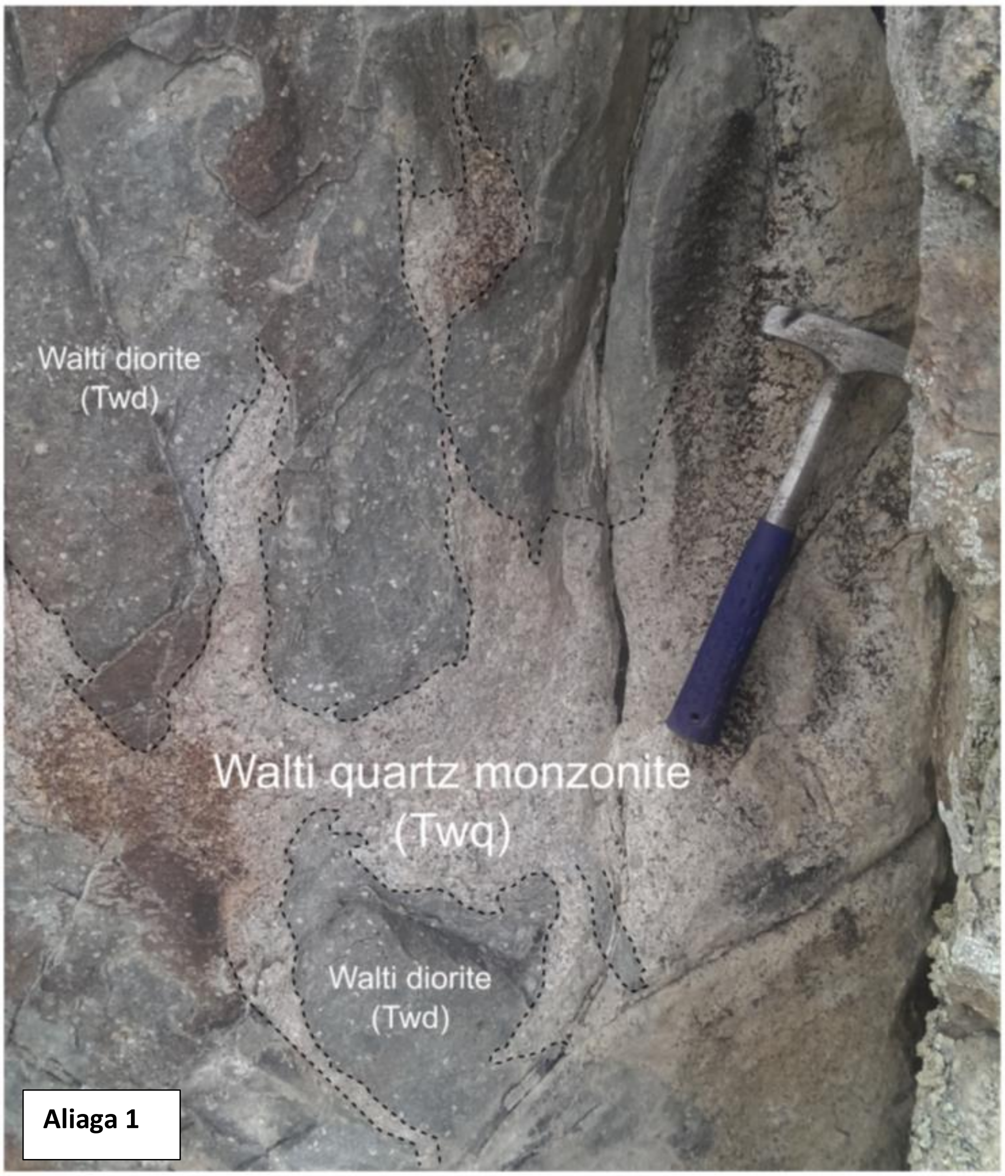


Diagram D-12 :In this diagram I have changed the Symbol for 265 to show how alike it is geochemically to the Sophia sample 489. Sample 240, is generally less mafic and may be more similar to Group 1.

This photo comes from Gabe's Thesis. It is a wonderful example of magma mixing. I propose that the Type A dikes are the Twd Walti Diorite. This is based on the similarity of the geochemistry of Type A rocks to KS 67 and the similarity of the thin sections. Gabes' slides show resorbed quartz crystals in devitrified glass with some ground mass plagioclase.



The two photomicrographs below come from Gabe Aliaga's Thesis. Both **KS** samples are from mafic outcrops within the Walti Pluton. Samples KTC 265 and KTC 486 have resorbed quartz crystals. Furthermore, quartz crystals were noted in a completely destroyed dike KTC 493 located 100m SSE of the Sophia dike 486. Unfortunately there is no thin section or whole rock data for KTC 493.

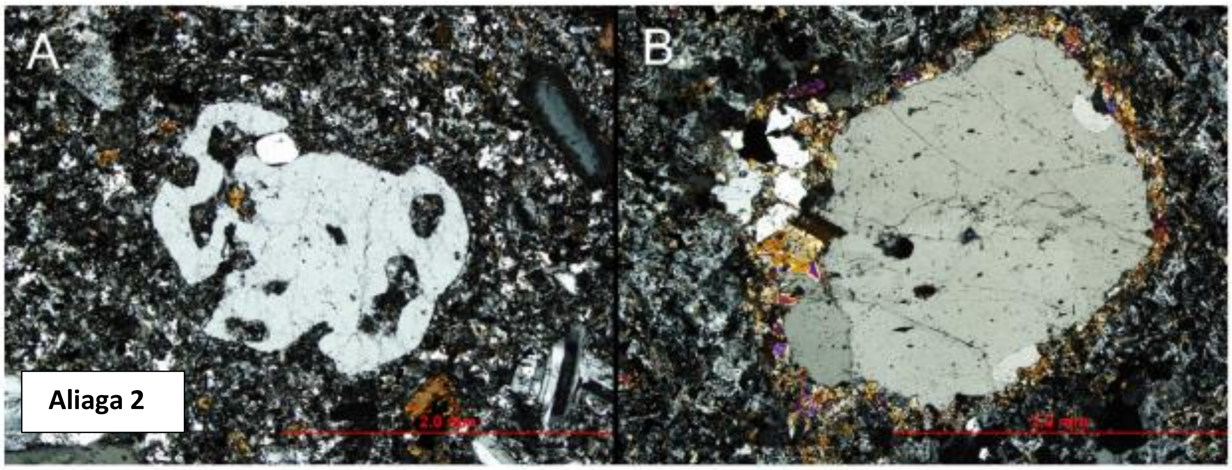
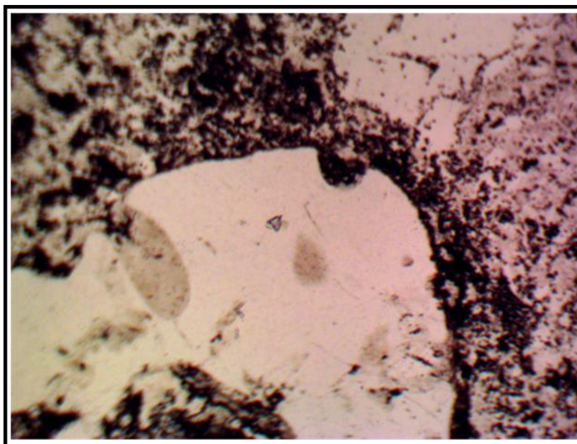
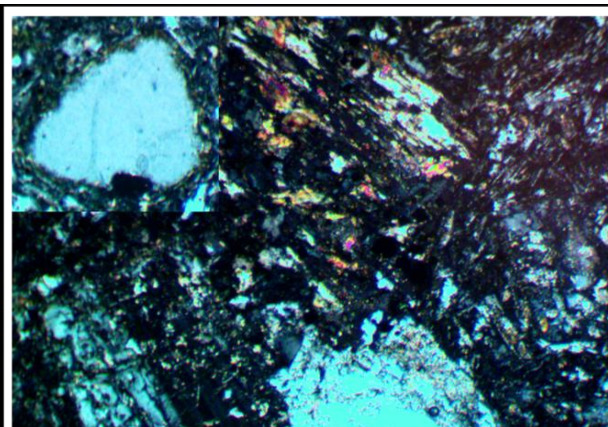


Figure 29. Micrographs of the Walti diorite in cross-polarized light showing textures compatible with magma mixing and disequilibrium. A) Sample KS068, quartz phenocryst with poor integrity and embayments. B) Sample KS067, quartz phenocryst mantled by fine-grained mafic minerals including clinopyroxene, hornblende, and biotite.

In the slides above the matrix is altered glass with a few small plagioclase phenocrysts. Slide A above matches the geochemistry of the A group and resembles KTC 265 except the latter is completely altered by kaolinite and is devoid of alkalis. The immobile elements are a match however. Slide B has similarities to KTC 489 though the resorbed quartz grains in the latter are smaller. Note the reaction rim around the quartz grain in the upper left of the slide.



Sheet B2 N 4419431 E 538609
Slide KTC 265: Plane light, 4X 5mm. Hematite stained (black) resorbed quartz, 2 feldspar with replaced biot or plagioclase. Some lithics present. Alteration is quartz, illite and hematite. Whole rock shows this sample to be a dacite porphyry dike.



KTC 489:4X xp . Sophia zone dike near drill hole Key 1706. The dike is a propillitically altered andesite with plagioclase + minor hornblende and pyroxene in a matrix of fine plagioclase laths, mafics and pyrite. Alteration is chlorite, calcite and minor epidote with limonite staining. The photo shows plagioclase + a hornblende crystal that has high relief harlequin colored epidote and chlorite alteration. Between the hornblende and the plagioclase the very low birefringent material is chlorite which may have altered pyroxene. Note resorbed quartz crystal.

The **A** group sample KTC 240 plots as only slightly more mafic than the Mud Springs Pluton whereas KTC 489 and KTC 265 are considerably more mafic and very alike geochemically. Thin sections reveal that KTC 240 does not have quartz phenocrysts and looks like a typical andesite. Also it varies somewhat in the immobile elements from the other **Type A** samples. However it does resemble the Twd thin section description. Therefore it may belong to the group. In thin section it resembles the tholeiitic Upper Plate andesite dikes. However, since it cuts the Gund Sill, it must be younger than 35.8 ma and consequently unrelated. Also the ternary diagram below shows that the dike lies outside the Tholeiitic field. Note that both **A** samples and the **Y** sample (KTC 265) plot together in the diagram.

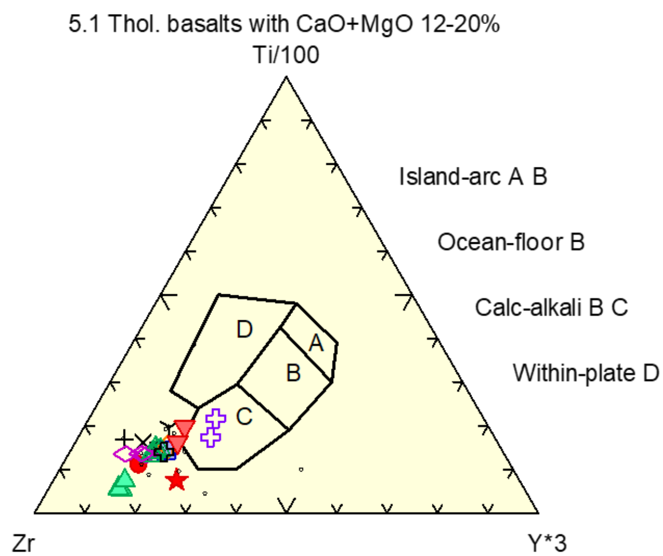
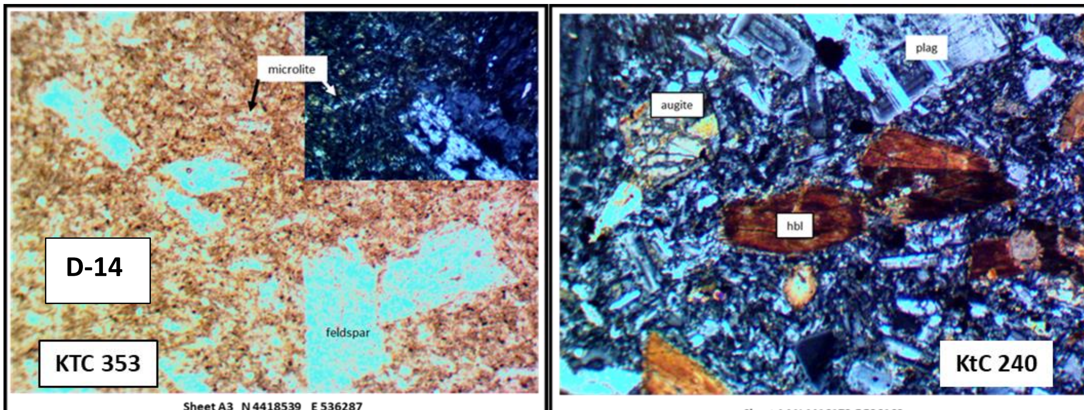


Diagram D-13 : This slide clearly shows that the trachyandesite dikes are tholeiitic and not part of the Tertiary magmatic event.

The thin sections below compare one of the Tholeiitic andesite samples with KTC 240. In the field the sample looked like a classic basaltic andesite dike with easily recognized plagioclase, hornblende and pyroxene phenocrysts in a trachitic plagioclase matrix. In some ways it resembles a Nevada Rift dike. Unfortunately, the photo of KTC 353 is of poor quality. However, the plagioclase phenocryst outlines can be seen as well as the microlitic plagioclase matrix.



Slides KTC 353 + 240. Though it is tempting to compare these two trachyandesites, sample 250 is much younger than 353. Geochemically 353 is a tholeiite and far more alkaline than the Paleozoic andesite. See the TAS diagram.

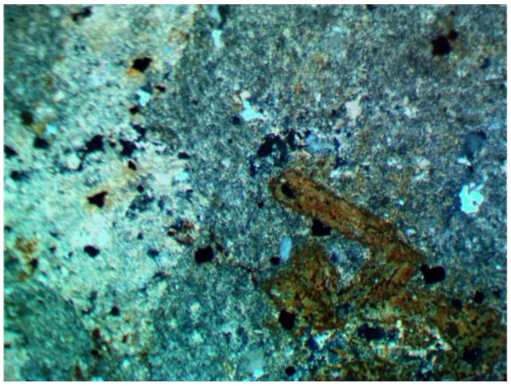
If we look at the location of the **Group A** dikes, including sample KTC 265, they are located in the principal jasperoid areas under **Tip Top** to the north, and the **Lonesome Dove** area south of the Walti Pluton. The **A** dikes are also found in the **Sophia Zone**. Other species of dikes lie outside these prospective zones in the Northern Cross and Blue Lagoon target areas.

Group B, C, and D dikes of the Blue Lagoon Area.

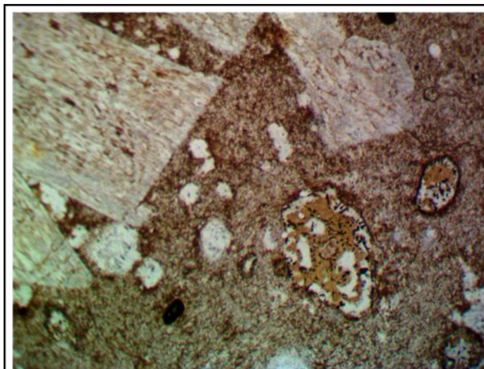
The Blue Lagoon area includes all the dikes and sills found underlying the west flank of Breccia Ridge westward to the conglomerate on the west side of Pete's wash. Altered dikes are found cutting the western Tertiary conglomerate outcrops. They also cut upper plate skarn south of the spring at **KTC 293** and are found on the same ridge that runs north of the spring. **Key 293** has a separate symbol – **X** - since it does not plot with other species.

Type B dikes are found on the north end of the central ridge and in the wash between Breccia Ridge and the lagoon. They are also found at the headwall of Pete's Wash. The three sills in Drill Hole Key 1601 are **Type B**. The **B** dikes are intermediate dacite dikes and appear to plot geochemically between the Mud Springs Pluton and the Walti Pluton. They also plot on the differentiation trend line of the district with respect to TiO2 plots vs SiO2, P2O4 and MgO. Their position relative to the immobile elements is less clear.

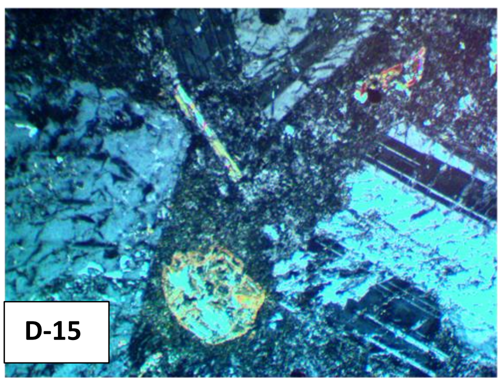
In thin section these dikes have relict plagioclase and possibly K-spar, pyroxene and hornblende. The samples have glomeroporphyritic plagioclase mafic clumps as well as individual crystals of feldspar and hornblende. The identification was done largely on shapes since the minerals are altered to clays, sericite, chlorite and quartz. See the diagram below.



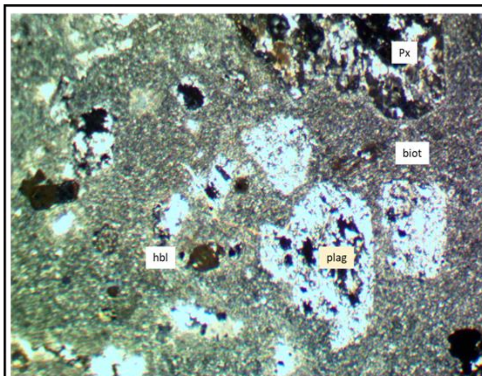
KTC 448: 4X xp: Blue Lagoon. 1cm 30% Porphyry with isolated feldspar and hornblende and probably px as well as composite intertwined feldspar patches and glomeroporphyritic patches similar to Muds Springs Pluton.



KTC 441: 4X pl: The sample is from a dike or sill near the Blue Lagoon. It is a 20% 1cm porphyry of individual crystals of feldspar + mafics + glomerophenocrysts similar to the Mud Springs Pluton that has a combination of K-spar and plagioclase intermixed with zones of pyroxene and probably hornblende. The mafics and groundmass are altered to sericite and chlorite with abundant calcite. The black opaque appears to me mnox.



KTC 486: 4X pl. N Sophia. This photo shows plagioclase, biotie, hornblende and pyroxene. Glomerophenocrysts are also present of plagioclase and pyroxene. This comes from a sill or dike and is centered in a sericite alteration zone within the upper plate. It resembles both the Mud Springs diorite and some of the Blue Lagoon dikes. The matrix is mostly feldspar. Interestingly the only alteration product in this sample is chlorite which exclusively alters some of the mafics, the rest are unaltered.



Slide KEY 1601-1090: X-p, 4X 5mm. The sill plots as a dacite porphyry or andesite. Feldspar phenocrysts are completely altered to sericite. Some is clearly plag, some may be K-spar. Mafics are altered to manganese oxide and sericite +/- quartz. Mafic shapes range from classic pyroxene, classic hornblende and elongate shapes that have feathery pyrolusite which is probably biotite.

Type C dikes are Rhyodacite and plot on the differentiation trend line between the Walti Pluton and the Quartz Rhyolite porphyry on the Wood and TAS diagrams and with respect to TiO2 vs MgO, SiO2, P2O4, Vanadium and Scandium. However, the Type C group is wildly off trend with respect to Zircon and Hafnium. This is undoubtedly due to the immiscibility of Zircon in the last melt which has extremely high silica necessitating the remaining zircon to form prior to the Rhyolite Porphyry Plug.

Three **Type C** samples are found on the ridge north of the Blue Lagoon and one sample that plots with the group was taken from the east nose of Sophia Ridge, just under altered Tertiary conglomerate. In thin section the rhyodacite dikes show quartz puddles similar to Gabe Aliaga's Twp dikes. The photo micrographs below come from his thesis.

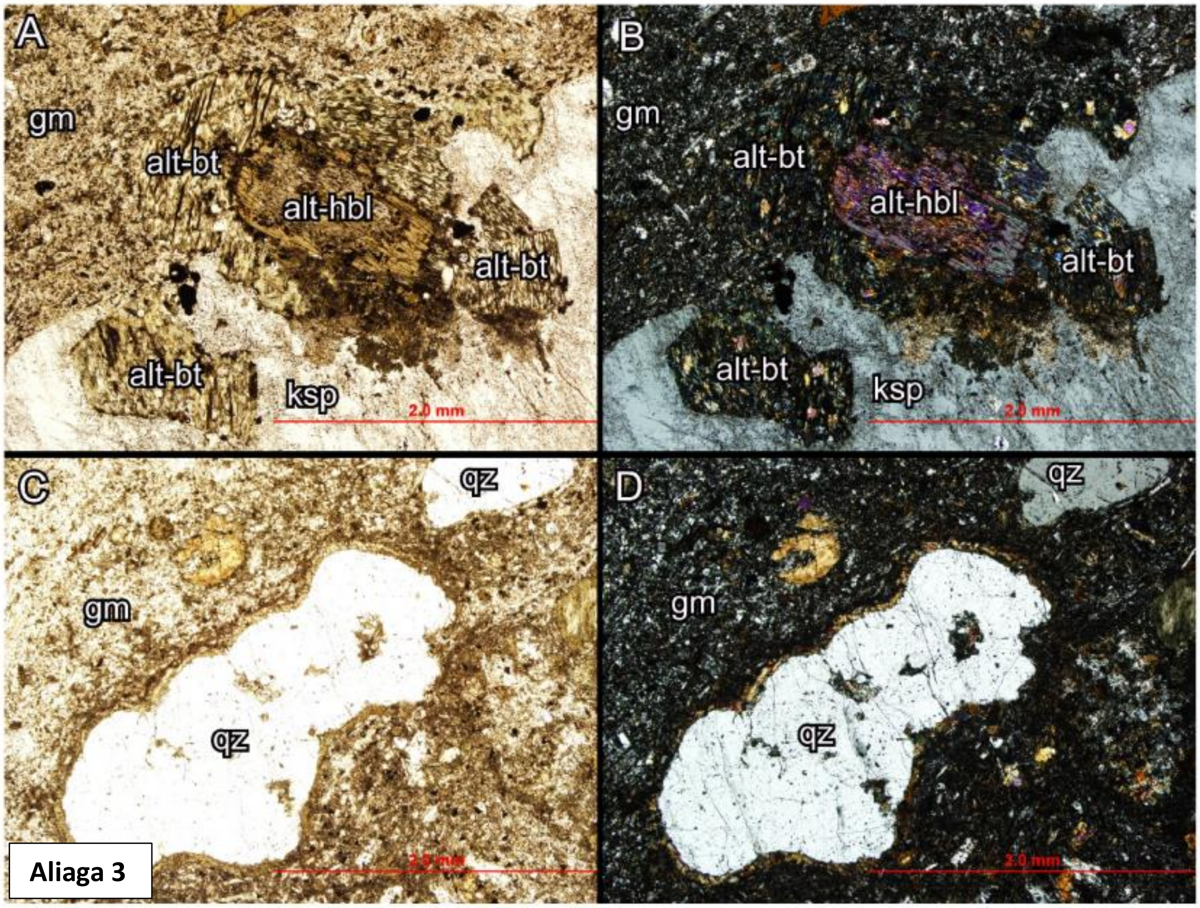
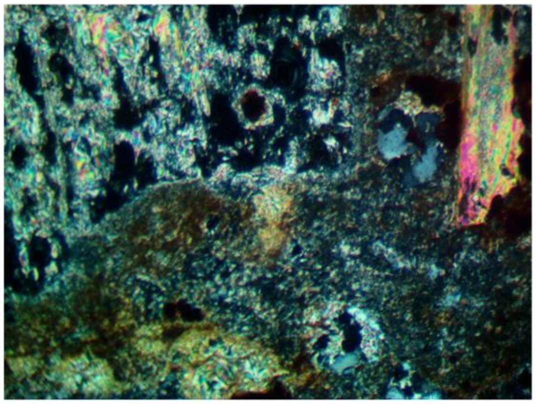
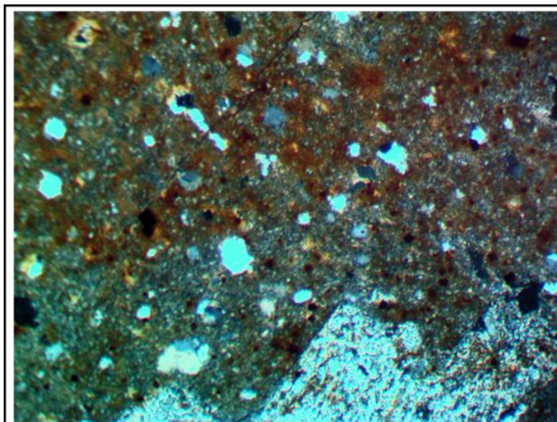


Figure 30. Micrographs of the Walti intermediate porphyritic dikes. A-B) Sample KS095 in plane- and cross-polarized light. The rim of a K-feldspar megacryst is resorbed and altered to mafic minerals biotite and hornblende, which are now mostly altered to chlorite and sericite. C-D) Sample KS095 in plane- and cross-polarized light. Quartz phenocryst rims are resorbed and altered to clinopyroxene and chlorite. The textures in (A-D) are compatible with magma disequilibrium, and suggest the phenocrysts were transported in a relatively mafic melt.

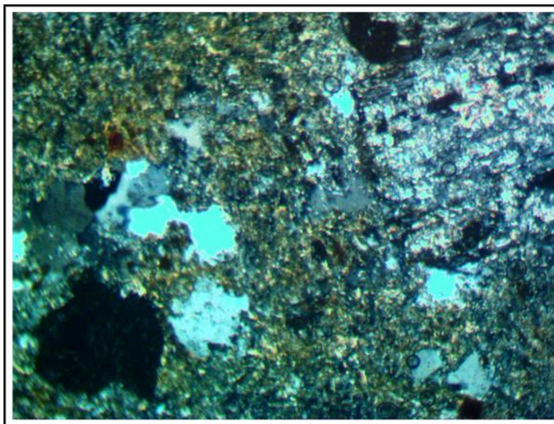
Though Gabe believes that these are related to the Walti Pluton, the Zircon data indicate that the dikes postdate the Walti and predate the Rhyolite porphyry. Like the Twp dikes, plagioclase and relict chlorite altered mafics are present. The quartz patches appear more irregular in the dikes identified as **Type C** and confirm that Zircon should be immiscible in the melt. Also present in **Type C** dikes are either biotite or phlogopite which was not seen in other species. The alteration is mainly propylitic with chlorite, pyrite, epidote and calcite present in the matrix. Plagioclase is altered to sericite and calcite.



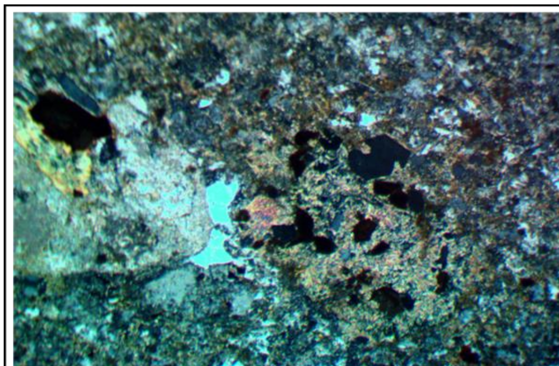
KTC 440: 10X xp. The sample is of a sill located in the wash between Breccia Ridge and Blue Lagoon. The intrusion is completely altered to sericite and quartz with secondary phlogopite-biotite (upper right). The dark shape top left is a 1cm altered phenocryst, possibly plagioclase. the slightly higher relief yellow brown minerals are altered to sericite and chlorite and may be relic mafics.



KTC 446: 4X xp: another Blue Lagoon Dike. Note the different aspect of the matrix which appears to have abundant small quartz crystals. Altered feldspar is in lower portion. Alteration is quartz, sericite, chlorite and pyrite with late phlogopite. Looks most like 438 and 439.



KTC 453: 4X xp. 0.5cm feldspar mafic porphyry. Feldspar altered to quartz and sericite with twinning evident. Matrix is altered to chlorite and quartz and probably was intermediate glass. Rest of slide is obscure but probably same as the rest of the Blue Lagoon dikes.

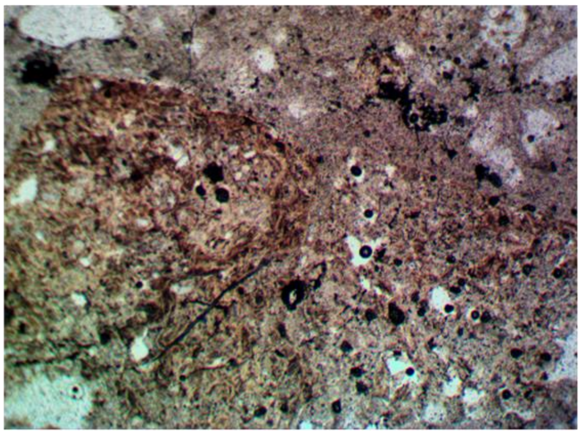


KTC 496: 4X xp. The sample is from the west nose of Sophia ridge, under Tertiary conglomerate. The slide is heavily altered to calcite, chlorite, sericite, epidote and oxidized pyrite. The groundmass is holocrystalline with small plagioclase crystals and quartz identified. Chlorite disseminated throughout the matrix is probably altered pyroxene. There are 1cm phenocrysts of plagioclase and probably some orthoclase judging by the short rectangular shapes. The sample is glomeroporphyritic with plagioclase pyroxene knots. Apatite is very abundant as a late crystalline element. This slide shows a chorite knot, pseudo hexagonal apatite, quartz rimming calcite altered K-spar. It most resembles the top of the Mud Springs Stock.

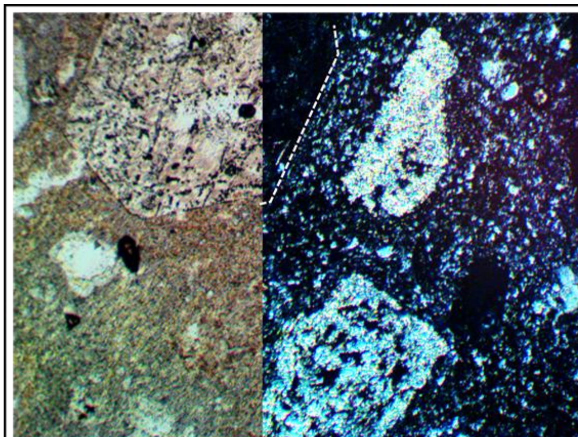
Figure D-16: Type C dikes have propylitic alteration. Note the irregular quartz patches in all four slides.

Type D dikes: The west flank of Breccia ridge has highly altered white sills or dikes that occur under the orthoquartzite and presumably are the source of variscite, silica sponge and jarosite found within the conglomerate of Breccia Ridge. These dikes are the most highly altered rocks in the group, (sideways magenta diamonds KTC 416, 438 and 439). The variscite found at the lagoon may have been formed by this group.

Geochemically **Type D** dikes plot as rhyolite on Wood Diagram - SiO_2 vs the Zircon/Titanium ratio. The TAS diagram Alkalis vs SiO_2 shows them also to be rhyolite, but with very low alkalis. On the TiO_2 vs major oxides (SiO_2, MgO and P_2O_4) they plot off the differentiation trend. The diagrams show that D dikes have the same TiO_2 as group B dikes. However, the samples are enhanced in quartz and depleted in P_2O_4 and MgO. This effect is undoubtedly alteration. MnO is highly mobile and is also highly depleted. With respect to the immobile elements the results are mixed but they generally plot with Group B dikes. They have slightly more zircon and hafnium and more or less the same tantalum, lanthanum and vanadium. However, it is likely that Group D dikes are highly altered Group B dikes.

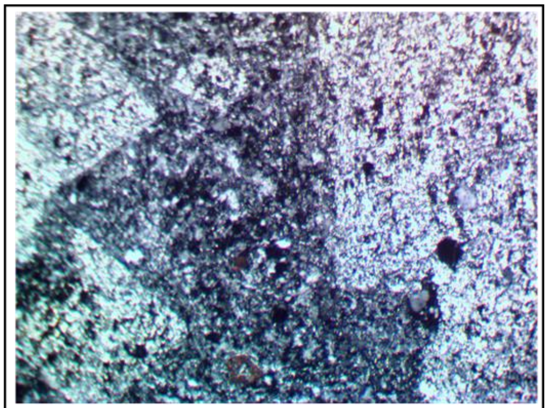


KTC 439: 4X pl. The sample comes from a concentrated zone of float. It is a clay altered porphyry that is totally destroyed. The matrix is fine white clay with yellow birefringence, probably illite. Many composite phenocrysts are altered to brown clay that in some ways resembles chlorite, possibly montmorillonite family. Best guess is Kspar+ plagioclase + glomeroporphyritic mafics based on crystal shapes only and similarity to other slides. Probably andesite or daci-andesite



KTC 438: 4X xp: Quartz sericite altered plagioclase in a recrystallized matrix of quartz. In plane light the dark patches have the outline of hornblende or euhedral pyroxene such as augite. one mafic had relict hornblende. The sample is of float beneath sample 416 and could have been derived from it. Plane light view on left shows the mafic minerals that are completely altered to quartz and turgid green material. This rock is probably a hornblende, pyroxene plagioclase andesite porphyry.

Figure D-17: Type D dikes are highly altered but may be related to the Type B dikes



KTC 416: Collected from north end of Breccia Ridge above quartzite. This is a plagioclase feldspar porphyry completely altered to quartz and sericite. No quartz eyes no indication of smaller mafics or mica. Regrowth of quartz in matrix suggest sample has seen thermal overprint.

I originally thought this was a different group, however pyroxene, hornblende, feldspar and relict glomeroporphyritic clasts were identified. These are very tough slides due to the quartz sericite overprint.

PROSPECTIVITY OF THE DIKES

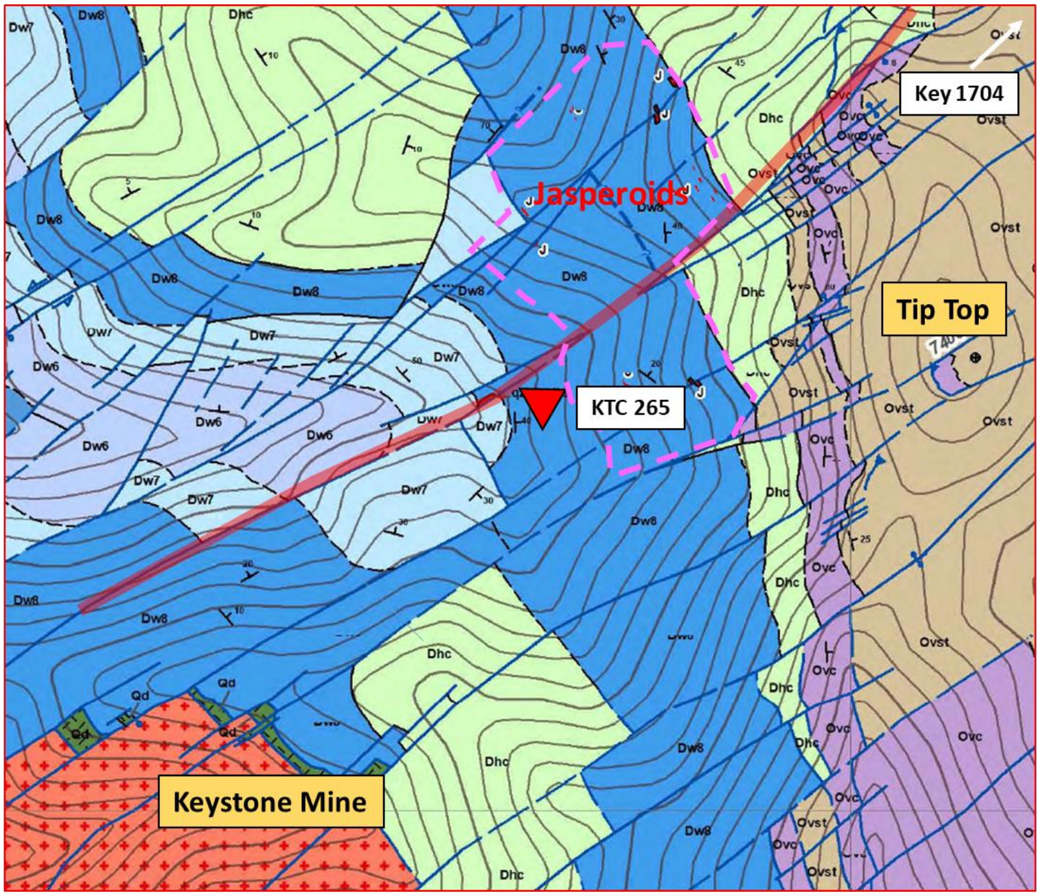
Group A Dikes

The purpose of the dike study was to see if there is a relationship between the dikes and favorable settings for Carlin gold deposits. The Keystone project has long been known for having Carlin Style mineralization consisting of jasperoids in carbonate rocks, arsenic – thallium – gold geochemistry and Tertiary igneous activity. Four areas are of particular interest; the Tip Top area north of the Keystone Mine, the Sophia zone east of the Walti Pluton extending south of the Mud Springs Stock, the Lonesome Dove area in the carbonates south of the Walti Pluton and the Blue Lagoon area including Breccia Ridge. The first three of these areas have **Type A** dikes. The Blue Lagoon area has Type B and D dikes associated with variscite limonite quartz mineralization and float samples collected by Brion Theriault had high arsenic values. The area will be discussed separately with the Greenstone Gulch area.

Tip Top Area

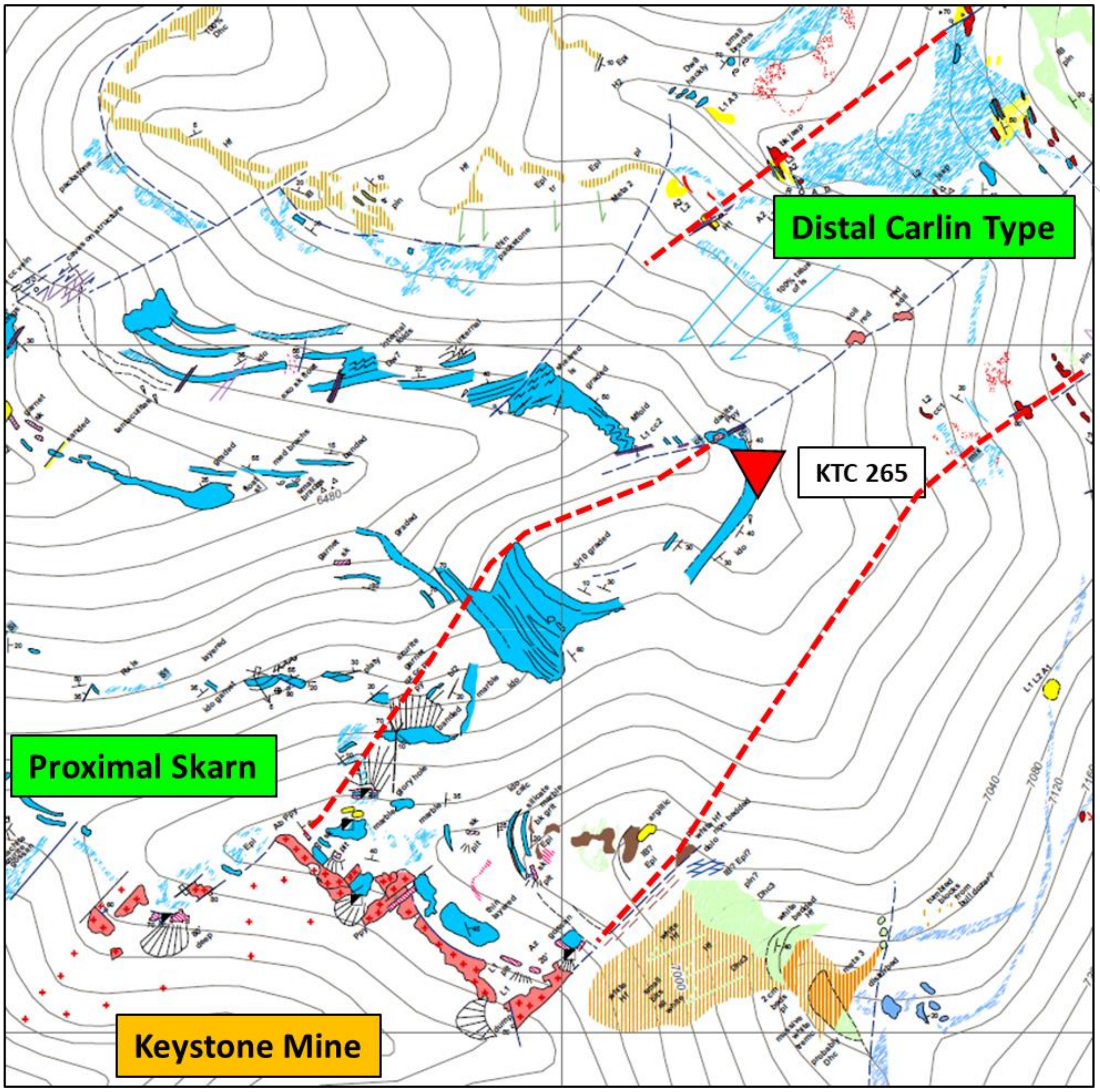
The Tip Top area is underlain by lower plate carbonate rocks of the Horse Canyon and Wenban formations. The area hosts abundant jasperoids and low level arsenic-gold geochemistry encountered in numerous drill holes. At the center of this area, a small highly altered dike is located below the main concentration of jasperoids. It lies near or on a NE striking fault that may also control the main adit at Keystone. The dike itself was problematic both geochemically and petrographically since it is completely altered to kaolinite with only ghosts of plagioclase evident and resorbed quartz eyes. The abundant limonite staining seen in outcrop probably was created from the oxidation of pyrite or arsenian pyrite within the dike which created abundant acid leaching. Petrology (see the TAS diagram **Figure xx**) shows that Na2O and K2O are completely absent from the sample leaving only SiO2 which becomes highly elevated. The dike should have an intermediate andesitic signature based on the remaining TiO2 which is quite elevated. I used the **Y** symbol originally to keep track of the sample. In the diagrams below, the sample has been converted to the red triangle of **Type A** dikes for the reasons previously discussed.

Two views of the Tip Top area have been provided. One is the interpreted geology and the other is the outcrop fact map. The first shows the location of the dike beneath Tip Top and the zone of jasperoids outlined by the dashed magenta line. The best target horizons are typically below Wenban 7. Most of the structures in the area strike NE and many of them have calcite veining. One of the structures in particular seen on the west side of this diagram had strike slip kinematics which would make their genesis tectonic rather than a passive collapse breccia feature. Drill hole Key 1601c located southeast of Tip Top encountered three dikes or sills which are **B** type dikes. It is possible that the **A type** dike occupies a corridor of favorability that strikes from Keystone through the west edge of Tip Top. Unfortunately, two of our drill holes Key 1704 and Key 1808 drilled just east of this corridor. Key 1704 encountered the duplex discussed in the 2017 report. Up to 2ppm gold was encountered at the base of the duplex between 940 to 975 feet. Key 1808 was drilled to the NNE and also did not cross into the favorable corridor. Looking at the diagram, perhaps angle holes perpendicular to the trend would be more favorable.



Map M-4 : Tip Top area. KTC 265 is a **Group A** dike that is completely altered to kaolinite and limonite. All that can be recognized are resorbed quartz crystals. Note that the dike is found just under the zone of jasperoids where early drilling concentrated. It is possible that the dike actually trends into the Keystone Mine adits. See **Outcrop Map B2.**

The next view of the Tip Top area shows the facts. The KTC 265 fault has been swung towards the Keystone Mine by imposing a dip to the NW. One can clearly see that the Keystone workings are aimed at the very small dike occurrence. It is quite likely that the strike of the dike is not constant and that the measurement of its attitude is purely local. Also shown in the figure are deep purple colored calcite filled faults and two other faults in red that are associated with jasperoids and pits in the Keystone Mine area. It is possible that the NE structures were pathways for hydrothermal fluids causing high temperature proximal skarn mineralization of copper, silver and gold, and distal Carlin style gold-arsenic occurrences.



Map M-5 : The **Type A** dike, KTC 265 may actually be related to the Keystone Skarn deposit. It is reasonable to suggest that the same mineralizing event can create skarn close to the intrusion and a Carlin Style mineralization further away.

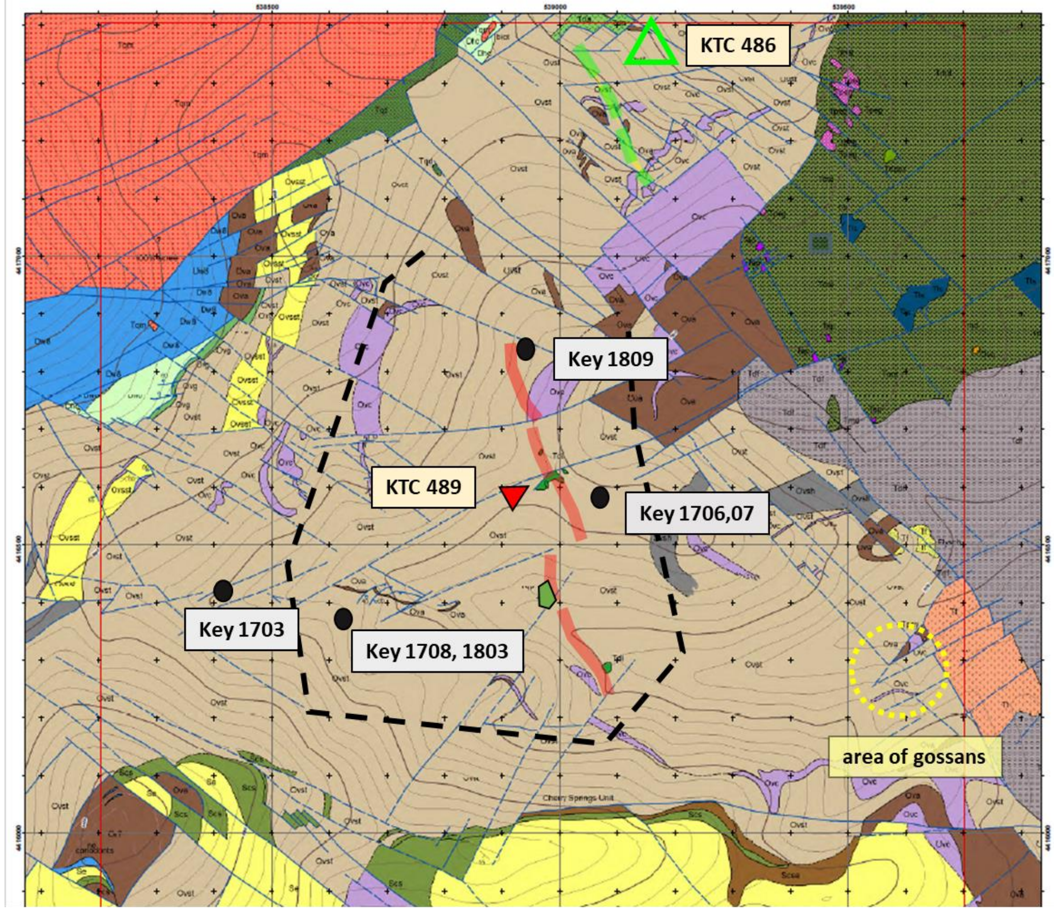
Sophia Zone

The Sophia Zone is shown on **Figure xx** and is considered to include all of the area exclusive of the large igneous intrusions. Skarn of the Lower Plate is located at the contact with the Walti Pluton. Gabe Aliaga identifies the dikes in the area as Twp. This is not consistent with the petrologic study presented in this report. The main suite of dikes in the Sophia are much more mafic and probably are precursors to the Gund and Mud Springs intrusions. The north end of the Sophia Zone does contain **Type B** dikes which are related to the Walti intrusion.

The **Type A** dikes are represented solely by KTC 489 though several other outcrops that appeared to be andesitic are found in the area. One exposure is at the extreme south end of the trend line. Additionally, Ken Coleman found andesitic outcrops running up the south flank of Sophia Ridge to KTC 489. A drill pad located at the base of the ridge exposed white chalky outcrops that had quartz eyes. This was initially thought to be a rhyolitic occurrence but now the quartz eyes are considered to be xenocrysts. The pad at Key 1809 uncovered andesitic dike material. These occurrences have been linked as one feature perhaps disrupted by NE structures.

Though all the drilling in the Sofia area encountered the lower plate and gold-arsenic intercepts, Key 1809r is perhaps the most interesting hole. Here, two intervals were encountered. The uppermost is magnetite diopside skarn presumably formed in calcareous Comus sediments where a 30 foot zone of gold mineralization including one sample at 2ppm was located from 960 to 990'. The lower zone, from 1420 to 1475', was located above and within an area of caving beneath the Blue Hill unit and in the Horse Canyon Formation. This setting mirrors the multi-million ounce setting of the Gold Ridge deposit. The caving presumably is a collapse feature created at the boundary between the Horse Canyon and clastic rocks above. The mineralization of this area is classic Carlin Style with strong arsenic, elevated antimony and very robust thallium levels up to 308 ppm. The above trace geochemistry extends 200 feet or more above the strongest gold intercepts showing the validity of these elements as prospecting tools.

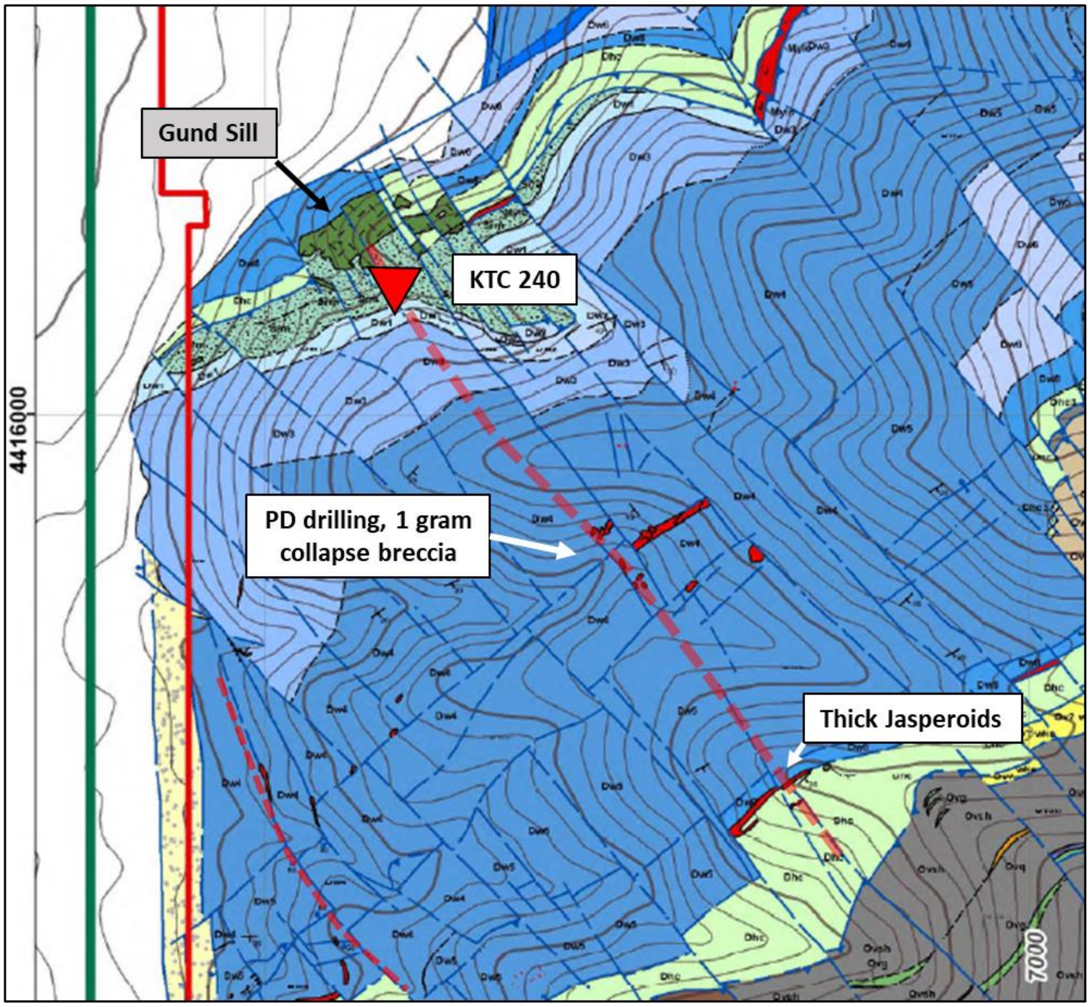
The presence of caving at the Horse Canyon contact is found over a widespread area at Sophia and was found in all the drill holes noted in **Figure zz**. The caving outline is open to the north due to a lack of drilling, but the area around sample KTC 486 is also fairly altered as are some outcrops to the SE. The Sophia area is cut by NE and NW structure. The NW features may be older than the NE and are potential feeder structures. If the **Type A** dikes are precursors to the Mud Springs pluton as the differentiation lines on the petrography diagrams suggest, then the structures would be available to hydrothermal fluids and consequently a focus for the Carlin mineralization.



Map M-6 : Sophia Zone. Drill holes in the area have collapse breccia at the top of the Horse Canyon. The zone is outlined in black. Key 1809 encountered Carlin Type alteration with gold above the caving. KTC 489 is a **Group A** dike and its general trend is outlined in pale red. KTC 486 is a **Group B** dike which is intermediate but is located in a strong alteration zone. ENE structures are younger than the dikes and displace them.

Lonesome Dove Area

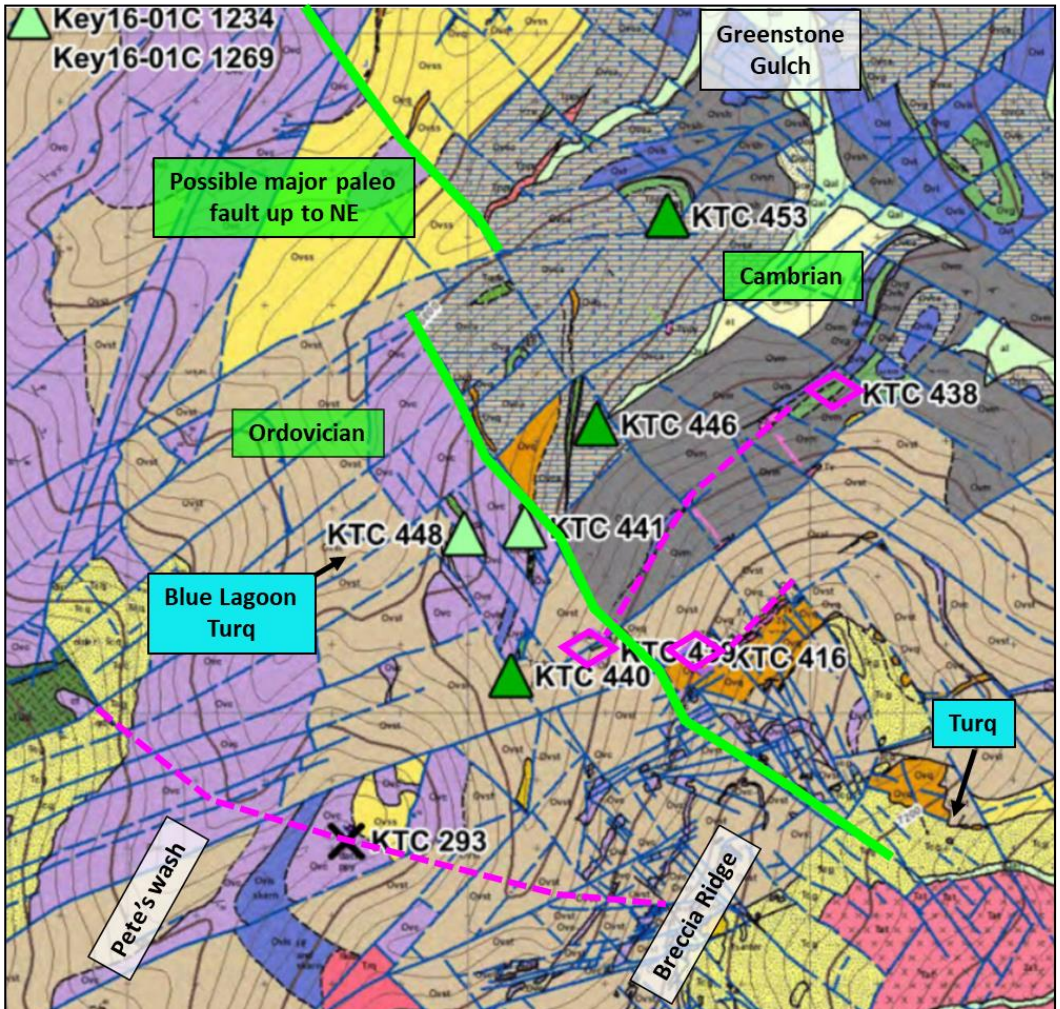
The Lonesome Dove area is located south of the Walti Pluton and the Gund Sill. An andesite dike cuts the Gund Sill which is diced by small NW faults. The name of the area comes from a gray dove seen while exploring the wash that hosted 1ppm gold bearing jasperoids that were the target of Placer Dome's drilling. The fact that there is a **Type A** dike in the NW structures coupled with the presence of a collapse breccia in the wash, and further south more large jasperoids at the Horse Canyon – Wenban contact make this an intriguing trend. The figure provided below also suggests a parallel trend closer to the range front. Angle drilling perpendicular to the trend is recommended.



Map M-7 : KTC 240 is a **Type A** dike. The sample is taken from a pyroxene, hornblende, biotite, plagioclase dike that is emplaced parallel to a series of NW striking faults associated with the Placer target which drilled under a collapse breccia associated with gold bearing jasperoids. Note the large jasperoids located at the Wenban Horse Canyon contact and the parallel trend westward.

Blue Lagoon Area Types B, C and D

The Blue Lagoon area extends from Breccia Ridge to the conglomerate west of Pete's Wash and north to Greenstone Gulch. The Greenstone Gulch area is Cambrian early Ordovician. The quartzite outcrops that lie north of the dashed bright green line are lower middle Ordovician and cap the Comus limestone. On the other side of the green line, the rocks are Katian in age and consequently down relative to the Comus. During the Tertiary, a peneplain covered the area forming conglomerate outcrops that cap Breccia Ridge and the ridge west of Pete’s Wash. The conglomerate is cut and strongly altered by the Tertiary igneous activity. The figure below shows the main features of the area.



Map M-8: Blue Lagoon to Breccia Ridge Area. The type B dike symbol is light green, Type C is dark green. The highly altered Type D dikes are the magenta diamonds. KTC 293 resembles a Type D dike. The trend line through KTC 293 is based on altered dacite dikes seen underlying the Tertiary conglomerate. The green line separates older rocks from younger, note quartzite.

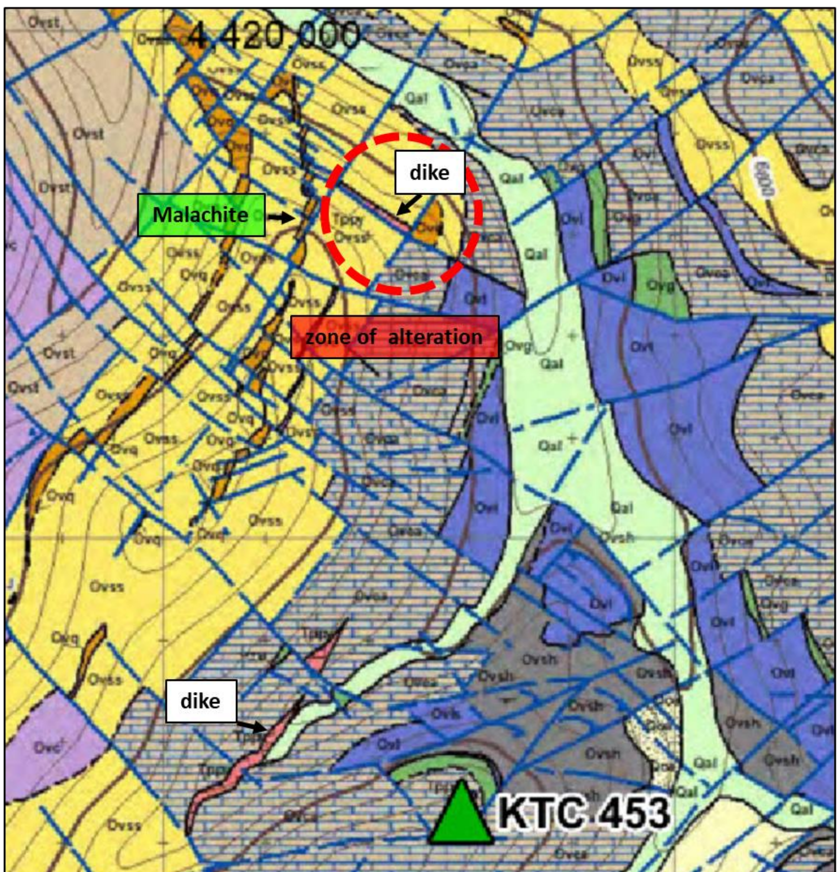
The Blue Lagoon area contains a dike or sill swarm which is generally altered to quartz sericite. **Type B** dikes and **Type D** dikes are probably related since they have the same TiO2 signature. It is proposed that the turquoise occurrences and the strong argillic alteration seen at breccia ridge is related to the **D** dikes. **Type C** dikes are quite different geochemically and are probably precursors of the Quartz Porphyry **Trq** and the aphyric Tuff **Tat.** Very strongly altered type D dikes underlie Breccia Ridge. Ken Coleman reported several dikes in road cuts leading to drill hole Key 1709. These may be linked either to the **Type D** underlying the ridge or to KTC

293 which is a very small occurrence within a strong argillic alteration zone. A small skarn is located near KTC 293. The westward end of the trend line is linked to an altered porphyritic dike cutting the conglomerate. This association is quite sketchy however.

The **Type C** dikes are quite different than the other dikes and they plot as a distinct group with geochemistry that falls between the Walti Pluton and the Rhyolite Porphyry. Since they are fairly strongly altered, they may also be important players in the metallogenisis of the area.

Greenstone Gulch

Greenstone Gulch is an area located just north of the Blue Lagoon zone. Two dikes or Sills were mapped in the area. Unfortunately, neither occurrence was sampled for whole rock



Map M-9: Greenstone Gulch. Two dike occurrences were discovered In the area. There is no whole rock geochemistry or thin sections for them. However, the north occurrences underlies a prospect that has chalcedony and malachite. The dike itself is strongly altered.

data or thin section analysis. The assay data for KTC 459 from the alteration area has high Titanium and Chromium. However, though the dike might be fairly mafic, none of the other immobile elements plot with the rest of the dike data due to the dissimilarity of whole rock data to the trace element geochemistry we use for prospecting. KTC 454 next to KTC 453 sampled a small structure that contained gossan. Not surprisingly it is 32% Fe. It also has strong Barite, Manganese, Nickel, and Zinc. These are fairly mafic signatures which may be related to the greenstone that sits nearby.

The paragraph above highlights a classic case where one cannot compare data from different laboratory methods since the quantity of the elements digested vary considerably and would lead to false conclusions.

Extrusive Rocks Surrounding the Keystone Window

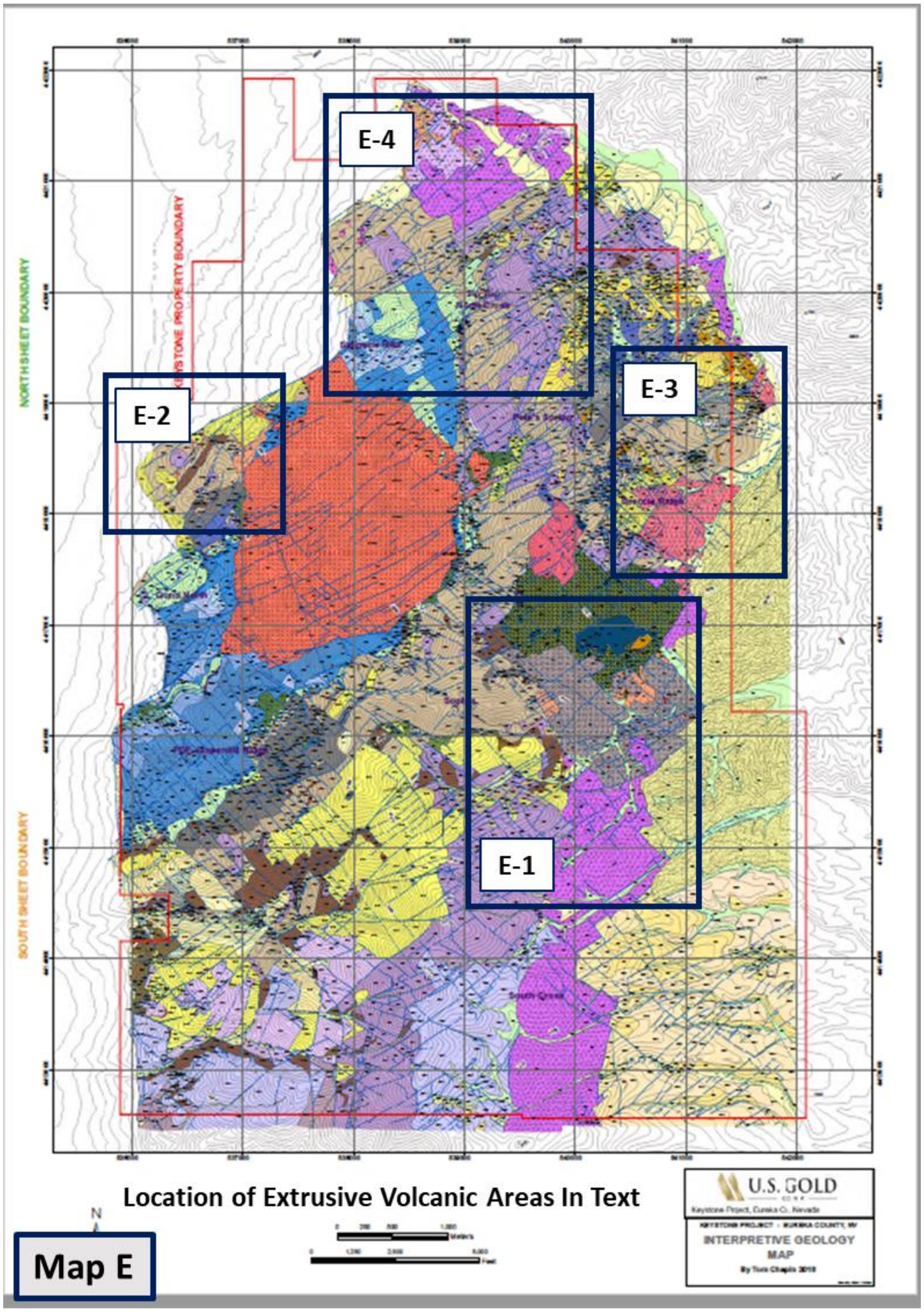
The extrusive rocks of the Keystone window overlie a Tertiary peneplain that was present prior to the onset of Tertiary igneous activity in the region. The peneplain was covered by conglomerate deposits that are found throughout the region including the Caetano Trough near Cortez. At Keystone four conglomerate packages were mapped. Gabriel Aliaga dated the conglomerate at 35.62ma, the oldest Tertiary date on the property. They underlie Tertiary extrusive lava and tuff which gave inconclusive results for several of the units. Drilling has revealed that up to 700' of volcanic material underlies the McClusky andesite which makes it the youngest unit in the extrusive package. Therefore, the date provided in his thesis of 35.99ma, younger than the conglomerate, seems unlikely.

This chapter provides the stratigraphic section below which is based on map and drill evidence. The conglomerate is presumed to predate tertiary extension and consequent tilting. Lithic tuff, the basal tuff, and the aphyric tuff are all found deposited directly on the tertiary unconformity. The Vitrophyre is found deposited on the basal tuff, and possibly the agglomeratic andesite. Elsewhere it is in fault contact with the Paleozoic.

Tertiary Extrusive Volcanic Stratigraphy

Vitrophyre	Daci-Andesite	**Tvit**
Aphyric Tuff	Rhyolite Tuff	**Tat**
Agglomeritic Andesite	Dacite Flow	**Tdf**
Basal Tuff	Rhyodacite Tuff	**Tt**
Lithic Tuff	Rhyolite + Valmy	**Tlt**
Conglomerate	Reworked Paleozoic	**Tcg**

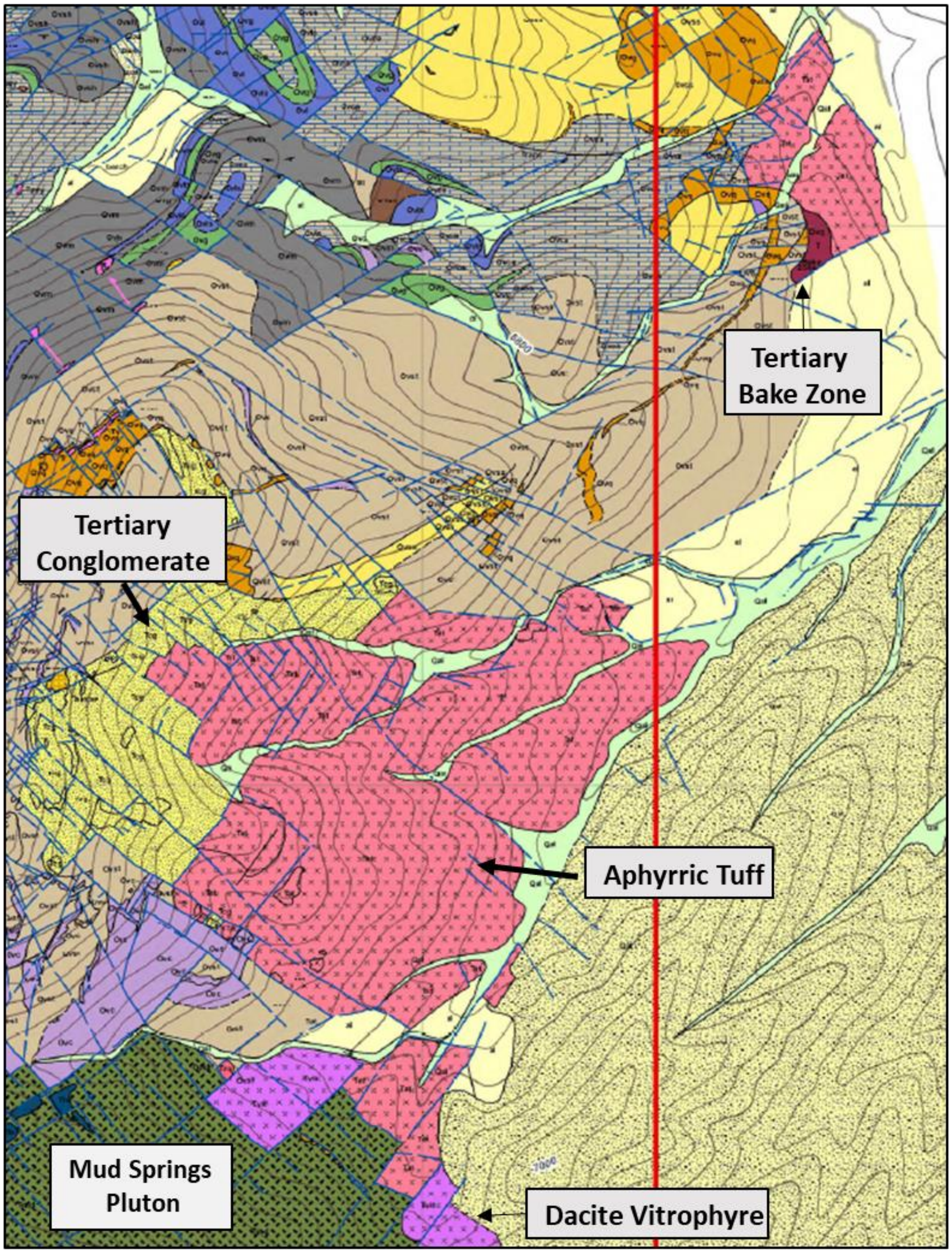
The figure below outlines the four areas that have significant extrusive igneous facies discussed in this part of the report. **E** denotes Extrusive.



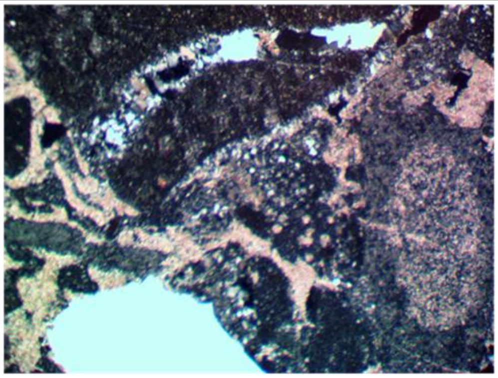
The tertiary conglomerate is found on Maps E-1, E-2, and E-3. Two thick widespread occurrences are found over the Blue Lagoon Area, see target **Map T-4.** The outcrops west of Pete's Spring (Blue Lagoon) form bold 70' high cliffs. The conglomerate consists of rounded cobble to gravel sized reworked Paleozoic clasts. The exposure surrounds a tongue of the Walti intrusive facies and also forms roof pendants to the intrusion. The outcrops on Breccia Ridge overlie Paleozoic hornfels and what may be Type D type sills or dikes that have leached the conglomerate clasts leaving sponge like textures reminiscent of sinter. The conglomerate in this area is strongly jarositic with minor variscite or turquoise veinlets.

Photo E-1: Background is from west of Pete's Wash. The strata is approximately 70' thick. The closeup is of altered conglomerate from Breccia Ridge. On BX ridge, the Tcg is leached, silicified, and jarositic with occurences of turquoise. The BX ridge outcrops are underlain by Type D dikes.

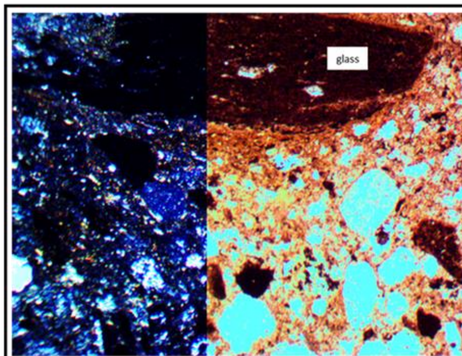
Small occurrences of conglomerate also underlie the volcanics at the bottom of Sophia Ridge, west of Mud Spring and under the lithic tuff on the west side of the property **Map E-2.** At the extreme northern end of the property, abutting McClusky wash there is a red bake zone between aphyric tuff and the Paleozoic Valmy. This is also considered to be the paleo surface at the time of volcanism **Map E-3.** A photo micrograph of the conglomerate is provided in **Figure xx .**



Map E3 : East Flank of Breccia Ridge. The Mud Springs Pluton is dark green. Breccia ridge has the conglomerate and aphyric tuff on its east flank. A small area of white tuff overlies a bake zone that sits on the Valmy - equivalent to the Tertiary conglomerate paleo surface.



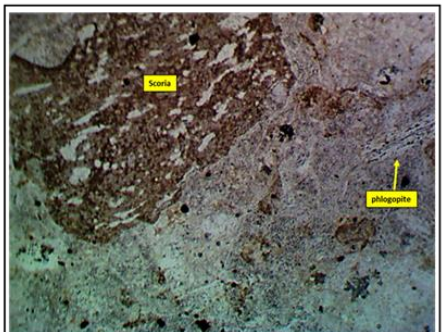
KTC 403: Breccia Ridge. Conglomerate clasts include quartz grains from the Ovq quartzite unit, fine wake sandstone, siltstone, mudstone, chert and black argillite. The conglomerate is Tertiary with post depositional sericite fracture fill. The quartz vein in the upper portion of this slide is clearly older than the conglomerate.



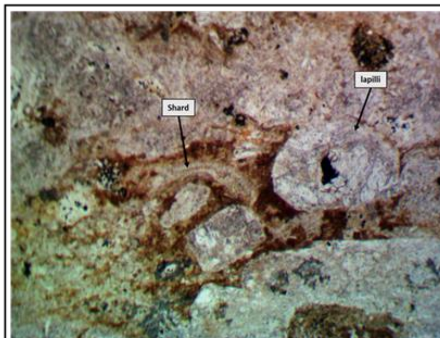
Sheet A3 N 4418540 E 536931

Slide KTC 351: X-p pl, 4X 5mm. The sample comes from a brown colored rock with an intrusive breakage pattern. It underlies lithic tuff. This sample is polymict sandstone that contains sedimentary clasts, siltstone and sandstone, and volcanic clasts of glass that have delicate, non-transported margins presumably this is a basal facies underlying the tuff.

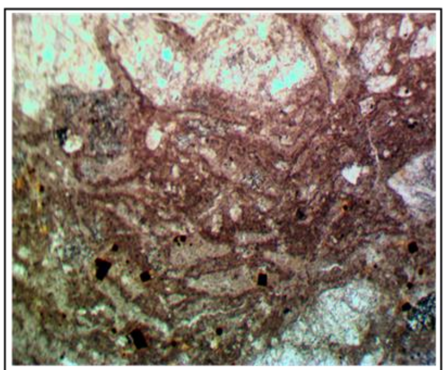
E-6: Slide 403 is the breccia ridge conglomerate. It does not have volcanic clasts and hence is older than the extrusive volcanism. Slide 351 is lithic tuff that overlies a small outcrop of conglomerate. It is found at the base of bleached white tuff.



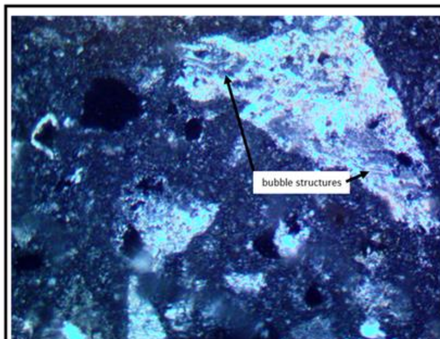
KTC 013: 4X pl. South of Sophia Road. This plane view shows a scoria piece and the low relief pale cream colored mica in a matrix of broken phenocrysts and glass shards.



KTC 013: 4X pl. This view of the slide shows more aspects of the basal tuff The central area has flow texture that apparently entrained a shard and possibly an accretionary lapilli.



KTC 021: 4X pl. The sample comes from Mud Springs valley. It is taken from highly altered material above the Mud Springs Pluton. The 20% plag porphyry shows flowage and breakage of phenocrysts. These look a little like shards which would make the sample a welded tuff and hence the basal tuff under the andesite flow.

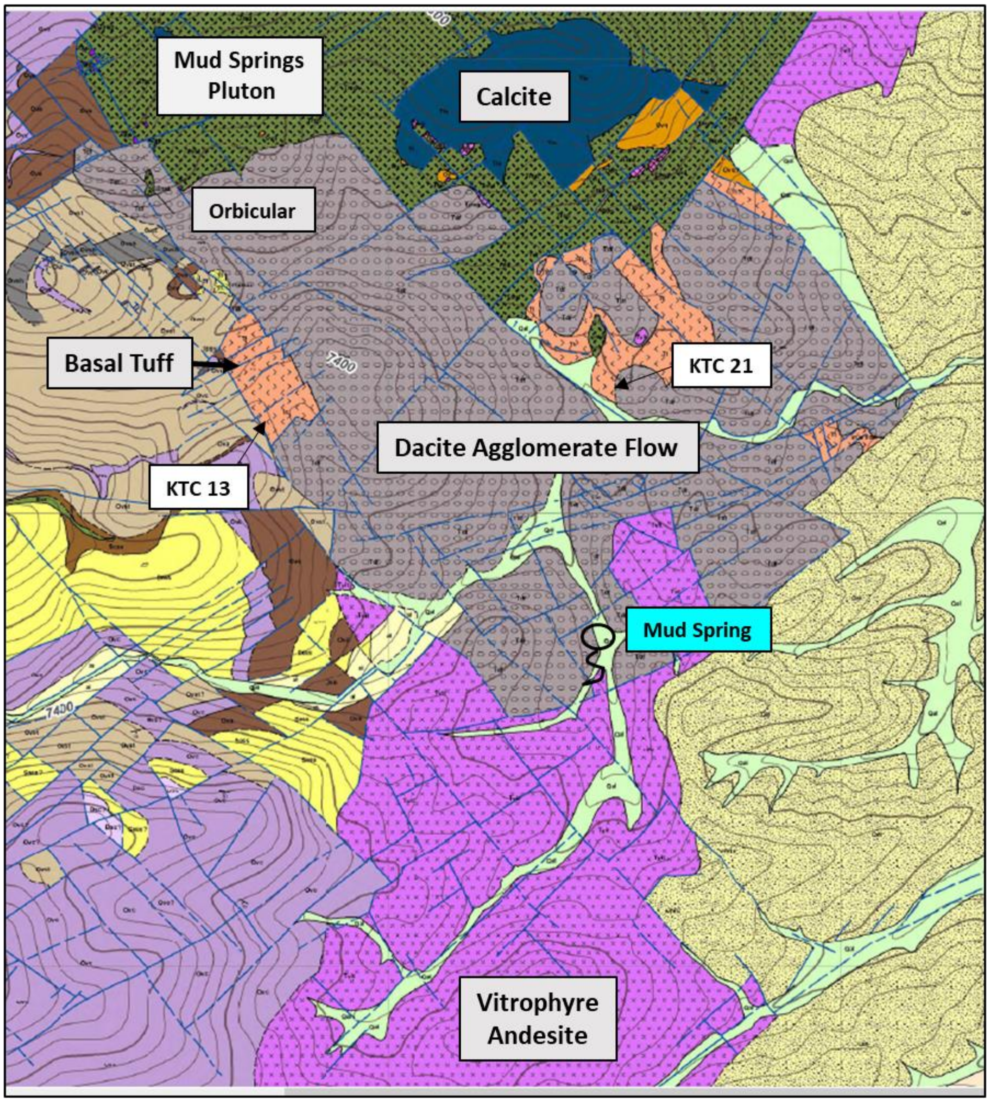


Sheet A3 N 4418684 E 536658

Slide KTC 348: X-p Pl, 10X 2mm. Lithic tuff on Grass Valley range front. Lithic tuff with clasts of sedimentary as well as volcanic rock. Main clast here is pumice. Alteration is quartz, pyrite sericite. Whole rock has this as a rhyolite.

E-7: Slide 348 is an example of the west side lithic tuff **Tlt.** The two top slides **Tt** overlie the lithic tuff and are found under the Dacite Agglomerate **Tdl.** Slide 021 **Tt** is found in the altered area north of Mud Spring.

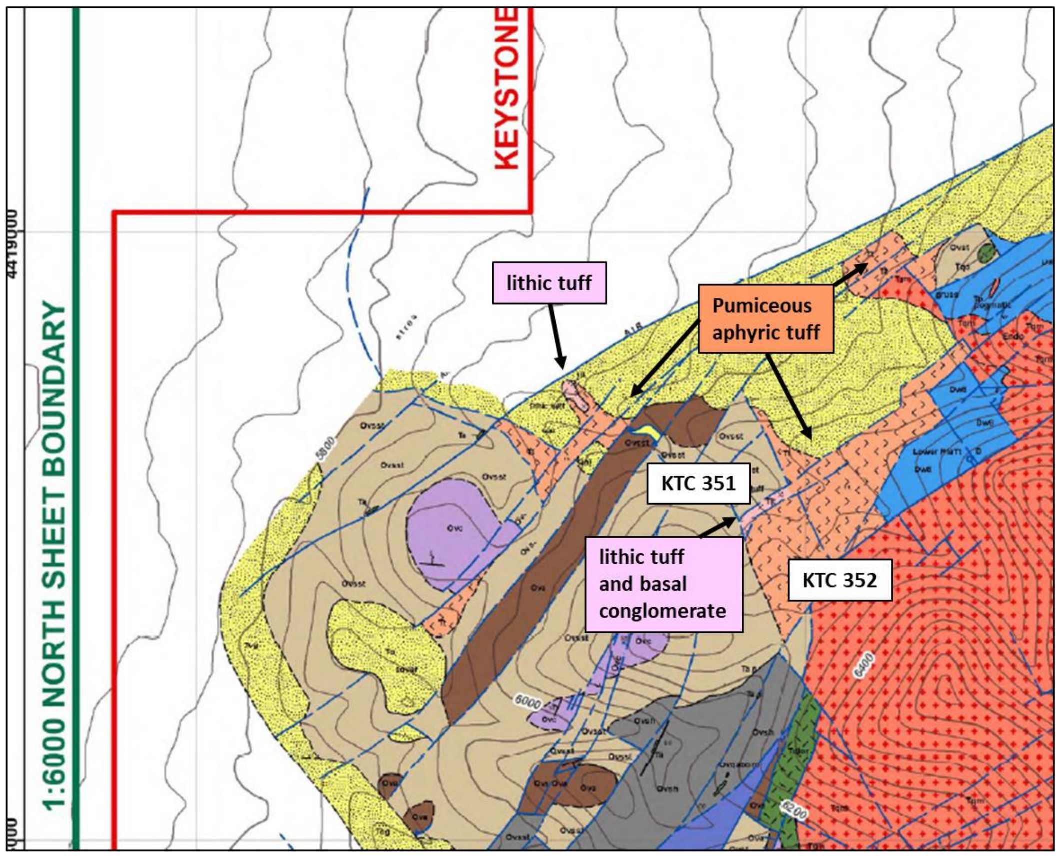
Lithic Tuff: The conglomerate is overlain by different extrusive facies depending on location. **Map E-1** on the east side and **E-2** on the west side have lithic tuff directly on the paleosurface. In the case of slide KTC 351 above, the sample is mixed with Paleozoic clasts as well as volcanic glass and scoria fragments. These rocks are not suitable for geochemical comparison due to the sedimentary contamination.



Map E 1 : This figure emphasizes the extrusive stratigraphy with the Basal Tuff overlain by the Dacite Agglomerate and subsequently the McClusky vitrophyre. The northwest control of the Tertiary rocks indicates that the structures were active post emplacement.

Basal Tuff: The basal tuff lies on top of the Lithic Tuff. It plots as a rhyodacite. Several micrographs of this material are shown on **Figure zz** above. The Basal Tuff is only a few meters thick south of Mud Spring where it is overlain by the dacite agglomerate. East of the Mud

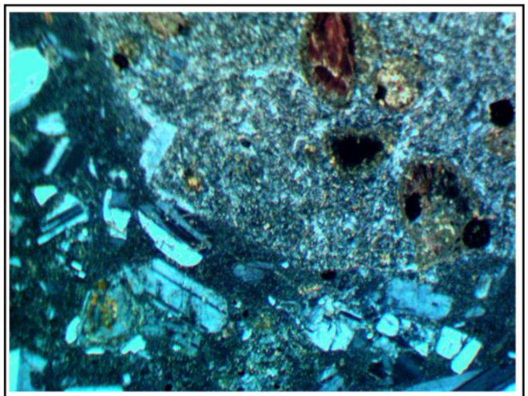
Spring Pluton, in the highly argillic alteration area, it lies directly on the Mud Springs Stock, apparently as a pendant. One small occurrence is found as float north of Greenstone Gulch.



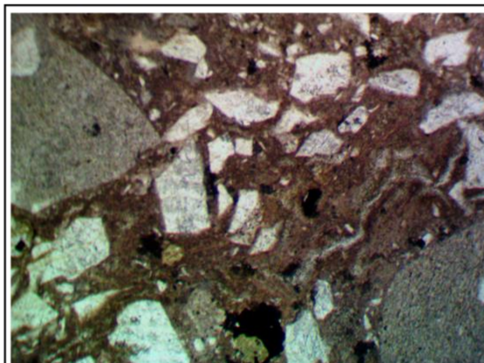
Map E 2 : West flank of the Walti Pluton: Lithic tuff appears to overlie a small outcrop of Tertiary conglomerate. The lithic tuff yields to pumice bearing tuff that is devitrified to chalky white material containing shards.

Dacite Agglomerate: The Agglomerate andesite may be the same unit as the Orbicular Dacite which is in contact with the Mud Springs Pluton, **Map E-1**. It plots generally with the Basal Tuff though the agglomerate has more Hafnium and Zircon than the tuff. In the field, the orbicular unit has fine mafic round balls of porphyritic material surrounded by messy looking diorite. Though thin sections of the orbicular were fairly inconclusive, the photograph provided below shows clearly the mixed texture. Two photomicrographs of the dacite agglomerate clearly show that balls of fine magma are entrained in lava that has broken crystals due to friction caused by flowage. The photo comes from the intrusive contact of the Mud Springs Pluton with overlying rocks. The contact has a variety of facies including fine grained pink diorite, pegmatite, baked calcite, and baked quartzite. The Orbicular Unit was originally thought to be a facies of the Mud Springs Diorite but the geochemistry (Symbol **X)** matched the agglomeritic andesite and was much less mafic than the diorite.

E-8 The photo comes from the south margin of the Mud Springs Stock. The rock is bleached. Thin sections show that there are two mixed igneous textures with the finer material in the brown patches surrounded by coarser porphyry. The rock was called the orbicular unit in the field, but it is now thought to be andesite agglomerate.



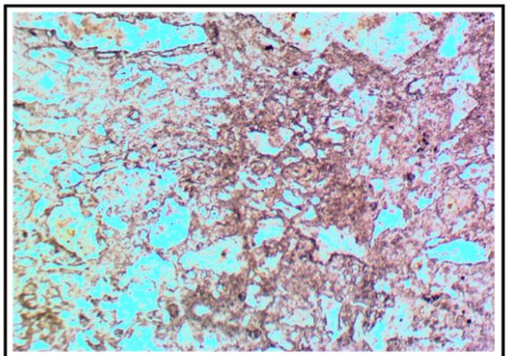
KTC 017: 4X xp. Above Mud Spring. This is mapped as the agglomeritic andesite flow. Note the autolith with a fine textured matrix surrounded by broken feldspars in a much fresher looking matrix. The phenocryst content of the autoliths and matrix is plagioclase, pyroxene and hornblende.



KTC 015: 4X pl. South of Sophia Road, top of agglomerate flow. This sample is much cleaner than the previous slide. It contains lithics that in outcrop appear to be comagmatic. All lithics are igneous. Note the flow like texture between the lithics and the broken appearance of the feldspars. The matrix has phenocrysts of plagioclase, minor hornblende and muscovite. Alteration consists of calcite chlorite patches that may have been pyroxene, and sericite calcite alteration of plagioclase.

E-9: These two slides are of andesite agglomerate. Though they plot as dacite, the phenocryst content and microlites in the matrix are more andesitic than dacitic. Note the broken crystals in the matrix that must have occurred during flowage. Tuff shards were not observed. The rock is a plagioclase, pyroxene hornblende andesite.

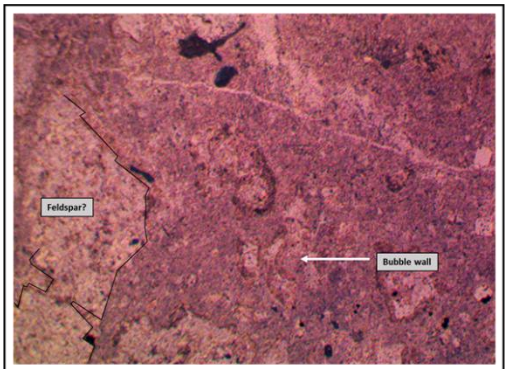
Aphyric Tuff: Map E-2and E-3. The largest outcrop of the rhyolite tuff overlies the conglomerate of Breccia Ridge. Similar looking material is found on the west side of the property on **Map E-2.** The tuff forms chalky white outcrops and the field description was a devitrified aphyric, welded, pumiceous tuff with large to small cavities either gas cavities or weathered out pumice fragments. Some zeolites were noted. There has been some dispute whether the material is a tuff or a flow. The thin sections show evidence of shards. Sample KTC 352 lies over lithic tuff on the west side of the property. The outcrop is description is identical



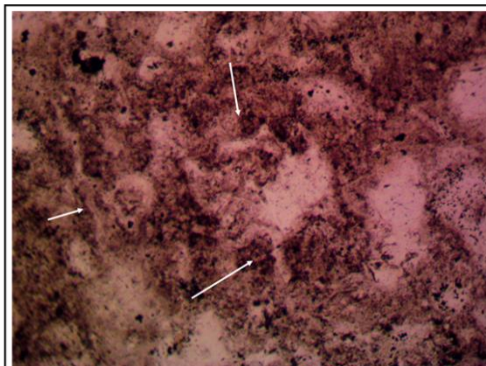
Sheet A3 N 4418499 E 536936

Slide KTC 352: Pl, 4X 5mm. Devitrified annealed glass fragments in what looks like a spatter texture. Sample 351 underlies this outcrop of pure volcanic material. 351 is not devitrified. Sample 338 is similar.

KTC 011: 4X pl. Ridge South of Sophia Road between upper plate rocks and the agglomerate andesite flow. It is a lithic tuff with clasts of upper plate as well as magmatic lithics. This photo is of vesicular unwelded glass. Plagioclase, K-spar, quartz and biotite phenocrysts are present. The rock is strongly altered to quartz, sericite and pyrite. The pyrite is oxidized to limonite and the sericite is stained brown.



KTC 412: 4X pl: Breccia Ridge Tat tuff. Arrow points to a clear bubble wall. Texture of the slide shows some flowage Faint straight edge forms outlined by sericite may be relict feldspars. The alteration is 100% qz sericite.



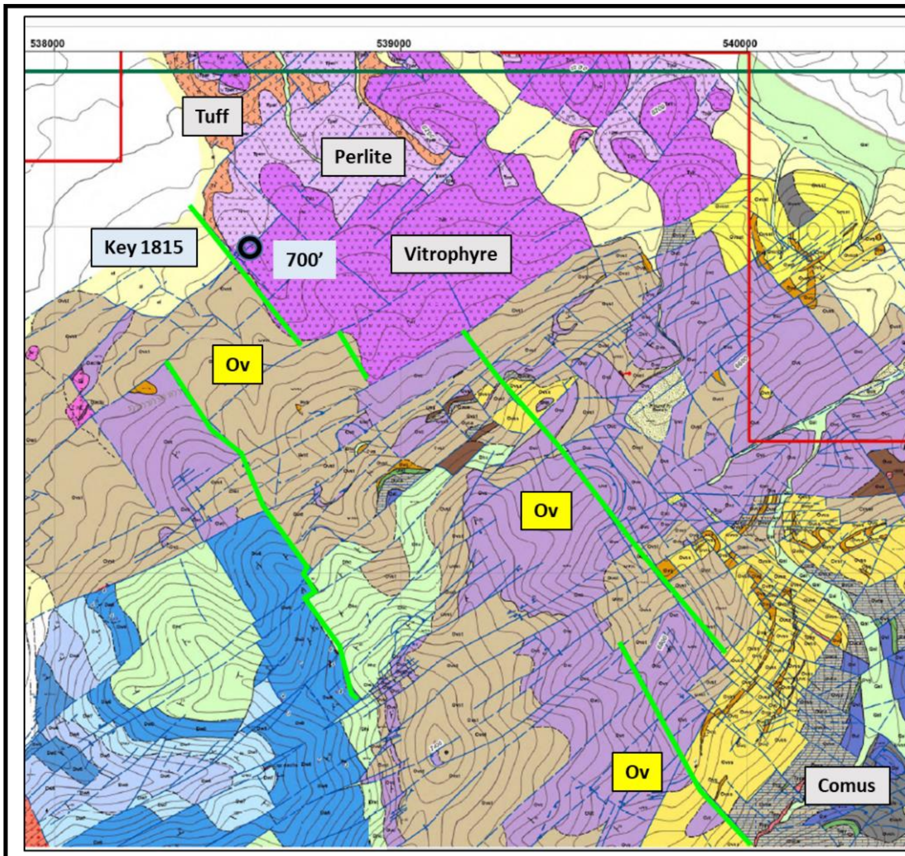
KTC 407: 10X: Breccia ridge. Tertiary aphyric devitrified tuff showing vesicles and shard fragments. Pumice was also noted. The sample is completely devitrified and forms bold white outcrops overlying the Tertiary conglomerate.

E-10: Slide 352 is Aphyrric Tuff **Tat** from the west side of the Walti Pluton. Slide 011 is located south of Mud Spring and east of the Sophia Ridge and is mapped as **Tt.** Slides 407 and 412 overlie the Breccia Ridge conglomerate. The outcrops are heavily devitrified leading to debate of whether the rock is a flow or a tuff. The slides indicate that it is tuff.

to the exposures on breccia ridge. Sample KTC 011 overlies the lithic tuff but underlies the agglomerate flows. Slide KTC 407 and 412 come from breccia ridge. The arrows point to bubble walls. The material is all quartz and clay. Geochemically the rock appears to be related to the quartz porphyry rhyolite plug that lies south of Breccia Ridge.

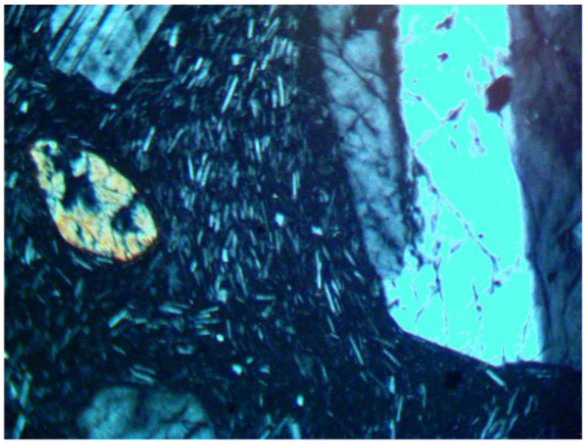
Vitrophyric Daci-andesite

Two large exposures of daci-andesite vitrophyre flows are exposed in the NW and SE of the property. The NW occurrences are called the McClusky Andesite by Gabriel Aliaga since the outcrops straddle the McClusky wash. Exposures in the NW area appear to have a basal tuff that forms white iron stained recessive outcrops. Above the punky material the vitrophyre is altered to perlite which yields upwards into fresh vitrophyre. Drill hole Key 1815r was located on the N side of a NW trending fault separating upper plate exposures from vitrophyre outcrops. Surprisingly, the fault had over 700' of throw since rocks described as andesitic tuff and welded tuff were encountered on the footwall. The material is strongly pyritic.

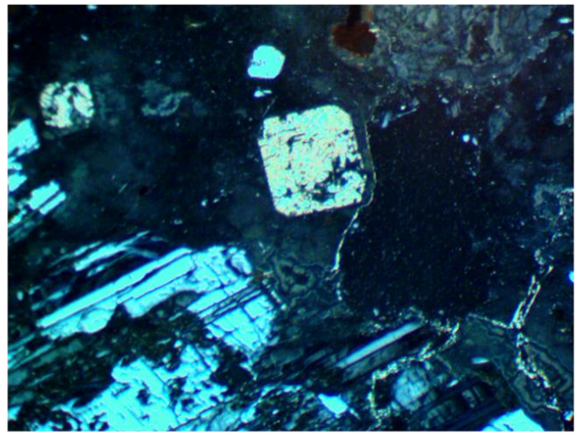


Map E4 : Northern Andesite. The exposures of andesite are in magenta, and light magenta, while tuff exposures are organge with pattern. The SW contact of the vitrophyre mimics other NW structures, including the boundary between the Comus in gray from Valmy in yellow orange and lavender.

The drill results are a total surprise. Thin sections taken from the outcrops show that the vitrophyric andesite is a flow with a holocrystalline matrix of fine plagioclase and 40% phenocrysts of plagioclase, pyroxene, hornblende and minor biotite. Glomeroporphyritic clusters of plagioclase and mafics are also common. The perlitic base of the flow has the same phenocrysts, but the matrix is weakly altered glass with perlitic cracks. The log of Key 1815r does not comment on phenocrysts and since there is a tuff beneath the perlite, one may assume that the material described by Ken Coleman is a different unit that was not exposed at the surface. Perhaps the material is similar to the aphyric tuff, basal tuff and agglomerate encountered around Mud Springs.



KTC 474: 4X xp. Andesite from north end of property. Trachitic plagioclase glass groundmass, 0.7mm plagioclase, very small hornblende. No pyroxene.

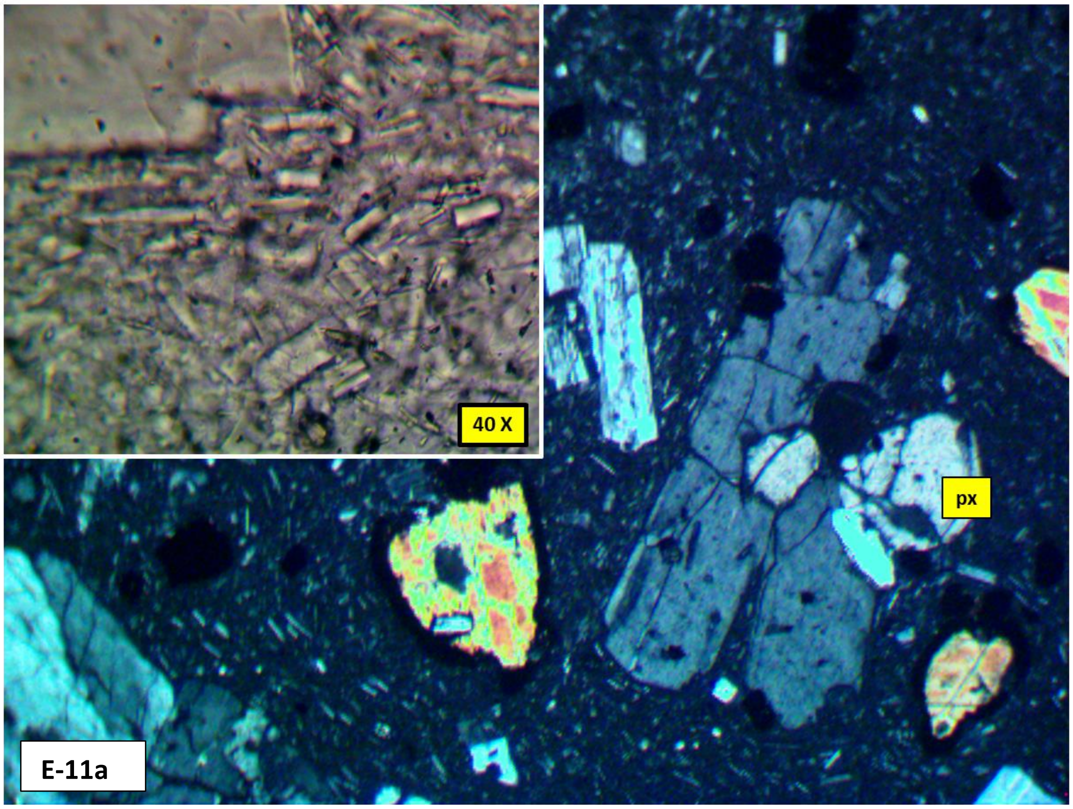


KTC 468: 4X xp. 40% xtal porphyry andesite with perlitic alteration of the glassy matrix. The phenocrysts are largely plagioclase, with lesser amounts of orthopyroxene and much lesser hornblende and minor biotite. Some pyroxene glomerocrysts are also present.

E-11 :Slide KTC 474 is an example of unaltered andesite with plagioclase laths, and phenocrysts of plagioclase and hornblende. Slide KTC 468 is and example of the perlite with an altered glass matrix showing perlite cracks and phenocrysts of othopyroxene and plagioclase. All the slides of the vitrophyre had approximately 40% phenocrysts of plagioclase, pyroxene, hornblende and minor biotite.

The east side of the property also has exposures of similar appearing vitrophyre. This unit lies on top of exposures of altered glomeroporphyritic flows, lithic tuff and highly altered white rocks that may be part of the aphyric tuff. The exposures directly east of Mud Springs appear to be a thin skin over the other material, and hence it must be younger than the tuffs and the conglomerate dated at 35.62.

The exposures of vitrophyre lie east of a major NS trending fault that defines the east margin of the Simpson Park Mountains in the Keystone Area. Drill hole Key 1710r drilled 400' what is described as dacite tuff. The drill hole is located 100m east of the NS striking range front fault. Exposures in the area however are not tuffaceous as seen in thin sections and field mapping. The northern and southern McClusky andesite exposures are remarkably similar petrographically and geochemically and probably formed from one eruptive event. The photo micrograph below is one of five taken from the southeastern exposures. The extremely high power inset emphasizes the trachytic flow texture.



KTC 046: 4X xp. South Mud Spring Valley. Vitrophyric andesite with 40% phencocrysts with plagioclase, pyroxene, hornblende and biotite in a matrix of fine plagioclase phenocrysts (seen in 40 power insert). There is one glomerophorpyritc cluster of plagioclase and augite. The flow is practically unaltered.

Though the rocks have been called andesites, the petrology shows that the data plot across the andesite dacite line. Two samples were altered and plot as rhyodacites due to added quartz. The Cox Bell and Pankhurst and the Fenner diagrams below demonstrate that their chemistry with respect SiO_2 is very similar to the Gund Sills. However, the immobile element diagrams do not support this conclusion since the Vanadium and Yttrium data lie between the Gund and Mud Springs values and the values found for the Walti Pluton. This suggestion is at odds with the McClusky age of 35.99ma which is older than the Gund and Mud Springs dates. However, since the McClusky lies on top of the dacite agglomerate which yielded fairly young dates there may be a problem with the Ar40/Ar39 date which came from illite.

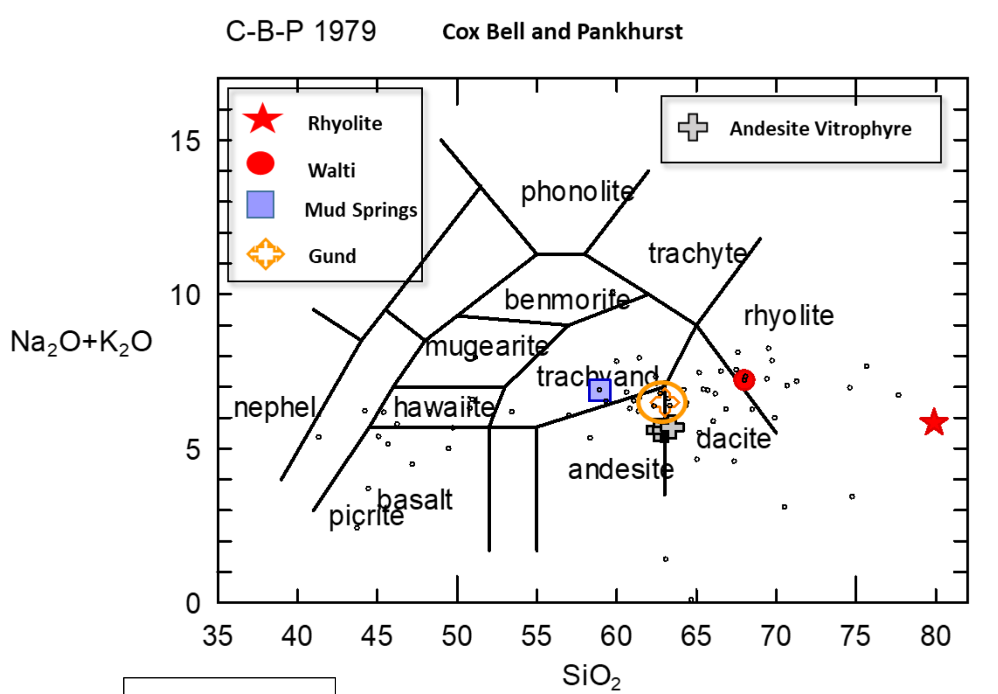


Diagram E-12: This diagram shows that the vitrophyre straddles the andesite dacite field and that the Gund Sill is the most similar to the Andesite Vitrophyre.

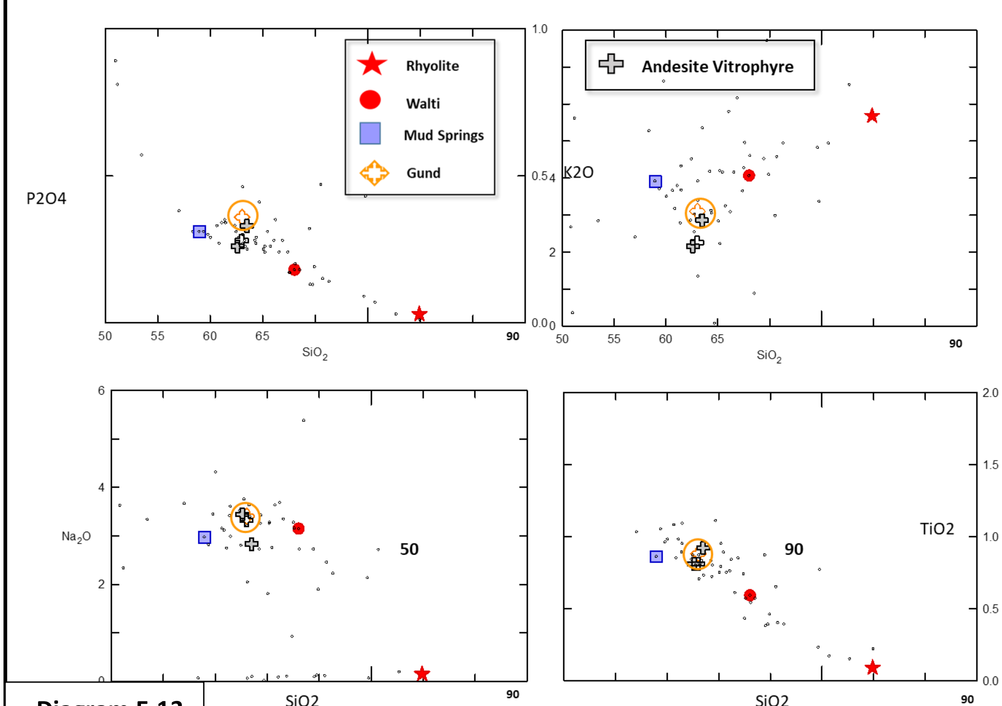


Diagram E-13 These Fenner diagrams all demonstrate that andesite vitrophyre matches the P2O4, K2O, Na2O and TiO2 of the Gund Sill highlighted by the circle. Numerous more complex diagrams show the same results.

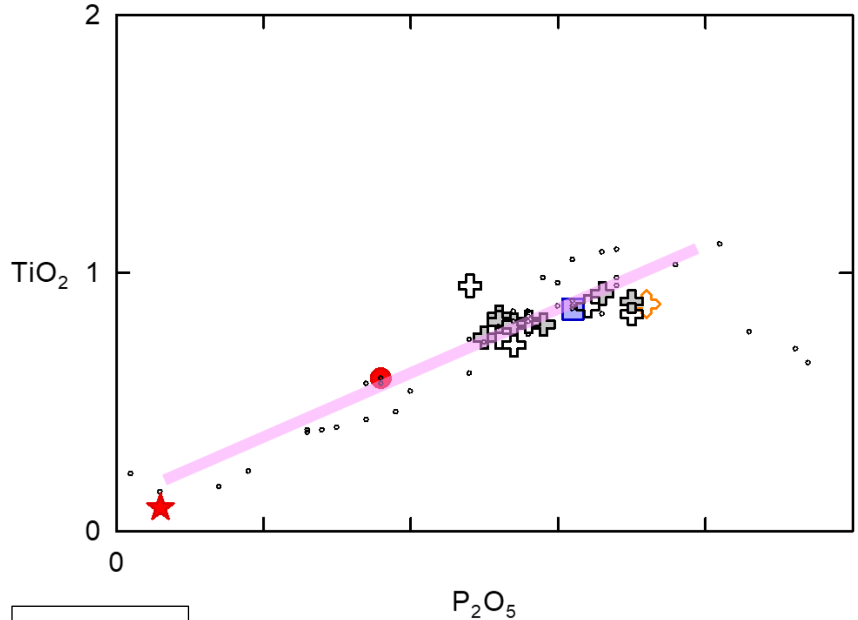
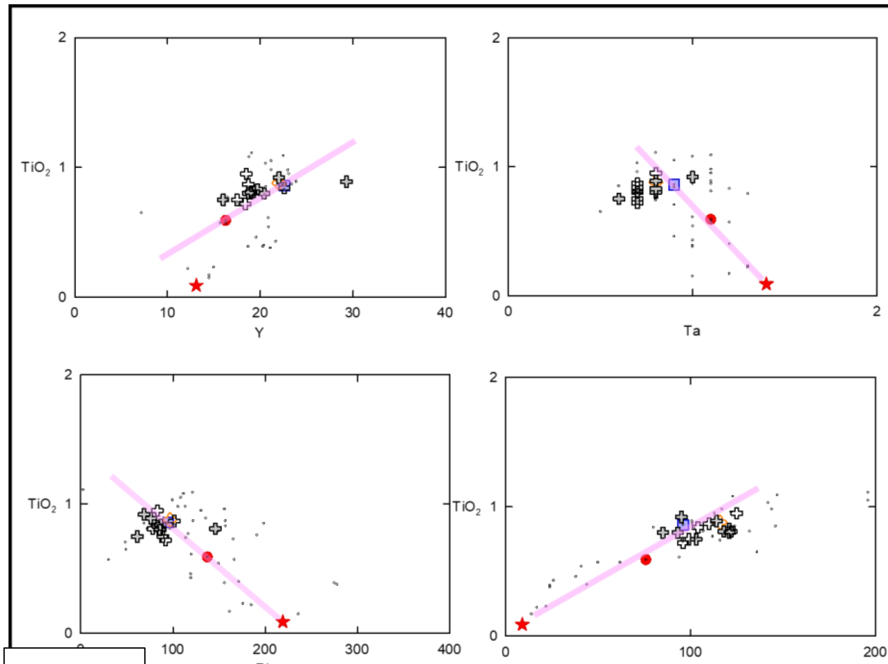


Diagram E-14 The vitrophyre dikes lie on the differentiation line between the Gund Sill and the Walti Pluton.



.Diag E-15 These TiO2 vs immobile elements diagrams demonstrate that the vitrophyre has similar Titanium to the Gund and Mud Springs intrusions but that the immobile elements indicate some differentiation towards the Walti pluton with respect to Yttrium, and Vanadium.

Geochemistry of the Extrusive Rocks Compared to Dikes:

The Winchester – Floyd diagram below compares the extrusive rocks to the major intrusions and provides the rock type used in this discussion. See the table at the beginning of this section to identify the symbols used below. The basal tuff in magenta diamonds is the lithic tuff which is contaminated by Paleozoic sediment clasts. The basal tuff in blue crosses is a rhyodacite and the flow that overlies it is a dacite. The vitrophyre daci-andesite vitrophyre varies considerably with respect to SiO2 and has a lower Zr/TiO2 ratio at .011 than the dacite flow that underlies it which has a ratio of 0.015. The difference is significant enough to conclude that the two flows are not the same. The aphyric tuff that lies directly on the conglomerate is a quartz rich rhyolite related to the Rhyolite Porphyry.

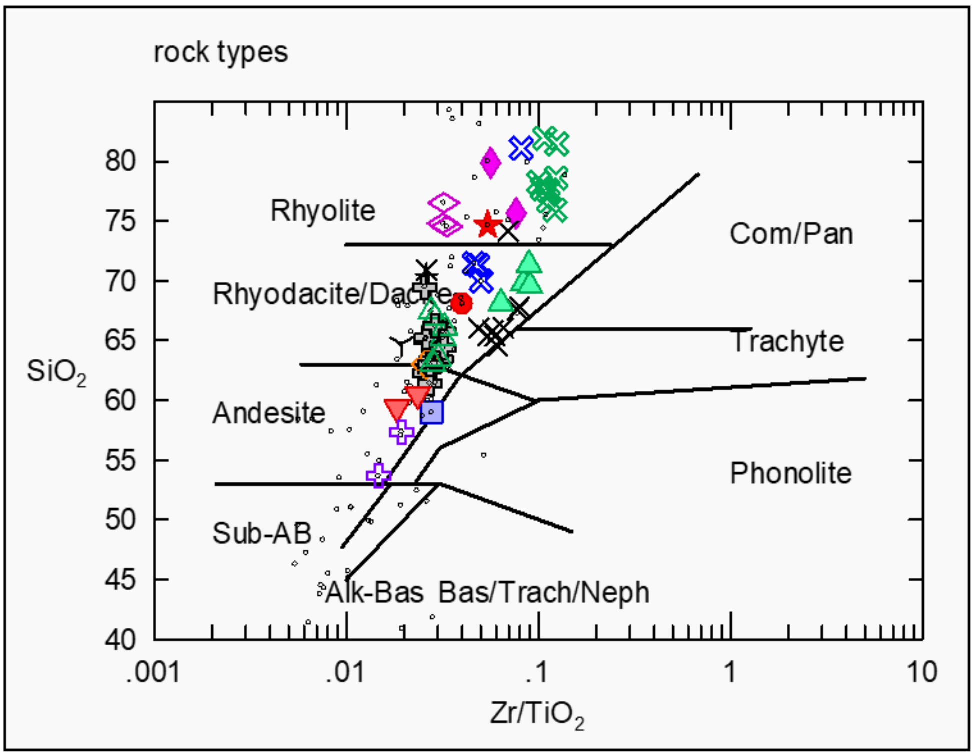


Diagram E-16 the diagram compares the flows with tuffs. The flows are more mafic than the basal tuff that seems Walti related, and the aphyric tuff that plots with the Rhyolite porphyry. The lithic tuff has extra silica due to Valmy sand input.

At first the extrusions were examined separately from the dikes, however, there is sufficient correlation between the dikes and extrusions that a combined diagram has been provided. One can see that the extrusions have the most similarity to **Type B and C** dikes. The Aphyric Tuff however does not have a dike equivalent but is closely related to the Rhyolite Porphyry Plug. The upper two TiO2 plots, P2O5 and Vanadium show a standard differentiation trend. The Vitrophyre geochemistry clusters around the Mud Springs and Gund chemistry but seems to be slightly more intermediate and associated to **Type B** dikes. The basal tuff and agglomerate flow are associated with **Type C** dikes and appear to be differentiates of the Walti Pluton.

The lower two diagrams compare TiO2 to immobile elements and one can see the inverted V shape on both diagrams. As a melt differentiates, silica becomes enriched to the point that zircon and hafnium are no longer compatible with the melt forming a zircon rich magma source. **Type C** dikes and the agglomerate dacite lava both have moved to the right of the diagram suggesting that they are inter-related. The basal tuff on the other hand (blue crosses) shares the same zircon and hafnium levels as both the Walti and Mud Springs stock and **Type A and B** dikes.

A simple differentiation trend does not completely explain the data since there is a paleo surface in contact with the lithic tuff, basal tuff, agglomerate and the aphyric tuff. Furthermore, the conglomerate is dated as 35.62 ma, younger than the vitrophyric daci-

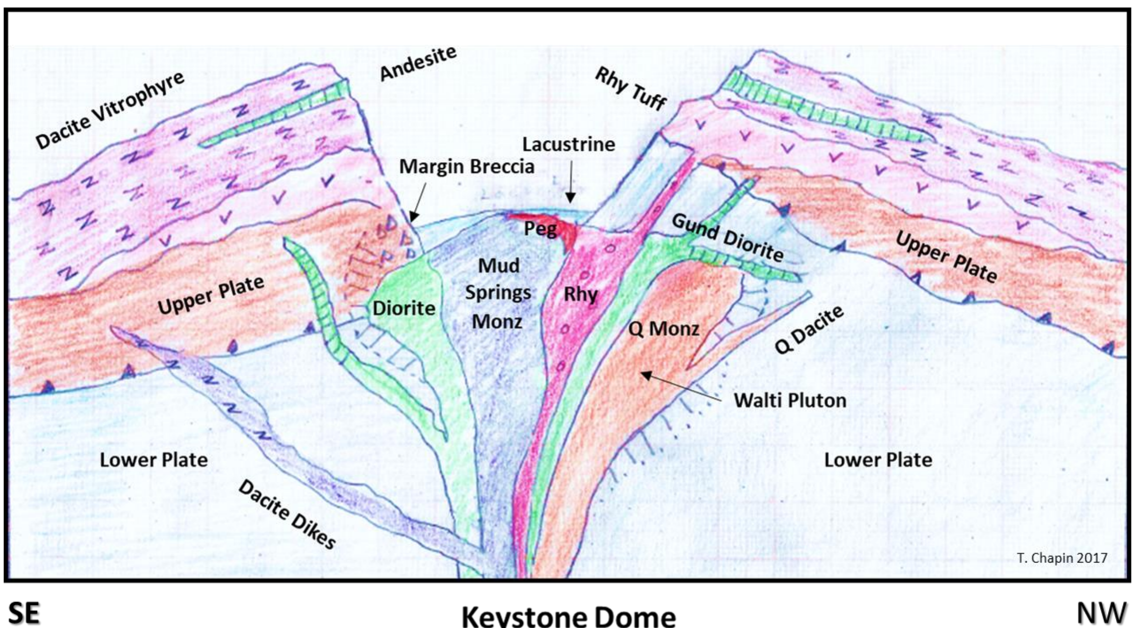


Figure E-17 Schematic sketch of the volcanic complex underlying the Keystone Project. The Paleozoic sediments are intruded by a complex of intrusions ranging from diorite to quartz rhyolite. Each intrusion has a set of daughter dikes and extrusive facies. The hypabyssal rhyolite creates a quartz rich rhyolite tuff that overlies the Upper Plate on both sides of the dome. The Walti Pluton is Quartz Monzonite and forms a skarn. The Mud Springs Monzonite forms dacite dikes and a thick sequence of dacite vitrophyre. Likewise, the Gund Diorite forms both andesite dikes and some andesite flows. Calcite outcrops and quartzite meta breccia outcrops overlie and flank three sides of the Mud Springs Pluton suggesting that the pluton is overlain by a crater lake.

andesite which yielded illite dates of 35.99ma. Field relationships and drilling place the vitrophyre on top of all the other Tertiary units. The extrusive data can be explained as a stratovolcano that alternately erupts andesite and rhyolite in several repeated cycles. The paleo surface could then have both rhyolite and andesite deposited on the paleosurface in different areas of the volcanic edifice. A consideration is that the vitrophyre may have had a separate source than the other extrusive rocks.

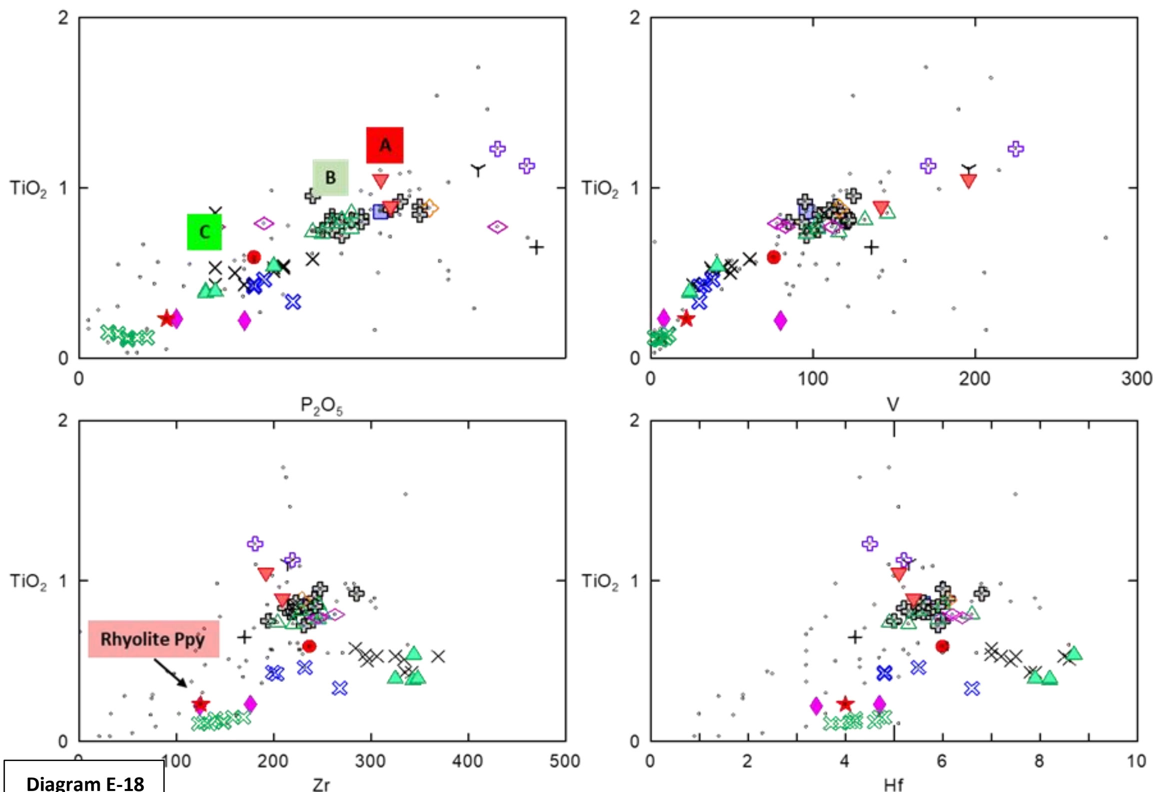


Diagram E-18

Comparison of intrusions, dikes and extrusive volcanics. The Vitrophyre plots with the **Type B** dikes. The basal tuff and agglomerate plot with **Type C** dikes on the upper two diagrams but the basal tuff is more similar to the type B dikes with respect to Zr and Hf. The aphyric tuff is completely separate and clearly most like the Rhyolite Porphyry.

GEOCHEMISTRY

The Keystone Project routinely uses down hole geochemistry as a tool both to identify favorable tracer elements for Carlin Systems but also as a helpful guide to identify various units such as the Comus from the Horse Canyon Formation. Unfortunately, the method used at present is not adequate for the latter task since the titanium values are not accurate enough to be used as discriminators and the zircon data is absent.

Titanium is useful in identifying upper plate Comus facies that have abundant epiclastic detritus derived from submarine basalt. It also picks out greenstone and spilite quite well. This is important since the latter facies are often confused with limestone since the lava fizzes quite readily. Vanadium also can discriminate fizzy lava from limestone. An example of the inadequacy of our present method is seen in Key 1801r where an interval of greenstone is logged from 415 to 460'. The titanium levels are in .01% range where one would expect 1-3% TiO_2. But there is a big jump in vanadium indicating that the rock is igneous. However further down the hole the interval 520-570 was logged as limestone in the Horse Canyon. The geochemistry shows that the interval is igneous with high vanadium numbers and low calcium. Consequently the Horse Canyon contact has to be moved.

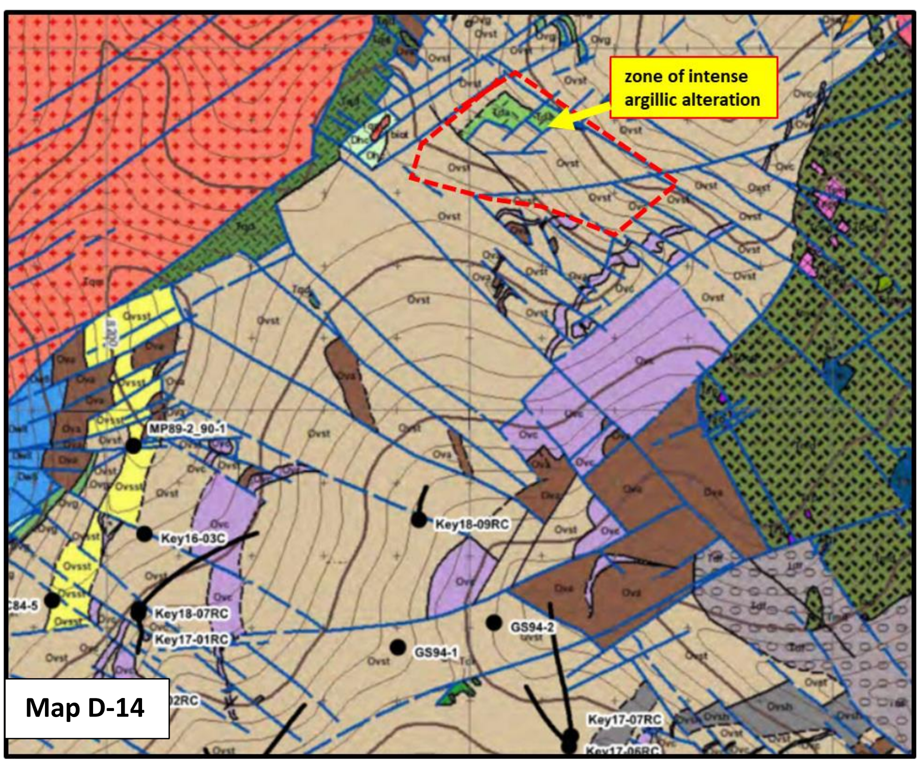
Zircon is very useful in the Lower Plate as it varies greatly depending on which unit one encounters in the Wenban Formation. This is because it represents continental detritus. The target horizons in the Wenban have higher zircon since they have abundant turbidite deposits which increase the porosity of the unit Wenban 5. The less favorable units Wenban 3 and 4 have low zircon. Zircon is very useful identifying the Roberts Mt – Wenban contact since the upper Roberts has very high levels of zircon. Zircon is immobile so once can easily discriminate the formation, even through the metamorphic overprint or hydrothermal alteration. The present analytical method does not digest Zircon. The whole rock analysis MeMs 81 is much more accurate than the exploration suite we are using. However, MeMS 43 has been used successfully and is much cheaper. Unfortunately, one cannot compare data from one type of analysis to another.

The author provided whole rock data and thin section analysis of several intervals sampled from seven drill holes which demonstrate the usefulness of the technique. In many cases the data confirmed the original log; in some cases not. The file named **Analysis of Drill intervals** contains the seven analyses separately so they can be inserted in the log file. The discussion of Key 1809r is of particular interest and is included below.

DRILL HOLE Key 1809 THIN SECTION AND WHOLE ROCK ANALYSIS

Ten intervals were sampled from Key 1809. The drill hole is very interesting since there are two gold bearing intervals within the hole that have different mineralizing fluids. The first interval occurs from 965 to 1005' with ppm values of gold associated with skarn. This is a typical skarn interval with a magmatic signature of elevated moly, tellurium, bismuth titanium and Tungsten. The economic minerals of gold, copper, zinc and silver are typical of skarn deposits. The second interval ranges from 1370 to 1490' with 100' of elevated gold values up to 200 ppb. This thick zone is clearly a Carlin system and has the classic arsenic, antimony, mercury, thallium and phosphorous trace elements. Thallium values between 20 and 60 ppm are very high.

One point of interest is to see if the skarn mineralization is a carbonate host rock or if the skarn represents a sill. In the latter case, the potential for significant gold mineralization beneath the sill is of great interest and coupled with surface geology one might be able to vector into the main Carlin zone of mineralization. To that effect, ten samples were sent for thin section analysis and whole rock evaluation.

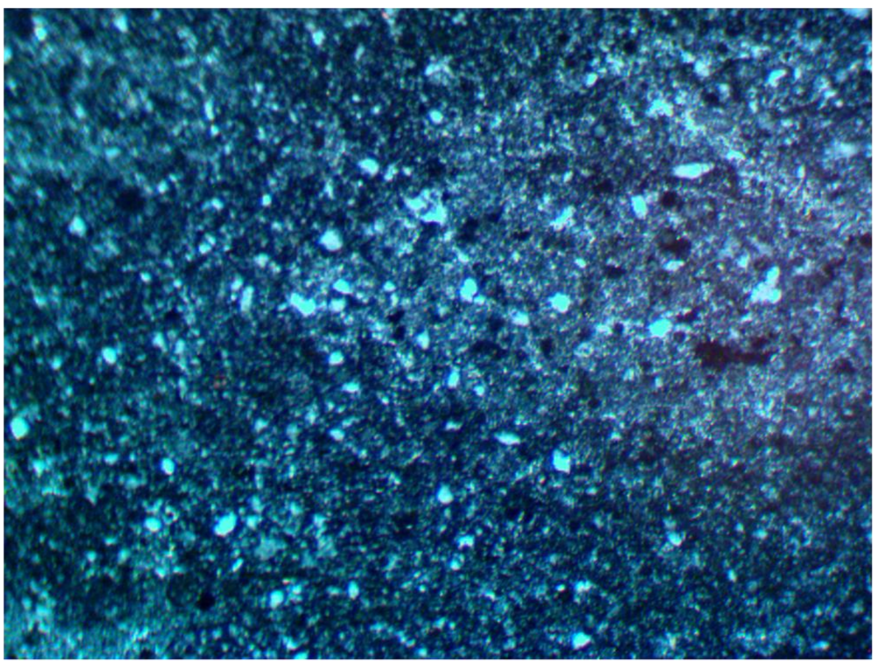


Map of the Northern Sophia area. The Walti Stock and its mafic carapace are on the top left. The Mud Springs diorite is center right. The rhyolite intrusion is very top right corner. The zone of strong alteration is centered on a Tertiary dike. Key 1809 is south central. GS 94-1 and GS94-2 are 600' holes that encountered some gold but were not drilled to the levels where Key 1809 encountered gold. The saddle between the two intrusions is a suggested target.

The map shows that the majority of the surface sediments are Valmy siltstone, argillite and chert. The map also shows that there is steeply dipping 35-45^0 lower plate that underlies the Valmy. Drill hole Key 1809 may have encountered the lower plate at 1,500'. The hydrothermal system intensifies below 1300'. Moving toward the red outlined alteration envelope should bring the lower plate up to shallower depths. The position between the two main intrusions is also very appealing. The following is an in depth analysis of the drill hole intervals.

Key 1809-405

The slide is composed of pale gray chips of fine graywake showing indistinct laminations. The sediment is a weak hornfels with recrystallization effects that created feathery quartz and minor sericite. The log description is a silicified mudstone. The correct identification would be siliceous wake mudstone since there are no quartz veins.



Key 1809-405: 4X xp. All the chips are a quartz grain graywake showing minor thermal metamorphism. Sericite is a minor constituent as are rare detrital feldspar grains.

The whole rock data indicates that the sample is siliceous with a minor pelitic contents which is expressed by the Al2O3 and K2O levels.

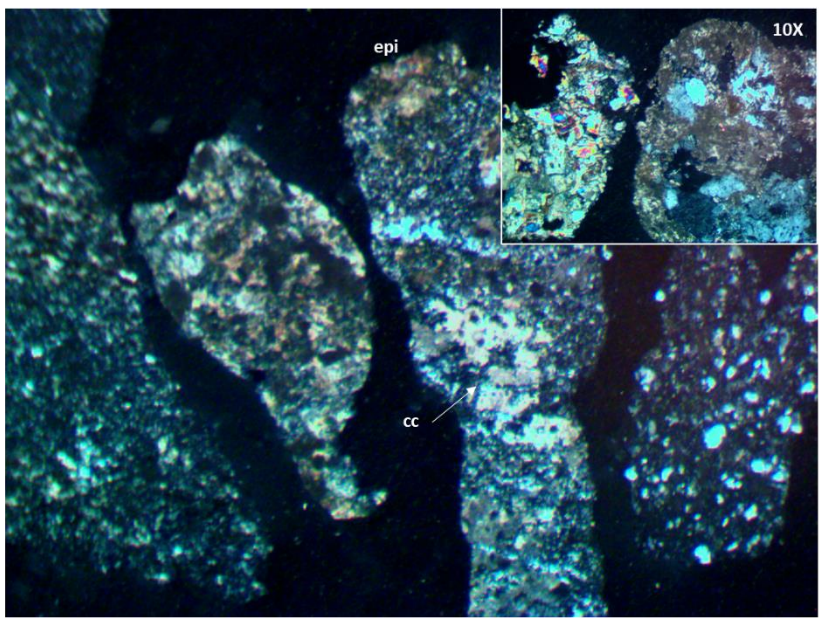
SiO2	Al2O3	FeO*	CaO	MgO	Na2O	K2O	Cr2O3	TiO2	MnO	P2O5	SrO	BaO
78.62131	10.6012	0.994972	0.689839	0.507234	0.243472	7.354897	0.008116	0.547813	0.005072	0.040579	0.020289	0.365209

Key 1809-750

This interval has a diverse collection of chips that include the following;

1. Quartz sandstone
2. Quartz siltstone
3. Skarn of a possible epiclastic rock that provides carbonate
4. Plain calcite chips and calcareous siltstone chips
5. Debris flow textured sandstone into siltstone
6. A felty textured rock that is possibly greenstone

The metamorphic minerals identified are epidote, cordierite, amphibole and sericite. The diversity of the chips suggest that the protolith is either Valmy or Comus which agrees well with the log.



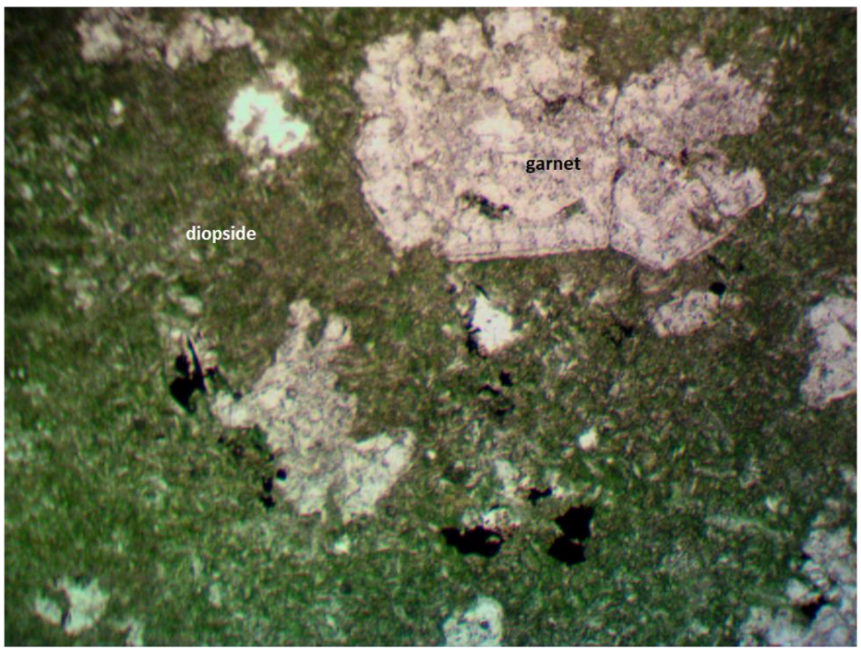
Key 1809-750: 4X xp. The chips are mainly quartz siltstone, calcareous quartz siltstone and possibly epiclastic siltstone. They have been metamorphosed to hornfels with epidote and white mica as common constituents, amphibole is present and probably cordierite. 10X insert may be altered mafic; the minerals are epidote, cordierite and calcite.

The whole rock data suggest that the majority of the sample was quartz silt. The FeO and TiO2 do not suggest much epiclastic mafic material and hence the sample is probably Valmy.

Key 1809-850

SiO2	Al2O3	FeO*	CaO	MgO	Na2O	K2O	Cr2O3	TiO2	MnO	P2O5	SrO	BaO	B
71.1689	11.55205	2.487264	5.167481	2.506383	2.351668	3.589388	0.011346	0.567288	0.041257	0.371316	0.030943	0.154715	

The log suggests that this is a greenstone and limestone derived skarn. In thin section the chips are green colored due to abundant diopside with pink patches of garnet. Also present are porphyroblasts of cordierite and some strained meta-quartz. The skarn is associated with magnetite. Other chips range from calcite amphibole chips, what appears to be a meta-quartz calcite vein with garnet and some hornfels calc-siltstone and graywake chips. The latter are probably contamination. The log makes the reasonable assumption that the protolith was greenstone and limestone.



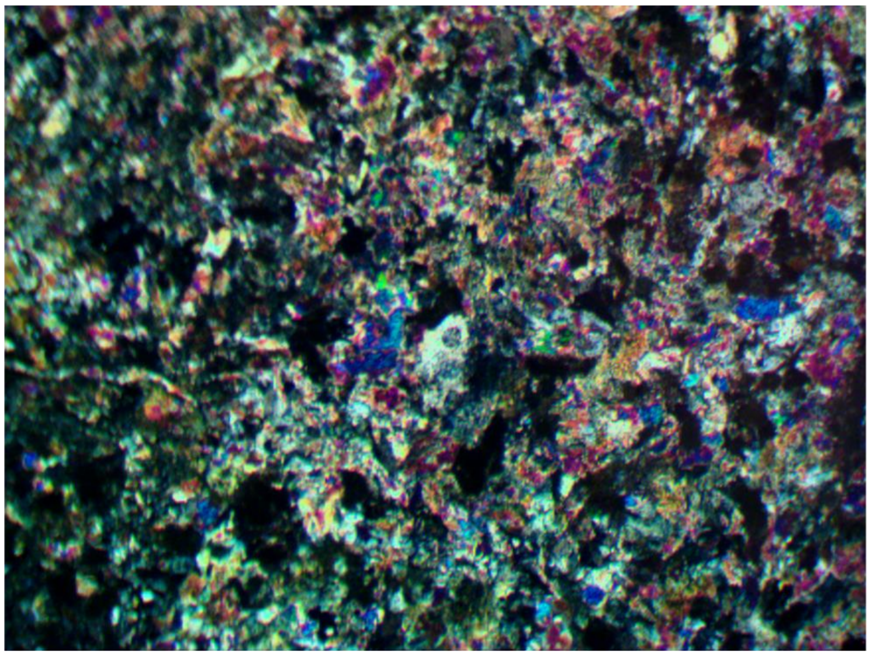
Key 1809-850: 4X pl. The chips are largely garnet, diopside magnetite skarn with porphyroblasts of cordierite. A few quartz silt chips are probably contamination. The whole rock data suggests that the protolith was a limestone with some quartz component.

The whole rock data strongly suggest that the majority of the sample is a carbonate with a silica component. The low Al2O3 and TiO2 preclude a greenstone source. The high FeO is probably expressed by magnetite. The CaO is tied up in diopside and garnet.

SiO2	Al2O3	FeO*	CaO	MgO	Na2O	K2O	Cr2O3	TiO2	MnO	P2O5	SrO	BaO
51.51961	3.805183	21.15896	18.17082	2.982152	0.83372	0.491681	0.006413	0.288595	0.309973	0.406171	0.005344	0.021377

Key 1809-910

The slide consists of two large metamorphic chips and a few small chips of hornfels siltstone that appear to be contamination. The large chips show compositional layering probably induced by bedding. It is logged as dark green skarn. Magnetite, cordierite, clinopyroxene, pistachio green epidote and phlogopite have been identified. Since the log indicates that the section varies between hornfels and skarn, the protolith probably is a mix of epiclastic sediments expressed as the small chips, and a quartz silt limestone.



Key 1809-910: 4X xp. Metamorphic chips of cordierite, pyroxene, epidote and phlogopite. The relatively fine grained texture of this photo would suggest that the protolith was an impure limestone with abundant nucleation sites. Therefore a quartz lime siltstone perhaps.

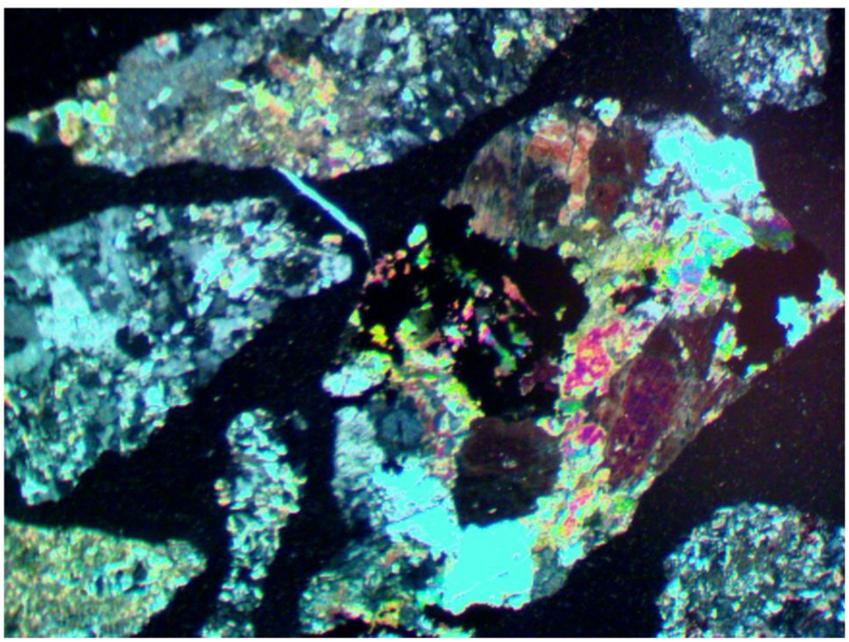
The geochemistry unlike the previous interval has abundant Al2O3 suggesting an igneous source. Coupled with the TiO2 values, an epiclastic mafic source is likely. The silica and carbonate values are consistent with a calc arenite composition. Note that the FeO is much lower than the magnetite skarn in interval Key 1809-850. Like many samples below 800' the molybdenum levels are high.

SiO2	Al2O3	FeO*	CaO	MgO	Na2O	K2O	Cr2O3	TiO2	MnO	P2O5	SrO	BaO	E
57.51487	12.27261	4.482668	15.23676	4.669833	1.674484	0.780039	0.00936	2.641732	0.062403	0.613631	0.031202	0.010401	

Key 1809-985

This slide comes from within the upper skarn related gold zone. The log identifies the zone as a green colored magnetite skarn with garnet and epidote. The slide is made up of lots of small chips that vary considerably in texture, minerals encountered and that show some metamorphosed veins (with pyroxene and quartz) that suggest that there was either a breccia zone or vein zone prior to metamorphism. This would indicate that the high heat source (intrusion) overprinted a vein zone. It is possible that some of the coarser textured material is endoskarn of a quartz diorite. The following chips were identified:

1. Chert
2. Meta quartz chips showing prismatic habit
3. Microcline and amphibole bearing chips
4. Chlorite, phlogopite, diopside and cordierite assemblage
5. Quartz cordierite and calcite as possibly a vein (coarser grained)
6. Biotite and cordierite
7. Epidote and magnetite, again coarse and possibly vein material



Key 1809-985: 4X xp. Various chips ranging from cordierite quartz muscovite to muscovite epidote magnetite and chlorite. Other chips have diopside muscovite epidote and cordierite. Some chips are hornfels quartz silt to very fine sandstone.

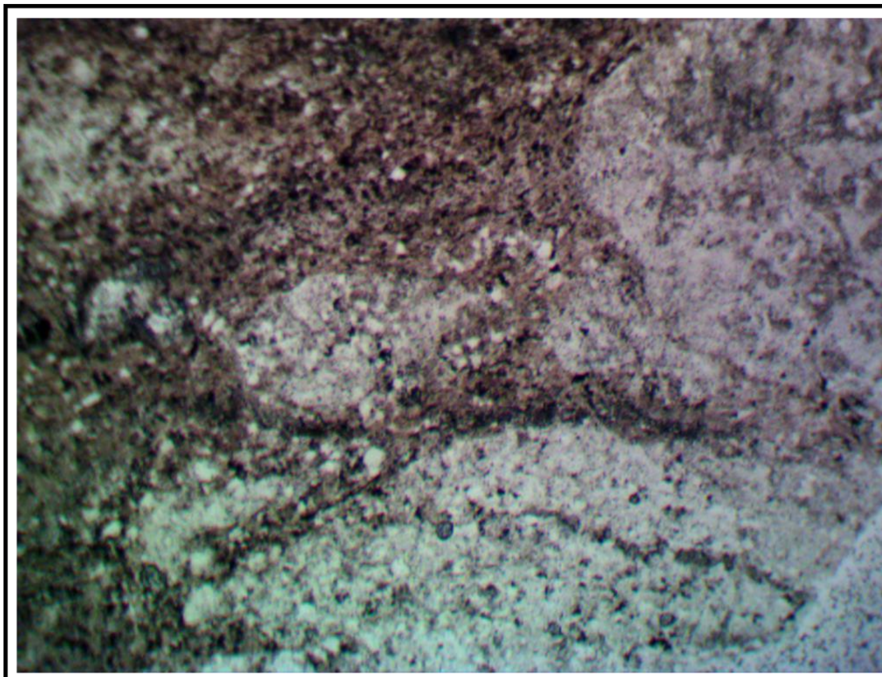
The coarser chip in the middle might be a piece of vein.

The geochemistry is very similar to the previous sample. It looks like a mix of igneous and sedimentary material. The protolith likely included a mix of clastic as well as carbonate dominated sediment.

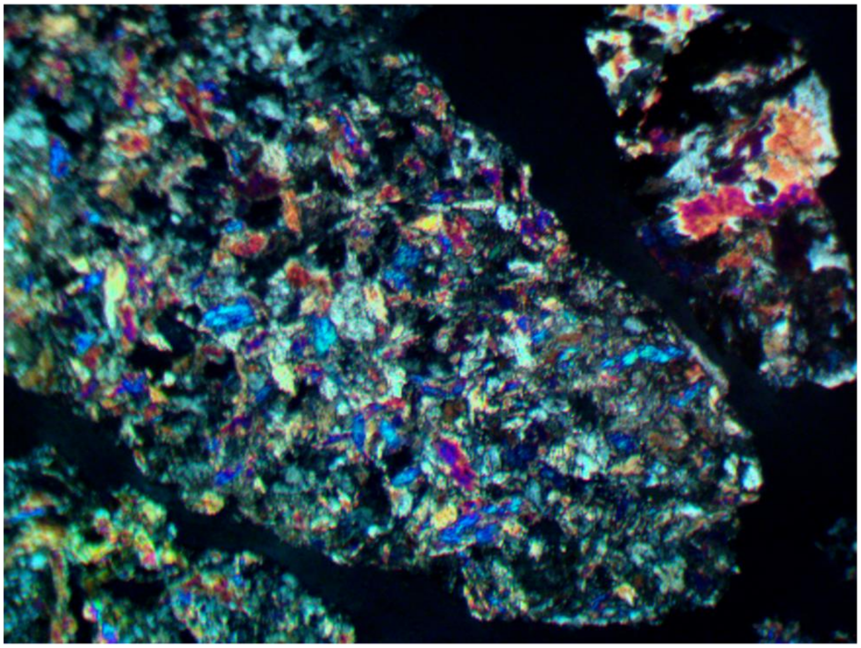
SiO_2	Al_2O_3	FeO*	CaO	MgO	Na_2O	K_2O	Cr_2O_3	TiO_2	MnO	P_2O_5	SrO	BaO	B
55.46449	11.41308	10.64124	13.42716	3.367118	2.654446	0.671358	0.006197	1.642245	0.123943	0.537086	0.030986	0.020657	

Key 1809-1050

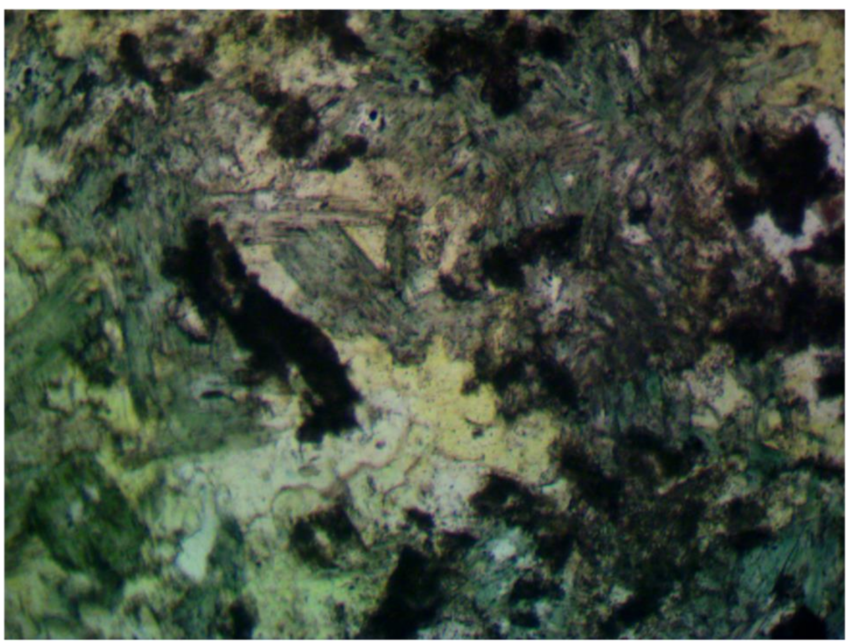
The slide consists of many white colored chips, some have patches of green color. The chips range from 40% metamorphic calc silicates to weak hornfels of pelitic rocks. This would suggest that the protolith is a heterogeneous mix of calcareous beds and siliciclastic beds. One chip is weakly metamorphic calc-silicate mudstone. In these small chips the identification of a metamorphosed greenstone would be impossible. Three photos were taken, the first is of slump textures in wake mudstone and siltstone. The second is a low power view of several fine grained skarn chips with diopside, tremolite, talc, cordierite, and epidote being the principal minerals. One slide is a higher power view of green to bluish amphibole and talc. The green color of the talc is problematic, and the birefringence could be higher. However, the MgO geochemistry is reasonable for talc.



Key 1809-1050: 4X pl. 40% of the chips are pelitic mudstone to siltstone. Here rounded blobs of fine quartz sandstone suggest soft sediment deformation and mixing.



Key 1809-1050: 4X xp. 40% of the chips are pyroxene, tremolite, talc, cordierite skarn. Epidote is confined to a few chips, where it is the dominant mineral. One chip looks like it might be a meta-vein or igneous endoskarn fragment.



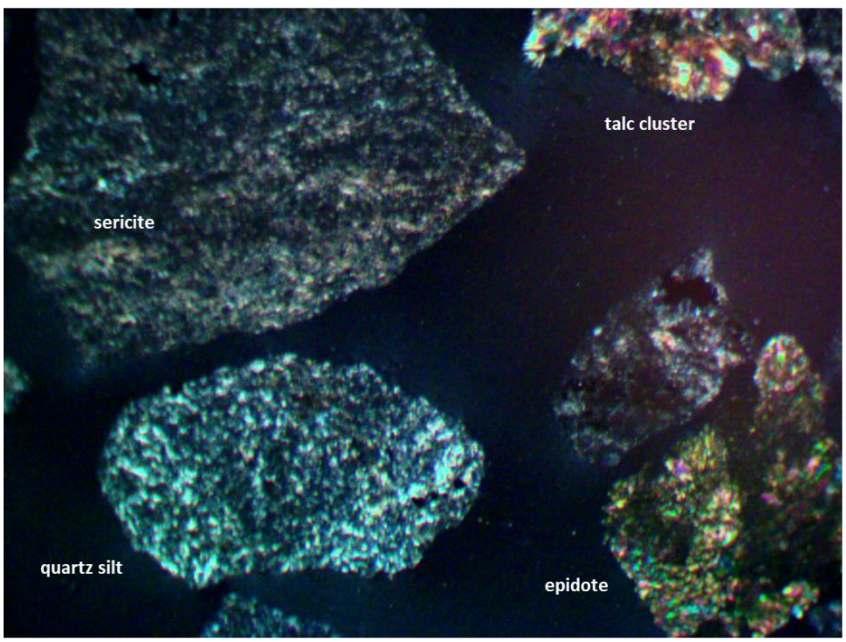
Key 1809-1050: 10X pl. The prismatic mineral has blue green to pink pleochroism and a low 2V (-) and nearly parallel extinction consistent with tremolite. The yellow green hexagonal, platy, moderate relief mineral has strong second order colors and a low 2V with high dispersion. It is probably talc though the color is problematic. Note some is uncolored. Whole rock shows high 4.2% MgO which supports the presence of talc.

The whole rock data is consistent with calcareous siliciclastic sediments. The low TiO2 does not support the presence of much mafic greenstone material, but is sufficiently elevated for some epiclastic sediment.

SiO2	Al2O3	FeO*	CaO	MgO	Na2O	K2O	Cr2O3	TiO2	MnO	P2O5	SrO	BaO
59.04029	14.11833	4.074415	12.16743	4.281705	3.562953	0.523662	0.013348	1.704468	0.041072	0.410715	0.041072	0.020536

Key 1809-1130

The chips are ground very finely by the drill. They are highly variable ranging from brownish tan to blackish green in color and very fine grained. 60% of the chips are weakly metamorphic meta-pelites. 40% of the chips have a calcareous protolith and are altered to talc and epidote. Amphibole is minor. There are several meta-vein pieces associated with talc and magnetite.



Key 1809-1130: 4X xp. Most of the chips are hornfels siliceous sediments with unidentified brown clay. Some chips are talc, magnetite and cordierite, others are epidote and talc. The protolith is largely quartz silt and calcareous silt.

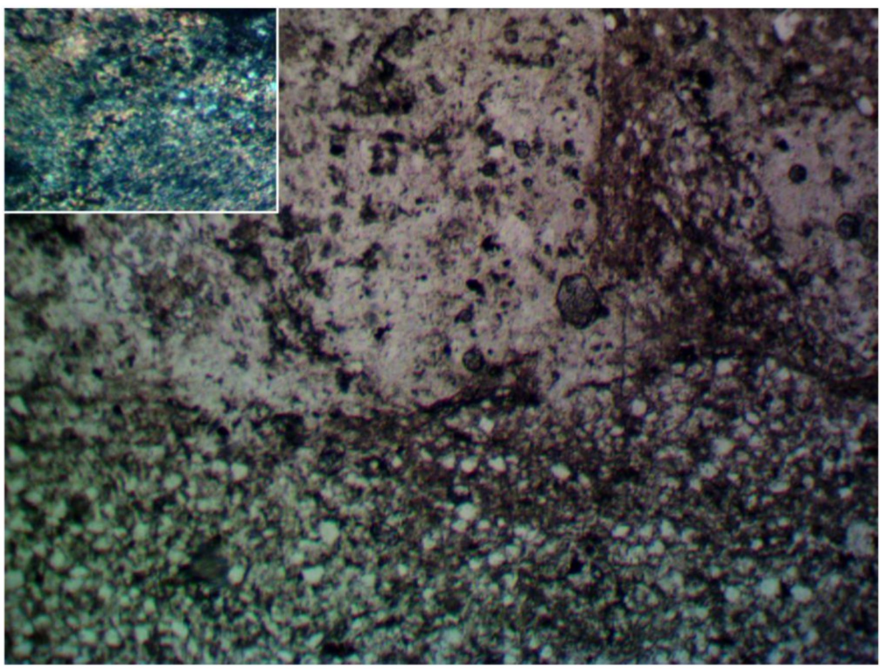
The whole rock data indicate the interval is more silicic and less calcic than the previous samples. K2O and Al2O3 is probably reflected by the sericite since the other minerals are low in those oxides. The MgO is probably taken up by talc.

SiO2	Al2O3	FeO*	CaO	MgO	Na2O	K2O	Cr2O3	TiO2	MnO	P2O5	SrO	BaO
61.25297	15.54803	4.309707	6.125297	4.549625	1.99307	4.841802	0.012522	0.980882	0.010435	0.198263	0.031305	0.146089

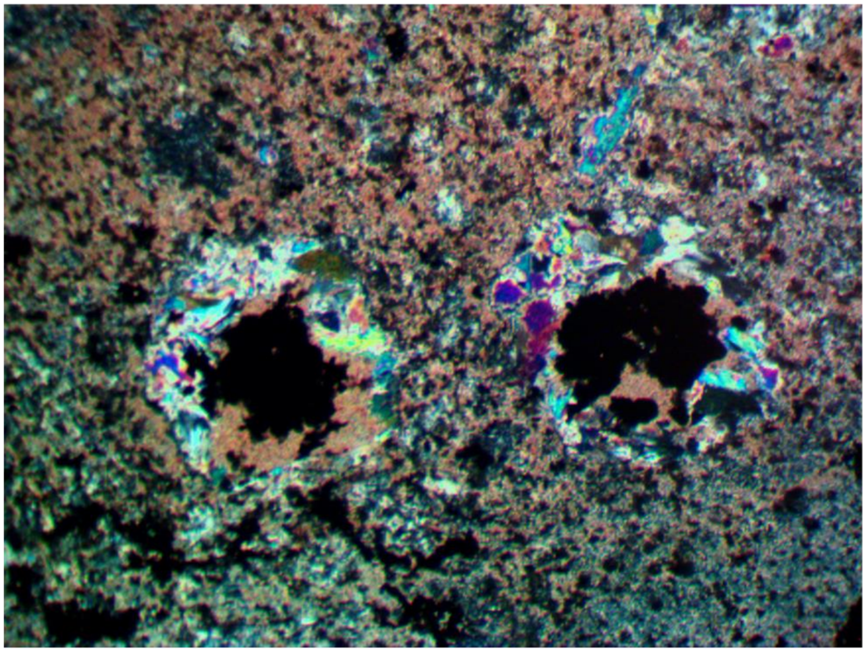
Key 1809-1250

The chips in this slide are fairly large and lightly iron stained to pale brown. Most of the chips show a variety of quartz pelitic textures ranging from very fine quartz sandstone, to clay mudstone that has been thermally altered to brown colored sericite (brown stain due to hydrothermal alteration of magnetite). Some of the brown material may be siderite since it has a high relief and pseudo orthorhombic form. Jarosite is a form of alunite. Basically four kinds of chips were found;

1. Quartz silt wake
2. Sedimentary hornfels showing altered quartz sericite grains
3. A large brown clast showing vesicles with magnetite at the center and surrounded by talc. Presumably the brown quartz, cordierite jarosite material is fine grained basalt.
4. Some chips are largely talc and cordierite with minor chlorite.



Key 1809-1250: 4X pl. Quartz silt and quartz mudstone graywake mixed by soft sediment deformation. Inset is crossed polar view showing that fine material is quartz and brown jarosite



Key 1809-1250:4X xp. Talc with jarosite and black iron oxide (magnetite?) in a groundmass of quartz and cinnamon colored high relief mineral probably jarosite.
The protolith may be a metamorphic greenstone if the voids are amygdules.

The whole rock data shows this interval to be more silicic than the previous intervals. The TiO2 is pretty low so the greenstone call may be a bust.

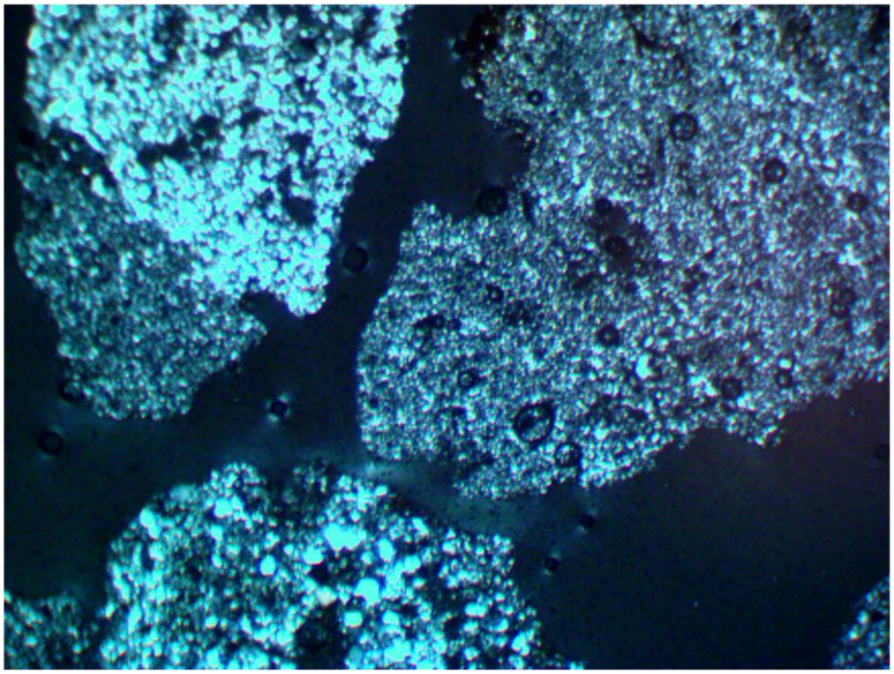
SiO2	Al2O3	FeO*	CaO	MgO	Na2O	K2O	Cr2O3	TiO2	MnO	P2O5	SrO	BaO
68.34994	14.40044	2.948305	4.059256	4.309698	0.876549	4.027951	0.010435	0.699152	0.005218	0.198267	0.02087	0.093916

Key 1809-1320

This interval is logged as metamorphic siltstone. The slide shows the chips to be primarily quartz silt to very fine sandstone. Some chips are recrystallized and a few oxides are present. The photo below shows how simple the lithology is.

The geochemistry shows that the sample is largely quartz. One thought is that the zone is the Blue Hill unit which is largely flysch. Not enough evidence is provided in this examination to make that call.

SiO2	Al2O3	FeO*	CaO	MgO	Na2O	K2O	Cr2O3	TiO2	MnO	P2O5	SrO	BaO
89.57659	6.937595	1.468811	0.224452	0.204047	0.071416	0.82639	0.007142	0.561129	0.005101	0.081619	0.005101	0.030607



Key 1809-1320: 4X xp. All the chips are quartz silt to very fine quartz sandstone. No alteration or other minerals were noted but some chips are recrystallized.

Key 1809-1460

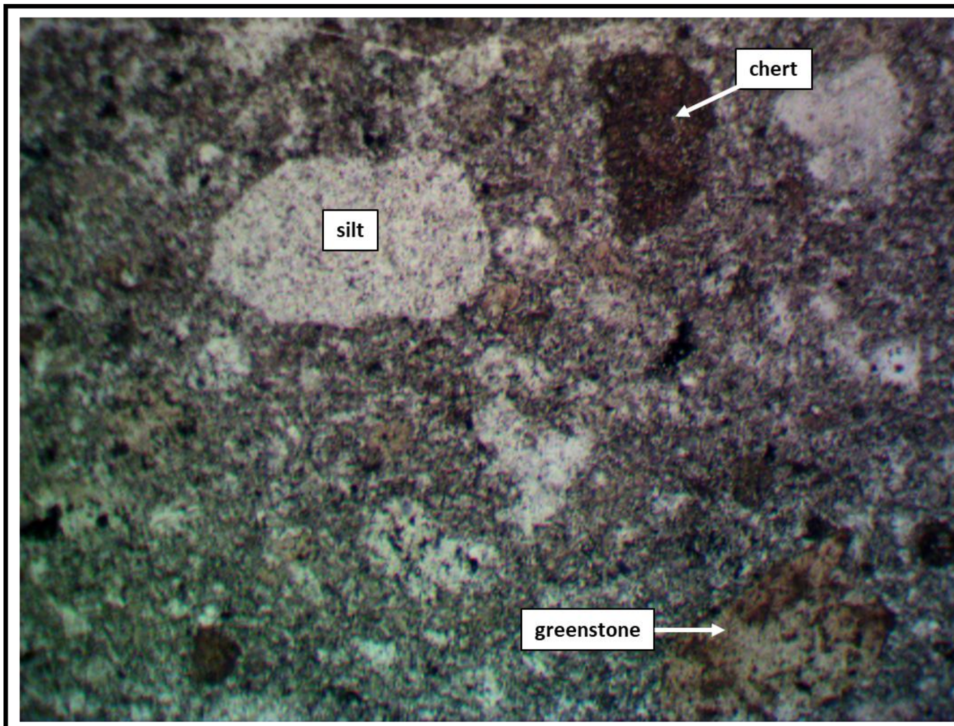
This sample was collected from the Carlin style gold zone that begins at 1460' and extends to 1475'. However, the Carlin geochemistry persists to 1605' where a void was encountered. There is elevated gold for the last 30'. The log shows that the upper interval is a brecciated siltstone. Below the interval, the log expresses that the material is clay rich breccia with goethite and a reddish mercury color from a zone that is postulated as cave fill. The hole TDd in a void. The cave setting is very interesting since the Goldridge deposit is associated with a zone of caves.

The thin section is largely meta quartz silt and fine pebble conglomerate. Some skeletal pieces may be greenstone fragments. Since the larger clasts in the conglomerate are a combination of chert, greenstone and quartz silt without any carbonate clasts, it is probable that the protolith was derived from the upper plate. A clay zone at 1270 may be a thrust fault because the material below the clay zone is no longer described as epiclastic and the geochemistry changes abruptly. At 1295', as noted in the log, the geochemistry essentially becomes much more sterile with lower values of Ba, Ca, Co, Cr, Cu, Na, Mg, Sr, and Ti. Therefore, it is proposed that the RMT is located somewhere between 1270' and 1295' and that the material below the fault is Overlap Sequence which is a section of reworked upper plate flysch. Locally, at Cortez, this is the Blue Hill unit that overlies the Horse Canyon Fm. and underlies the Comus. The cave deposit model would then be placed at the interface of the Blue Hill with the Horse Canyon.

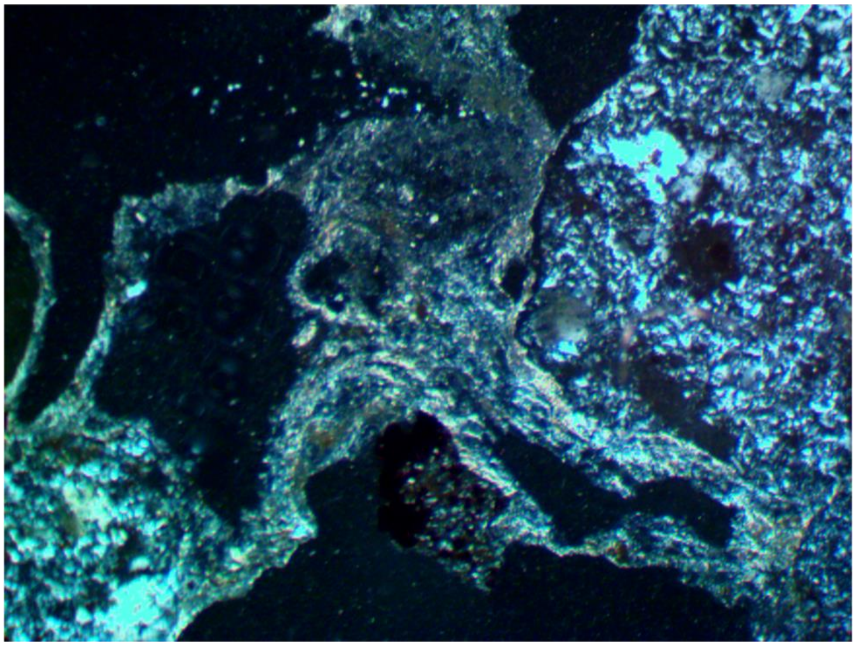
Where does the Horse Canyon start? Below 1,500', calcium, strontium, silver and zinc rise sharply. The strontium rises from the 20s to over 150. Zn is known to be elevated in the Horse Canyon and the rise in silver may be associated more with the zinc than the Horse Canyon fm. Since we are discussing a broken zone with small chips in clay, vertical mixing in this area is possible. The very high zinc values at the bottom of the hole, over 7000 ppm suggest that the cave was formed by hydrothermal fluids and that the drill might have encountered the edge of a chimney. Obviously the exploration implications are positive.

The whole rock data shows that the sample is a quartz sediment without much else and is entirely consistent with a flysch call.

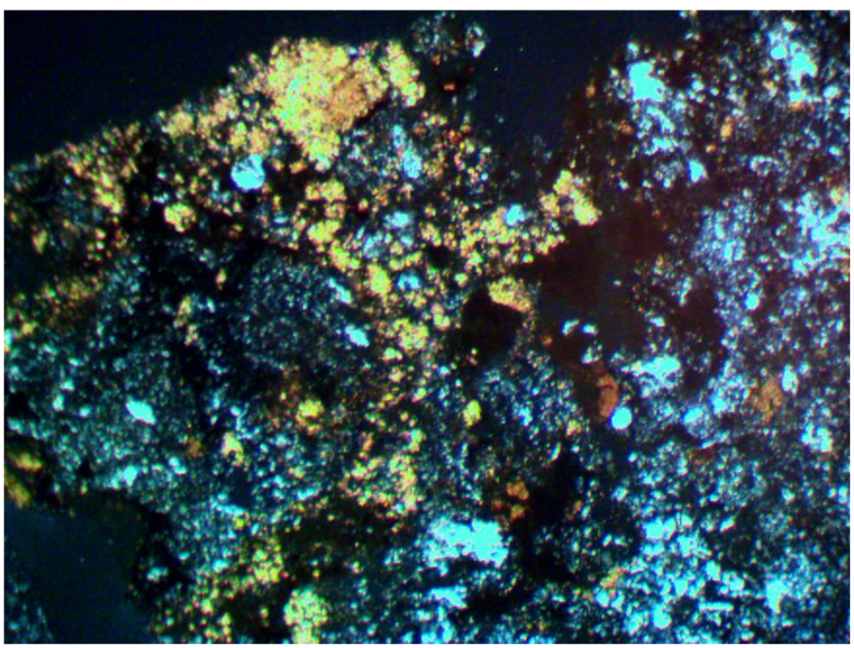
SiO2	Al2O3	FeO*	CaO	MgO	Na2O	K2O	Cr2O3	TiO2	MnO	P2O5	SrO	BaO	E
87.28715	5.20143	5.267646	0.336935	0.200055	0.073704	0.92657	0.006318	0.473814	0.010529	0.063175	0.005265	0.147409	



Key 1809-1460: 4X pl. This is a meta graywake with grains of silt and greenstone. The majority of the chips in the sample show recrystallized quartz and small pebble like grains that look like greenstone in plane light. There are no carbonate grains and probably the source of the sediment is upper plate.



Key 1809-1460: 4X xp. Annealed metamorphic quartz silt chips in a matrix of finer quartz and clay. Though this chip is skeletal, the soupy nature of the finer grained material is very evident and the interval clearly demonstrates soft sediment deformation.



Key 1809-1460: 4X xp. Jarosite (alunite) alteration in a meta quartz silt. The chip also has talc in trace amounts. Essentially the is very little indication in the slide of hydrothermal alteration except for the presence of limonite (goethite) and jarosite alteration. Only 10% of the chips have feox.