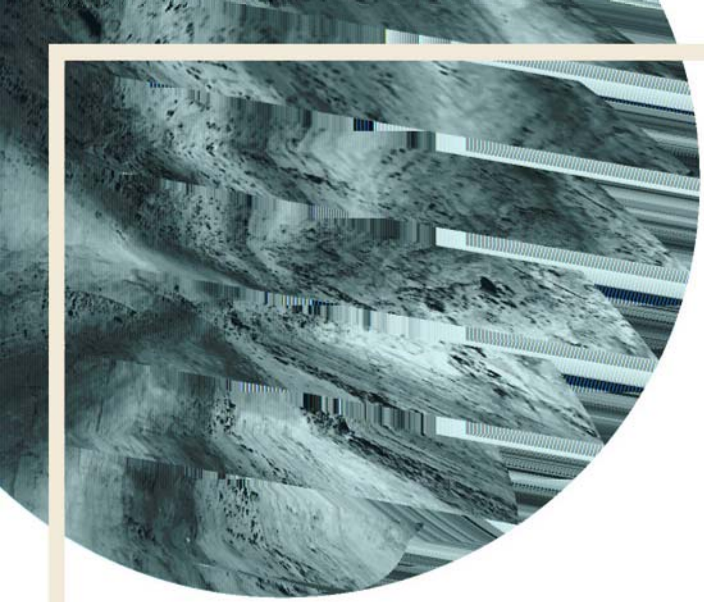

JUNE 13 - 16, 2024

MINERAL ODDITIES

Twinning, Pseudomorphs, Inclusions, and More!

SYMPOSIUM

Field Trip Guidebook

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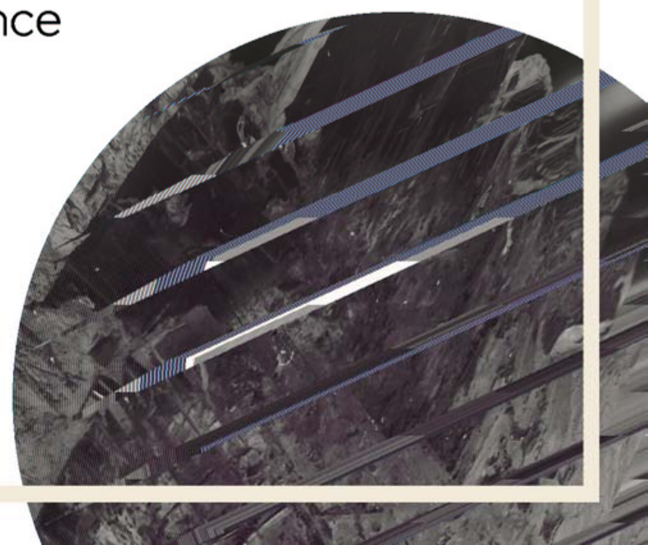

Field Trip Guidebook for the Mineral Oddities Mineral symposium

Sponsored by the Friends of Mineralogy – Colorado Chapter

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Field Trip guide to the pegmatites in the St. Peters Dome area, El Paso County

Pegmatites and related rocks of the Mesoproterozoic Mount Rosa Peralkaline Granite Complex, El Paso County, Colorado (USA)[1]

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Overview

Located in the central Front Range of Colorado, the 1.08 Ga A-type Pikes Peak Batholith (fig. 1) is host to numerous REE-enriched late-stage peraluminous to peralkaline granitic plutons (Barker et al. 1976; Gross and Heinrich 1965, 1966; Smith et al., 1999). The ~1.04 Ga peralkaline ((Na_20/K_20) > Al_2O_3) Mount Rosa granite (MRG), ~15 km west of the city of Colorado Springs, is composed of multiple sheet-like masses, dikes, and ovoid bodies covering an area of ~50 km^2 with numerous spatially-related mafic dikes, aplite dikes, and fayalite-bearing granite bodies (fig. 2). The Mount Rosa Complex is enriched in rare earth elements (REE) and other high field strength elements (HFSE, e.g. Th, Ti, Zr, Nb and Ta) and also hosts numerous simple to complex-type Niobium-Yttrium-Fluorine (NYF)-type pegmatites. Additionally, pegmatites of the Mount Rosa complex show zonation with respect to their distance from the inferred parental Mount Rosa granite main body, with simple or residual melt type pegmatites hosted close to or within this body of Mount Rosa granite, and more complex pegmatites hosted in Pikes Peak granite or fayalite granite 3-10 km from the MRG. Simple type pegmatites typically contain alkali feldspar, quartz, Na-amphibole, biotite, zircon, thorite, and fluorite, whereas complex-type pegmatites contain aluminofluoride minerals, REE minerals (typically fluorocarbonates and Na-F-REE phases). columbite-tantalite, and sulfides.

Geology of the Mount Rosa Complex & Pikes Peak Batholith

The Mount Rosa granite is the southernmost (Fig 1) of 7 studied late-stage plutons within the Pikes Peak Batholith, a 1.08 Ga anorogenic, ‘A-type’ composite pluton with ~3300 km^2 of surface expression dominated by coarse-grained biotite ± amphibole syenogranite with minor monzogranite (Smith et al. 1999). The Pikes Peak batholith is considered a ‘classic’ example of an A-type granite and features 3 large (20-25 km. diameter) intrusive centers in addition to the aforementioned late-stage plutons, and exhibits a diversity of rock types including gabbro, diabase, syenite, and fayalite and riebeckite granite (Smith et al. 1999). The late-stage plutons of the Pikes Peak batholith

[1] Reprinted from the Field Trip Guidebook of the 2016 Second Eugene Foord Pegmatite Symposium.

are divided into two populations, a sodic series (SiO_2 = ~44-78 wt%; K/Na = 0.32-1.36, includes the Mount Rosa granite), and a potassic series (SiO_2 = ~70-77 wt%; K/Na = 0.95-2.05), which likely have different petrogenetic histories, as indicated by their geochemical and Nd isotope data (Smith et al. 1999). More than 90% of the late-stage rocks in the Pikes Peak batholith belong to the potassic group (Na_20/K_20) <1), which is dominated by biotite granite (Hanson & Zito 2014).

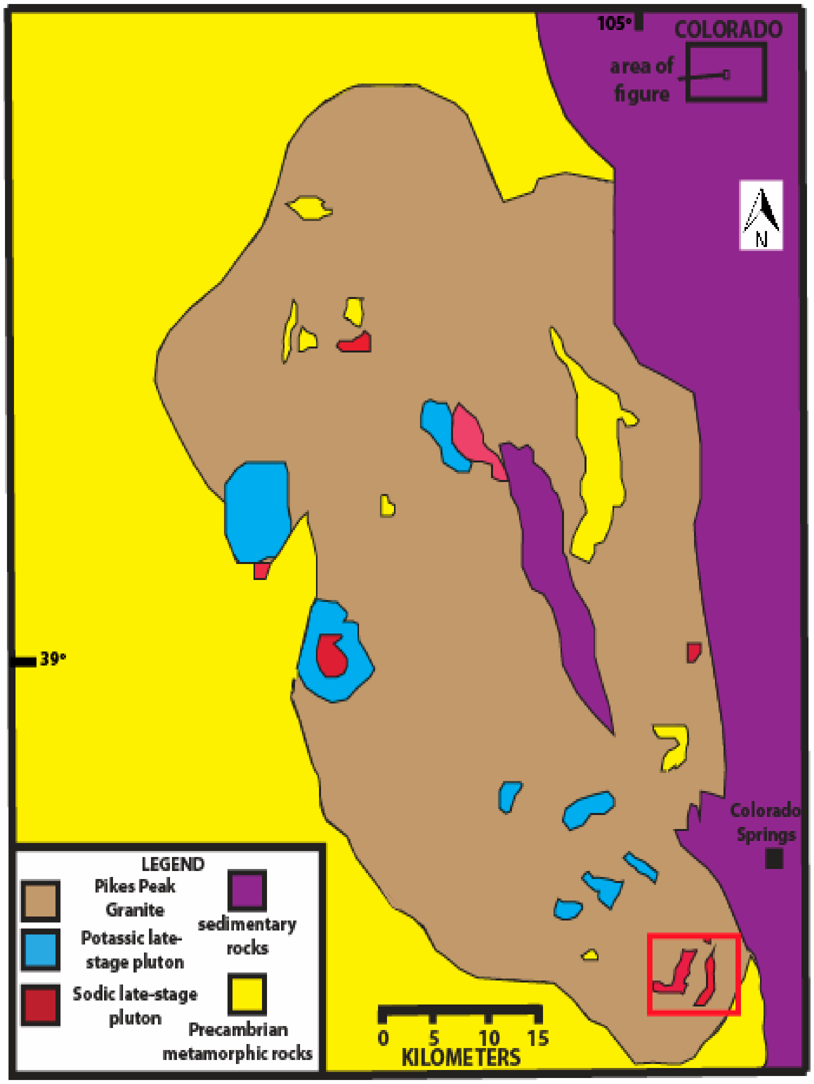

Figure 1. Overview of the Pikes Peak Batholith, showing late-stage plutons of the potassic and sodic groups and the location of the Mount Rosa Complex [red box] (after Smith et al. 1999).

The Mount Rosa granite and related Pikes Peak batholith rocks were emplaced at ~1.08 Ga into the Yavapai province, a ~500 km. wide belt which was accreted onto the southern edge of the Archean Wyoming craton around ~1.7 Ga (Smith et al. 1999). Gross (1962) obtained several K^{40}/Ar^{40} dates on rocks of the Mount Rosa granite ranging from 1020-1045 Ma, and unpublished dates from the U.S Geological Survey (Unruh & Premo;

personal communication) also cluster around 1040 Ma, making it distinctly younger (but temporally-related to) the 1.08 Ga age obtained from an average of recent geochronological work on the Pikes Peak batholith main phase by Smith et al. (1999). Some workers have proposed that the Pikes Peak batholith evolved from extreme fractionation of an upper mantle-derived basaltic melt which ascended through underplated crust in an intra-plate extensional tectonic setting, which may have been due to post-orogenic collapse and 'localized' trans-tension and extension following the proposed ~1.4 Ga Berthoud orogeny (DePaulo 1981, Frost & Frost 1997, Smith et al. 1999). The melt generated during this crustal extension likely interacted with metasomatised middle to lower crust which had been affected by a preceding alkaline fluid which 'fertilized' it, a process that may explain the mixed geochemical patterns seen in some studies of the Mount Rosa and Pikes Peak granites (DePaulo 1981, Martin 1999). While some have proposed an upper mantle origin for the Mount Rosa Complex (Barker et al. 1975; DePaolo 1981), it may also represent the transition from a peraluminous (Pikes Peak batholith) to peralkaline (Mount Rosa granite) melt, as has been suggested for other peralkaline granite complexes (Thomas et al. 2006; Costi et al. 2009). This melt evolution from peraluminous to peralkaline, aided by fluids rich in F, OH, CO_2, and other volatiles, may explain the patchy, irregular distribution of Mount Rosa granite, as well as the spatial relationship between cogenetic rocks including pegmatites. Average F content increases from ~.30% in the relatively early fayalite granite & associated quartz syenite to ~.63% in the Mount Rosa granite, and reaches much higher levels within the more evolved pegmatites (Bailey 1980; Smith et al. 1999).

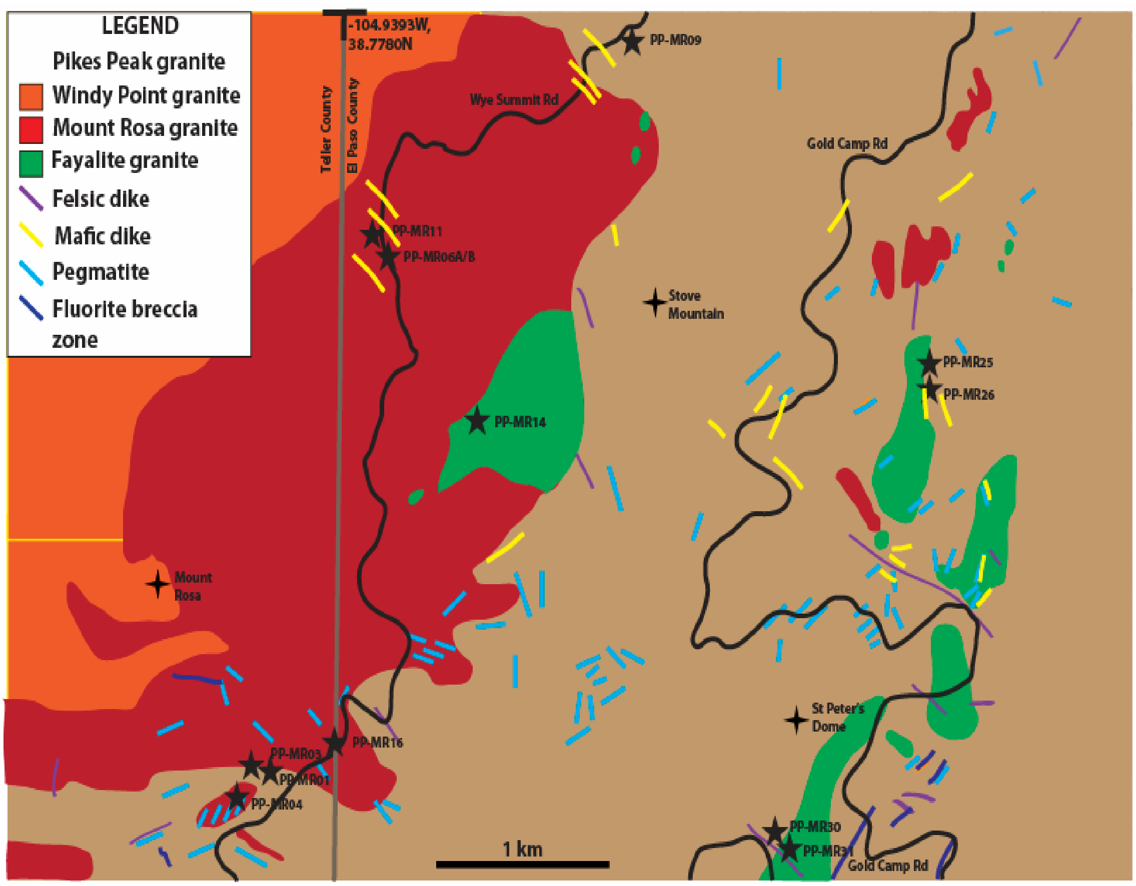

Figure 2. Overview of the Mount Rosa Complex showing major rock units and pegmatites (synthesis of mapping by Persson 2014-2016, Keller et al. 2004; and Gross 1962).

Petrology

The Pikes Peak Batholith in the Mount Rosa area is a medium to coarse-grained, allotriomorphic biotite syenogranite to monzogranite containing ~70% feldspar, with some samples containing only perthitic orthoclase/plagioclase, and others containing primary orthoclase crystals (~50%) mantled by plagioclase (~20%) in typical Rapakivi texture. Moreover, Pikes Peak granite samples contain ~25-35% quartz, ~4-8% biotite and accessory fluorite, Fe/Ti-oxides, apatite, and zircon. Opaque phases and zircon crystallized first, followed by plagioclase, alkali feldspar, quartz, and finally biotite. The Pikes Peak batholith is generally a hypersolvus granite, with one (perthitic) primary feldspar indicating crystallization at relatively low H_2O fugacity and overall volatile content.

The Mount Rosa granite is a medium to fine-grained, allotriomorphic to aplitic granite containing ~40-60% albite, ~25-40% quartz, 0-10% orthoclase, ~5-10% Na-amphibole, <3% biotite, and minor amounts of Na-pyroxene, fluorite, opaques, zircon, REE minerals, and astrophyllite. Opaques and zircon crystallized earliest, followed by orthoclase and later quartz and albite, commonly forming micrographic and other granophyric textures. Poikilitic Na-amphibole (commonly rimmed by Na-pyroxene), fluorite, REE minerals, and astrophyllite crystallized last. Fluorite & REE minerals (fluorocarbonates & phosphates) are commonly associated and occur as late interstitial segregations between major mineral grains, along with possible hydrothermal zircon showing abundant inclusions (fig 3). The Mount Rosa granite is a subsolvus granite, with primary albite and orthoclase as well as abundant granophyric textures indicating crystallization at relatively high H_2O fugacity and volatile content.

Fine-grained to porphyritic mafic dikes and mafic enclaves cut Mount Rosa granite, Pikes Peak granite and fayalite granite and contain ~40% orthoclase, ~20% quartz, ~15% calcic plagioclase, ~12-30% biotite, <25% pyroxene, <5% amphibole and minor amounts of opaques, fluorite, apatite, zircon, REE minerals, and rare accessory phases of alkali association such as bafertisite. Opaques, apatite and zircon were the first minerals to crystallize, followed by pyroxene, biotite, amphibole, alkali feldspar, quartz, and finally interstitial fluorite and REE minerals.

Fayalite granite occurs as isolated ovoid bodies of coarse-grained greenish-gray syenogranite in the Pikes Peak granite and is composed of ~35% perthitic orthoclase, ~30% albite, ~30% quartz, ~3% biotite, and accessory Na-pyroxene, opaques, zircon, and fayalite. Opaques, zircon and fayalite crystallized first, followed by biotite, plagioclase, alkali feldspar, quartz, and finally Na-pyroxene.

Pegmatites

The Mount Rosa Complex is noteworthy for its large number of pegmatites, ranging from small unzoned miarolitic cavities 10-50 cm. across to large zoned Niobium-Yttrium-Fluorine (NYF)-type bodies over 40 meters long (Gross & Heinrich 1966). Cerny & Ercit (2005) classified the pegmatites of the Mount Rosa granite as belonging to the Peralkaline NYF-type and Na-amphibole subtype, similar to pegmatites on Hurricane Mountain, New Hampshire, or the Franklin Mountains of western Texas.

Pegmatites of the Mount Rosa Complex can be generally assigned into three different groups. The first are the miarolitic-type pegmatites, which are hosted in pink to white medium to coarse-grained biotite syenogranite of the Pikes Peak batholith and generally occur from ~4-10 km from the main body of Mount Rosa granite. These were described as 'Pikes Peak granite-type' pegmatites by Gross & Heinrich (1966) and are generally small (<2 meters), irregular, poorly-zoned bodies, and often containing miarolitic pockets with euhedral crystals. These are genetically-similar to other miarolitic pegmatites of the Pikes Peak granite, but differ in their rare mineral content, including euhedral crystals of rare species such as the Zn-Be silicate genthelvite, REE-F carbonates (e.g.; bastnäsite, fluocerite), and REE phosphates (e.g., xenotime-(Y) & monazite-(Ce); Hanson & Zito 2014). Many of these minerals replace or overgrow primary minerals such as feldspars, pyroxenes/amphiboles, and micas (Hanson & Zito 2014). In this regard, these miarolitic-type pegmatites show geochemical similarities to those of the Mount Rosa-type, and may have been affected by fluids associated with the Mount Rosa granite.

The second group of pegmatites are the 'simple-type' pegmatites hosted within or on the margins of the main body of Mount Rosa granite on the eastern and northern slopes of Mount Rosa proper. These pegmatites, classified as 'interior-type' by Gross & Heinrich (1966), are generally typically smaller is size, poorly-zoned, and less mineralogically-complex than the complex or 'exterior' type pegmatites, and are enriched in Zr, Th, Ti, with Nb>Ta, and Ce>Y (Gross 1962). Their mineralogy and chemistry is close to that of their host rocks, and their genetic connection to the Mount Rosa granite appears less ambiguous than the 'exterior' type bodies (Foord et al. 1984). A somewhat distinct sub-class of the 'interior type' pegmatites are the 'hydrothermal thorite veins' of Gross (1962) which occur near Rosemont on the eastern slopes of Mount Rosa proper. These pegmatites, up to 50 m. long and several meters wide, consist of highly-altered quartz, alkali feldspar and riebeckite as well as abundant zircon, thorite, thorogummite, uranothorite, and REE phases; generally fluorocarbonates (Gross & Heinrich 1966). Recent analyses also show the presence of minor aluminofluoride minerals including prosopite associated with and replacing interstitial fluorite in irregular blebs <500 um across in simple-type pegmatites from within the Mount Rosa granite. This confirms that these unusual phases are not unique to the evolved pegmatites of the complex and likely represent Na & F-rich autometasomatic fluids associated with the main body of Mount Rosa granite. Many of the simple-type pegmatites hosted within the Mount Rosa granite show irregular borders and preferential alignment of minerals suggesting they may represent residual melt during the late magmatic evolution of the MRG.

The third group of pegmatites in the Mount Rosa granite complex are the complex pegmatites, called 'exterior-type' by Gross & Heinrich (1966). These occur as generally tabular, sub-horizontal bodies ranging from ~.2 x 5 m to ~6 x 50 m in size, and cut fayalite granite, aplite dikes, and Pikes Peak granite. They often have intruded along the margins of fayalite granite bodies, and also show anastomosing and irregular contacts with parallel to sub-parallel mafic dikes and Mount Rosa granite dikes, suggestion contemporaneous emplacement in the larger exocontact of the MRG. Complex-type pegmatites generally occur 3-10 km from the main Mount Rosa granite body and are larger, more structurally-uniform, and more mineralogically-complex than either the simple or miarolitic-type pegmatites. Zonation is often strong and generally consists of an 'endocontact' of albitized host rock enriched in fine-grained zircon, fluorite & REE minerals, a wall zone with large prismatic riebeckite and Na-pyroxene crystals aligned perpendicular to the contact, and intermediate zone with large microcline-perthite and quartz crystals with interstitial albite, and a core zone with aluminofluoride minerals or dissolution holes formerly occupied by such phases, microcline, albite, REE minerals, zircon, and rare accessory phases. These pegmatites contain significant Be, Rb, Y, F, Zr, & Ce, with Ta>Nb, and sometimes contain 'exotic' minerals such as Al-Fluoride minerals (e.g.; cryolite, weberite, prosopite, pachnolite, thomsenolite; elpasoite) found only in a few other localities in the world such as Ivigtut, Greenland and the Pitinga Mine, Madeira Granite, Brazil (Gross & Heinrich 1966, Costi et al. 2009). Indeed; aluminofluoride minerals are endemic to a group of

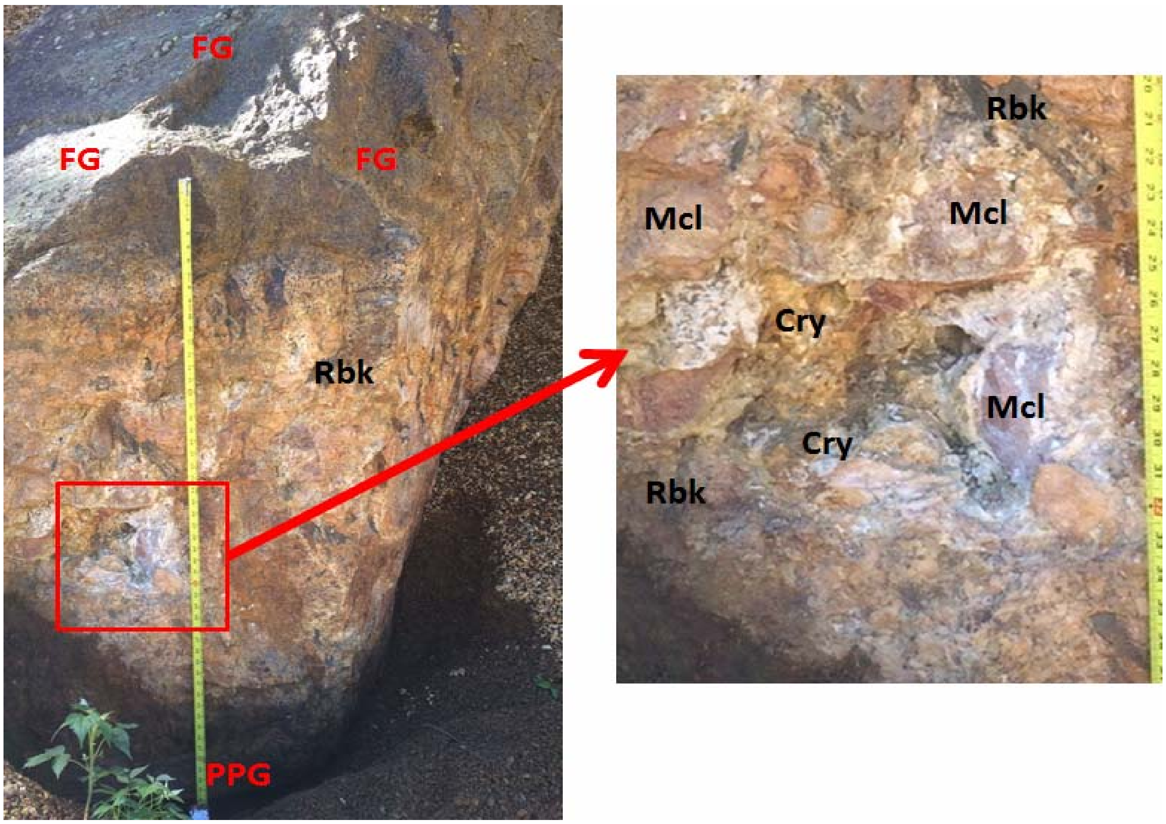

Figure 3. Typical complex-type pegmatite exposed along Gold Camp Road on St. Peter's Dome, showing contact with fayalite granite (FG) and Pikes Peak granite (PPG). Pegmatite contains large riebeckite crystals (Rbk) oriented perpendicular to contact, with core zone composed of large microcline crystals (Mcl), quartz, riebeckite, and interstitial cryolite (Cry) and other aluminofluoride phases which have largely dissolved away leaving boxy cavities.

complex-type pegmatites centered on St. Peter's Dome ~5 km southeast of the Mount Rosa granite, and help define their presence in this area (figure 3). Other unusual accessory minerals containing REE, HFSE, F, Na, and OH occur in the complex-type pegmatites, including murataite-(Y), Zn & Y-bearing senaite, pyrochlore (Pb-rich), cerianite-(Ce), and bastnäsite-(Ce) (Foord et al. 1984). Many of the complex-type pegmatites also show evidence for two generations of zircon, an earlier magmatic population and a later hydrothermal population (Ephraim 2013). Psuedomorphs are abundant in complex-type pegmatites and include Fe-oxides and clays after biotite, fluorite after riebeckite, various 'secondary' aluminofluoride minerals after fluorite and cryolite. Some of these pegmatites show also evidence for intense metasomatic alteration and their mineralogy may have been overprinted by late fluids associated with the intrusion of Mount Rosa granite (Foord et al. 1984, Gross & Heinrich 1966).

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Minerals from the St. Peters Dome pegmatite field

The following description of the minerals from the St. Peters Dome area has been extracted from Gross (1962, p. 112- 128) and modified as needed to represent our current knowledge of the minerals from this area.

Rare minerals were found in pegmatites of the Mount Rosa type as early as 1880. Bastnaesite, fluocerite, astrophyllite, and the uncommon fluorides were described by the early investigators Lacroix (1889), Allen and Comstock (1880), Cross and Hillebrand (1885), Eakins (1891a, b), and Glass and Adams (1953). More recently Gary Zito has prepared an exhaustive documentation of all the species from the St. Peters Dome area (Zito 2020) .

The first detailed study of the fluoride pegmatites, with an attempt to give paragenetic sequence and discussion of origin, was made by Landes (1935). The mineralogy of the interior pegmatites is relatively simple: quartz, microcline, albite, riebeckite, astrophyllite, zircon, and thorite.

The relative abundance of the pegmatite minerals in order of greatest to least is accordingly - quartz, microcline, riebeckite, albite, zircon, astrophyllite, thorite, ilmenorutile, pyrochlore, and fluorides. Columbite, microlite, bastnaesite, monazite, and the sulfides are very scarce. The minerals can be classified according to their position in the pegmatites.

Notes on Individual Minerals

Quartz: Clear or milky crystals, rarely smoky, is the most abundant constituent of the pegmatites and may show radial fracturing around thorite or brown zircon (cyrtolite).

Microcline: Salmon pink, in anhedral to subhedral grains, is associated with quartz and fluorides. Multiple oxides occur in the microcline. Oligoclase (Ab 84) forms veins in much of the microcline resulting in a perthite texture.

<u>Albite:</u> Albite was primarily observed in thin section in Carlsbad-albite twinned crystals, commonly included in quartz and zircons. Albite is very common in the border zone of pegmatite 77-4. The mineral replaces quartz and zircon. Albite has been interpreted as a secondary replacement.

<u>Aegirine:</u> It is only present in aggregates of bright green prismatic crystals which fill cavities less than 5 cm in diameter in the border zone of pegmatite 77-4. The[9] optical indices are Alpha =: 1.770, Beta = 1.81, and Gamma = 1.825, with a 2Vz = 115°. Pleochroism faint yellow green. The aegirine is interpreted as being composed of 94% of the acmite molecule in the diopside-acmite series (Winchell and Winchell 1951, p. 414, fig. 304).

<u>Riebeckite:</u> All of the Mount Rosa type pegmatites contain the sodic-iron amphibole, riebeckite. The blue-black crystals range in size from less than 0.5 cm across and 2.5 cm in length to large tapering crystals 10 to 15 cm in diameter and 50 to 75 cm long. In most of the pegmatites the riebeckite crystals are randomly oriented. In a few exposures they are aligned nearly perpendicular to the surface and tapering upward. The amphibole is associated with quartz and microcline. The X-ray diffraction powder patterns for the riebeckites of the Mount Rosa granite and pegmatites are similar. However, Hart (pers.comm., 1961) found that riebeckites from pegmatites (21-8) and (1-13) had perhaps 10 percent more glaucophane molecule than the sample (15-6) which came from the Mount Rosa granite. According to Coleman (1951) the chemical composition and X-ray examination prove that the mineral is a true riebeckite, although some mineralogists have referred to it as arfvedsonite.

<u>Astrophyllite:</u> It is present in many of the pegmatites and is commonly found in the border zone along the footwall contact of some pegmatites, especially where the country rock is fayalite granite. In a few dikes such as in pegmatite 61-4, the micaceous books of astrophyllite of golden-brown color exceed 5 cm in thickness by 10 cm in width and 25 cm in length, Astrophyllite is associated with quartz, feldspar, thorite, and galena in some pegmatites. The mineral formed probably during the late stage during magma crystallization and in pegmatites belongs to an intermediate stage of formation, perhaps during an early hydrothermal replacement stage. In fine-grained border zones the astrophyllite replaces riebeckite. It is followed by late- forming sulfides such as galena, sphalerite, and fluorite. No apparent differences appear in optical properties of astrophyllite occurring in fractures of Mount Rosa granite and in the pegmatites. Chemical analysis of astrophyllite shows a decrease in MgO from that contained in riebeckite which may account in part for the source of Mg for the fluorides weberite and ralstonite.

<u>Zircon:</u> The mineral occurs abundantly in pegmatites in crystals and in anhedral, granular aggregates. Crystals are bipyramids, usually with a narrow prism form, rare with no prism at all. They are red brown to light brown, rarely green. Clear crystals are wine-red or green in color and only weakly radioactive. The larger red- brown crystals are zoned, highly radioactive, and show weak fluorescence under ultraviolet light. Under the microscope they show small patches of orange-brown alteration but are never completely metamict. Zircons range in size from a few millimeters to 2 cm in cross-section. All of the larger crystals are translucent and zoned. Uncommonly green and red-brown zircons occur in the same specimen but only brown ones are strongly radioactive. The crystals are

found in quartz and feldspar and are associated with thorite and pyrochlore. A radial fracturing of quartz borders the larger crystals. Small clear crystals occur at the Eureka tunnel locality (1-15) and the green variety in the 30-6 pegmatite. Zircons are also abundant in pegmatites 11-4, 25-128 and 39-11.

Rutile: Occurs in small greenish-black crystals in a few pegmatites. The grains are several millimeters in diameter and are found in groups associated with quartz and zircon. Due to their greenish-black color, they are easily confused with pyrochlore. The mineral has been observed at deposits 11-4 and 11-3.

Niobium-bearing rutile, formerly ilmenorutile: This oxide mineral is found in many of the mineralogically complex pegmatites and in a few border zone phases. The mineral is in dark greenish-gray blades measuring as much as 7 mm wide by 8 cm long. It penetrates quartz and microcline in a criss-cross of blades, producing triangular interstitial areas which contain columbite, fluorite, sphalerite, chlorite, and quartz. In thin section (0.02 mm thick) the ilmenorutile appears to consist primarily of grains of quartz with included granules in parallel alignment of a grayish ilmenorutile. Thus an X-ray pattern of the aggregate shows strong quartz and fluorite lines among weaker lines of the mineral.

The mineral is rich in amounts of Nb, Sn, Ti, Si, and Fe. Much of the Ca and Si are due to contamination by quartz and fluorite. Thin seams of fluorite, chlorite, and galena are commonly included in the mineral. In pegmatite (65-6) the ilmenorutile is best developed in a zone 3 to 4 feet thick above a 6-inch zone of zircon-quartz rock. Other pegmatites containing notable amounts of ilmenorutile are 25-12 and 62-12.

Thorite: It occurs in red brown, tabular to irregular mass1ve crystals associated with quartz and zircon. The crystals range 1n length from a few millimeters to 30 mm and are less than 20 mm thick. It is highly radioactive and metamict. It has been the radioactivity from the thorite that has prompted most of the prospecting for uranium in the area.

Nearly all of the more mineralogically complex pegmatites contain some thorite.

Columbite: It has been observed in pegmatites 65-6 and 7-10. The black, subhedral crystals are in small grains associated with microcline and quartz, or in interstitial areas in the specimens containing ilmenorutile.

Fergusonite and euxenite (?): These minerals have been listed as occurring in the area but have not been observed by the writer. They probably belong to Pikes Peak type pegmatites if they actually occur.

Pyrochlore: This mineral occurs in small greenish-black euhedral to subhedral crystals less than 4 mm in cross section . The X-ray diffraction powder pattern gives d-spacing values close to that of pyrochlore, but Weissenberg single crystal X-ray values suggested betafite (Boyer 1961, personal communication to Gross). In thin section the mineral is isotropic, but it is not metamict. The mineral is closely associated with zircon and quartz in pegmatite 11-4. It occurs as waxy yellow grains of 5 mm cross section in pegmatite 77-4.

Microlite: Microlite is an isotropic yellow-orange mineral observed in the border zone of 60-3. The mineral is associated with zircon and quartz and as a yellow granular material around thorite.

Monazite: This mineral was only observed as a crushed fragment in an immersion mount and was identified by X-ray powder methods. The mineral is relatively rare, occurring in small red-brown grains associated with quartz and feldspar.

Bastnaesite: Is a rare mineral which is associated with monazite in light-brown to orange colored grains. An unusual occurrence of bastnaesite is at pegmatite 67-5 where it is present as scattered small grains included in fluorite that is in a graphic intergrowth with quartz.

Metallic Sulfides: Galena, sphalerite, pyrite, and molybdenite are found in a few pegmatites. Pyrite and molybdenite are very rare, occurring with microcline in Mount Rosa type pegmatites that intrude Pikes Peak granite. Sphalerite is associated with ilmenorutile. The most abundant sulfide, galena, occurs in large masses, up to 15 centimeters in diameter. It has an alteration layer of anglesite. The galena is closely associated with astrophyllite, quartz, and thorite. Galena belongs to the late stage hydrothermal replacement unit. Pegmatites containing considerable galena are 60-4 and 61-4. Galena has been rarely found with cryolite in the Cryolite mine.

Fluorides: These minerals are found in the exterior zone pegmatites 30-4, 1-15 (Eureka tunnel), and 65-2 (Cryolite mine, water flooded adit). They include cryolite and its alteration products pachnolite, prosopite, ralstonite, thomsenolite, elpasolite, and weberite..

Cryolite. Cryolite occurs in massive light gray specimens which show a light pink tint when fresh. Cleavage in three directions, nearly at right angles, produces a blocky appearance on weathered surfaces. The cryolite is associated with quartz and microcline. It alters to massive, blue-gray pachnolite, or red-brown stained prospite. Ralstonite, thomsenolite, and elpasolite are very rare. They occur in minute crystals and require X-ray diffraction patterns for positive identification. The first identification of weberite from El Paso County, Colorado, was made by Pauly (1954). The mineral is common in the Eureka tunnel associated with quartz and microcline. Because of its brick-red color, it has been confused with iron-stained feldspar. All of the fluorides, which have been described in detail by early investigators, were· identified by the Gross (1962) except for thomsenolite and elpasolite. The fluorides alter to gearksutite, which is a white powder occurring in cavities rimmed by microcline.

Fluorite: It is a very abundant mineral occurring in most of the pegmatites. Veinlets and aggregates of purple to green fluorite are associated with quartz and microcline. The surface of fluorite bleaches light gray in sunlight.

Bertrandite: The mineral has been identified by the oil immersion method from red-brown samples obtained from pegmatites 1-15 and ll-3a. The crystals are associated with quartz, microcline, and fluorite.

Although visual indications suggest that bertrandite is rare, berylometer surveys by prospectors in the St. Peters Dome district have detected several small anomalies indicating weak concentrations of beryllium. At the Eureka tunnel and along the prospect roads near pegmatites 60-1 and 61-4, a berylometer registered above background counts.

The source of beryllium is probably in the mineral bertrandite, which suggests it is more widespread than originally considered in the area.

Doverite: Doverite is a very rare mineral which has been tentatively identified by X-ray and index of refraction from pegmatite 7-10. It is associated with quartz, microcline, and zircon.

Chlorite, hematite, and sericite: Chlorite and hematite are formed from breakdown of riebeckite and astrophyllite. Sericite is formed by replacement of feldspar which has been attacked by hydrothermal solutions. The sericite and hematite fill fractures in pegmatites ln a late low temperature stage of hydrothermal replacement.

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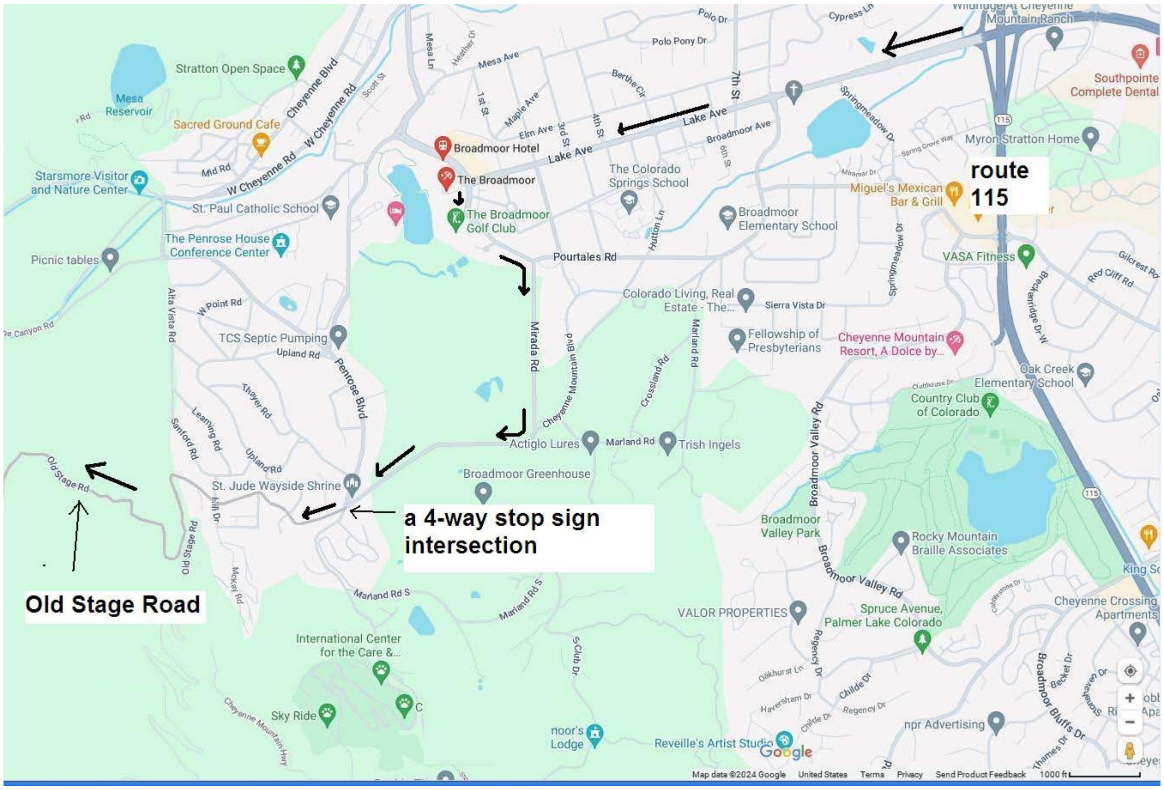
St. Peters Dome field trip guide and instructions

Physical Fitness warning

People who are considering participating in this field trip need to be physically fit enough to walk between 5 and 7 miles round trip to visit these two localities. If you have an accident or a medical event, help will not be arriving for some time; other participants will either have also walked in or are on one person vehicles, that is bicycles or ebikes. FMCC nor the field trip leader are responsible for your care, even if we assist as much as possible. All participants will need third party insurance which if they are paid up members of any Rocky Mountain Federation mineral society or Friends of Mineralogy – Colorado Chapter, they are covered. If you are not member, you can not participate in this field trip. Field Trip releases will also need to be signed and provided to the field trip leader. Pets on leashes are welcome. Off leash pets are not welcome.

Field trip access plans

Directions: From Denver, take I-25 south to the State route 115, going south from I-25 after passing the downtown turnoff for central Colorado Springs. Once on the service road heading east, take a right turn at the SECOND light, onto Route 115 going south. Take the Lake Avenue exit, a right turn, going to the Broadmoor Hotel. At the **Broadmoor Hotel traffic circle**, go left and follow along the south side of the golf course traveling west to a four way stop intersection. At the intersection, continue straight which turns into the Old Stage Road. After a short stretch of paved road, it becomes a graded dirt road (safe for 2 wheel drive vehicles). The distance from the Broadmoor Hotel traffic circle to the trailhead parking areas is 8.5 miles and takes an estimated 30-35 minutes. Stay on this dirt road until the parking area turnoff to the right and park near the railroad grade trail gate. The distance from Route 115 turnoff onto Lake Avenue to the parking area is a total of 10 miles and takes approximately 33-40 minutes.

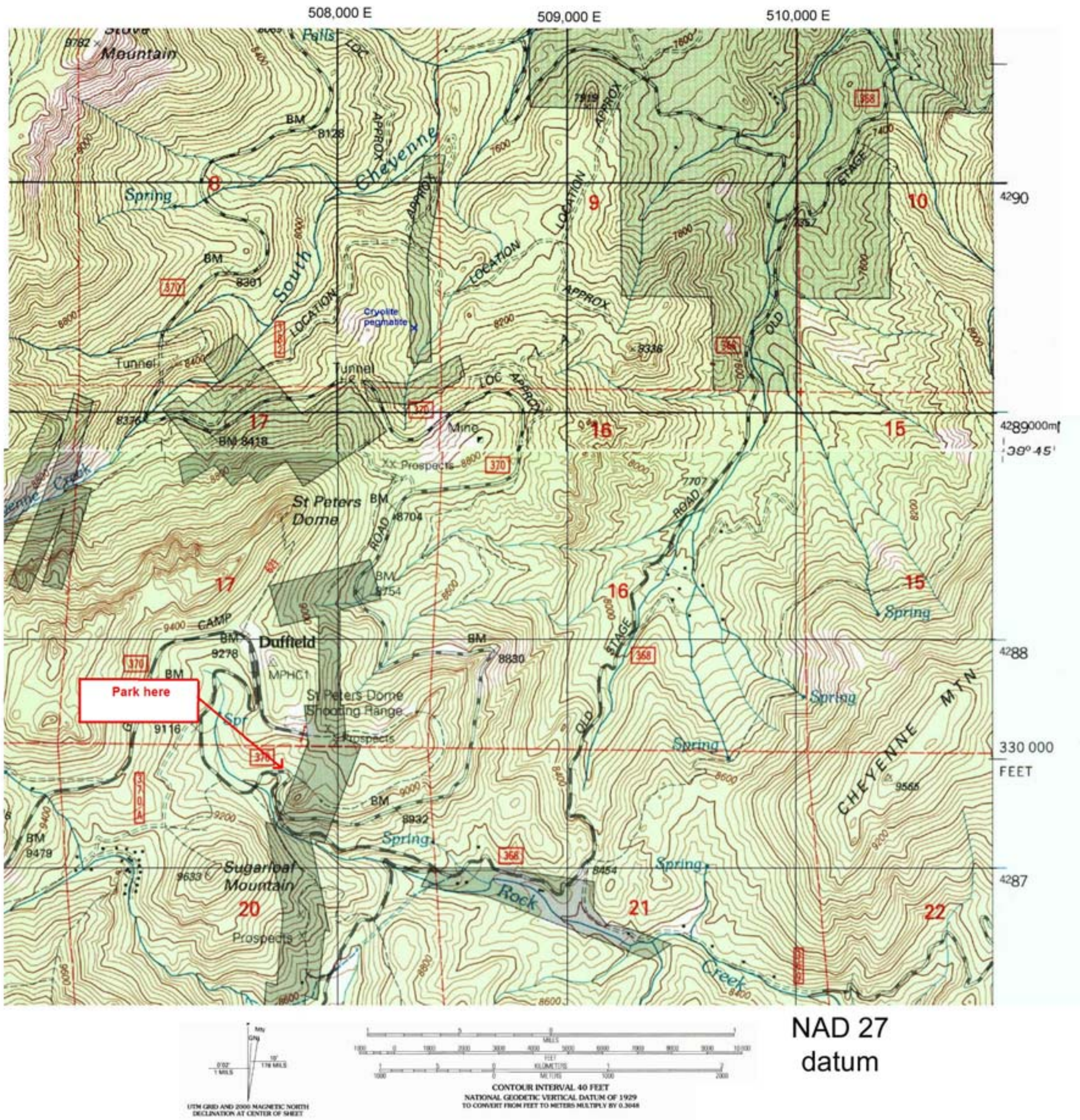


Field trip participant will drive on their own to the Railroad grade trail trailhead, which is accessed by the “Old Stage Road” that starts just west of the Broadmoor Hotel. A map with instructions will be provided. Meeting at the trailhead will be at 9 AM. If you are not there at 9 AM, do not be surprised if we have already started our trip to the locality.

Parking will be at the trail head for the abandoned railroad grade. Once this small parking lot is filled parking can be done along the road where sufficient space is available.

The railroad grade road allows use by hiking, bicycles, ebikes, ATVs, and motorcycles. Only 4 wheel drive motorized vehicles are prohibited. The hike on foot along almost flat terrain on the road is about 2 miles with a quarter mile walk from the road to the pegmatite pit. From the trailhead by walking, this is estimated to take about 1-½ hours. If all participants have a bicycle or an ebike, that will be the preferred transportation method, otherwise I will guide the people who are walking on foot.

The distance from the astrophyllite to cryolite pegmatite is about another mile. Thus all participants should expect about 7 miles of hiking for the day. If this is a challenge for you then you should not go on this trip. If you have an ebike or bicycle then the trip is trivial.



Railroad Grade trailhead parking lot location

The parking lot at the start of the Railroad Grade trail is located at NAD83, UTM13, 507,696 E and 4,287,649 N at 9078 feet elevation from a handheld GPS receiver.

The astrophyllite pegmatite 61-4

Right side (east) turnoff location from Gold Camp road to the pegmatite is at NAD83, UTM 13, 508,770 E and 4,289,113 N measured from a handheld GPS. This pegmatite has a four wheel drive road that accesses the pegmatite, thus walking or riding on a bicycle, ebike or motorcycle is possible and legally allowed.

Pegmatite location: NAD27, UTM 13, 508,874 E and 4,289,428 N or NAD83, UTM 13, 508,830 E and 4,289,635 N at 8176 feet elevation. Both were measured from a handheld GPS

The cryolite pegmatite 65-2

An abandoned road is located on the east side of the road just after exiting the north side of the railroad tunnel. This road, now only legally accessible by foot or bicycle, leads to the Eureka tunnel. Walk eastward on this road. Where the road leaves the ridge crest, continue east on the bare gravel until trees block the way. This will be located just above the Cryolite mine at NAD83, UTM13, 508,153 E and 4,289,619 N at 8,449 feet elevation from a handheld GOPS receiver. If you use a bicycle or ebike to access this mine, please lock your bike to a tree with both the frame and both wheels securely locked.

Pegmatite location at the top of the dump about 25 feet away from the adit: NAD27, UTM 13, 508,354 E and 4,289,375 N or NAD83, UTM 13, 508,310 E and 4,289,590 N, at 8271 feet elevation from a handheld GPS. Both were measured from a handheld GPS.

The Pegmatite map of Gross (1962)

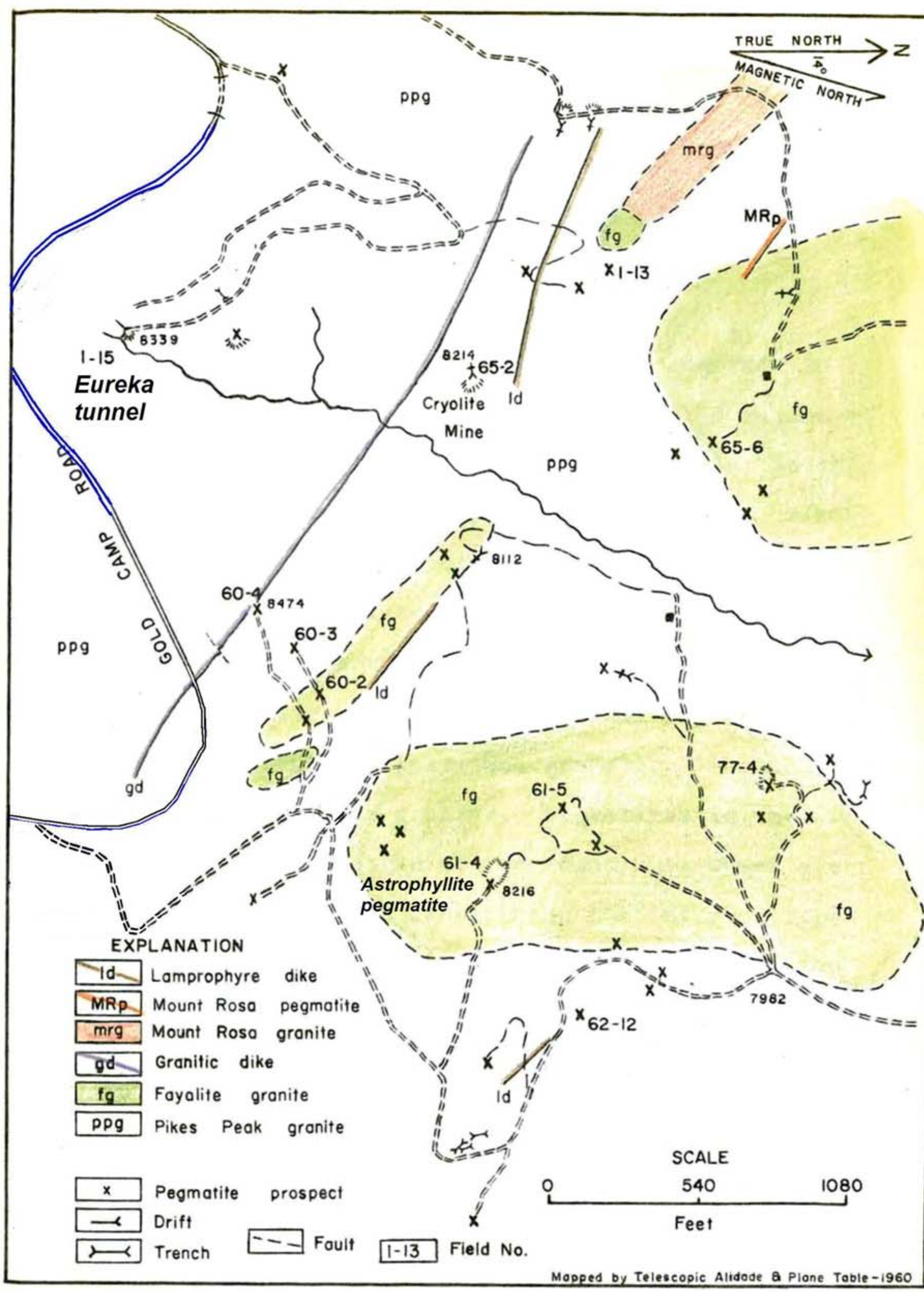


Fig.33. Pegmatite deposits of the St. Peters Dome area.