Champion Sillimanite Mine, White Mountain
Mono County, California

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DESCRIPTION OF AREA:

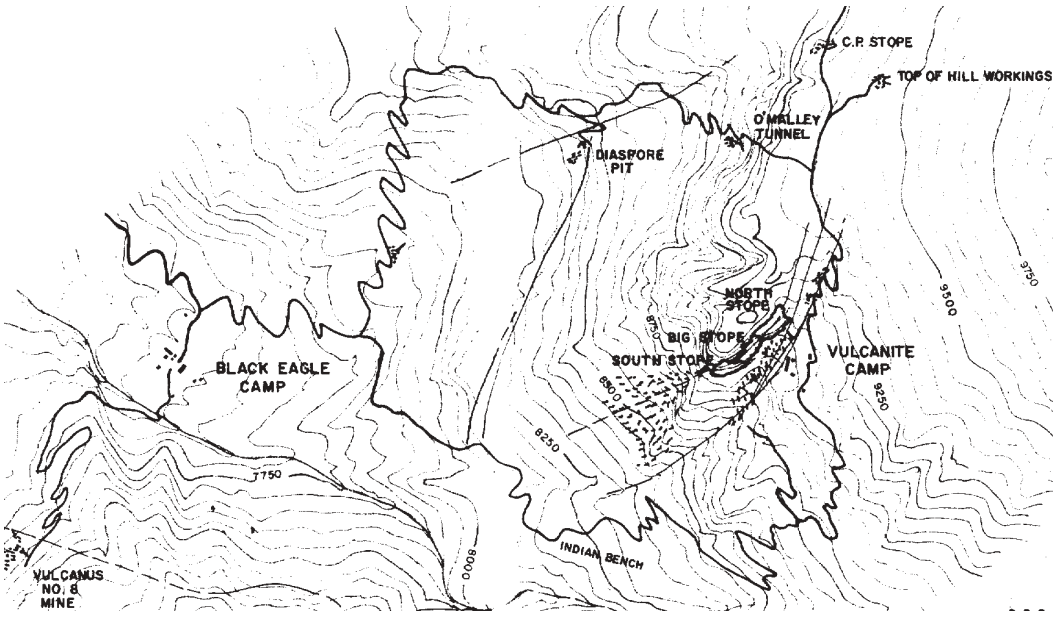
The Champion Sillimanite Mine is located on the west flank of White Mountain about 20 miles north of Bishop on the western face of White Mountain in Jeffrey Mine Canyon. The mine is about 3 miles east of White Mountain Ranch and lies at an altitude of about 8,000 feet. It is in section 13, T. 3S., R. 33E., M.D.M. and is at latitude 37° 56' 20" North and longitude 118° 12' 00" East on page 113 of Delorme's Northern California Atlas and Gazetteer. The access road to the old mule corrals and the location of the main workings are shown on the map but none of the trails or secondary roads are.

The Champion Mine is only accessible by foot over the old mule trails due to the steep and rugged nature of the terrain. The only "maintained" road is the one that leads from White Mountain Ranch to the site of the old mule corrals and this is usually in poor shape. Occasionally the section of the road that leads into the area of the old Moreau Claims is graded and passable but this is infrequent and this section of road usually has several washouts and is impassible to all but foot traffic. In the upper sections of Jeffrey Mine Canyon no roads were built and all the supplies needed to sustain the mining operation were carried in by mule and these trails are the only way in. Considering that these trails have been not been maintained since 1942 when the mine was shut down they are in remarkably good shape. In the area of Jeffrey Mine Creek they are often washed out and periodically they have sections removed by slides but considerable care was taken to build them and they are remarkably durable.

The large quartz outcrops that make up a considerable portion of the face of White Mountain were the subject of much prospecting in the early days but the extensive andalusite deposits were not recognized until 1914 but no commercial use was then present. When World War 1 started andalusite became an important article used in the manufacture of spark plug insulators and the area was explored by the Champion Spark Plug Company. The size and purity of the andalusite deposits were such that the company constructed trails, a camp and other facilities and commenced mining.

Because of the demand for food and fodder The White Mountain Ranch was started and most of the provisions and livestock needed for the operation were produced here. The bulk of the production from the mine was from the period during World War 1 but the difficult terrain and lack of easy transportation hindered operations. After this

Figure 1 Topographic map of Champion Sillimanite Mine area showing various workings



initial period the mine produced a small tonnage of high-grade andalusite for many years. Improvements to the camp were made and electricity was brought in during this period. In later years developments in the production of insulating ceramics from other sources, the decling ore reserves and the difficulty in supplying the mine finally forced its closure in 1942.

The Champion Sillimanite Mine is a collection of workings spread over a large area. Each of these workings was named the Vulcanus and each separate working had a number. The main working was the Vulcanus Number 1 while the most southerly working was the Vulcanus Number 8. None of the workings are extensive as most of the “ore” occurred as high-grade segregations in massive quartz and large rooms and stopes were used to mine most of the ore and tunnels used haulage of ore or exploration only. The ore was hand sorted to produce a shipping grade ore of high purity.

In later years the major effort was concentrated on the aluminiferous schist’s which are abundant in the area but the grade of the ore was not high enough and no practical way to treat it was found.

The Champion Sillimanite Mine was quite modern for its time and was completely electrified and a generating plant was constructed on Pine Creek to supply power for the mines operation. During the life of the mine two complete camps were constructed. The upper camp serviced the early workings and consisted of a bunkhouse, laboratory and a blacksmiths shop. At a later date the lower camp was constructed. This camp served as a hub for the distribution of supplies and for accommodations for the miners working on the more southerly prospects. Again the camp was complete with cookhouse, generator facilities, laboratory, bunkhouses and cabins for the miners and staff. During the latter years of the mines life C.D. Woodhouse and D.M. Lemmon were employed as mine manager and chemist and they studied many of the unusual phosphate minerals that the mine is noted for. The augelite from this locality was the first known United States occurrence and the unusual sulfate phosphate, woodhouseite, was first described from this locality.

GEOLOGY AND MINERALOGY

The Champion Sillimanite Mine explores an andalusite rich quartz body that is enclosed in an aluminiferous schistose rock. The quartz body was formed by pneumatolic action on these aluminiferous rocks that occurred as the result of the emplacement of the nearby Birch Creek Pluton. This activity produced an andalusite rich quartz mass that is about two miles long and varies from 20 to 70 feet thick. It has a strike of 20 degrees northwest and a dip of 75-80 degrees to the southwest. The andalusite masses produced by the metamorphic action were essentially pure with only minor accessory minerals. The thicker sections of the quartz produced the largest andalusite masses and most of the mined ore came from the thickest portion of the body. The walls enclosing the quartz mass were altered to a schist-like material that is composed mainly of andalusite, diaspore and corundum.

As the andalusite bodies were being produced secondary hydrothermal phosphate phases occurred and a series of phosphate minerals were produced. This activity started before the formation of the quartz was complete and phosphate minerals were found embedded in the quartz as well as in cavities and fractures in the quartz. These solutions were rich in iron, calcium, strontium and barium and produced the phosphate minerals that the area is noted for.

There are three different mineral environments found in the area. Each has its own differing mineral content and time of formation. The most important of these environments was the andalusite masses. These are essentially composed of pure masses of andalusite associated with minor quartz.

The quartz mass surrounding the andalusite bodies is the most interesting mineralogically and contains the largest proportion of secondary sulfate-phosphate minerals. Woodhouseite is the most common of these minerals though svanbergite also occurs in this environment.

MINERALS IN COLLECTION

Andalusite was the principal ore mineral and excellent specimens may be found here. Most of the andalusite mined consisted of a loose mass of intergrown prismatic crystals that may reach several inches in length. While

the prism faces are prominent terminated crystals are less common. The prisms are commonly a blue gray in color but occasional specimens of a light green have been found. The andalusite commonly has a white coating of some claylike mineral but this is just a surface alteration and no completely pseudomorphed specimens have been found.

The andalusite bodies frequently contain small crystals of lazulite in cavities and often small groups of pyrite crystals may be found associated with the lazulite.

Andalusite crystal section with muscovite

The best specimens of andalusite came from the early workings and the best specimens come from the large dump below the main Champion Sillimanite Mine, the Vulcanus # 1 Workings. Large bladed crystals associated with pyrophyllite have also been found in the C.P. Stope, a small working above the main mine.

Augelite was relatively common during the early days of mining and small cavities within massive quartz were frequently lined with augelite crystals and loose crystals were common. The crystals were flat colorless tablets and crystals up to an inch were found in the late 1930's before the mine shut down. Material of this type is almost impossible to find however augelite has been found as isolated hexagonal plates in quartz pockets and is also a prominent constituent of an unusual Phosphate-pegmatite vein that is exposed near the quartz-schist contact above the main camp. At this locality augelite occurs in a rock composed principally of massive white to colorless augelite and blue trolleite. Pockets in the rock contain small glassy augelite crystals, blue trolleite crystals, and pale blue to yellow hexagonal prisms of hydroxylapatite and tan disapore cleavages.

Augelite has also been found at the Vulcanus # 8 Claim in a thin quartz seam cutting massive quartz-andalusite rock. At this locality the augelite occurred as small light yellow hexagonal plated associated with orange svanberegite.

Barite is widespread throughout the main workings of the Champion Sillimanite Mine where it is found as small crystals and as pink to tan massive seams. This seam material is usually associated with blue to greenish blue trolleite. Barite crystals are not common though they have been found in a number of different environments. Small tabular crystals have been found in pockets in limonite masses and crystals have been found associated with woodhouseite. During the active period when the mine was working barite crystals up to six inches long were found.

Carbonate-fluorapatite is another of the unusual phosphate minerals occurring in the unusual Phosphate-pegmatite vein that is exposed near the quartz-schist contact above the main camp. Pockets in this rock frequently contain colorless augelite crystals, light blue trolleite crystals and hexagonal prismatic light green crystals of carbonate-fluorapatite.

Corundum is widespread at White Mountain but rarely occurs in quantity at any one locality. Probably the best specimens are obtained from the Champion Mine where dark blue plates of corundum are found embedded in pyrophyllite. Corundum is also found as small black plates embedded in the schist that encloses the quartz body.

Crandallite is one of the rarer phosphate minerals that occurs in pockets in the phosphate-pegmatite. It occurs as a white radiating sprays of small acicular crystals and was one of the last minerals to form. It forms on carbonate-fluorapatite and is often associated with viseite. Only a few specimens are known.

Diaspore is common in the workings at White Mountain and often occurs as large relatively pure bodies. It is most common at the Diaspore Workings where large rutile crystals are found. There it forms the bulk of the rock and is associated with pyrophyllite and generally contains rutile in small grains and crystals. Both the diaspore and the pyrophyllite are heavily iron stained but large cleavage masses are common. Diaspore also occurs in the phosphate pegmatite as tan cleavages and crystals that are usually associated with augelite and trolleite. Occasionally small crystals are found in the cavities at this locality.

Diaspore is also one of the rock forming minerals in the aluminiferous schists that enclose the quartz mass and make up most of White Mountain.

Fluorapophyllite has not been previously reported from White Mountain. It was first noticed as rough cleavable masses associated with unusual orange quartz crystals. The color and rough nature of the masses closely

resembled the quartz in the area but occasional fractured specimens displayed a perfect cleavage. A subsequent more careful examination of the material revealed significant physical differences between it and quartz. A subsequent x-ray analysis of the material proved it to be fluorapophyllite. It has only been found in the Vulcanus # 8 Tunnel in a vuggy quartz seam. Most material was found on the tunnel floor. Very little of this material was ever found and most was probably discarded due to its similar appearance with the quartz in the vein. Unusual locality and not reported in any of the literature on the locality.

Goethite psudomorph after pyrite.

Fluorellestadtite is another of the unusual minerals found in the phosphate-pegmatite. It occurs as a replacement of carbonate-fluorapatite and is one of the rarer minerals found in the pockets of the mixture of white augelite, blue trolleite and tan diaspore. Cavities in the rock contain yellowish hexagonal prisms of fluorelledtadtite associated with pale blue fluorapatite, augelite crystals and trolleite crystals.

Goethite is relatively common in the area occurring as a replacement of pyrite. Generally the goethite occurs as a coloring agent but occasional pseudomorphs after pyrite are found. Goethite pseudomorphs are most abundant in the pyrophyllite and massive muscovite selvages in the quartz bodies.

Goyazite is probably the least common of the phosphate minerals found at White Mountain. A cavity in the phosphate-pegmatite contained a small rhombohedral light green crystal of goyazite that was associated with trolleite, augelite viseite and carbonate-fluorapatite. Only two specimens are known.

Halotrichite is not common at White Mountain because of the lack of suitable conditions. The Blackhawk Tunnel explores a pyrite rich body that is porous enough to allow seepage and protected enough to allow soluble sulfates to form. At this locality crusts of halotrichite colored red by iron oxides can be up to an inch thick and stalactitic masses can also be found. The halotrichite dehydrates to a yellowish fibrous material and this forms the outer crust of most halotrichite specimens.

Hematite is not common, but has been found in the talus along the trail leading up to the base camp.

Hematite Spray.

Jarosite occurs as a late stage mineral at the Diaspore Workings and is found as botryoidal crusts in fractures in the massive diaspore and andalusite. It is not common but when jarosite has formed large areas can be covered by thin crusts of this mineral.

Lazulite and scorzalite are locally abundant in the quartz seams that are associated with the andalusite bodies. They both occur as dark blue anhedral masses and occasional crystals can be found, both as crystal lined pockets in massive material and as octahedral tetragonal crystals embedded in quartz. In general the material found in the northern portion of the mine has a higher magnesium content and is considered to be lazulite while material from the southern portion of andalusite bearing quartz is generally higher in iron and is usually ascribed

to the iron rich end member scorzalite. Lazulite was fairly common in the andalusite bodies that were mined during the early says as small ill-formed crystals and andalusite specimens found frequently have small lazulite crystals growing in open spaces in the crystal mass. Lazulite is also a fairly common constituent of the phosphate-pegmatite where it occurs as dark blue crystals embedded in the augelite-trolleite groundmass. Both lazulite and scorzalite occur at White Mountain and are almost impossible to tell apart without a chemical analysis.

Muscovite is ubiquitous in the workings of the Champion Sillimanite Mine and can be found in almost all the workings. The muscovite varies in color from colorless to pale green and is often associated with pyrophyllite and andalusite. Most muscovite found will occur as white granular masses but occasional seams will show individual flakes an inch or more across. Crystals are rare but occasionally pieces of wall rock will be covered with thin hexagonal plates of pale green muscovite. The vein sections that are associated with pyrophyllite make the most attractive specimens with the large green flakes of muscovite making an attractive color contrast with the white radiating pyrophyllite

Natroalunite is locally abundant and is often associated with barite that it often closely resembles. It is always associated with trolleite and this combination makes colorful specimens. Natroalunite is not found in the southern portion of the mine and is confined to the main workings and to the phosphate-pegmatite. Crystals are not common but occasional pockets containing chisel shaped crystals have been found.

At the phosphate-pegmatite, natroalunite is relatively abundant and is often found in pockets with augelite, blue trolleite, pale green hexagonal hydroxylapatite and orange crystals of natrojalunite. This material contains appreciable strontium and most of the orange material is strontium dominant and may be a new species, the strontium analogue of natroalunite.

Orthoclase in andalusite schist.

Orthoclase is occasionally found as small gray to white crystals embedded in andalusite schist. Material of this type is not common and only rarely found. Specimens have been found in the area of the Vulcanus # 8 Working but has not been noted elsewhere.

Phosphosiderite has been found as small red limonite-like masses embedded in quartz. This material came from the main working but was found as float material below the main quartz outcrop. These specimens represent the first California occurrence of this mineral and was first identified by Gail Dunning who wrote an article for the Mineralogical Record.

Pyrite is a common associate of the andalusite bodies and crystals and irregular masses are found throughout the andalusite mass and in the associated quartz bodies. Crystals are most commonly cubes although the larger crystals encountered typically show a pyritohedral form. Most of the pyrite crystals encountered are highly fractured and often fall to minute fragments when removed from the surrounding matrix.

Pyrophyllite is abundant in the rocks that make up White Mountain. It is a common constituent of the schist's that enclose the quartz body and it also forms seams in the andalusite bearing rock. In areas where the pyrophyllite occurs as seams it forms white radiating masses of crystals that are often associated with muscovite or diaspore. It is also relatively abundant in the Diaspore Workings where it forms thin seams of iron stained radiating crystals that often contain rutile crystals. It is also common in the Blackhawk Tunnel where it forms seams in andalusite bearing rock and often contains small brilliant rutile crystals.

Quartz is ubiquitous throughout the Champion Mine and occurs as massive bull quartz that often contains crystal lined cavities and as seams and pods in the andalusite bearing schist that encloses the main quartz body. Crystals occur in a variety of forms from typical bipyramidal prisms to crystals flattened on one pair of prism faces that have a tabular outline. Many of the crystals have a corroded surface and rounded forms. At the Vulcanus # 8 Tunnel small orange crystals were found on the surface of older white quartz specimens. Occasionally these specimens show a well-developed scepter termination. Also in this area seams and pockets in the aluminiferous schist contain quartz crystals that show a distorted form being bent into curving forms.

Bent Quartz dusted with rutile

Rutile in pyrophyllite

Rutile The Champion Sillimanite Mine is famous for the fine rutile crystals that have been collected here. Several localities have produced nice rutile specimens, most notably the Diaspore Workings and Blackhawk Tunnel. At the Diaspore Workings rutile crystals up to 2 inches across can be found embedded in diaspore and the nearby Blackhawk Tunnel slightly smaller crystals are found embedded in pyrophyllite veins. The crystals are well formed with sharp brilliant faces and often show a red internal reflection. Simple twins are encountered sometimes but generally the crystals are not intergrown.

Schorl is not common in the quartz at White Mountain. At the Vulcanus # 8 Tunnel occasional groups of quartz crystals are found with the spaces between crystal prisms containing acicular hair-like schorl crystals. This material is not common but some pockets contain a considerable amount of material.

Rutile in dopside

Scorzalite is the iron end member of the scorzalite-lazulite series. While phosphates belonging to this group are fairly common at White Mountain most contain varying amounts of iron and magnesium and pure end member specimens are impossible to find at this locality. In general the more iron rich end members are dominant in the southern portion of the mine workings while the magnesium content is greatest in the northern portion.

Scorzalite has been found as tetragonal bipyramidal octahedral crystals and anhedral masses embedded in massive quartz. The dark blue of the scorzalite with the white quartz makes for colorful specimens and masses several inches across may be found. Probably the most abundant source of specimens of this mineral is the Vulcanus # 8 Tunnel.

Strengite has been found in quartz seams in the main andalusite body as pockets of light pink massive strengite. The strengite is often associated with flakes of muscovite.

Sulfur was relatively common during the time the mine was working and often masses of it embedded in the andalusite body were set afire during blasting. Today specimens are not common but small yellow crystals are often found in cavities in the metamorphic rock that is composed of andalusite and corundum.

Svanbergite has been found in small amounts in the Vulcanus #8 Tunnel dumps and in quartz seams in the area. The original material was collected in August of 1966 when specimens of quartz containing massive orange svanbergite were found. It was identified as svanbergite by Gail Dunning and verified by Dr. Royall Marshal of the California Division of Mines. These specimens represented the first reported California occurrence of this mineral. Svanbergite has also been found as small orange pseudocubic crystals in quartz seams associated with woodhouseite, augelite and schorl variety “achroite” at this locality.

Svanbergite has also been found in the quartz mass surrounding the high-grade andalusite bodies. Specimens showing an unusual curved crystal form were found near the head of the big slide were originally found and thought to be woodhouseite but chemical analysis shows strontium to be the dominant element. This material was cream colored and closely resembles the woodhouseite found nearby.

Topaz is a common constituent of the andalusite “ore” mined where it occurred as small colorless granular masses that resemble quartz. Specimens of this type of material are quite difficult to identify, as there is little to differentiate between quartz and topaz other than a slight difference in hardness. Rare specimens of the phosphate complex that are composed mainly of blue trolleite and white augelite. This material also contains white porcelainlike masses of

viseite, pale blue carbonate apatite and occasional pale pink or amber topaz crystals. These crystals are often composed of a steep pyramid on a prism.

Trolleite is one of the more abundant phosphates found at White Mountain in the northern portion of the andalusite body. It is found as pale green to pale blue massive material that is often associated with pink to light orange natroalunite. Trolleite also makes up a large proportion of the material forming the phosphate-pegmatite where it forms a massive rock composed of blue trolleite and colorless to white augelite. Pockets in this material are often lined with blue to pale green trolleite associated, augelite, alunite and other unusual phosphates.

Viseite is an ill-defined silicate-phosphate that is a constituent of the phosphate complex which is composed mainly of blue trolleite and white augelite. This material contains white porcelainlike masses of viseite associated with pale blue carbonate apatite and orange grains of strontium alunite. Viseite is relatively common in the phosphate bearing pockets though large masses are uncommon.

Woodhouseite and quartz

Woodhouseite was first described from the Champion Sillimanite Mine by Dwight Lemmon and named for C.D. Woodhouse who was the mine manager. Woodhouseite is relatively common throughout the area and is found in fractures and cavities in the quartz. Woodhouseite almost always occurs as pseudocubic crystals however occasionally unmodified trigonal crystals will be encountered. The crystals range in color from white and pale yellow to pale pink. The pink colored specimens often contain several percent of strontium and the higher the strontium content the darker the pink color will be.

Woodhouseite is most abundant in the Vulcanus # 1 Workings where it occurs as small pseudocubic crystals that range in color from pale tan to a pinkish tan. It almost always occurs as isolated single crystals though groups of crystals can almost cover the surface of a cavity or fissure in the quartz. Probably the best woodhouseite specimens are those, which occur on prismatic quartz crystals, and have small tan pseudocubic crystals of woodhouseite scattered on the crystal faces. Often woodhouseite will form selectively in a fissure and plates covered with º inch woodhouseite crystals are often found.

Woodhouseite xls (Sr-rich)

Woodhouseite also occurs at the Vulcanus # 8 Tunnel. It is not abundant at this locality but generally the woodhouseite crystals found here will be larger. Pale yellow single crystals to 1/4 inch have been found in cavities formed by intergrown quartz crystals. At this locality the cavities containing woodhouseite occasionally contain tourmaline and the fine hair-like variety of schorl “achroite” is found growing on both the enclosing quartz and the woodhouseite crystals.

COLLECTING AT THE LOCALITY

While the Champion Mine is patented ground it has been abandoned to mineral collectors since 1942. The difficulty of access and steep terrain make movement a problem. The Champion Sillimanite Mine workings are in terrain that is shaped somewhat like a cup. Your camp is at the bottom and all the places you want to visit are on the cup rim. It is difficult to think of being in your base camp at 8.700 feet and to realize that all the localities you want to visit are about 1,000 feet higher.

There are several major localities at White Mountain. Probably the first and foremost is the main workings of the Champion Sillimanite Mine, the Vulcanus # 1 Workings. These are a series of short tunnels and stopes that produced the andalusite ore mined during the early days of the operation. While this locality requires a strenuous climb it can produce some good specimens. Woodhouseite is locally abundant and probably the best specimens come from this area. Areas where quartz rock falls are common generally produce the best specimens and fracture surfaces up to a foot across may be found covered with small pink to pale yellow pseudocubic crystals. The workings also cut several corundum rich zones and nice specimens of dark blue corundum may be found here. Many other minerals are also found in the fractured quartz found in this area and careful examination of the rock will disclose pockets with crystals.

The phosphate-pegmatite lies a short distance up the trail above the Vulcanus # 1 Working. This locality is not large in area but the rock type is unique and contains a number of unusual minerals that are not found at other localities. Collecting at this site requires patience and a hand lens as most of the minerals that occur here occur in small crystals and finding good specimens require careful examination.

The Blackhawk Tunnel offers a number of unique minerals and is one of the two areas where good rutile specimens have been found. Pyrophyllite specimens are also found on the dump and nice specimens may be found here. This is also the only locality on White Mountain where halotrichite is protected enough to form. The tunnel is driven into loose aluminiferous shale and has collapsed in several places. There are several areas in the vicinity of the Blackhawk Tunnel that produce specimens. The bottom of the big slide ends here and the boulders that occur here often contain unusual minerals and spending time in this area is often rewarded with good natroalunite, barite and trolleite specimens. On the slope below the tunnel several large boulders of massive andalusite may be found. These boulders occasionally contain pockets with crystals of trolleite and lazulite in them.

The Vulcanus # 8 Working is the last of the andalusite prospects that provide.

Nevertheless White Mountain is a fascinating place to collect and contains a number of rare and unusual minerals. Scorzalite is the dominant phosphate at this locality and excellent specimens of dark blue scorzalite in Quartz can be found with a bit of careful looking in the dump material.

While woodhouseite is not as common at the Vulcanus # 8 Tunnel the crystals found here tend to be larger and crystals up to Ω inch have been found here. The woodhouseite crystals are not abundant and require a lot of looking at a lot of broken quartz to find. The most prolific area to find woodhouseite is the large quartz outcrop just south of the tunnel. The Vulcanus # 8 Tunnel is the only locality where the strontium end member, svanbergite, can be found. Only a few specimens were ever found but svanbergite has a distinctive orange color and it is difficult to mistake.

REMARKS

It is difficult to imagine the effort to maintain this operation entailed as at the time it started the area was basically a wilderness and the nearest railroad was many miles away. Every bit of equipment and supplies necessary to sustain the mine was brought up the hill on mule back over narrow steep trails and the mine remained in operation for over twenty years. The amount of material moved in this manner is difficult to comprehend and when one remembers that all the ore removed from the mine traveled in a similar manner.

The mine was difficult to operate and the logistic situation was extremely difficult. When the mine ceased operation the ore reserves were depleted and little demand for andalusite exited. Questions have been asked as to why the operation continued in the face of these daunting problems. One interesting theory was that Dr. W.E. Jeffrey, who was president of the Champion Spark Plug Company, enjoyed vacationing at the ranch and had a cabin at the lower camp kept the operation going long after it was necessity to provide ceramic material for spark plugs.

Be that as it may it is difficult to imagine a more scenic collecting site than White Mountain. The scenery is grand, the specimens are interesting and it is an extremely pleasant place to spend some time.

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