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MINERALOGY OF THE CHAMPION MINE
WHITE MOUNTAINS, CALIFORNIA

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The bold, bleached outcrop of quartzite at the 2800 m level on the west front of the White Mountains of eastern California is visible for tens of miles. For mineral collectors it marks a locality* well known for its large rutile crystals and rare phosphate minerals.

The locality is known mainly because it was mined by the Champion Sillimanite Company for andalusite during the 1920's and 30's. The mining operation was supervised during most of this time by C. D. Woodhouse (see Bancroft, 1976), who was an excellent mining geologist and a dedicated, perceptive mineralogist. This description of the mineralogy and geology of the deposit is dedicated to his memory, for without his generosity and encouragement my research into the minerals and paragenesis would not have been carried out.

The deposit was discovered in 1919 by J. A. Jeffery, then president of the Champion Porcelain Company. Using descriptions of occurrences of andalusite in the White Mountains (Knopf, 1917) he found rich masses of andalusite-bearing rock in the near vertical cliff faces (Fig. 1 and 2). The difficulties encountered in the mining of ore from the hard, vertical faces were described by Woodhouse (1951). The ore was of sufficient value to be sorted and loaded into sacks at the mine. This part of the White Mountains is so steep that the ore had to be carried by mule 3½ miles and down 780 m to an area where it could be loaded into trucks.

With a few notable exceptions the minerals in the Champion mine and close vicinity are compounds of aluminum. The general assemblage is similar in many ways to that at Graves Mountain, Georgia (Hurst, 1959). Here I will describe some of the more interesting minerals and the geologic setting for the deposit, and then will offer an explanation for the origin of the entire assemblage.

GEOLOGY OF THE DEPOSIT

Recent mapping of the western front of the White Mountains by Crowder and Sheridan (1972) shows that all the localities in Figure 3 lie within the White Mountain fault zone. This zone has a width up to one mile and is composed of sheared and mixed blocks of metavolcanic and metasedimentary units of Permian to Jurassic age. In the northern part of the range the fault is cut by Cretaceous dikes of aplite and pegmatite (Crowder, Robinson, and Harris, 1972). The part of the fault zone in which the Champion mine is located is believed to be composed of a metamorphosed rhyolite. Elsewhere along the fault zone these metarhyolites appear as muscovite-albite-quartz schists. The more mafic metavolcanic rocks form chlorite-chloritoid schists.

The Jurassic intrusion near the fault zone in the vicinity of the andalusite deposit is similar to those cut by the fault to the north and therefore is older than the formation of the deposit. However, an outcrop of Cretaceous granitic rocks is within 2 miles and may have a genetic connection with the andalusite.

MINERALOGY

Table 1 is a list of the major minerals that have been identified at the Champion mine, and Figure 3 shows the best collecting localities for these minerals. Much of the data presented here were obtained from specimens donated to the University of California, Santa Barbara, by C. D. Woodhouse, but frequent reference was also made to Lemmon (1937b) and Gross and Parwell (1968). The mineralogy descriptions will concentrate on two major parts of the area: the **orebody** (locality **A** in Fig. 3) and the **phosphate rock** (locality **B**, Fig. 3) formed along shear zones in andalusite-quartz rock.

Minerals of the ore body

Andalusite (Al_2SiO_5). Much of the andalusite occurs as coarse granular masses in the quartzite of the ore body. Crystals or clusters of crystals form columnar masses (Fig. 4). The andalusite is pale green or yellow-brown to white, but most crystals are coated with a thin layer of pyrophyllite or muscovite. The prismatic crystals, ranging from a few millimetres to 10 cm in length have simple {210} and {101} forms.

Some of the andalusite — most of that forming the columnar crystals projecting into cavities — has had some of the alumina leached away by late fluids. These prismatic crystals, such as in Figure 4, are partial pseudomorphs of quartz after andalusite. During the mining operation the specific gravity of the ore samples was periodically determined to eliminate this kind of

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*The mine has carried a number of names in the past. It is referred to in *Minerals of California* (Murdoch and Webb, 1966) variously as the Champion Sillimanite mine, Champion Sillimanite Incorporated mine, Champion Sillimanite Company Incorporated mine, and the Mono County mine of Champion Sillimanite Incorporated. Woodhouse (1951) was bothered by the fact that no sillimanite has ever been found at the locality, and followed the practice of company reports (of the Champion Sillimanite Company), calling it the Mono County Andalusite mine. Many labels in the Smithsonian give the locality simply as the Champion mine, and this name is in frequent use among collectors. I therefore propose that it be officially adopted.

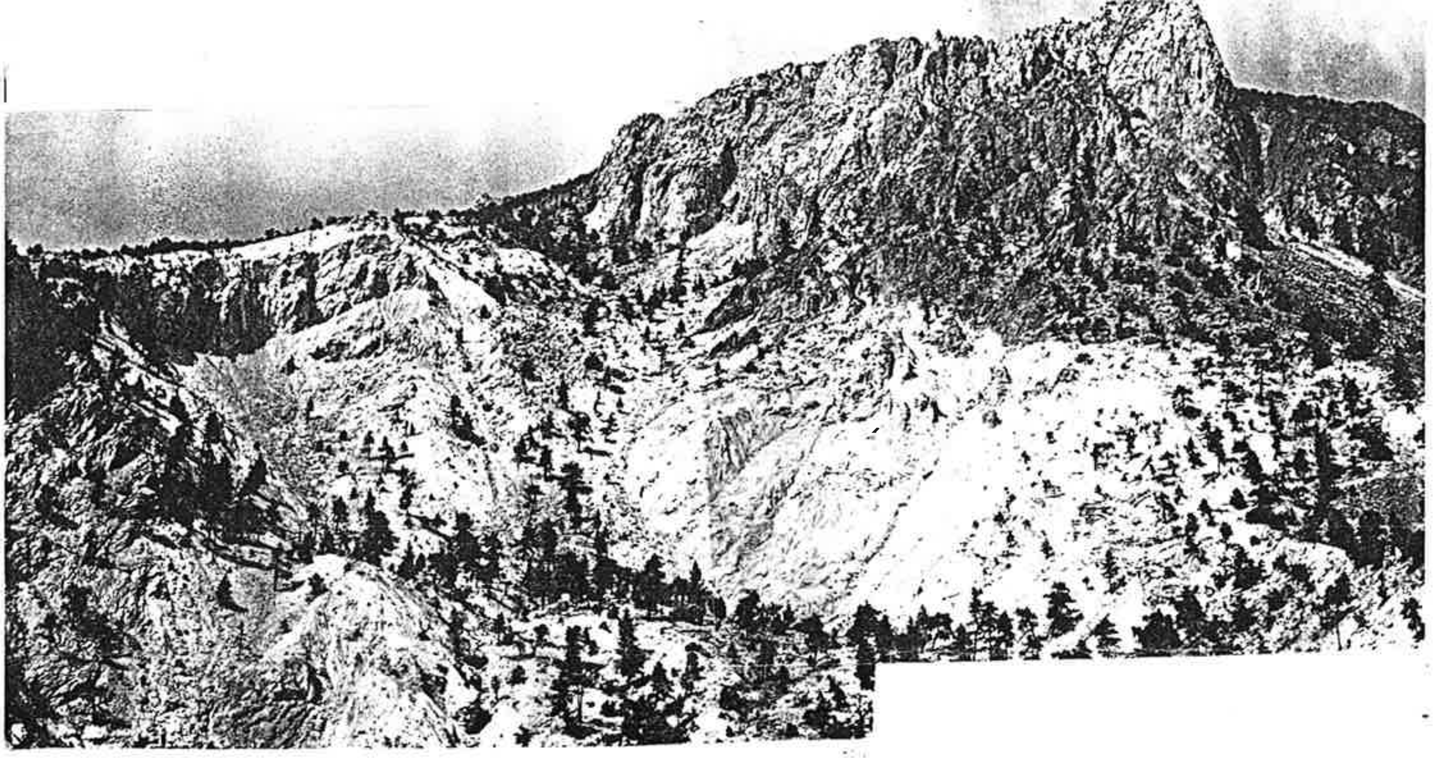
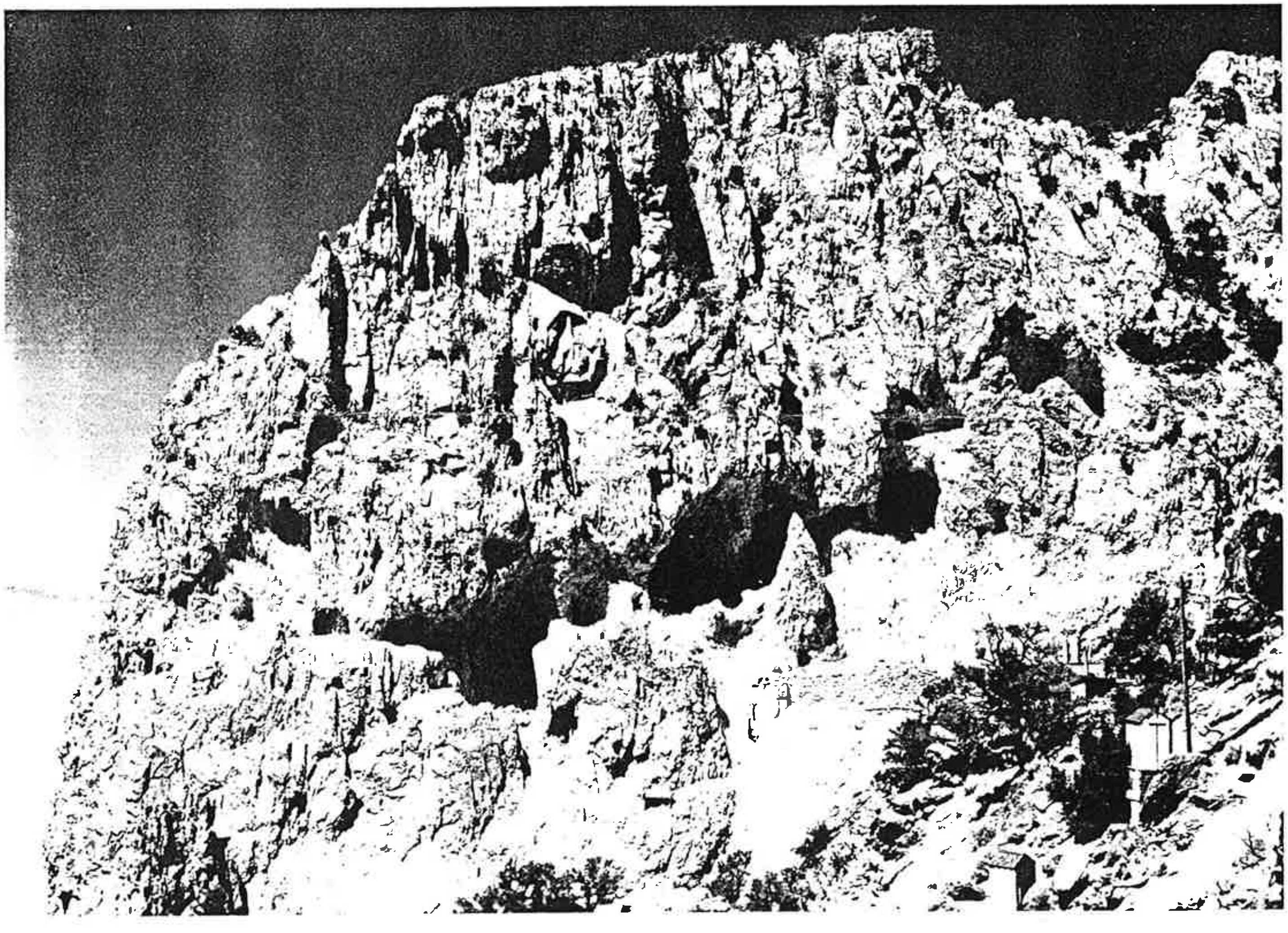


Figure 1. (above) **A view of the Champion mine. The ore body was located in the cliff face of the highest outcrop. Most of this view is shown on map Figure 3.**

Figure 2. (below) **The mining operation in 1935. The string of pockets are mined out andalusite ore bodies, and illustrate the distribution of ore (Lemmon photo).**



material. Therefore specimens can still be found in the dump talus slopes.

Quartz (SiO_2). Quartz is certainly the most abundant mineral in the area, forming the bold outcrops. However, long prismatic crystals up to 10 cm were found lining the walls of vugs and fractures. They are commonly associated with tourmaline (schorl), pyrophyllite, muscovite, and woodhouseite (Fig. 5).

Corundum (Al_2O_3). Corundum is a scarce but persistent mineral in the ore body. It occurs most commonly as plates or irregular crystals included in andalusite masses. Clusters of crystals up to 15 cm were found during the mining operation. All of the corundum is deep blue. Lemmon (1937b) noted that the color was not evenly distributed but strongly concentrated in a few spots within a crystal. These spots are similar in size and distribution to the disseminated rutile in the deposit, strongly supporting the supposition that titanium causes the blue color.

Topaz ($Al_2SiO_4F_2$). Topaz is a common mineral, but almost never displays any crystal form at this locality. It is frequently overlooked in the ore because of its similar appearance to quartz. A few topaz crystals have been found in vugs in the andalusite body and in the Al-phosphate rock (see below).

Rutile (TiO_2). Occurring mostly as tiny crystals less than 1 mm across, rutile is disseminated throughout the entire area. The quartzite and andalusite ore are tinted pink from the tiny red grains, forming about 0.5% of the rock. As reported by Lemmon (1937b) and Gross and Parwell (1968) much larger crystals occur in two zones below the main quartz mass (see Fig. 3) and at a small claim a few hundred metres west of the map area of Figure 3. These large crystals occur in zones of particularly coarse-grained diaspore-pyrophyllite rocks, easily breaking free. Crystals range up to 6 cm (Fig. 6 and 7).

Generally the rutile forms crystals that are complexly twinned and are nearly equidimensional. They are deep red to red-brown with a submetallic luster. Figures 6 and 8 illustrate the simple untwinned tetragonal prism with various bipyramid forms. All of the crystals for which the twinning relations have been solved are twinned on (031) (Fig. 8), although eightlings have been reported (presumably twinned on (011)).

Diaspore (AlOOH). Diaspore forms white to yellow-brown blades and plates up to 3 cm in length. In the andalusite ore it occurs as sparse, thin plates. In localities such as near H in Figure 3 it forms massive bodies of interlocking plates associated with pyrophyllite and rutile. Very few crystals exhibiting faces have been found.

Pyrophyllite ($Al_4Si_4O_{10}(OH)_2$). This mineral is wide-spread throughout the area. It occurs as white to colorless plates, commonly in radiating clusters up to 1 cm in diameter. Small clusters or sheaves occur throughout the ore body, commonly as a late replacement of andalusite. Only where pyrophyllite forms radiating clusters is the distinction clear. Much of the pyrophyllite has formed as a reaction product from andalusite and water vapor. It can be thought of as an adjustment of the system to cooling temperatures.

Woodhouseite ($CaAl_3SO_4PO_4(OH)_6$). The White Mountain deposit is the only known locality for this member of the alunite group. First described by Lemmon (1937a), woodhouseite occurs in open cavities in quartz veins and alteration seams in the andalusite rock and quartzite. Crystals vary from clear and colorless to translucent and pale orange pseudo-cubic rhombohedra. Typical growths of the larger woodhouseite crystals are shown in Figures 10 and 11. In some cavities tiny crystals are perched on schorl fibers (Fig. 12). The common forms are shown in Figure 13.

Microprobe analyses (Wise, 1975b) of samples from many localities (A, F, and D. Fig. 3) reveal a complete solid solution series with **svanbergite**. Moreover, a few crystals have been found that contain Ba in amounts to 20 mole percent.

Because of its location in seams and vugs in andalusite ore and quartzite, woodhouseite is clearly a late-formed mineral. It formed from sulfate- and phosphate-bearing solutions reacting with andalusite or pyrophyllite.

Svanbergite ($SrAl_3SO_4PO_4(OH)_6$). Pale yellow to orange simple rhombohedral crystals up to 5 mm occur with fibers of blue-gray schorl in a quartz vein at locality H in Figure 3. Crystals found at the Moreau claim by A. Ordway contain an excess of phosphorus, indicating a partial solid solution series with goyazite (Wise, 1975b).

Phosphate Rock Minerals

The phosphate rock formed along two shear zones (locality B, Fig. 3) through andalusite-muscovite schist. It is composed chiefly of augelite, trolleite, strontian natroalunite, and topaz with minor rutile and quartz (Fig. 16). All of these minerals are clearly later than the formation of andalusite. The phosphate rock also contains small cavities containing even later phosphate minerals (Fig. 16).

Strontian natroalunite ($(Na,K,Sr)Al_3(SO_4,PO_4)_2(OH)_6$) This compositional variety of natroalunite occurs abundantly in quartz veins and with augelite and trolleite in the area around locality B (Fig. 3). It most commonly forms granular, pink to pale brown masses, but also forms rhombohedra modified by basal faces. Although the compositions are variable, an average can be represented by 45% natroalunite, 30% alunite, and 25% svanbergite (Wise, 1975b).

Augelite ($Al_2PO_4(OH)_3$). This mineral occurs rarely as fracture coatings and miarolitic cavity fillings in the andalusite bodies and in the massive phosphate rock of locality B (Fig. 3). The crystals from the fractures and cavities are commonly euhedral, colorless, and transparent (Fig. 14). Lemmon (1935) described the crystal forms of this material, and Figure 15 is a drawing of the common tabular form. Some of the early found crystals are nearly 2.5 cm across, while those with the best crystal form are about 1 cm.

In the phosphate rock the augelite is anhedral and is recognized by its white color and prominent basal cleavage. Some of these crystals reach 10 cm, and commonly include smaller grains of rutile, trolleite, and topaz.

Experimental work has shown that augelite can form readily from a reaction of andalusite and phosphoric acid. Moreover, augelite is not stable at temperatures above 500°C (Wise and Loh, 1976).

Trolleite ($Al_4(PO_4)_3(OH)_3$). Trolleite is a very rare mineral, having been reported from only three localities in the world. Gross and Parwell (1968) were the first to note its existence in the phosphate rock in the White Mountains. It forms pale blue to pale blue-green masses intergrown with augelite and topaz. Crudely formed crystals have been found only in a few cavities in the phosphate rock.

Trolleite is easily synthesized, and has a stability range at somewhat lower temperatures than does augelite (Fig. 17).

Lazulite [$(Mg,Fe)Al_2(PO_4)_2(OH)_2$]. The deep blue color of this mineral makes it the most striking of the deposit. It occurs in veinlets cutting the ore body, widely disseminated in the phosphate rock, and in vein quartz (locality H. Fig. 3). Well-formed crystals are rare; those that have been found have the simple pyramid forms, typical of the mineral at Graves Mountain, Georgia. Masses up to 10 cm across occur in quartz veins near locality H (Fig. 3).

Samples from various locations (A, B, and H) were analyzed with an electron microprobe. All except those associated with svanbergite and schorl have Mg > Fe, and are lazulite. The

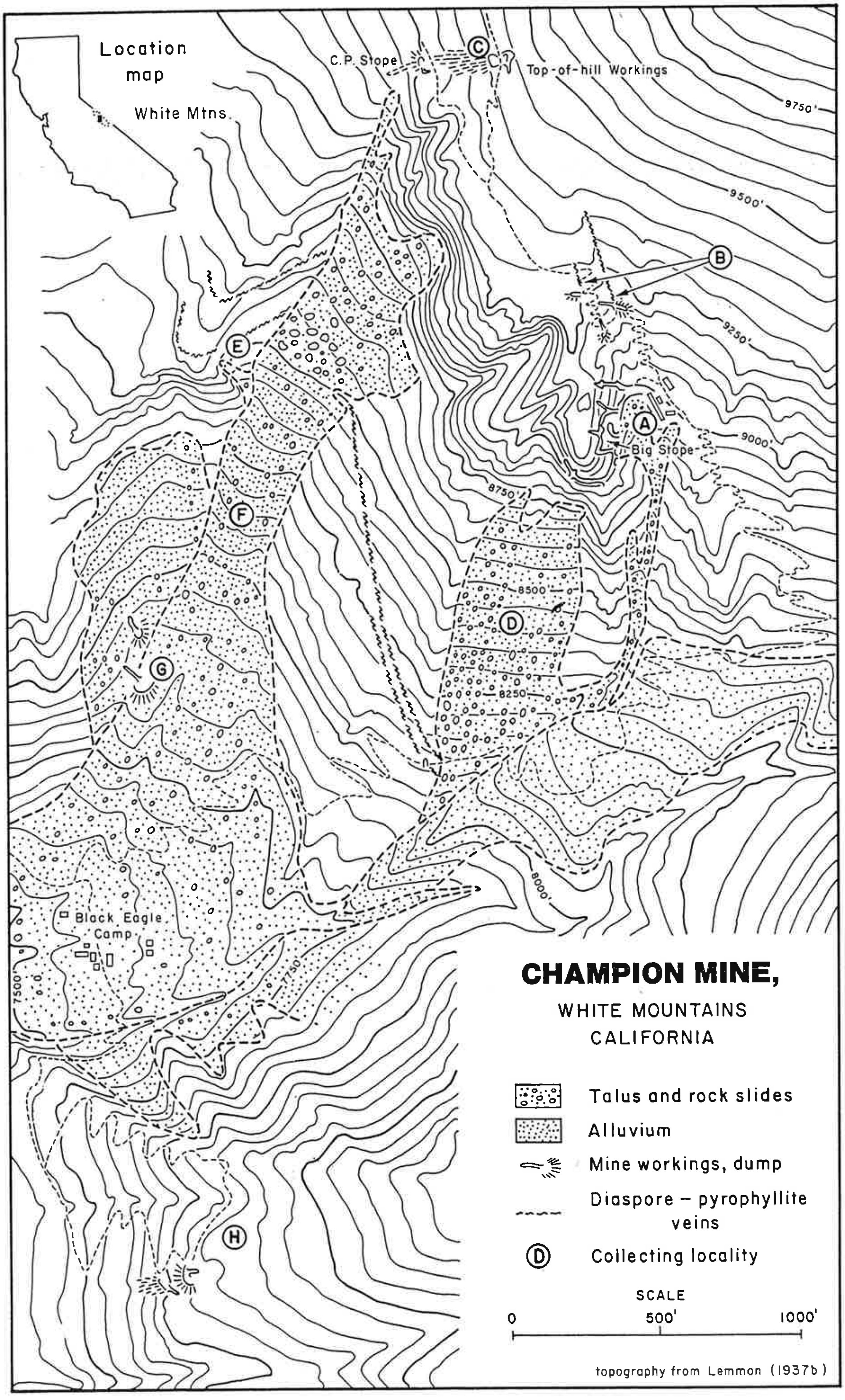
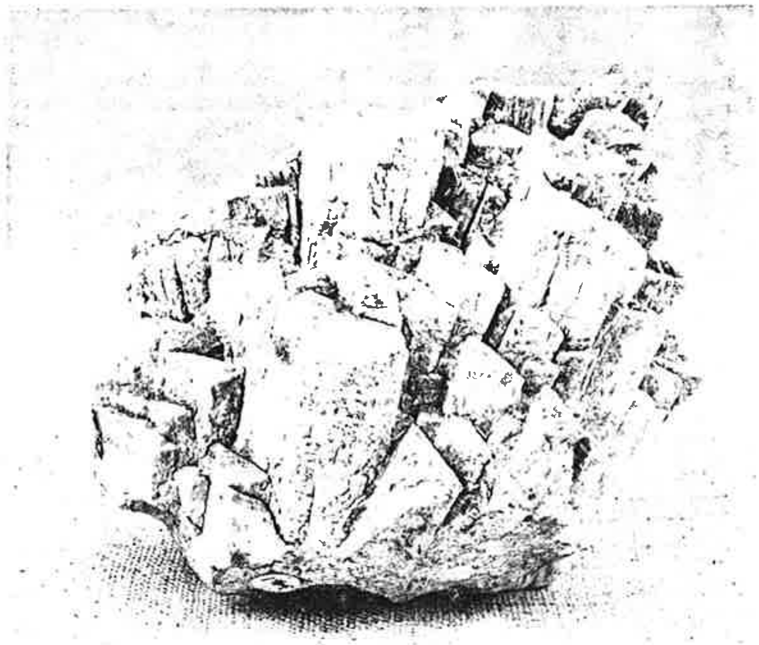


Figure 3. **Collecting localities at the Champion mine.**



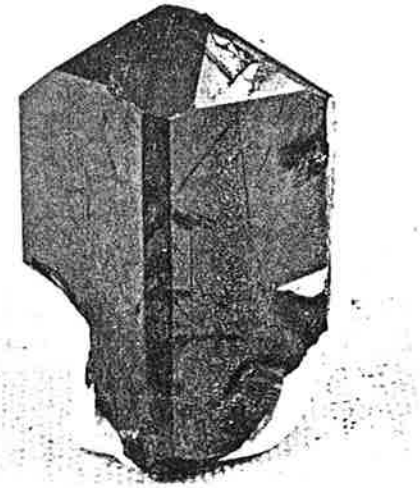


Figure 4. (above left) **A cluster of andalusite crystals with simple prism and dome faces. The crystals are about 3 cm long.**

Figure 5. (below left) **A quartz crystal 4.5 cm long with inclusions of pyrophyllite and rutile.**

Figure 6. (above right) **A complexly twinned rutile crystal in pyrophyllite. The crystal is 5.5 cm in the longest dimension.**

Figure 7. (below right) **A single crystal of rutile (3.5 cm high). Compare with Figure 8 to identify the crystal forms present.**

material with the svanbergite is then **scorzalite.**

Other minerals:

Many cavities in the phosphate rock are partially lined with pale orange **apatite** crystals (see Fig. 16). Forming even later is **visêite** in the form of white, earthy aggregates.

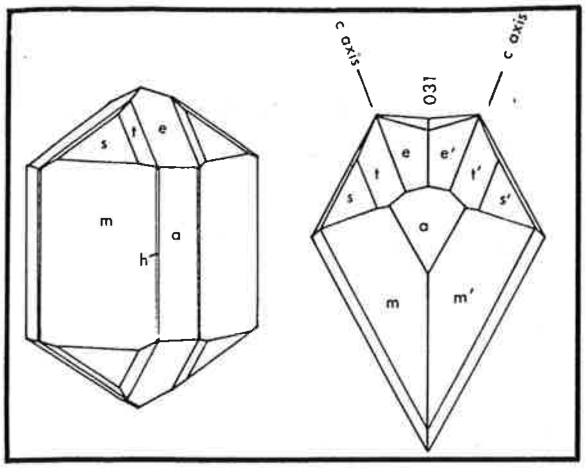
The experimental work by Wise and Loh (1976) indicates that berlinite ($AlPO_4$) is to be expected in this mineral environment. However, since berlinite is very nearly identical with quartz in its physical properties, it has not yet been recognized at this locality.

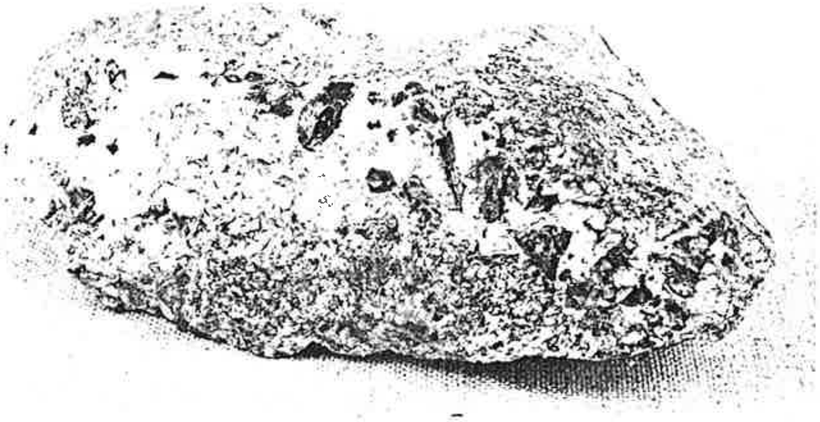
Table 1 lists other minerals that occur largely as weathering products. Most are found in seams and on joint surfaces.

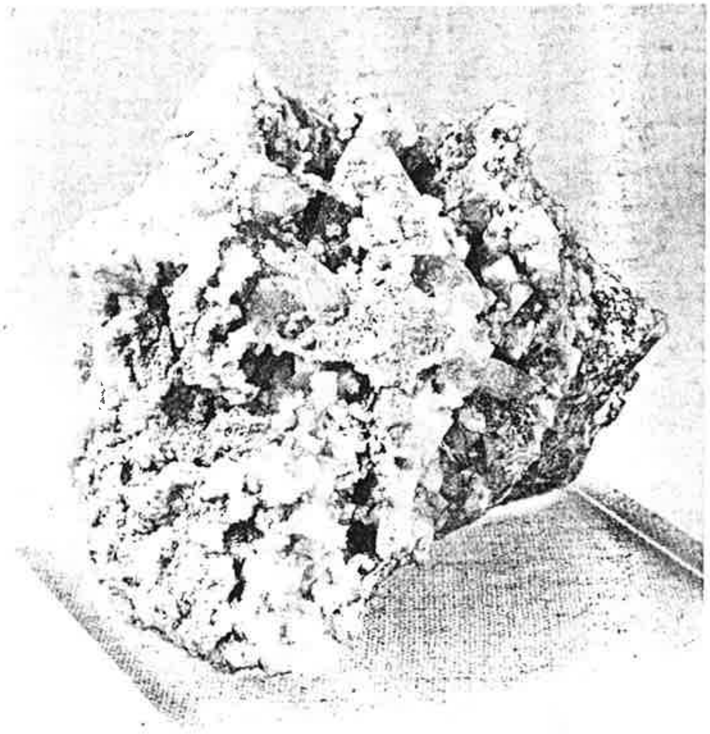
ORIGIN OF THE DEPOSIT

For earlier workers the mass of quartzite, large pods of andalusite or pyrophyllite, finely disseminated rutile, local concentration of diaspore, corundum, topaz, and Al-phosphates have defied easy explanation. Recent experimental work (Wise, 1975a, and Wise and Loh, 1976) provides the basis of an hypothesis that makes explanation of the observed features easier. First, the coexisting minerals provide the temperature-pressure range within which the deposit formed regardless of the mechanism that brought these elements together. In Figure 17 we can see that the andalusite could have formed at the highest temperatures (between 400 to 600°C), while the augelite is limited to temperatures lower than 475°C. The phosphate rock could not have formed at temperatures much above 400°C. The pyrophyllite-diaspore rich zones probably crystallized below 350°C.

Kerr (1932) suggested that the andalusite formed from the metamorphism of aluminous volcanic material or sediment interlayered with trachytic flows. Gaseous and aqueous solutions were thought to have caused the crystallization of topaz and schorl and, as temperatures decreased, pyrophyllite and diaspore. Lemmon (1937b, p. 59) argued that the andalusite formed by *"metamorphism of a highly aluminous quartzite at considerable depth..."* with the addition of boric, sulfuric, hydrofluoric,







Crystal 8. (top left) Crystal forms and twin of rutile. The common forms are *a*{010}, *h*{120}, *m*{110}, *s*{111}, *e*{011} and *t*{133}. The twin plane is (031). Note that the dominant prism form is {110}, not {120} as in similar twins from Cerrado Frio, Brazil.

Figure 9. (top right) Coarse-grained pyrophyllite (blades up to 1 cm) with rutile in diaspore and andalusite. Sample length is 16 cm.

Figure 10. (center left) Woodhouseite rhombohedra up to 6 mm forming crusts on tapering quartz crystals. Specimen width is 10 cm.

Figure 11. (center right) Pale orange woodhouseite rhombohedra (9 mm across) on quartz.

Figure 12. (bottom right) Microcrystals of woodhouseite on tourmaline fibers with quartz crystals in a vug in quartzite. Width of view, 1 cm.

Table 1. Minerals of the Champion mine.

Mineral	Abundance and form *	Illustrated in figure	Best collecting locations (Fig. 3)	Comments
***high temperature minerals* (400-600°C)**				
Quartz	*X, M*	5	A	Best crystals are in partially filled fractures and vugs
Corundum	(x), (m)		A	Occurs as deep blue plates (in andalusite)
Andalusite	m, x	4	A and C (also D, E)	Many crystals have been partially leached of the alumina, and are now quartz and andalusite.
Hematite, Ilmenite	m		B and elsewhere	In schists
Pyrite	*M*, x		A and H	Many pseudomorphs, goethite after pyrite
Muscovite	X, m		A and elsewhere	In veinlets with tourmaline and quartz
Topaz	M	16	A and B	Occurs in quartzite and trolleite-augelite rock
***moderate temperature minerals* (300-400°C)**				
Schorl	x, (m)	12	A, H, and in country rocks	Occurs as fine, hair-like fibers in veinlets, also as porphyroblasts
Trolleite	m	16	B	Massive with augelite, lazulite and topaz
Rutile	*M*,x	6, 7, and 8	E, G, and elsewhere	Large crystals at E and G in pyrophyllite, occurs as small grains throughout entire area
Diaspore	M		H, near D, E	Massive with lazulite and pyrophyllite or muscovite
Pyrophyllite	M,X	9	G and elsewhere all localities	Radiating clusters of plates up to 12 mm near G
Lazulite-Scorzalite series	M		All localities	Masses from all occurrences are dark blue, in quartz veins and quartz or phosphate rocks
Augelite	m, (x)	14, 15, 16	B (massive)	Occurs as massive crystals up to 13 cm with trolleite-lazulite-topaz
			A (crystals)	Crystals in veinlets with tourmaline, quartz, and muscovite
Woodhouseite	x	10 to 13	A (original loc.) and F and D in talus	Occurs as 2 to 6 mm crystals in fracture fillings
Svanbergite	(x)		H (and D)	Occurs with quartz in veinlets and similar to woodhouseite
Strontian natro-alunite	M, (x)		All localities	In veinlets with quartz
***low temperature minerals* (lower than 300°C) forming later than those above**				
Barite	(x)		A, B, F, G	In fractures
Apatite group	(x)	16	B	In cavities replacing augelite
Jarosite-natro-jarosite series	(x)		F and G, others	Late fracture fillings
Visēite	(m)	16	B	In cavities with apatite
Strengite	(m)		A, B	
Variscite	(m)			

Other minerals occurring mostly as low temperature reaction products are: limonite, sulfur, calcite, cacoxenite, opal, todorokite, chloropal, alunogen, and alumino-copiapite.

* M = massive, X = crystals; *X, M* = abundant, X, M = common, x, m = rare, (x), (m) = very rare

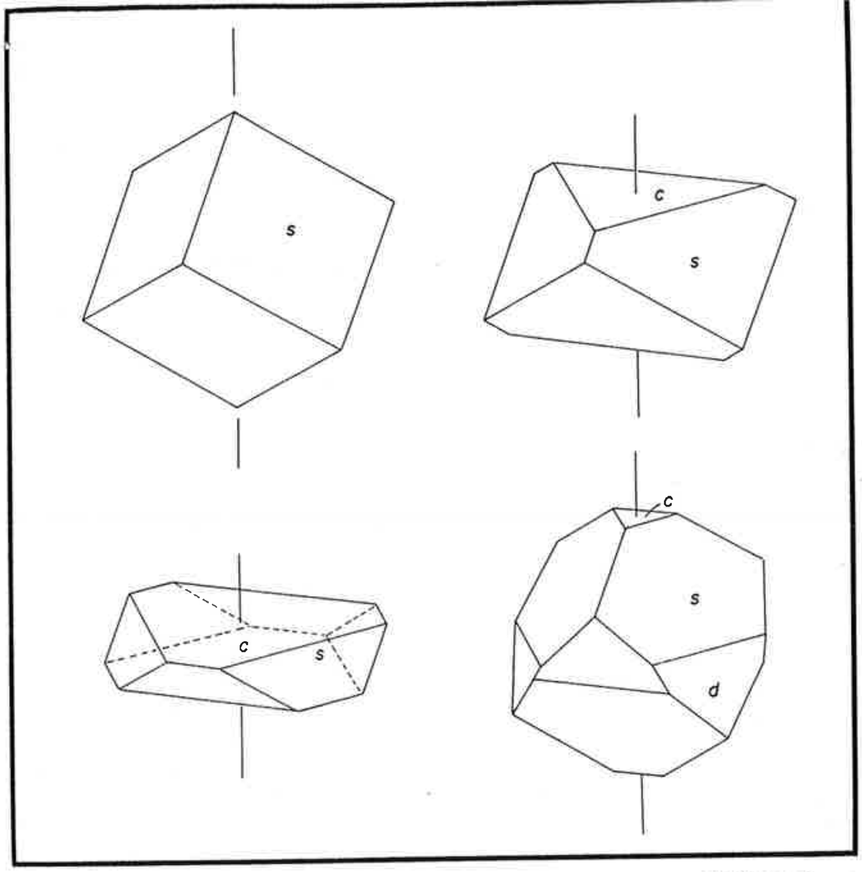
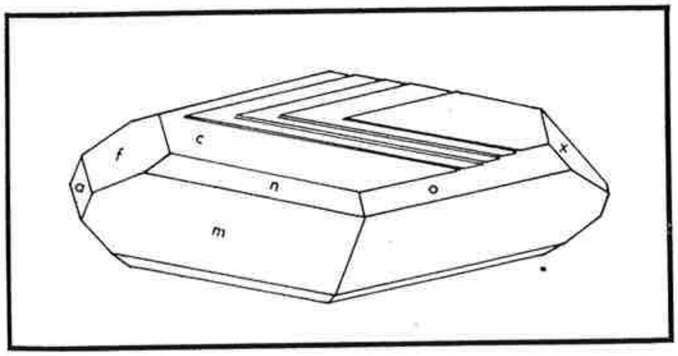
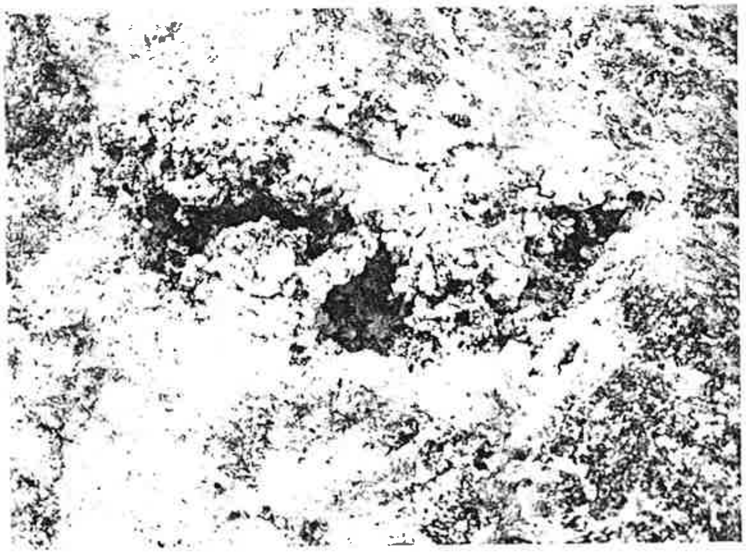


Figure 13. (top) Common forms and habits of woodhouseite. The forms are $s\{01\bar{1}2\}$, $c\{0001\}$ and $d\{02\bar{2}1\}$.

Figure 14. (top right) Augelite crystal, 2.5 cm in length, showing *c, m, n* and *o* faces (see Fig. 15).

Figure 15. (below) Common forms of augelite, and the origin of the common stepped feature of the *c* face. The forms are $c\{001\}$, $a\{100\}$, $m\{110\}$, $n\{111\}$, $f\{201\}$, $x\{\bar{2}01\}$ and $o\{\bar{1}11\}$. Steps result from alternating *c* and *n* (as well as *c* and *o*) faces. See Lemmon (1935) for a complete listing of forms.





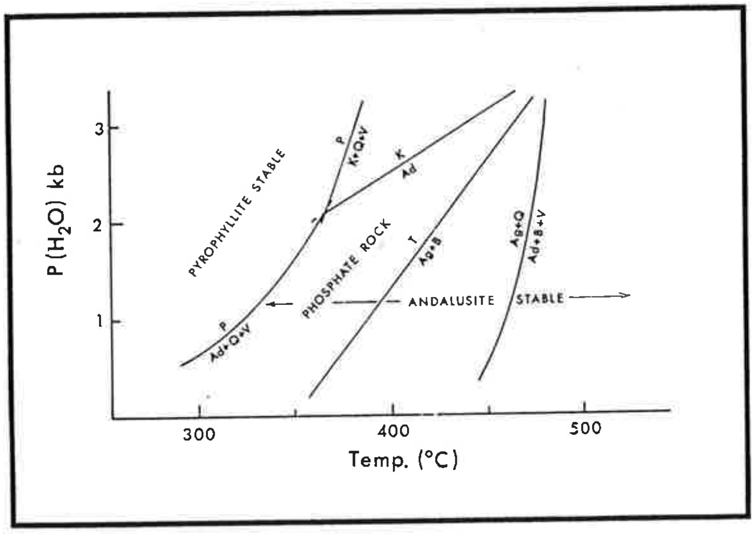


Figure 16. (center right) Phosphate rock. Lightest areas are mostly augelite and topaz; darker, trolleite; nearly black, lazulite. Dark specks are rutile. Within the vug apatite and viséite have formed as a low temperature reaction. Width of the vug is 4 cm.

Figure 17. (bottom right) Pressure-temperature diagram illustrating the stability limits of some of the minerals occurring in the Champion mine. Andalusite probably formed at temperatures above 400°C, and the phosphate rock (augelite+trolleite) between about 350° and 450°C. Pyrophyllite can form only below about 325°C. Abbreviations: P = pyrophyllite. Ad = andalusite, K = kyanite, Q = quartz, V = water vapor, T = trolleite, Ag = augelite, and B = berlinite. Adopted from Wise and Loh (1976).

and phosphoric acids from the nearby magma. Gross and Parwell (1968), who were primarily concerned with the rutile, felt the titanium was also introduced by high temperature fluids.

Wise (1975a) presented data and calculations to show that a muscovite-albite-quartz schist could be converted to an andalusite-quartz rock by reactions like:

$$2H^+ + 2KAl_2AlSi_3O_{10}(OH)_2 \rightarrow 3Al_2SiO_5 + 3SiO_2 + 2H_2O + 2K^+$$

acid + **muscovite** → **andalusite** + **quartz**

The H^-participates in such reactions as an acidic fluid, even as a gaseous phase. The K^+ and Na^+ are carried away by the fluid. The results of such reactions (called hydrogen metasomatism) are commonly observed in porphyry copper deposits.

The advantages of this theory are that it accounts for the andalusite in the environment of volcanic rocks without appealing for special aluminous material or sediments. It also accounts for the widespread rutile. Crowder and Sheridan (1968, Table 2) show that the metarhyolite contains 0.5% TiO_2, probably as titanite. A reaction of an acidic fluid with titanite ($CaTiSiO_5$) might easily result in the formation of rutile and iron oxides.

If the acid in the fluid is largely hydrochloric, the main product will be andalusite or pyrophyllite. Local concentration of aluminum causes the formation of corundum or diaspore, depending on the temperature. A hydrofluoric acid component to the fluid will produce topaz, while boric acid leads to schorl and, as discussed above, phosphoric acid is necessary for the formation of trolleite and augelite.

These fluids could have originated in the nearby Cretaceous granitic intrusion. The fault zone provided a ready made channel for these fluids, concentrating their effects in one local area.

ACKNOWLEDGMENTS

I greatly appreciate the generous donation of additional study specimens by A. L. McGuinness, Al Ordway, Wayne Leicht, Gerhard Muller, and William Moller. Robert Gill assisted in the photography of the specimens.

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CHAMPION TRIP INFORMATION

DEPARTURE: Assemble on Friday, August 26, in the Chisholm Hall parking lot at 5:45 AM to load vehicles for 6:00 AM departure.

RETURN: We will aim to arrive at CSUN by 6:00 PM on Sunday, August 28.

WHAT TO BRING:

This is a back packing trip, so pack as lightly as you can but don't be caught unprepared. Make an effort to share items such as pots and pans, stoves, water filters, etc. The camp is big enough so that everyone should be able to sleep indoors. However, recently there were only about 12 beds with mattresses on them. The camp is on public land and the housing is first come, first serve, so you may wish to bring a foam pad.

There is water at the camp, but none at the trail head or along the trail, so it is important that you arrive at CSUN with filled water bottles for the hike in. Unless things have changed recently, the water is good to drink untreated, but contaminated water is always a concern, and you should probably plan to bring a filter. Group members will be encouraged to use them.

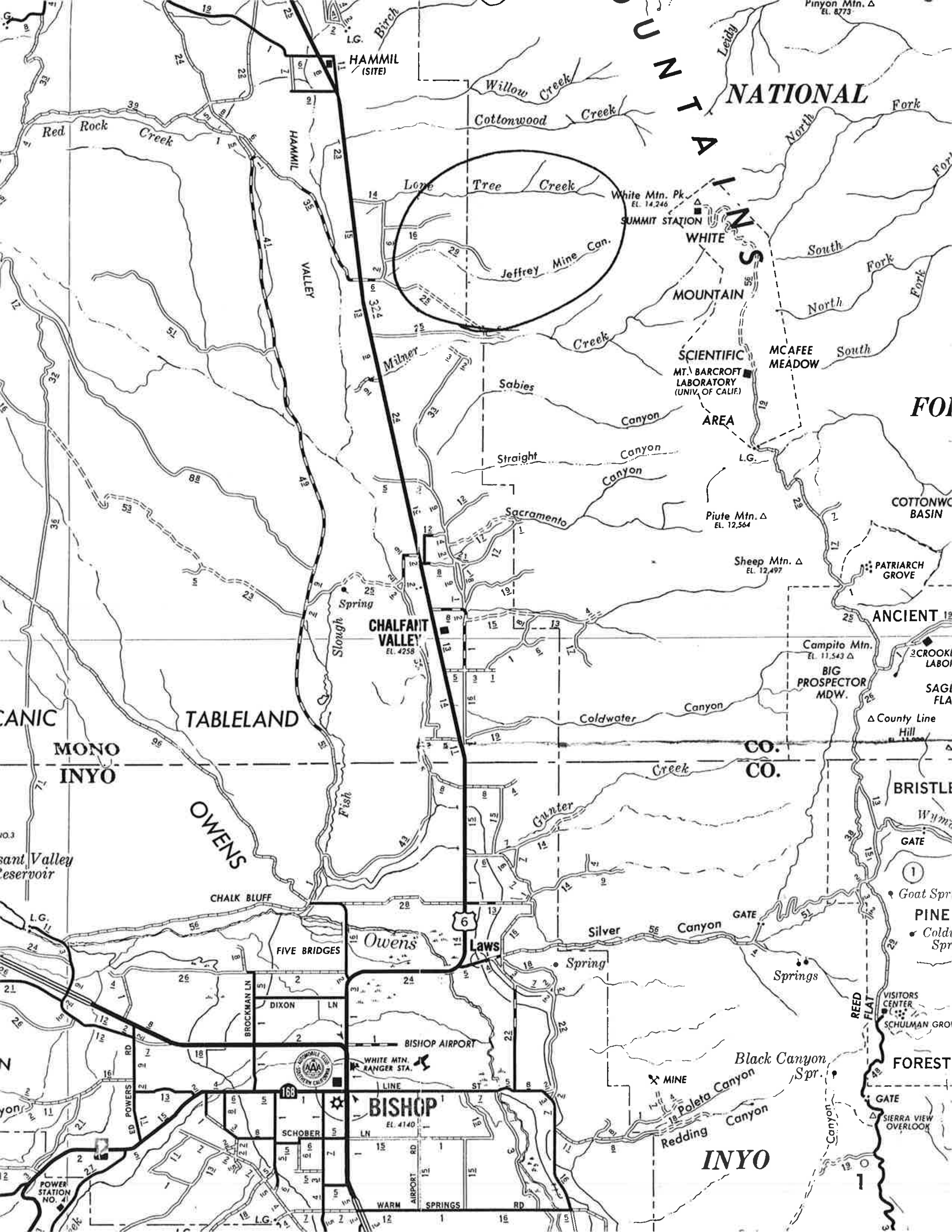
Cooking may be done on the wood stove in the mess hall if desired, but back-packing stoves are recommended to conserve fire wood.

CHECK LIST:

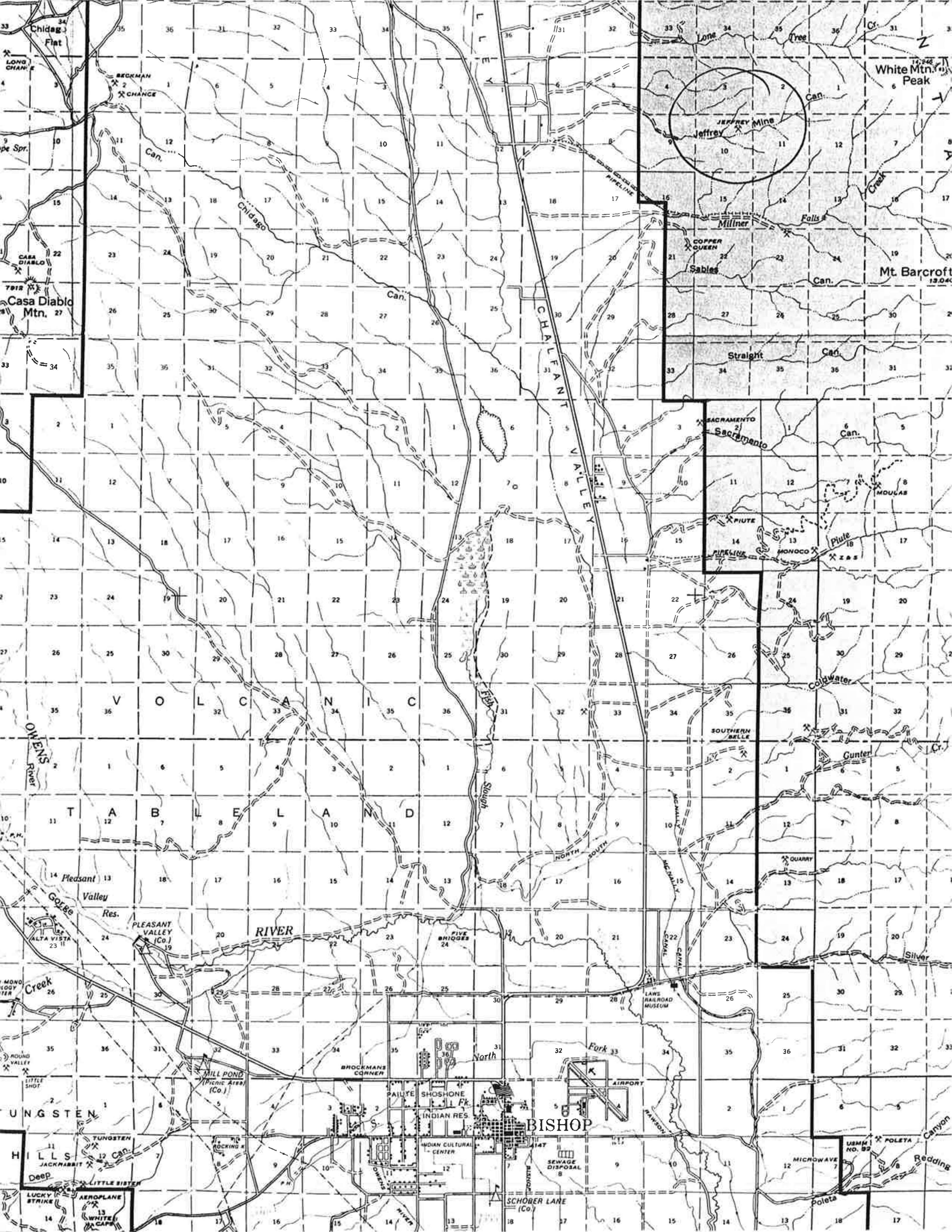
- Clothing -
  - Dress in layers so that you can be comfortable in the heat and to below freezing.
  - Bathing suit (if desired, for the very public shower)
  - Hat
  - Sturdy boots
  - Light-weight rain gear or poncho, just in case
- Sleeping bag plus pad
- Collecting equipment -
  - Rock hammer, small chisel (if you have one), extra toilet paper or plastic bags for wrapping specimens, sample bag, hand lens
- Food -
  - Sack lunch and drink for picnic en route on Friday. (No ice chests, please.)
  - Back-packing food for Friday dinner, Saturday breakfast, lunch and dinner, and Sunday breakfast.
  - Food to leave in vehicles or money for fast-food lunch on Sunday.
  - Cooking and eating utensils, pans, lighter or matches
- Water -
  - You must start the hike with at least <u>two quarts</u> of <u>water</u> in your pack.
  - Have these water bottles filled when you arrive at CSUN.
- Personal articles -
  - Toilet articles
  - Camera and film (optional)
  - Toilet paper (the two-seater has a nice view.)
  - Biodegradable soap
  - Sun screen

Absolutely NO pets, firearms, fireworks, or firewater!

PWWAdm2E:CHAMPTRIP.DOC



Pinyon Mtn. EL. 8773
HAMMIL (SITE)
L.G.
Birch
Leidy
NATIONAL
Willow Creek
Cottonwood Creek
North Fork
Red Rock Creek
HAMMIL VALLEY
Lone Tree Creek
White Mtn. Pk. EL. 14,246
SUMMIT STATION
WHITE MOUNTAIN
MOUNTAINS
Jeffrey Mine Can.
South Fork
North Fork
Creek
SCIENTIFIC AREA
MT. BARCROFT LABORATORY (UNIV. OF CALIF.)
MCAFEE MEADOW
South
Milner
Sabies Canyon
Straight Canyon
Canyon
Sacramento
Piute Mtn. EL. 12,564
COTTONWOOD BASIN
Sheep Mtn. EL. 12,497
PATRIARCH GROVE
ANCIENT
Spring
CHALFANT VALLEY EL. 4258
Slough
Campito Mtn. EL. 11,543
BIG PROSPECTOR MDW.
CROOKED LABORATORY
SAGE FLAT
County Line Hill
Coldwater Canyon
TABLELAND
CANIC
MONO
INYO
CO.
CO.
Creek
BRISTLECONE
OWENS
Fish
Gunter
Wyman
GATE
NO.3
Pleasant Valley Reservoir
Goat Spr.
PINE
Cold Spr.
CHALK BLUFF
L.G.
Owens
FIVE BRIDGES
Laws
Silver Canyon
GATE
Spring
Springs
BROCKMAN LN
DIXON LN
BISHOP AIRPORT
WHITE MTN. RANGER STA.
REED FLAT
VISITORS CENTER
SCHULMAN GROVE
Black Canyon Spr.
MINE
FOREST
GATE
SIERRA VIEW OVERLOOK
LINE ST
168
BISHOP EL. 4140
ED POWERS RD
SCHOBER LN
AIRPORT RD
Poleta Canyon
Redding Canyon
Canyon
INYO
POWER STATION NO. 4
WARM SPRINGS RD
L.G.
6
1


Chidago Flat
LONG CHANCE
BECKMAN
CHANCE
Chidago Can.
CASA DIABLO
7912
Casa Diablo Mtn.
CHALFANT VALLEY
PIPELINE
Lone Tree Cr.
White Mtn. Peak
14,246
JEFFREY Mine
Jeffrey Can.
Creek
Millner
Falls
COPPER QUEEN
Sables Can.
Mt. Barcroft
13,040
Straight Can.
SACRAMENTO
Sacramento Can.
MOULAS
PIUTE
Piute
MONOCO
Z & S
Coldwater
SOUTHERN BELLE
Gunter Cr.
Fish Slough
VOLCANIC TABLELAND
OWENS River
McNALLY
NORTH
SOUTH
QUARRY
P.H.
Pleasant Valley
Gorge
Res.
ALTA VISTA
PLEASANT VALLEY (Co.)
RIVER
FIVE BRIDGES
Creek
MONO
LAWS RAILROAD MUSEUM
CANAL
Silver
ROUND VALLEY
LITTLE SHOT
MILL POND (Picnic Area) (Co.)
BROCKMANS CORNER
North Fork
PAIUTE SHOSHONE INDIAN RES.
AIRPORT
BISHOP
RAWSON
TUNGSTEN HILLS
TUNGSTEN
JACKRABBIT
Can.
Deep
LITTLE SISTER
LUCKY STRIKE
AEROPLANE
WHITE CAPS
ROCKING K
INDIAN CULTURAL CENTER
SEWAGE DISPOSAL
SCHOBER LANE (Co.)
OWENS RIVER
MICROWAVE
USMM NO. 82
POLETA
Poleta
Canyon
Redding

Plan now for the 1994 Fabulous Fall Field Frolic...

Backpack into the Champion Sillimanite Mine

a world-famous mineral locality in the White Mtns!

When? 6:00 am Friday, August 26 to 7:00 pm Sunday, August 28.

Who's going? The trip is for Earth Science and Geology majors and will be led by Dr. Peter Weigand and Dr. Janet Hammond from Pasadena City College. Others will be considered on a space-available basis. Dr. Weigand is coordinating the trip, so direct questions to him.

Why go? The scenery is so extraordinary that some go just for the view. Others go for the fun of visiting the well-preserved mining camp. We will go to check out the extraordinary minerals: rutile, andalusite, quartz crystals, lazulite, woodhouseite, pyrophyllite, and others which occur in the metamorphic rocks of the White Mountain fault zone.

Where is this place? The mineral deposit is located on the flanks of White Mountain Peak about 18 miles northeast of Bishop. It's about a three-hour hike up to 7,500 feet to the camp and lower part of the deposit. Be prepared to climb up to 10,000 feet looking for minerals.

How hard is the hike? This hike is not for the timid. The trail is steep, very narrow in places, and generally in bad repair. It can be very hot or very cold; afternoon thundershowers are common in September. You must carry all your gear, including plenty of water for the hike up. However, most people who are in good physical condition have no problems if they are patient with their slow progress upward.

What do you need to take? Standard back-packing equipment and food. However, there is no need to take a tent up the mountain because there should be cabin space for everyone. Layered clothing suitable for temperatures from 20 to 90° F is essential. Also, heavy mountaineering boots are significantly better than light-weight boots.

What about transportation? Plan to ride in a CSUN van. The number of vehicles will be kept to an absolute minimum.

How much does it cost? About $20.00 for transportation.

How to sign up? See Arlene in the Department Office (SC 526), pay a $20.00 deposit, and leave your address and telephone number. The limited number of places will be assigned on a first-come first-served basis.

Homework? Yes, before you go (or if you are trying to decide if you should go) read *Mineralogy of the Champion Mine, White Mountains, California* by W.S. Wise in The Mineralogical Record, 1977, volume 8, p. 478-486. A copy can be found in the Geology Office.

PWW3B:FROLIC.F94

CALIFORNIA STATE UNIVERSITY, NORTHRIDGE
MOTORPOOL REQUISITION

GEOLOGICAL SCIENCES
Department Name

DR WEIGAND
Requested By

DWeigand
Authorized Signature

8266 — Mail Code
SC 526 — Bldg. & Room
3541 — Phone
6/8/94 — Date Submitted
8/25/94 — Date Required

RECEIVED
JUN 9 11 01 AM '94
CAL
PHYSICAL

1113374561
Account Number

94957001
Req. No.

| 4 | 5 | 6 | 1 |
Description

VEHICLE RESERVATION AND TRIP AUTHORIZATION

Departure Date THURS 8/25/94 Time 1600 a.m./[✓ p.m.]

Return Date MON 8/29/94 Time 0900 [✓ a.m.]/p.m.

Destination (City): BISHOP, CA Number of Passengers 12

Purpose (Must be State business) GEOL. FIELD TRIP

Type of vehicle requested (sedan, van, etc.): 12 PASSENGER VAN

If vehicle is larger than sedan, please explain reason for needing a larger vehicle.
TO TRANSPORT STUDENTS, FACULTY, EQUIPMENT

I certify that:

1. I have read and understand the *C.S.U. State Vehicles Regulations and Policies booklet.*
2. I possess a valid California Driver's license and Defensive Driving training certificate. (Note: a Class 2 license is required for driving passenger vans.)
3. I have not been issued more than three moving violations nor been responsible for more than three accidents (or any combination of more than three thereof) during the past twelve month period.
4. I will only use this vehicle for University instructional purposes and/or official business for the University and/or State of California. I am an employee of the State of California.
5. I am aware that seat belts and harnesses must be worn by the driver and all passengers of State vehicles at all times.

DAVID LIGGETT, DEPT. TECH.
Name and position of Primary Driver

D L Liggett
Signature of Primary Driver

Ending Mileage ______

Beginning Mileage ______

PHYSICAL PLANT MANAGEMENT USE ONLY

Trip Mileage ______ X Rate ______ = TOTAL COST $______

Released by: ______ Date Out ______ Vehicle # ______

White - PPM Yellow - Billing Pink- PPM Goldenrod - Dept.

TCA C-169 Rev. 11/88