INVESTIGATIONS OF TALC IN OREGON

1988

TALC END USES

STATE OF OREGON
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SPECIAL PAPER 18

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1988

Conducted in conformance with ORS 516.030

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SUMMARY

More than 100 separate talc occurrences in 18 talc areas are identified in altered serpentinites. The talc occurrences, in the form of talc, talc-amphibole, talc-chlorite schists, and talc-carbonate rock, are found in the older pre-Tertiary terranes of northeastern and southwestern Oregon (Figure 1). Some deposits are hydrothermal in origin and are spatially associated with lode and/or placer gold deposits. Other deposits are metamorphic in origin and are located within contact metamorphic aureoles of granitic intrusions.

Oregon talcs were formed by the dehydration of serpentine minerals and generally contain iron. Many of the Oregon talcs contain one or more of the amphibole minerals anthophyllite, cummingtonite, and tremolite. The amphibole minerals often occur in asbestiform habits and, because of health concerns, may be considered as unacceptable contaminants in industrial talcs.

The larger talc-carbonate masses near Sumpter in northeastern Oregon appear to be free of amphiboles and may yield an industrial-grade talc with beneficiation. Presently, the only use of Oregon talc is in the production of high-quality, carving-grade soapstone from the Pugh Mine in southwestern Oregon. A potentially valuable massive chlorite possibly suitable for the manufacture of marking crayons occurs near Rock Creek in southwestern Oregon.

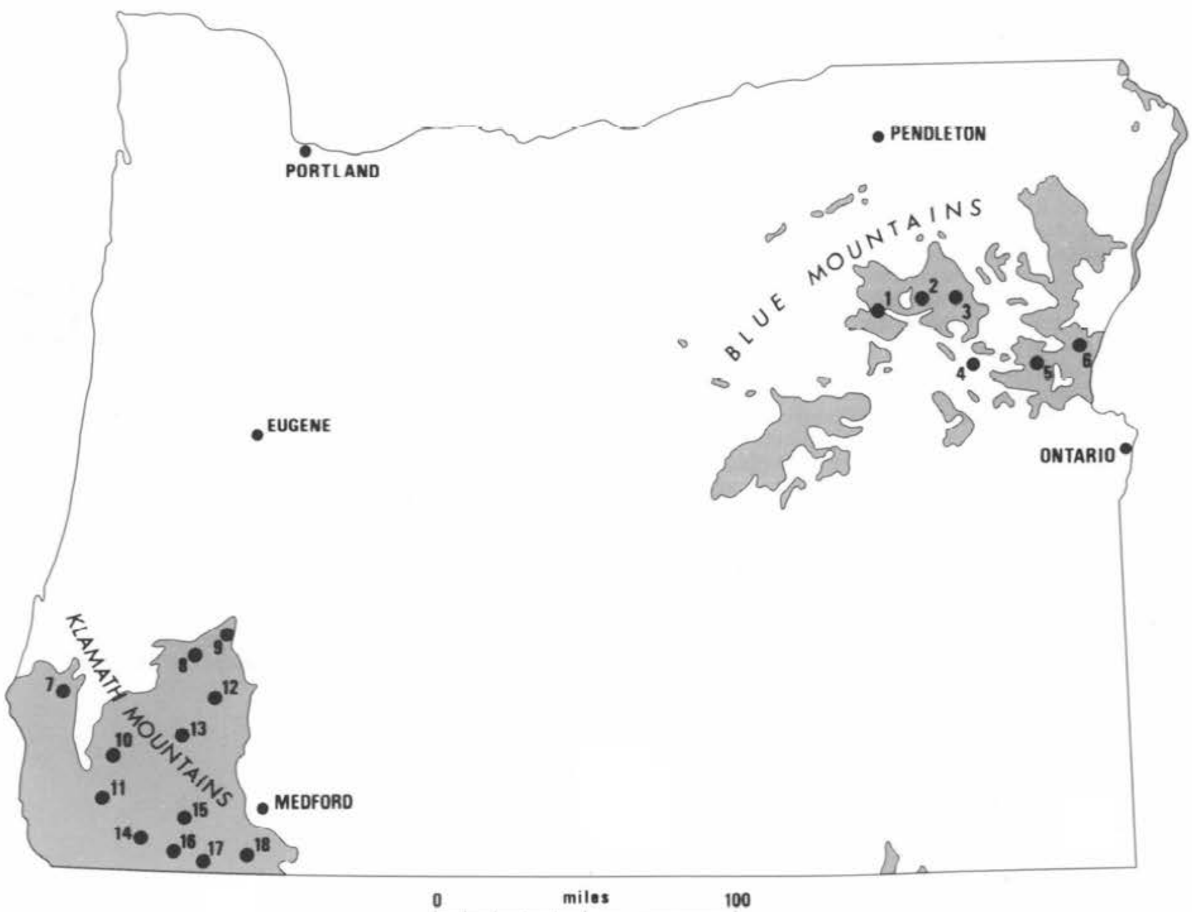

Figure 1. Oregon talc areas. Shaded areas indicate rocks of Late Jurassic and greater age. Numbered areas referred to in text: 1 = Greenhorn, 2 = Sumpter, 3 = Elkhorn, 4 = Dooley Mountain, 5 = Basin Creek, 6 = Connor Creek, 7 = Powers-Agness fault zone, 8 = Coast Range thrust, 9 = Myrtle Creek, 10 = Galice, 11 = Pearsoll Peak, 12 = Red Mountain-Upper Pleasant Creek, 13 = Greenback, 14 = Sucker Creek, 15 = Williams, 16 = Carberry Creek, 17 = Elliott Creek Ridge, 18 = Siskiyou Peak.

INTRODUCTION

LOCATION

Oregon talc deposits are associated with altered serpentinites in the pre-Tertiary terranes of the Blue Mountains in northeastern Oregon and in the Klamath Mountains in southwestern Oregon (Figure 1). Altered serpentinites are found primarily in the metamorphic halos of quartz diorite intrusions of Late Jurassic age. Placer gold deposits are spatially associated with many of the talc occurrences.

PAST PRODUCTION

Industrial talcs have not been produced in Oregon. The only active talc mine in the state is the Pugh Mine (Steatite of Southern Oregon) on Elliott Creek Ridge in the Klamath Mountains in Jackson County, which produces carving-grade soapstone. Small amounts of talc used in carving figurines were also produced from a few other localities in earlier years.

PREVIOUS INVESTIGATIONS

Little information has been published on talc occurrences in Oregon. The Pugh Mine in Jackson County, described by Peterson and Ramp (1978), is the only Oregon talc deposit previously described as such in the literature. Westgate (1925) and Gilluly and others (1933) showed the distribution of talc-bearing rocks in several eastern Oregon areas during studies of gold deposits and asbestos occurrences. Prostka (1967) described talc-tremolite deposits in the Durkee quadrangle in eastern Oregon.

Talc deposits described in unpublished Oregon Department of Geology and Mineral Industries (DOGAMI) file reports include the Powell Creek (Occurrence W-1 on Plate 3), Canyonville (Lilja), Summit Lake (Elliott Creek Ridge), and Bratcher deposits in southwestern Oregon (Treasher, 1941; Ramp, 1964) and the Harbo deposit in northeastern Oregon (Wagner, 1964). Theses that mention talc occurrences include Black (1979), Ferns (1979), and Wolff (1965).

PRESENT WORK

The talc project was started in late 1985 in response to the DOGAMI commitment to the task of identifying and characterizing the industrial-mineral resources of Oregon. The project began with a literature search for published and unpublished references to Oregon talc. Field work began in the spring of 1986, with the senior author working mainly in the Blue Mountains and the junior author concentrating on the Klamath Mountains. The early part of the summer was spent in mapping the larger deposits previously known in the literature or previously recognized by DOGAMI geologists during earlier mapping projects. The larger talc deposits were mapped to determine size, homogeneity, and geologic setting. The latter part of the summer and early fall were spent in searching for reported occurrences and in areas mapped by previous workers as serpentinite.

Samples collected during the study were examined under the binocular microscope before preliminary petrographic analyses. Powders were examined in immersion oils, and thin sections were made of selected samples. The mineralogy of pulverized splits from some samples was checked by X-ray diffraction. Reflectance readings were determined for those samples. Sample splits were also assayed for precious and selected platinum-group metals. Due to time constraints, samples collected from deposits located during the latter phase of the study were examined only microscopically and were not subjected to X-ray or chemical analysis.

ACKNOWLEDGMENTS

The authors wish to thank Dick Berg of the Montana Bureau of Mines and Geology for his assistance in developing this project and in reviewing the manuscript. We also wish to thank Jack Rice of the University of Oregon for critically reviewing the manuscript. Patrick K. Starnes of Ashland assisted with much of the field work and mapping of the Elliott Creek Ridge deposits. We especially thank Gary Baxter, DOGAMI Geochemist, who prepared the samples for chemical and physical analyses and performed brightness tests. We also thank Ron Geitgey, DOGAMI Industrial Minerals Specialist, for interpreting X-ray diffraction data and providing a critical review of the manuscript. John Pugh, Steatite of Southern Oregon, is thanked for his cooperation and assistance in providing material for the report. Beverly Vogt and Klaus Neuendorf of DOGAMI edited the manuscript and prepared the report for publication; Paul Staub and Mark Neuhaus prepared the maps and illustrations.

COMMERCIAL ASPECTS OF TALC

MINERAL TALC

The mineral talc is not the same as the industrial commodity talc. The mineral talc is a hydrous magnesium silicate with the molecular formula of approximately ($Mg_3Si_4O_{10}[OH]_2$) that may contain minor amounts of Al, Fe^{+2}, and Fe^{+3}. The industrial commodity talc, which is a rock used in industrial applications, contains talc and other minerals such as tremolite and chlorite.

The mineral talc is a monoclinic silicate that is made up of a sheet of octahedrally coordinated magnesium ions sandwiched by layered sheets of silica tetrahedra. Because of this layering, talc, as other sheet silicates such as chlorite and mica, can be split into very thin sheets that tend to slide easily past one another, a property called "slip" that is important in some industrial talc applications.

Other industrially useful properties of talc include softness, whiteness, and brightness. Talc is an exceptionally soft mineral that can be scratched by a fingernail. The softness and platy habit of talc allow it to be pulverized into very small particles only a few microns in size. When pulverized, pure talc is dead white in color and can be used in a number of industrial applications requiring white material.

COMMERCIAL TALC

The industrial commodity talc is a rock comprised mainly of the mineral talc that is used in industrial applications. In the past, the industrial commodity talc was often very different from the mineral talc, in that much of the talc used commercially contained a large amount of the calcium amphibole tremolite. Other minerals often present in commercial talcs include chlorite, mica, dolomite, magnesite, pyrophyllite, serpentine, anthophyllite, quartz, and montmorillonite.

A number of terms are used to describe different industrial varieties of talc. Steatite is a massive, cryptocrystalline form of talc that is suitable for making electronic insulators and can be easily sawed, drilled, or machined. The term "lava talc" is sometimes applied to steatite talc suitable for firing. French chalk is a soft, massive talc used in marking cloth, while the name "soapstone" refers to all massive gray, bluish-gray, or green talcs that usually have a slippery feel and can be hand carved.

USES

The largest use of talc and talc-group minerals is in the manufacture of ceramics — kiln furniture, sanitary ware, floor and wall tile, dinnerware, glazes, and electrical porcelains. Much of the talc used in ceramics is a mixture of talc and tremolite.

The second largest use of talc minerals is as filler and/or pigment in paint. Platy talcs are most suitable, since they generally have good hiding power, act as pigments in their own right, and serve to entangle and buoy up particles of other pigments, helping to keep them in suspension during prolonged storage.

The third largest use of talc is in the roofing industry. Talc is added to tar paper, asphalt shingles, and roll roofing to provide a nonsticking, chemically inert, fire-retardant, and weather-resistant surface.

The paper industry is the fourth largest consumer of domestic talcs. The paper industry uses high-purity talcs that are used for adsorbing pitch resins that would otherwise leave brown spots in the finished paper. The talc also acts to increase the whiteness of the paper and adds weight to the paper.

The plastics industry is now the fifth largest user of talc minerals. Talc is used as a filler and/or reinforcer in either thermosetting or thermoplastic resins to improve chemical and heat resistance, dimensional stability, hardness, thermal conductivity, tensile strength, creep resistance, and electrical insulation.

Talc is used in other industries, as well. Chemically stable, grit-free soft talcs are used by the cosmetic and pharmaceutical industry. Talc is also widely used in the rubber industry, where it functions as an inexpensive mold release agent that prevents adjacent rubber pieces from sticking to each other. The rubber industry also uses talc as a filler in applications where it provides internal lubrication.

Other uses of talc include its use as a carrier and/or diluter for insecticides and chemical-warfare agents, as a filler in floor waxes and shoe polishes, and as an agent in peanut polishing and salami dusting. Massive talc is sawed into blocks and used for marking crayons, sink tops, and decorative carvings. Massive, varicolored talc such as that produced by Steatite of Southern Oregon is especially in demand as carving material.

Clifton (1985) provides a list of industrial uses that require specific talc properties. These are listed below:

1. **Ceramics:** For this use, talc must have uniform chemical and physical properties. Manganese and iron are usually objectionable contaminants. No more than 0.5 percent CaO, 4 percent Al_2O_3, and 1.5 percent iron oxide can be tolerated in making high-frequency insulators.
2. **Paints:** Impure talcs that grind to colors other than white are highly objectionable. At least 98.5 percent of the talc must pass through a 325 mesh screen to produce the desired smooth paint film. Suitable talc-carbonate rock is acceptable for some uses.
3. **Roofing:** Low-grade off-color and impure talcs are acceptable.
4. **Insecticides:** Acceptable talcs must be chemically inert with respect to toxicants and have low abrasive characteristics and satisfactory bulk densities.
5. **Rubber:** Individual requirements depend on specific compounding formulations where talc is used as a filler. Volume changes, amount of filler, and particle size all affect the stress-strain characteristics of the product.
6. **Paper:** Suitable talcs must be chemically inert, soft, and free from grit; they must also have suitable ink acceptance, brightness, and dispersibility-in-water characteristics.
7. **Cosmetics and pharmaceuticals:** Suitable talcs must be free from grit, chemically pure, and pleasing in color, with uniformly fine particle distribution. Cosmetic talcs must have good dry slip characteristics.

DEMAND

According to the U.S. Bureau of Mines (Clifton, 1985), the average price received by domestic talc-group mineral producers for finished (pulverized) talc in 1983 was $93.55/

Table 1. *Talc supply-demand relationships, 1973-1983 (Values are in thousand short tons)*

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
					World production						
United States	1,247	1,290	965	1,092	1,205	1,384	1,453	1,240	1,243	1,135	1,066
Rest of world	4,710	4,994	4,420	4,714	4,995	5,667	6,126	7,060	6,612	6,460	6,487
Total	5,957	6,284	5,385	5,806	6,200	7,051	7,579	8,300	7,955	7,595	7,553
					Components and distribution of U.S. supply						
Domestic mines[1]	1,247	1,290	965	1,092	1,290	1,384	1,453	1,240	1,343	1,135	1,066
Imports	33	30	23	20	22	19	22	21	27	27	44
Industry stocks, Jan. 1	71	448	521	420	419	370	476	487	428	398	396
Total U.S. supply	1,351	1,768	1,509	1,532	1,731	1,773	1,951	1,748	1,798	1,560	1,506
Distribution of U.S. supply											
Industry stocks, Dec. 31[e]	448	521	420	419	370	476	487	428	398	396	304
Exports	180	183	158	212	322	267	316	275	311	232	218
Industrial demand	1,004	1,064	931	901	1,039	1,030	1,148	1,045	1,089	932	985
					U.S. demand pattern						
Ceramics	346	221	185	280	317	274	323	295	387	312	346
Cosmetics	40	35	31	37	75	69	74	59	75	45	50
Insecticides	43	47	42	40	47	40	46	39	42	26	17
Paint	178	158	141	191	211	193	238	198	207	171	167
Paper	80	89	67	60	69	87	105	102	88	79	81
Plastics	*	*	*	60	120	148	113	111	111	55	58
Refractories	54	39	50	62	63	45	62	71	41	24	25
Roofing	60	93	88	95	80	128	132	102	90	104	105
Rubber	32	25	16	19	52	37	40	38	36	22	28
Other	171	364	315	57	5	9	15	30	12	94	108
Total demand	1,004	1,064	931	901	1,039	1,030	1,148	1,045	1,089	932	985

e = Estimated
1 = Crude ore mined
* = Included in "other"
Data from Clifton, 1985

ton (based on 1983 dollars). The total 1983 production of domestic talc and talc-related minerals was 1,066 thousand short tons (980 thousand short tons of talc and 87 thousand short tons of pyrophyllite), while imports of talc and pyrophyllite were 44 thousand tons. Domestic sources consumed 985 thousand tons of talc and pyrophyllite, and an additional 218 thousand tons were exported. Production has increased steadily since 1983 from 1,042,000 tons in 1984 to 1,188,000 tons in 1985 and 1,219,000 tons in 1986.

Despite periodic economic recessions, the demand for talc has remained relatively constant since 1973 (Table 1). General end-use trends include a gradual increase in uses as fillers in plastics and in roofing materials and a gradual decrease in uses in insecticides and refractories.

Many materials, including calcium carbonate and clay minerals, compete with talc in filler applications. However, there are currently no economic substitutes for talc in applications that depend on talc's unique properties in the production of ceramics, cosmetics, and plastics.

The U.S. Bureau of Mines expects that the domestic demand for talc in the year 2000 will be between 1.4 and 4.8 million tons (Clifton, 1985). Identified reserves of talc and pyrophyllite in the United States are at least 150 million tons. The currently identified domestic reserves are more than adequate to meet anticipated domestic demands. However, continued uncertainties in the Occupational Safety and Health Administration (OSHA) regulations regarding tremolite may decrease use of tremolite-bearing talcs and reduce both domestic demand and the domestic resource base. Already some talc consumers have turned to competing products due to court cases and publicity surrounding the asbestos issue.

FIBROUS MINERALS

The presence of asbestiform minerals sharply reduces the value of certain industrial talcs due to the public concern in recent years regarding carcinogenic effects of asbestos exposure. This problem has affected the domestic talc industry because there is considerable confusion over what constitutes asbestos minerals due to the lack of semantic differentiation between massive amphibole and serpentine minerals and their asbestiform varieties. For example, the mineral tremolite is commonly associated with talc. The name "tremolite" is the only term given to both the nonfibrous and asbestiform varieties. Chemically and mineralogically, both varieties are identical. X-ray diffraction patterns are identical. As another example, the mineral serpentine is actually a group of minerals of approximately the same composition, one of which, chrysotile, is normally asbestiform. Chemical analyses cannot distinguish between massive chrysotile, asbestiform chrysotile, or the other serpentine minerals lizardite and antigorite.

The U.S Bureau of Mines (Campbell and others, 1977) has attempted to address the semantics problem by defining asbestos as "a term applied to six naturally occurring minerals exploited commercially for their desirable physical properties, which are, in part, derived from their asbestiform habit. These six minerals are the serpentine mineral chrysotile and the amphibole minerals grunerite asbestos (also referred to as amosite), anthophyllite asbestos, riebeckite asbestos (also referred to as crocidolite), tremolite asbestos, and actinolite asbestos. Individual mineral particles, however processed and regardless of their mineral name, are not demonstrated to be asbestos if the length-to-width ratio is less than 20 to 1."

OSHA considers the naturally occurring amphibole minerals amosite, crocidolite, anthophyllite, tremolite, and actinolite and the serpentine mineral chrysotile as asbestos if individual crystallites or crystal fragments have lengths greater than 5 micrometers, maximum diameters less than 5 micrometers, and length-to-diameter ratios of 3:1 or greater. Any product containing any of these minerals in this size range is considered by OSHA to be asbestos.

The debate over asbestiform minerals continues. OSHA issued a standard in June 1986 that would regulate all forms of tremolite and actinolite as stringently as asbestos. The current OSHA standard for asbestos is 0.2 fibers/cubic centimeter of air in the workplace. Given this uncertainty, talc users have been searching for sources of amphibole-free talc and alternative materials that can be used as talc substitutes. This report does not distinguish between fibrous and prismatic or massive forms of amphiboles in talc samples. In terms of present regulations, a worst-case scenario is one in which all amphiboles are considered to be deleterious minerals that greatly reduce the suitability of the talc for industrial applications. At this juncture, it appears that a dirty, amphibole-free talc is more desirable than a clean, amphibole-bearing talc.

GEOLOGY AND MINERALOGY OF OREGON TALC DEPOSITS

PRE-TERTIARY ROCKS

With the exception of a very minor amount of talc associated with dolomite at the Bristol silica mine in Jackson County, all Oregon talc deposits occur in altered serpentinites located in the older pre-Tertiary terranes of northeastern and southwestern Oregon. In the Klamath Mountains of southwestern Oregon, serpentinites sometimes underlie relatively unserpentinized peridotite at or near the base of major low-angle thrust faults. Serpentinites in the Klamath Mountains often mark major tectonic boundaries between large crustal plates. Small serpentine lenses associated with blueschist pods are also found in argillaceous melange zones of Late Jurassic to Early Cretaceous age.

Relatively narrow zones of sheared serpentinite and serpentinite-matrix melanges occupy fault zones in both northeastern and southwestern Oregon. Serpentinites in the Blue Mountains of northeastern Oregon occur mainly as matrix material in serpentinite-matrix melange zones.

OREGON TALCS

Almost all Oregon talcs are impure and consist of complex mixtures of talc, carbonate minerals, serpentine minerals, chlorite, and iron oxides (Table 2). The amphibole minerals tremolite, cummingtonite, and anthophyllite are common constituents in carbonate-free talcs. Although the talc-carbonates are nearly always highly iron stained and visually the least appealing of the Oregon talcs, the talc-carbonates may offer the best hope for industrial applications due to their apparent lack of contained amphibole minerals.

MINERALOGY

Talc

Most of the Oregon talc is a rusty shade of green or gray and has a soapy feel. When pulverized, talc surface samples yield powders that are light tan in color. The variation in talc color from white and light green or gray to the darker greens is a function of the amount of chlorite and/or serpentine minerals in the sample. The rusty color is from oxidized iron minerals that are present in nearly all samples. The talcs are soft, and nearly all can be easily scratched by a fingernail. In thin section, talc presents a number of forms ranging from microcrystalline mats of aligned, feathery crystals to individual plates measuring as much as 3 mm in diameter. The coarser crystalline varieties occur mainly as granular crystals intergrown with carbonate minerals.

Amphibole

The amphibole minerals tremolite ($Ca_2Mg_5Si_8O_{22}[OH]_2$) and/or anthophyllite ($[Mg,Fe]_7Si_8O_{22}[OH]_2$) are common constituents of Oregon talcs. Tremolite occurs both as well-crystallized, prismatic forms and as fibrous or acicular needles. The white or gray tremolite crystals are easily recognized in hand specimen, even though they seldom make up more than 1 to 2 percent of the talc rock. As evidenced by Figure 2, the analyzed Oregon talcs do not contain enough CaO to allow for formation of abundant tremolite. The tremolitic talcs usually grind to a white or off-white powder and are lighter in color than amphibole-free talcs, which are usually softer. Other amphiboles that are sometimes present

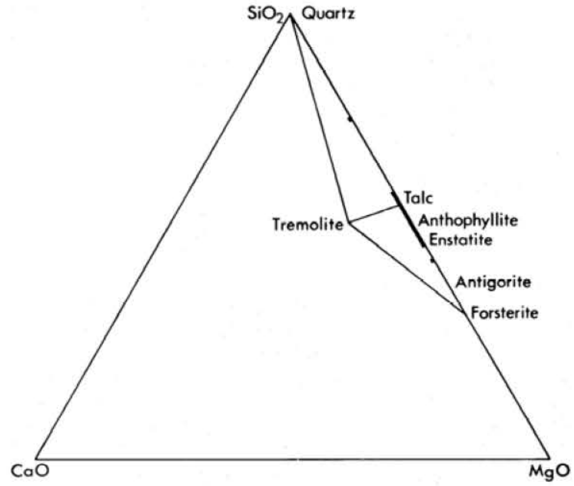

Figure 2. CaO-MgO-SiO_2 diagram. Heavy lines denote Oregon talc analyses. See Appendix 7 for individual analyses.

include the orthorhombic magnesium amphibole anthophyllite and the iron-bearing monoclinic amphibole cummingtonite ($[Mg,Fe^{+2}]_7[Si_8O_{22}][OH]_2$). Anthophyllite can be recognized in thin section by its parallel extinction. Cummingtonite has a higher refractive index than tremolite and can be distinguished in immersion oils. Neither tremolite nor anthophyllite has been identified thus far either by X-ray diffraction or by petrographic methods in the massive talc-carbonates from northeast Oregon.

Carbonate minerals

The types of carbonate mineral(s) in the talc-carbonate masses have not been unequivocally determined. According to the X-ray diffraction analyses, magnesite and less commonly dolomite are the major carbonate phases. The low CaO concentrations in analyzed samples (Table 3) indicate that the carbonate(s) are probably not high-Ca varieties.

The talc-carbonates are made up of as much as 40 percent carbonate minerals. The carbonates are often weathered out, with limonitic pits left on weathered surfaces, giving massive talc-carbonate rocks a characteristic reddish-orange color in outcrop. This characteristic limonite stain indicates that the carbonates probably contain a substantial amount of iron and are likely ferromagnesite, ankerite, or siderite. The carbonate ranges from white to pale orange in color in unweathered samples and, when finely powdered, will react with hydrochloric acid. In thin section, the carbonates are sometimes rimmed with a nearly isotropic mixture of chlorite and iron oxides. Ground talc-carbonate powders range from light tan to dark tan in color, with the unweathered samples characteristically being lighter in color.

Serpentine minerals

The specific identity of serpentine minerals associated with Oregon talc deposits could not be determined for this

Table 2. *Mineralogy of selected Oregon talcs (Identification by X-ray diffraction and/or optical mineralogy)*

Minerals present	Sumpter talc schists (Sumpter area)	Sumpter talc-carbonate (Sumpter area)	Dooley Mtn. talcs	Elliott Creek talcs	Red Mtn. talcs	Dutchman Peak talcs (Siskiyou Peak area)	Rock Creek chorite	Connor Creek talcs	Carberry Creek talcs	Little Applegate talcs (Siskiyou Peak area)
Talc	M	M	M	M	M	M	-	M	M	M
Tremolite	m	-	m	m	m	m	-	m	m	m
Anthophyllite/ cummingtonite	m	-	m	m	m	m	-	m		m
Chlorite	m	tr	tr	m	tr	m	M	tr		m
Carbonate	-	M	tr	x	tr	tr	-	-		tr
Serpentine	tr	tr	tr	-	tr	-	-	m		tr
Quartz	m	tr	-	-	-	-	-	-	-	tr
Chromite	tr	tr	tr	x	tr	tr	tr	-	-	-
Magnetite	tr	tr	tr	x		tr	tr	-	-	tr
Olivine	-	-	-	-		-	-	tr		-
Pyrite	-	-	tr	x	-	-	-	-		-
Amphibole and carbonate	N	N	N	N	-	O	-	N		-

M = Major phase
m = Minor (<5%)
tr = Trace
N = Not observed in same sample
O = Observed in same sample

study by either X-ray diffraction analysis or optical methods. Relict olivine grains in the talc-olivinites were usually nearly totally replaced by mesh-textured serpentine minerals. Narrow serpentine veinlets were observed in thin section in a small number of samples. Chrysotile was observed in asbestiform veinlets in the Dooley Mountain area (Area 4, Figure 1). A fine granular serpentine veinlet was observed in a thin section from a Sumpter area talc-carbonate.

Areas of partial to nearly complete steatization of serpentinite are common in southwestern Oregon, especially in major fault zones such as the Coast Range thrust (Area 8, Figure 1) and in the Greenback gold district (Area 13, Figure 1). These rocks are perhaps best described as sheared talc-serpentinites that are usually slightly magnetic due to included magnetite dust. Sheared talc-serpentinites such as those in the Greenback and Sucker Creek areas often contain minor gold values (see Appendix 6).

Chlorite

Chlorite is a common constituent in Oregon talc and talc-carbonates. In thin section, chlorite is usually colorless under plain light and nearly isotropic under crossed nicols. Chlorite containing opaque inclusions occurs as rims about carbonate in talc-carbonates from the Sumpter area (Area 2, Figure 1).

FORMATION OF TALC

INTRODUCTION

The following discussion of the genesis of talc applies only to deposits derived from serpentinites and metaserpentinites. Talc associated with dolomite at the Bristol Mine in southwestern Oregon is of a different origin. The reader is referred to Berg (1979) for a discussion of talc formation from dolomitic limestone.

This report classifies metamorphosed serpentinites containing metamorphic olivine as either antigorite-olivinites, talc-olivinites, anthophyllite-olivinites, or enstatite-olivinites, depending on the coexisting magnesium-silicate phase. Metaserpentinites containing carbonate minerals are classified as antigorite-carbonates or talc-carbonates, again depending on the coexisting magnesium-silicate phase. Carbonate-bearing metaserpentinites are commonly referred to as "ophicarbonates" (e.g., Trommsdorff and Evans, 1977).

Most Oregon talc deposits were formed by dehydration reactions involving serpentine during low-temperature metamorphism. Minerals of the serpentine group all have the approximate composition of $Mg_3Si_2O_5(OH)_2$. The three principal polymorphic forms of serpentine are lizardite, chrysotile, and the higher temperature phase, antigorite ($Mg_{48}Si_{34}O_{85}[OH]_{62}$). Chrysotile, which often occurs in veins of silky fibers, is the asbestiform serpentine mineral.

Talc ($Mg_3Si_4O_{10}[OH]_2$) is a magnesium silicate that contains proportionally less magnesium and water than the serpentine minerals. Talc may form from serpentine during either hydrothermal alteration or prograde metamorphism. Important processes include (1) dehydration of antigorite to form talc + olivine + H_2O; (2) addition of silica to serpentine to form talc + H_2O; and (3) dehydration of antigorite in the presence of a CO_2-rich fluid to form talc + magnesite ($MgCO_3$) + H_2O. Most of the Oregon talc deposits involve two or more of the above processes.

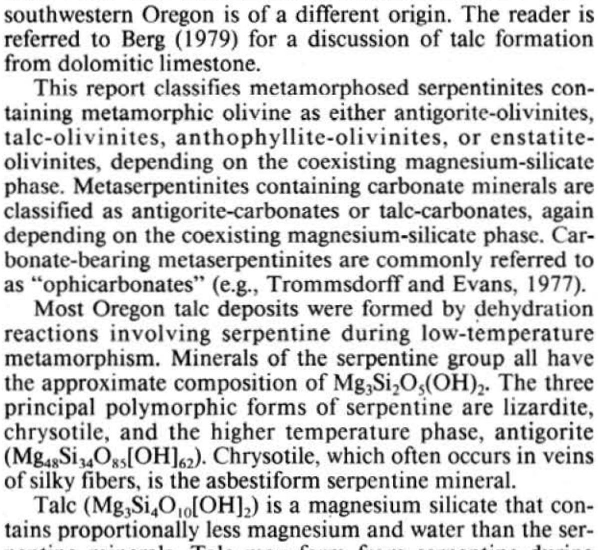

Figure 3. T-X_{CO_2} diagram at 2,000 bars total pressure (from Trommsdorff and Evans, 1977). Shaded area shows the temperature and fluid composition conditions under which tremolite would be an unstable mineral phase that would not be expected to coexist with talc and carbonate minerals. Numbered reactions are referred to in text.

PROCESSES INVOLVING CO_2-RICH FLUIDS

The largest homogeneous talc deposits identified in this study are the talc-carbonate masses in the Sumpter area and the massive talc lenses at the Pugh Mine on Elliott Creek Ridge in Jackson County. Talc in both areas apparently formed by fluxing of serpentinites by hot CO_2-rich fluids during prograde metamorphism or hydrothermal alteration. An appreciable amount of silica was added to the Sumpter talc-carbonate masses, as evidenced by Table 3.

Metamorphic reactions summarized by Trommsdorff and Evans (1977) for the CaO-MgO-SiO_2-CO_2-H_2O system that define the stability fields of talc-carbonate assemblages are shown in Figure 3. Pertinent reactions include (1) 1 talc + 5 magnesite = 4 forsterite + 5 CO_2 + H_2O; (2) 17 talc + 45 magnesite + 45 H_2O = 2 antigorite + 45 CO_2; (3) 47 talc + 30 dolomite + 30 H_2O = 15 tremolite + 2 antigorite + 60 CO_2; (4) 13 talc + 10 dolomite = 5 tremolite + 12 forsterite + 20 CO_2 + 8 H_2O; and (5) 1 antigorite = 18 forsterite + 4 talc + 27 H_2O.

Figure 3, simplified from Trommsdorff and Evans (1977), shows relative temperature and fluid composition conditions at a total pressure of 2,000 bars under which talc-tremolite and talc-carbonate rock would form from serpentine. The diagram predicts that tremolite will not coexist as a stable phase with either olivine-free talc + magnesite or talc + dolomite assemblages. The prediction of tremolite-free talcs in talc-carbonate rock is in agreement with this report's petrographic and XRD studies of the Sumpter talcs in which no tremolite has yet been identified in olivine-free talc-carbonate rocks. Figure 3 may be directly applicable to the large talc-carbonate masses in the Sumpter area that were apparently formed when the Bald Mountain Batholith was emplaced. Stimson (1980) estimates that the batholith was emplaced under about 2,000 bars total pressure.

DEHYDRATION REACTIONS

Talc also forms with olivine during simple dehydration of serpentine during prograde metamorphism (Figure 4). Reactions (5) 1 antigorite = 18 forsterite + 4 talc + 27 H_2O and (6) 9 talc + 4 forsterite = 5 anthophyllite + H_2O together define the pressure and temperature conditions under which talc and olivine are stable (Evans, 1977) (Figure 4). Tremolite is the stable calcium-bearing phase under these conditions, as evidenced by talc-olivinites with accessory tremolite in regionally metamorphosed metaserpentinites in the Klamath Mountains (Ferns, 1979) and in the contact aureole of the Bald Mountain Batholith in northeastern Oregon (Stimson, 1980). Since the talc-olivinites often contain tremolite and seldom contain more than 30 percent talc, the talc-olivinites probably do not represent commercial talc resources and are not further described in this report.

HYDROTHERMAL TALCS

Talc deposits that formed during hydrothermal alteration of serpentine are often spatially associated with gold miner-

Table 3. *Major-element abundances in various commercial and Oregon talcs (All values are in weight percent)*

Oxide	Pure talc theoretical	Carbonate Vermont	Flotation talc Vermont Johnson Mine	Roofing granules Georgia Southern Talc Co.	Steatite Montana Yellowstone Mine	Talc ore New York Talcville	Talc Texas	Talc-carbonate Oregon Sumpter area (Average of 5)	Talc amphibole Oregon Sumpter (Average of 3)	Talc Oregon Elliott Creek	Talc-tremolite Oregon Elliott Creek	Talc Oregon Cow Creek	Talc-carbonate Oregon Little Applegate
SiO_2	63.36	35.98	59.15	47.92	62.65	59.8	54.92	49.76	56.2	58.5	50.9	59.1	31.2
MgO	31.98	32.95	31.34	26	30.23	27.45	27.2	29.6	22.9	29.9	28.4	31.2	36.0
Fe_2O_3	---	0.65	3.36	6.82	1.51	0.05	0.46	7.96	6.03	5.08	7.55	3.82	7.36
TiO_2	---	0.02	---	0.15	---	---	---	0.12	0.08	0.04	0.05	0.04	0.03
Al_2O_3	---	0.43	0.26	7.35	0.31	0.57	5.76	2.21	1.38	0.89	5.15	0.18	0.14
CaO	---	---	0.15	4.14	tr	6.8	---	0.29	0.21	0.01	0.25	0.27	0.19
K_2O	---	---	---	---	0.05	---	---	0.01	0.02	0.01	0.01	0.01	0.01
Na_2O	---	---	---	---	0.15	---	---	<.01	<.01	<.01	<.01	<.01	0.03
CO_2	---	20.45	1.76	---	0.27	1.18	---	---	---	---	---	---	---
H_2O	4.75	2.73	4.3	0.05	4.87	---	---	---	---	---	---	---	---
MnO	---	0.41	---	---	---	0.39	---	---	---	---	---	---	---
S	---	0.06	---	0.09	---	0.03	---	---	---	---	---	---	---
NiO	---	0.21	---	---	---	---	---	---	---	---	---	---	---
Cr_2O_3	---	0.18	---	---	---	---	---	0.3	0.21	0.25	0.25	0.12	0.53
P_2O_5	---	0.01	---	---	---	---	---	0.02	0.03	0.01	0.01	0.01	0.01
LOI	---	---	---	7.51	---	4.75	10.76	9.41	4.9	5.31	7.08	5.62	24.3

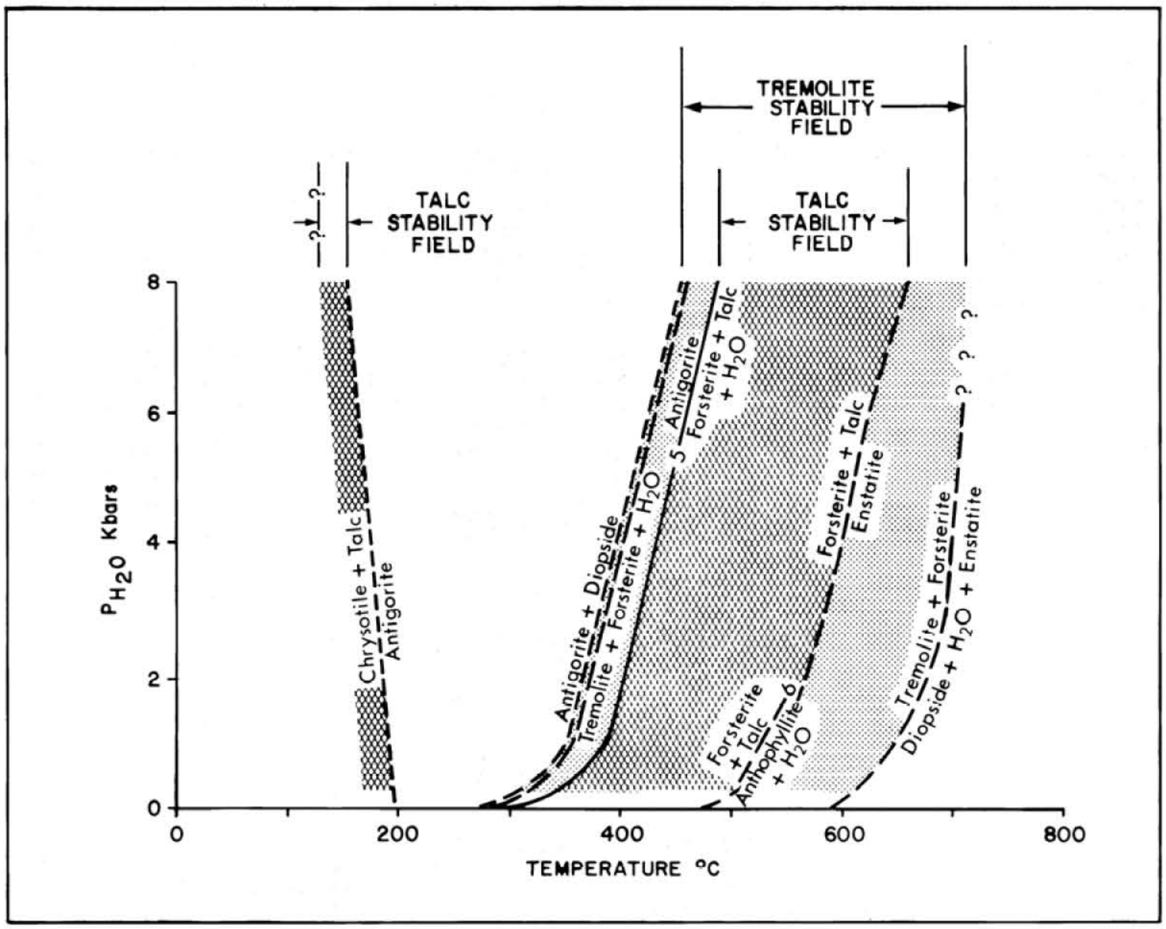

Figure 4. Metamorphic phase relationships for the system CaO-MgO-SiO_2-H_2O (simplified from Evans, 1977). Pressure and temperature conditions under which talc and tremolite can exist as stable minerals are shown. Note that tremolite is the stable CaO mineral phase over the high temperature-pressure range in which talc is stable. Numbers "5" and "6" indicate reactions 5 and 6 referred to in text.

alization. Many of these deposits are also closely associated with intrusions of Late Jurassic age. In some instances, as in the Susanville mining district in the Greenhorn area (Area 1, Figure 1), the hydrothermal talcs crosscut metamorphic talc-olivinites. Talc-carbonate zones have been often reported as envelopes separating gold-bearing listwaenites from unaltered serpentines (Buisson and Leblanc, 1985). According to Buisson and Leblanc (1985), listwaenites are altered ultramafic lenses that are composed of Mg-Fe-Ca carbonates (ankerite), quartz, serpentine, talc, fuchsite (Cr-muscovite), hematite, and magnetite that grade laterally through massive talc-carbonate rock into unaltered serpentine.

Gold mineralization in the listwaenite zones is believed to have been derived by leaching of serpentine by carbonate-rich waters. The talc-carbonate envelopes presumably are leached serpentinites that are depleted in gold. The extremely low gold values (<2 parts per billion [ppb]) of the talc-carbonate zones analyzed in this study as compared with adjacent unaltered serpentine (10 ppb) in the Sumpter area (Appendix 6) support the notion that carbonate-rich waters are capable of removing gold from serpentinites. In northeastern Oregon, the gold quartz veins of the Greenhorn district (Area 1, Figure 1) are excellent examples of listwaenites with talc-carbonate envelopes.

IRON-BEARING MINERAL PHASES

Since most serpentinites contain as much as 10 weight percent iron oxides, the behavior of iron during alteration is of major importance in evaluating talcs. Iron is a detrimental element in talc ores and must be separated from the ore prior to most industrial applications.

Our observations of iron-bearing mineral phases in the Oregon talcs are as follows:

1. Iron remains in the form of magnetite and chromite during most metamorphic dehydration reactions.
2. Some iron is incorporated into magnesite during carbonatization reactions. The weathering of magnesite and/or ankerite in talc-carbonate rocks forms limonitic vugs that are characteristic of talc-carbonate outcrops.
3. Iron may go into a silicate phase, as evidenced by the presence of the iron-bearing amphibole cummingtonite in carbonate-free samples.
4. Iron may also go into a sulfide phase, as evidenced by the pyrite locally present at the Pugh Mine, the Cow Creek deposit, and other occurrences.

INDUSTRIAL POTENTIAL

Two talc areas that may warrant additional research are the Elliott Creek Ridge area in southwestern Oregon (Area 17, Figure 1) and the Sumpter area (Area 2, Figure 1) in northeastern Oregon. The Elliott Creek Ridge area, which contains the only active talc mine in Oregon, is now producing small amounts of high-value per unit carving-grade soapstone. The economic incentive to produce high-value carving-grade material and the apparently limited volume of talc in this area makes it unlikely that the Elliott Creek Ridge material will ever be used in lower value industrial uses.

The talc-carbonate masses in the central part of the Sumpter area are the largest volume of potentially amphibole-free talc in Oregon. Future work is necessary to confirm that the talc-carbonates are actually free of amphibole minerals and that they constitute large enough masses to be economically mined. This type of work would require extensive surface sampling and some core drilling. Provided that initial testing indicated a substantial volume of amphibole-free talc-carbonate, beneficiation tests would then be necessary to determine if a suitable industrial-grade talc could be produced from the talc-carbonates. Any testing of the talc-carbonates should consider the possibility of potentially valuable coproducts such as dolomite, chromite, and nickel.

The other Oregon talc areas described below are less likely to host any potentially valuable industrial-grade talc. Carving-grade talc is likely to be found in some of the areas. These talc occurrences may be of most use as indicators of areas of hydrothermal alteration that may be of use in locating gold prospects.

The source for the chlorite boulders in Rock Creek (Occurrence A-1) in southwestern Oregon should be determined. The boulders appear to be suitable for the fashioning of marking pencils.

DESCRIPTION OF TALC OCCURRENCES

INTRODUCTION

Talc occurrences identified during the study are listed and briefly described below. They do not represent a complete catalogue of Oregon talc occurrences. The areas described in this text undoubtedly contain additional talc deposits that have not been seen by the writers. Characteristics common to the deposits include the following:

1. Talc is more often found in and along the disrupted smaller ultramafic masses that are often associated with zones of intense faulting (e.g., the Powers-Agness area and the Coast Range thrust, Areas 7 and 8, Figure 1) than in or along the larger ultramafic sheets such as the Josephine Peridotite and Canyon Mountain Complex.

2. Zones of talc alteration are commonly spatially distributed about the margins of intrusions of Late Jurassic age (e.g., Sumpter, Red Mountain-Upper Pleasant Creek, and Carberry Creek, Areas 2, 12, and 16, Figure 1).

3. Talc alteration zones are often spatially associated with placer gold districts (e.g., Dooley Mountain, Greenback, and Sucker Creek, Areas 4, 13, and 14, Figure 1).

NORTHEASTERN OREGON

Northeastern Oregon talc deposits (Plate 1) occur in the matrix of melange zones and along high-angle faults and thrust faults that have served as conduits for post-serpentine intrusions and hydrothermal fluids. Most of the occurrences are located in the disrupted oceanic crust terrane first described by Brooks and Vallier (1978). This belt of rocks, now called the Baker Terrane (Silberling and Jones, 1984), is a structurally complex tectonic collage of oceanic and island-arc fragments that now separates two relatively coherent island-arc fragments.

Baker Terrane talc deposits are found in two distinct structural settings. The largest deposits occur where talc has replaced the serpentine matrix in elongate belts of serpentinite-matrix and slab melanges in the central part of the Baker Terrane (Plate 1). Smaller deposits occur where talc has replaced the serpentinite selvages along thrust faults and high-angle fault zones.

The only talc occurrences identified outside of the Baker Terrane are in the narrow mixed-rock zones and serpentine-matrix melanges found immediately to the south of the Baker Terrane in the Jurassic Weatherby Formation (Brooks, 1979).

Nearly all of the northeastern Oregon talc deposits are spatially associated with large quartz diorite intrusions of Late Jurassic age and are located upstream from major gold placer deposits, suggesting that talc formation may be related to periods of gold mineralization associated with the intrusions. The largest northeastern Oregon deposits are melange-hosted metamorphosed serpentinites (talc-carbonates, talc-amphibolites, and talc-olivinites) located in the contact aureole of the Bald Mountain Batholith in the Sumpter area (Occurrences S-1 to S-23, Plate 1).

Sumpter area

Numcrous talc deposits occur in a northwest-trending belt 5 mi wide and 25 mi long in the Sumpter area in western Baker and eastern Grant Counties. The main talc-bearing zones are in eastern Grant County, immediately to the east of the old mining camp at Granite. The small town of Sumpter lies in the southeast part of the area. Geologic maps of the area include the 1:250,000-scale Canyon City quadrangle (Brown and Thayer, 1966), the 1:62,500-scale Desolation Butte quadrangle (Evans, 1988), and the 1:24,000-scale Mt. Ireland, Bourne, and Granite quadrangles (Ferns and others, 1982; Brooks and others, 1982a,b).

The Sumpter area is mountainous, and the lower elevations are generally densely covered with a conifer forest made up of varying proportions of ponderosa and lodgepole pine, western larch, and Douglas and white fir. Most of the area lies in the Wallowa-Whitman or Umatilla National Forests and is easily reached by a network of logging roads that provide the principal exposures. The northwestern part of the area lies within the North Fork of the John Day River Wilderness Area.

The largest talc bodies lie between Boulder Creek and Deep Creek in eastern Grant County, where numerous talc zones are exposed along logging roads and old placer ditches. Poor exposures outside of road and ditch cuts precluded making a detailed geologic map of the deposits in this area. Generally speaking, even well-exposed disrupted ultramafic melange zones can not be adequately mapped by any means short of extensive excavation.

The Sumpter area covers a part of one of the premier gold-producing regions in Oregon and includes parts of the old Sumpter, Cracker Creek, Granite, and North Fork mining districts. Although this area has been investigated by a number of workers in the past, there is little mention of talcose rocks in existing literature. Previous mining efforts in the immediate area of the talc deposits were directed primarily at placer gold deposits.

Westgate (1921) was the first to recognize talc-carbonate rocks in the Sumpter area during a study of eastern Oregon chrome deposits. Brooks and others (1982a) were the first to recognize the wide areal extent and general geologic setting of the talc-carbonate rocks and talc-chlorite schists.

Most of the Sumpter talc occurrences are contact metamorphic deposits related to emplacement of the Bald Mountain Batholith. Large tremolite-free, talc-carbonate masses and tremolite-bearing, foliated talc-chlorite schists replace serpentinite that occurs both as discrete slices and slabs and as matrix in a block melange. The largest talc masses are found in the McCully Fork Mixed-Rock Zone (MFZ) over a 4 sq mi area between Boulder Creek and Deep Creek along the southern metamorphic contact aureole of the Bald Mountain Batholith (Plate 2).

The MFZ is a prominent, 2-mi-wide, northwest-trending belt of structurally disrupted rocks. The zone is a block melange of discreet lensoid slices and elongate slabs of argillite, serpentinite, pyroxenite, gabbro, diorite, quartz diorite, basalt, volcaniclastic breccias and conglomerates, limestone, and chert that are locally separated by zones of serpentinite-matrix block melange. Individual slices of argillite and serpentinite are generally elongated parallel to the trend of the MFZ and are no more than 3,000 ft in length and 500 ft in width. Cleavage traces and foliation planes generally parallel the northwesterly trend of the MFZ.

Block melange zones with a matrix of metaserpentinite are concentrated in the central part of the MFZ, where it widens between Boulder Creek and Deep Creek (Plate 2).

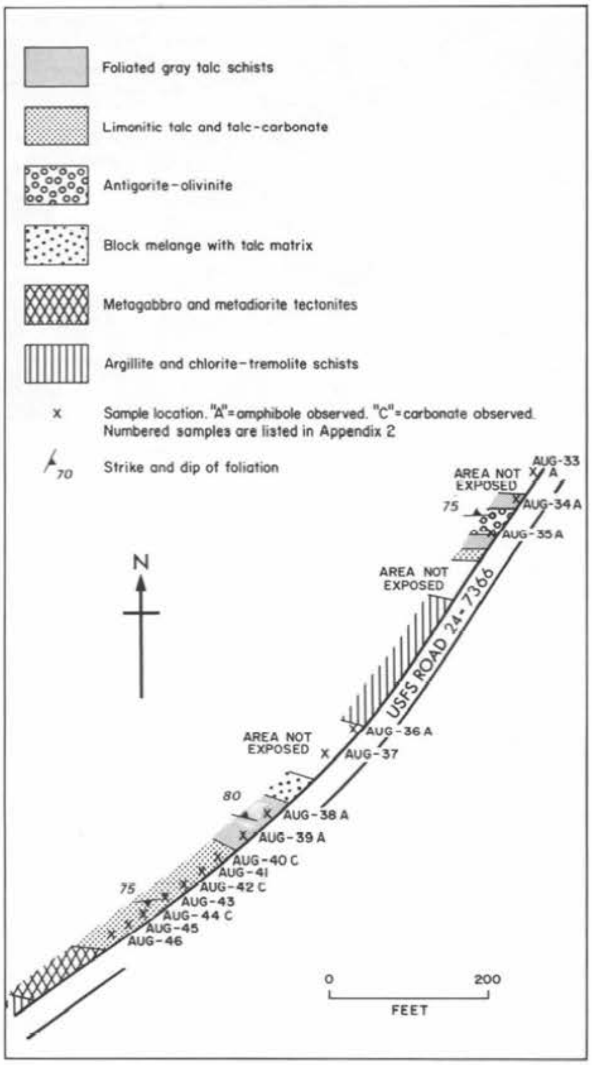

Figure 5. Sketch map of the Upper Corral Creek talc zone (S-1).

The block melanges are made up of nearly equidimensional blocks of greenstone and gabbro up to 100 ft in diameter that are randomly arrayed in a matrix of ultramafic rock. Blocks appear to make up from 30 to 90 percent of the material in the block melanges.

The talc occurrences between Boulder Creek and Deep Creek lie within the contact metamorphic aureoles of the Bald Mountain Batholith and the Grays Peak Stock (Plate 2). Metamorphic mineral assemblages in serpentinites are distributed in well-defined zones about the intrusions. Stimson (1980) identified an inner zone defined by the mineral assemblage of green spinel + orthopyroxene + olivine persisting to 690 ft from the Bald Mountain Batholith, a chlorite + orthopyroxene + olivine zone from 740 to 990 ft from the contact, and an outer zone of talc + olivine + antigorite + chlorite beginning at 990 ft from the contact. Our mapping in the Corral Creek area indicates that the talc + carbonate and talc + amphibole zones lie between 2,970 and 9,240 ft from the batholith contact. Metaserpentinites on the edges of the talc envelope are antigorite-talc-olivinites at 2,970 ft and antigorite schists at 9,240 ft.

Metamorphosed serpentinites within the talc envelope are totally converted to either talc-carbonate rock or talc-amphibole schists. Our petrographic and X-ray diffraction studies indicate that the amphibole minerals are confined to carbonate-free rocks within the talc envelope. If the talc-carbonate rocks are of sufficient homogeneity and size, they may constitute a source of amphibole-free talc.

Individual talc occurrences in the Sumpter talc area are described below. Occurrences S-1 through S-26 are metamorphic deposits dispersed about the Bald Mountain Batholith and Grays Peak Stock. Occurrences S-27 through S-35 are examples of hydrothermal talcs that lie outside of the contact aureoles of the major intrusions of Late Jurassic age. Many of these latter deposits contain quartz and carbonate in addition to talc. Most of the occurrences are exposed on U.S. Forest Service (USFS) roads and trails.

S-1 Upper Corral Creek 1 and 2

Location: NE¼NW¼ sec. 1, T. 9 S., R. 35½ E., 5,320-ft elevation, Mt. Ireland quadrangle.

Description: Two zones of talc-rich rocks cross USFS roads on the west side of Corral Creek (Figure 5). The northernmost zone is exposed along the upper road (USFS Road 24-7366) for about 100 ft across strike, and talc chips are found in soil along the road for an additional 65 ft. Talc occurs in foliated, limonitic gray talc-tremolite schists that occur on either side of a central core of massive antigorite-olivinite that is cut by 0.5-in.-wide talc veinlets. Talc-olivinites immediately to the north mark the outer edge of the talc-olivinite zone.

A second zone crosses USFS Road 24-7366 200 ft to the south. The northernmost 210 ft consists of intercalated talc-tremolite schists, chlorite schists, and talc-tremolite melange containing amphibolite blocks (Figure 6). The talc tremolite schists are foliated limonitic rocks that contain the monoclinic amphibole cummingtonite. The talc-tremolite schists are in sharp contact with a 212-ft-wide zone of massive, nonfoliated, vuggy limonitic talc-carbonate rock (Figure 7).

The talc ranges from various shades of gray to green in color. Several 8- to 16-in.-wide chlorite lenses are exposed in the southern edge of the talc-carbonate zone. Iron-oxides coat vugs containing relict orange-brown carbonate (magnesite).

Amphibole minerals were not detected in powders from seven samples taken at 25-ft intervals across the talc-carbonate zone that were analyzed in thin section, in immersion oils, and by X-ray diffraction.

S-2 Lower Boundary Creek

Location: SW¼NW¼ sec. 12, T. 9 S., R. 35½ E., 4,860-ft elevation, Mt. Ireland quadrangle.

Description: Two zones of massive, nonfoliated talc-carbonate rock partially replace serpentinite on the west side of Boundary Creek where USFS Road 24-7370 crosses Boundary Creek (Figure 8). The northern zone measures 46 ft across strike in outcrop on the south side of a fault separating Elkhorn Ridge Argillite and metaserpentinite. The talc is nonfoliated, white to gray in color, and heavily mottled with orange and brown iron oxides. Associated minerals include magnesite and trace amounts of chlorite, chromite, magnetite, and serpentine. The five samples from the zones that were examined petrographically and by X-ray diffraction did not contain amphibole minerals.

The northern zone includes an unexposed area of mixed talc-carbonate and serpentinite float and outcrops of massive

Figure 6. Outcrop of talc-carbonate rock on southeast extension of Upper Corral Creek zone (S-1).

green serpentine. Some of the serpentine float contains drusy quartz veinlets. In thin section, the serpentinites consist of mixtures of antigorite and magnesite.

The southern zone occurs adjacent to a 25-ft-wide fault zone containing talc, iron-stained gouge, and quartz stringers. The southern talc zone is about 60 ft wide and contains one discontinuous 6-in.-wide quartz vein.

Talc-carbonate samples (AUG-50, -51, -52, -53, and -54) from both zones are strongly depleted in gold (<2 ppb), as compared to the antigorite-carbonate rock (10 ppb).

S-3 Lower Corral 2

Location: SW¼NW¼ sec. 1, T. 9 S., R. 35½ E., 5,200-ft elevation, Mt. Ireland quadrangle.

Description: A 15-ft-wide zone of talc schist is exposed in a road cut along USFS Road 24-7366. Adjacent rocks are chlorite schists. An abandoned logging road across Corral Creek to the south cuts a 45-ft-wide talc-carbonate zone that occurs between argillite and a serpentine-carbonate rock veined with drusy quartz.

S-4 Lower Corral 1

Location: NE¼SE¼ sec. 2, T. 9 S., R. 35½ E., 5,120-ft elevation, Mt. Ireland quadrangle.

Description: A 15-ft outcrop of massive talc-carbonate rock is exposed along an 82-ft-wide zone of deeply weathered, heavily limonitic talc-carbonate rock on USFS Road 24-7366. Rocks to the south are dark-gray siliceous argillites, and rocks to the north are green chlorite-tremolite schists. Powders from three samples taken at 25-ft intervals across the talc-carbonate zone were examined under immersion oils and did not contain amphibole minerals.

Figure 7. Outcrop of talc-tremolite-chlorite schist on southeast extension of Upper Corral Creek zone.

S-5 Upper Boundary 3

Location: NW¼SW¼ sec. 6, T. 9 S., R. 36 E., 5,580-ft elevation, Mt. Ireland quadrangle.

Description: Talc-chlorite schists and talc-carbonate rock are poorly exposed as matrix in a gabbro knocker melange along USFS Road 24-7370 (Figure 9). A 200-ft-wide zone of talc-carbonate rock is exposed east of the melange. The eight samples from this zone examined in immersion oils did not contain amphibole minerals.

S-6 Upper Boundary 2

Location: NE¼SE¼ sec. 1, T. 9 S., R. 35½ E., 5,520-ft elevation, Mt. Ireland quadrangle.

Description: Talc-carbonate rock is exposed over a 75-ft interval on USFS Road 24-7370-035. The poorly exposed north end of the zone contains platy green talc-carbonate chlorite schist that can be traced by float to the ridge on the west, where abundant talc-carbonate float lies between greenstone and gabbro knockers. Two similar-appearing talc-carbonate zones occurring as matrix in block melange cross USFS Road 24-7370 to the southwest. The three samples (AUG-47, -48, and -49) taken at 25-ft intervals across the exposed zone on USFS Road 24-7370 were examined in thin section, in immersion oils, and by X-ray diffraction and did not contain amphibole minerals.

S-7 Upper Boundary 1

Location: NE¼SE¼ sec. 1, T. 9 S., R. 35½ E., 5,260-ft elevation, Mt. Ireland quadrangle.

Description: Limonitic talc-carbonate float is scattered along a 41-ft interval on USFS Road 24-7366. Float can be traced downhill for about 560 ft in elevation from the ridge top west of Boundary Creek down to the creek bed. Ten- to 20-ft-wide bands of talc-carbonate rock at the southeast extension of the zone separate blocks of greenstone, gabbro, and argillite exposed along a placer ditch east of Boundary Creek. A sample (AUG-71) from the 41-ft interval exposed on the road was examined in immersion oils and by X-ray diffraction and did not contain amphibole minerals.

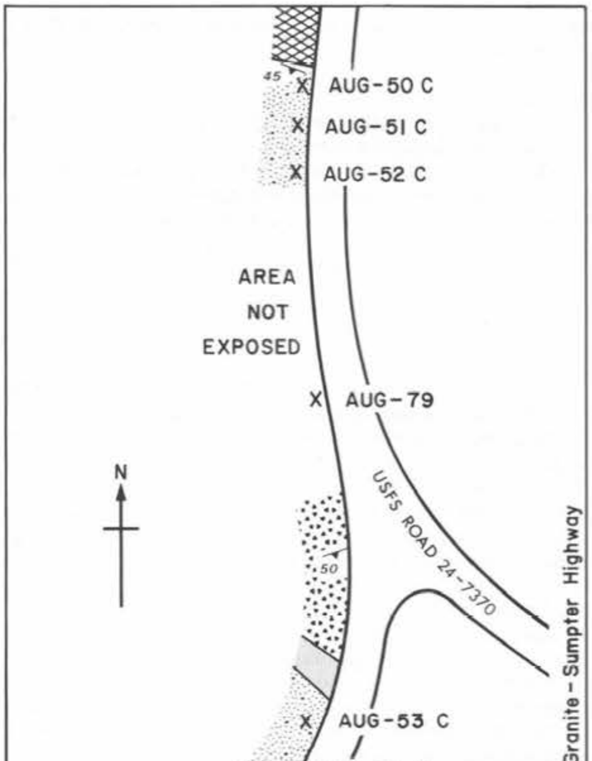

Figure 8. Sketch map of the Lower Boundary Creek talc zone (S-2).

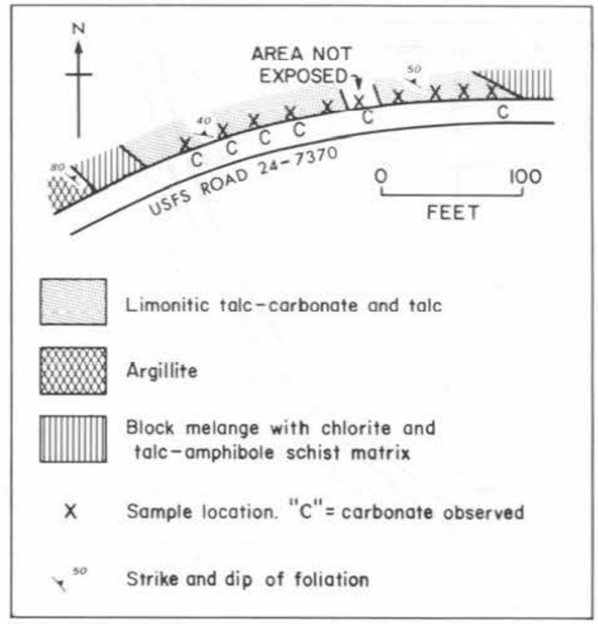

Figure 9. Sketch map of the Upper Boundary 3 talc zone (S-5).

S-8 Boundary Creek placer ditch

Location: SE¼SE¼ sec. 1, T. 9 S., R. 35½ E., 5,340-ft elevation, Mt. Ireland quadrangle.

Description: A talc-carbonate zone is exposed for 110 ft along an old placer ditch. The zone can be traced uphill to the southwest, where it grades into massive antigorite-carbonate rock that is veined by talc.

S-9 West Fork 1

Location: SE¼NE¼ sec. 7, T. 9 S., R. 36 E., 5,440-ft elevation, Mt. Ireland quadrangle.

Description: Three talc-carbonate zones ranging from 20 to 75 ft in width are exposed on an abandoned logging road (Figure 10). The zones are intercalated with slices of sheared argillite and chloritic greenstones. The zones grade into massive antigorite-carbonate rock veined with talc seams exposed 200 ft above the road.

S-10 West Fork 2

Location: NE¼NE¼ sec. 7, T. 9 S., R. 36 E., 5,640-ft elevation, Mt. Ireland quadrangle.

Description: Talc-carbonate float is scattered over an area of about 200 ft extending southeast from a 10-ft-wide talc-carbonate outcrop. The draw immediately to the northwest contains numerous placer pits that expose knockers of gabbro and greenstone in a talc-carbonate matrix. The carbonate was identified as dolomite by X-ray diffraction analysis.

S-11 Middle Fork 1

Location: NW¼NW¼ sec. 8, T. 9 S., R. 36 E., 5,400-ft elevation, Mt. Ireland quadrangle.

Description: Slabs of talc-chlorite and talc-tremolite schist are separated by two 25-ft-wide zones of talc-carbonate rock exposed along USFS Road 24-7370. The one sample of talc-tremolite schist (AUG-83) that was examined in immersion oils and by X-ray diffraction did not contain carbonate.

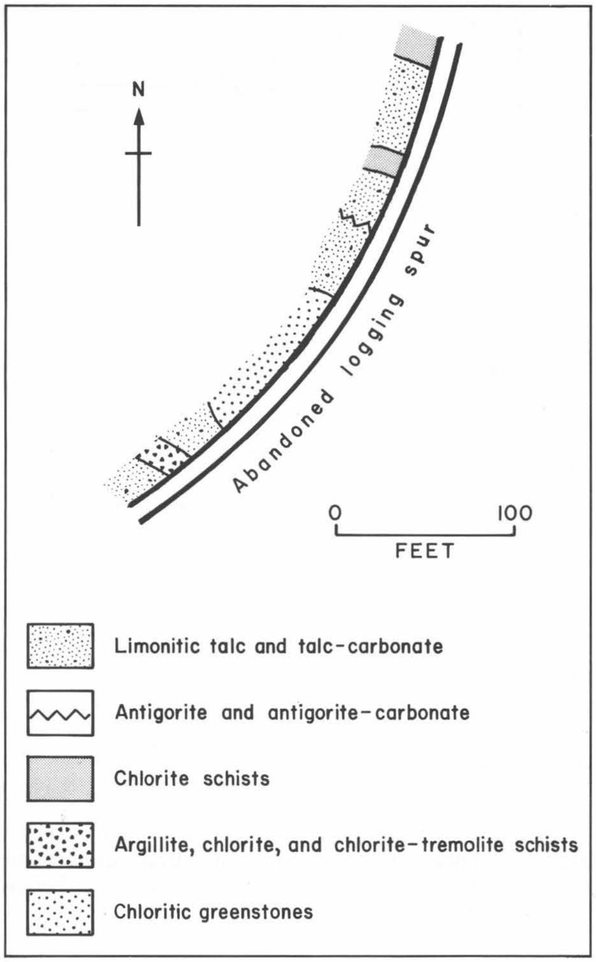

Figure 10. Sketch map of the West Fork 1 talc zone (S-9).

S-12 West Fork 3
Location: NE¼NE¼ sec 7., T. 9 S., R. 36 E., 5,720-ft elevation, Mt. Ireland quadrangle.
Description: An old placer ditch exposes talc-carbonate rock over a wide area. Blocks of massive carbonate-free talc tremolite rock and greenstone are enclosed within the talc-carbonate rock. The one sample of talc tremolite schist (AUG-82) that was examined in thin section, under immersion oils, and by X-ray diffraction did not contain carbonate.

S-13 Middle Fork 2
Location: SW¼SW¼ sec.5, T. 9 S., R. 36 E., 5,600-ft elevation, Mt. Ireland quadrangle.
Description: A short adit explores an outcrop of massive talc-carbonate rock 30 ft wide. The talc-carbonate rock can be traced to the east, where it is lost in a heavily timbered area containing large blocks of gabbro and greenstone. Microscopic examination with immersion oils and X-ray diffraction did not detect amphibole in the one talc-carbonate sample (AUG-70) taken from this locality.

S-14 Middle Fork 3
Location: NW¼SW¼ sec. 5, T. 9 S., R. 36 E., 5,820-ft elevation, Mt. Ireland quadrangle.
Description: Ground disturbed by a logging operation contains abundant talc-carbonate float distributed over a 200-ft-wide area.

S-15 East Fork 1
Location: NW¼NW¼ sec. 8, T. 9 S., R. 36 E., 5,400-ft elevation, Mt. Ireland quadrangle.
Description: Talc-carbonate bed rock is exposed in several old placer pits over 100 ft in diameter located on a low bench above and east of the east fork of Deep Creek. Talc-carbonate float is scattered west of the placer pits across a 100-ft-wide zone measured from north to south that is roughly perpendicular to the generally east-west-striking cleavage in this area.

S-16 East Fork 2
Location: NW¼NE¼ sec. 8, T. 9 S., R. 36 E., 5,600-ft elevation, Mt. Ireland quadrangle.
Description: A zone of talc-carbonate rock about 135 ft wide is exposed along USFS Road 24-7370-150 (Figure 11). The core of the zone contains 10 ft of massive antigorite. Talc-tremolite schist separates the zone from an additional 25-ft-wide zone of talc-carbonate rock to the north that is in contact with chloritic greenstone.

S-17 East Fork 3
Location: NW¼NE¼ sec. 8, T. 9 S., R. 36 E., 5,660-ft elevation, Mt. Ireland quadrangle.
Description: A 50-ft-wide zone of talc-carbonate rock is exposed in outcrop along USFS Road 24-7370-150. The talc-carbonate zone lies between chlorite schist and massive antigorite-carbonate rock.

S-18 East Fork 4
Location: SW¼SE¼ sec. 5, T. 9 S., R. 36 E., 5,660-ft elevation, Mt. Ireland quadrangle.
Description: A 65-ft-wide zone of talc-carbonate rock surrounded by chlorite schist is exposed along USFS Road 24-7370-150. The talc-carbonate zone encloses a 3-ft-thick lens of chlorite schist.

S-19 East Fork 5
Location: SW¼SE¼ sec. 5, T. 9 S., R. 36 E., 5,670-ft elevation, Mt. Ireland quadrangle.
Description: A 20-ft-wide talc-carbonate zone is exposed along the south edge of an 80-ft-wide zone of antigorite-carbonate rock along USFS Road 24-7370-150. A wet draw with talc-carbonate float marks the contact between antigorite-carbonate rock and greenstone to the north.

S-20 East Fork 6
Location: NW¼SE¼ sec. 5, T. 9 S., R. 36 E., 5,700-ft elevation, Mt. Ireland quadrangle.
Description: A 30-ft-wide zone of talc-carbonate rock that contains greenstone and gabbro blocks up to 1 ft in diameter is exposed along USFS Road 24-7370-150. The talc-carbonate zone can be traced by float to the southeast, where talc-carbonate lenses border round greenstone and gabbro blocks up to 100 ft in diameter.

S-21 East Fork 7
Location: NW¼SE¼ sec. 5, T. 9 S., R. 36 E., 5,740-ft elevation, Mt. Ireland quadrangle.
Description: Float and small outcrops of talc-carbonate rock occur over a 135-ft interval on USFS Road 24-7370-150. The talc-carbonate zone lies between slabs of chloritic greenstone and can be traced by float over a vertical distance of 220 ft from below the road uphill to the ridgetop to the west.

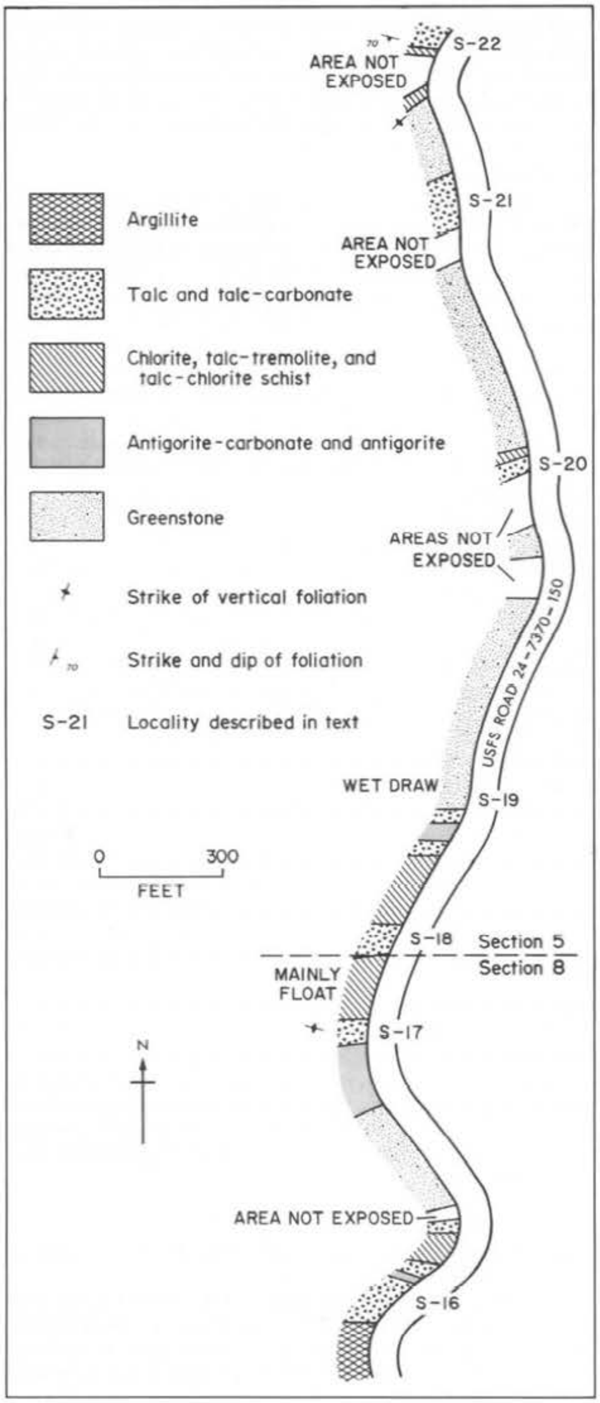

Figure 11. Sketch map showing talc zones exposed along USFS Road 24-7370-150 (S-16 through S-22).

S-22 East Fork 8

Location: NW¼SE¼ sec. 5, T. 9 S., R. 36 E., 5,780-ft elevation, Mt. Ireland quadrangle.

Description: A 35-ft-wide zone of sheared talc-carbonate rock grades southward into a 120-ft-wide zone of mixed talc-carbonate and talc-chlorite schist along USFS Road 24-7370-150.

S-23 Eastside placer ditch

Location: SW¼NE¼ sec. 8, T. 9 S., R. 36 E., 5,400-ft elevation, Mt. Ireland quadrangle.

Description: Talc-carbonate float is scattered over a 100-ft-wide, east-trending zone that can be traced for over 200 ft in elevation. The eastern extension of the zone is poorly exposed in a placer ditch at an elevation of 5,740 ft.

S-24 Bear Meadow road

Location: NW¼SE¼ sec. 19, T. 9 S., R. 36 E., 5,440-ft elevation, Mt. Ireland quadrangle.

Description: The construction of a new spur road, USFS Road 24-7375-011, has exposed a zone of sheared limonitic talc-carbonate and talc-chlorite schist over an interval of 100 ft. Amphibole minerals were not detected in the one sample (AUG-93) analyzed in immersion oils and by X-ray diffraction from this locality.

S-25 Blue Springs

Location: SE¼NW¼ sec. 27, T. 9 S., R. 36 E., 5,700-ft elevation, Mt. Ireland quadrangle.

Description: A 70-ft-wide, northwest-trending zone of sheared limonitic talc-carbonate and talc-chlorite schists is exposed on the Sumpter-Granite highway at Granite Mountain summit. Similar limonitic talc schist appears as float along a USFS road at 5,660-ft elevation to the northeast. The sample (AUG-73) studied in thin section, in immersion oils, and by X-ray diffraction contained neither carbonate nor amphibole minerals.

S-26 Weaver Mine road

Location: NW¼SE¼ sec. 27, T. 9 S., R. 36 E., 5,580-ft elevation, Mt. Ireland quadrangle.

Description: USFS Road 24-7390 crosses a 30-ft-wide zone of talc-carbonate rock in antigorite serpentinite. The zone contains cross-fiber asbestos veinlets that have been completely converted to talc. A sample (AUG-75) studied under immersion oils and by X-ray diffraction did not contain amphibole minerals.

S-27 McCully Fork Campground

Location: NE¼SW¼ sec. 24, T. 9 S., R. 36 E., 4,550-ft elevation, Bourne quadrangle.

Description: A 5-ft-wide zone of mixed iron-stained talc and talc-carbonate rock is exposed off of the Sumpter-Granite highway at the entrance to the McCully Fork Campground. Powder from a sample collected at this locality was studied in immersion oils and did not contain amphibole or carbonate minerals.

S-28 West Bear Canyon

Location: SW¼NE¼ sec. 24, T. 9 S., R. 36 E., 4,760-ft elevation, Bourne quadrangle.

Description: Three northwest-striking talc-carbonate zones varying from 2 to 10 ft in thickness cut actinolite-chlorite schists over an interval of about 200 ft along USFS Road 165. A sample from the central zone (AUG-77) contains carbonate and quartz but no amphibole.

S-29 Bear Canyon

Location: NE¼SE¼ sec. 24, T. 9 S., R. 36 E., 4,720-ft elevation, Bourne quadrangle.

Description: A 2-ft-thick zone of talc-carbonate rock is exposed along USFS Road 165. The zone cuts actinolite-chlorite schists.

S-30 East Bear Canyon

Location: SW¼SW¼ sec. 19, T. 9 S., R. 37 E., 4,700-ft elevation, Bourne quadrangle.

Description: A 25-ft-thick talc-carbonate zone is exposed along USFS Road 165. The zone strikes northwest and marks the northern contact between the McCully Fork Mixed-Rock Zone and the Elkhorn Ridge Argillite. One sample from this zone (AUG-74) contained talc, quartz, chlorite, and carbonate.

S-31 Sawmill Gulch

Location: NW¼SW¼ sec. 6, T. 10 S., R. 37 E., 4,920-ft elevation, Sumpter quadrangle.

Description: USFS Road 1055 cuts across an 8-ft-wide zone of sheared talc-chlorite schist that is exposed along a fault contact between Elkhorn Ridge Argillite and a narrow mixed-rock zone made up of disrupted gabbro, greenstone, and serpentine. An amphibole mineral, probably tremolite, was identified by X-ray diffraction in one sample (AUG-63) from this zone.

S-32 Sumpter highway

Location: SE¼SE¼ sec. 4, T. 10 S., R. 37 E., 4,320-ft elevation, Sumpter quadrangle.

Description: A 35-ft-wide zone of sheared talc carbonate schist is intercalated with talc-chlorite and serpentine-chlorite schist along the Sumpter-Granite highway east of Sumpter. A sample of talc-carbonate rock (AUG-76) examined in immersion oils and by X-ray diffraction did not contain amphibole minerals or chrysotile. A thin section of the talc schist contains embayed chrome spinels.

S-33 Oregon Gulch

Location: SE¼NW¼ sec. 14, T. 8 S., R. 34 E., 3,840-ft elevation, Desolation Butte quadrangle.

Description: Talc-carbonate rock is exposed along and above the North Fork Trail as lens-shaped masses as much as 50 ft in width within a mixed-rock zone composed of tuffaceous argillites, greenstones, and diorite. The zones are up to 200 ft in vertical dimension. Powders studied in immersion oils contained carbonate but no amphibole minerals.

S-34 Lake Creek

Location: NW¼SW¼ sec. 19, T. 8 S., R. 35 E., 4,080-ft elevation, Desolation Butte quadrangle.

Description: Talc-chlorite schist and talc-carbonate float are scattered over a distance of 140 ft along the North Fork Trail, which crosses an exposed 1-ft-wide rib of massive talc-carbonate rock. A sample of the exposed rib (AUG-91) contained talc, quartz, and carbonate. Neither the float (AUG-90) nor the rib contained amphibole minerals.

S-35 Indian Creek

Location: NE¼NE¼ sec. 30, T. 8 S., R. 35 E., 4,240-ft elevation, Desolation Butte quadrangle.

Description: Float from an amphibole-bearing talc zone is scattered over a 20-ft interval on the North Fork Trail. Float includes talc-carbonate and antigorite-carbonate rock. X-ray diffraction studies of sample AUG-92 showed abundant talc and amphibole, minor quartz, and no carbonate. Powder from a talc-carbonate sample did not show amphibole in immersion oils.

S-36 Blackwell Trail

Location: NE¼NE¼ sec. 17, T. 8 S., R. 35 E., 4,980-ft elevation, Desolation Butte quadrangle.

Description: Evans (written communication, 1986) indicates that the largest talc and talc-carbonate masses in the North Fork John Day Wilderness lie along the thrust contact between greenstones and underlying Elkhorn Ridge Argillite in this area. The mineralogy of the talc masses is not known.

Greenhorn area

Both hydrothermal and metamorphic talc deposits occur within the Greenhorn area, which is an area of serpentinite-matrix melanges between the North Fork and Middle Fork of the John Day River and the North Fork of Burnt River (Plate 1). The Greenhorn talc area is mountainous and typically densely covered by lodgepole and other pine. The northern part of the area is in the North Fork John Day Wilderness. Most of the rest of the area is encompassed by the Malheur, Umatilla, and Wallowa-Whitman National Forests and is covered by a network of logging roads. Geologic coverage is provided by the 1:250,000-scale Canyon City quadrangle (Brown and Thayer, 1966); the 1:62,500-scale Desolation Butte quadrangle (Evans, 1988); and the 1:24,000-scale Greenhorn, Bates NW, and Bates NE quadrangles (Ferns and others, 1983, 1984; Brooks and others, 1983).

Gold and silver deposits in the old Susanville, Greenhorn, and North Fork mining districts have been well described by Lindgren (1901), Pardee and Hewett (1914), and Gilluly and others (1933). Talc was first recognized adjacent to quartz veins in the Susanville district by Gilluly and others (1933). Subsequent mapping by Ferns and others (1983, 1984), Brooks and others (1983), and Evans (1988) has identified other talc occurrences associated with quartz veins.

The Greenhorn area lies along a major structural discontinuity within the Baker Terrane, marking the southernmost extent of identifiable Elkhorn Ridge Argillite and the northernmost extent of abundant serpentinite-matrix melanges. Quartz diorite masses of Late Jurassic age have intruded the serpentinite-matrix melanges and locally converted them to varieties of talc- and enstatite-olivinites. Talc-carbonate lenses have also formed as alteration envelopes encasing gold-bearing quartz veins (listwaenites) in the gold districts.

G-1 Welch Creek

Location: SW¼SW¼ sec. 17, T. 8 S., R. 33 E., 4,600-ft elevation, Dale quadrangle.

Description: A road cut along USFS Road 10 exposes a 5-ft-wide zone of limonitic talc-tremolite schist along a vertical fault zone. The fault separates serpentinite-matrix melange on the east from a sequence of interbedded greenstone and chert to the west.

G-2 Deep Creek

Location: NE¼NE¼ sec. 6, T. 10 S., R. 32 E., 4,840-ft elevation, Susanville quadrangle.

Description: A 50-ft-wide zone of talc chlorite schist that is exposed along USFS Road 4650 strikes N. 60° W. and dips 30° NE. The zone lies along a fault separating massive ultramafic rocks to the south and calcareous argillites to the north. The talcose zone contains elongate pods of massive talc-olivinites and argillaceous semischists. Anthophyllite was identified in immersion oils, in thin section, and by X-ray diffraction in one sample (AUG-86) from this locality.

G-3 Susanville area

Location: Secs. 7, 8, 9, and 12, T. 10 S., R. 33 E., Susanville quadrangle.

Description: Talc has been reported as alteration envelopes encasing a number of precious-metal veins in the old Susanville district. Recent core drilling on the Bull of the

Woods vein reportedly cut a wide talcose zone in serpentinite. Old mines reported by Gilluly and others (1933) to be associated with talc include the following:

Gem	SW¼NE¼ sec. 5,	T. 10 S., R. 33 E.
Chattanooga	NW¼NW¼ sec. 5,	T. 10 S., R. 33 E.
Daisy	SW¼SW¼ sec. 5,	T. 10 S., R. 33 E.
Princess	SE¼NE¼ sec. 31,	T. 9 S., R. 33 E.
Belle of the Hills	NW¼SW¼ sec. 7,	T. 10 S., R. 33 E.
Poorman	SE¼NW¼ sec. 8,	T. 10 S., R. 33 E.
Gold Bug	NE¼NW¼ sec. 5,	T. 10 S., R. 33 E.
Mocking Bird	SE¼SE¼ sec. 7,	T. 10 S., R. 33 E.
Ophir	SW¼SW¼ sec. 8,	T. 10 S., R. 33 E.
Blackhawk	SE¼NW¼ sec. 7,	T. 10 S., R. 33 E.
Side Issue	SE¼NW¼ sec. 7,	T. 10 S., R. 33 E.
Simcox	Center sec. 9,	T. 10 S., R. 33 E.
Skyscraper	SW½ sec. 12,	T. 10 S., R. 33 E.
Thompson	NW¼SW¼ sec. 8,	T. 10 S., R. 33 E.
Nelson	SE¼SW¼ sec. 12,	T. 10 S., R. 33 E.
Golden Gate	Secs. 7 and 8,	T. 10 S., R. 33 E.

G-4 O'Rouick Spring

Location: NE¼NW¼ sec. 4, T. 9 S., R. 34 E., 5,680-ft elevation, Desolation Butte quadrangle.

Description: Over 300 ft of talc and talc tremolite schist are exposed along USFS Road 10 (Figure 12). The talc schist contains tremolite and is intercalated with greenstone blocks. A 5-ft-thick zone of talc-carbonate rock is apparently amphibole free. Samples of talc schist (AUG-84) from this locality contain abundant tremolite.

G-5 Chrome Spring

Location: NW¼NE¼ sec. 10, T. 9 S., R. 34 E., 6,200-ft elevation, Desolation Butte quadrangle.

Description: Small, discontinuous talc schist lenses not more than 2 ft thick are exposed in a rock quarry in sheared serpentinite.

G-6 China Diggings

Location: NE¼SW¼ sec. 29, T. 10 S., R. 34 E., 4,400-ft elevation, Bates NW quadrangle.

Description: A 30-ft-thick sedimentary talc-bearing conglomerate is exposed on a USFS road. The conglomerate consists of rounded talc-carbonate boulders enclosed in a soft, white talc matrix. The zone is conformable with underlying chert-pebble conglomerates and overlying calcareous argillites and sandstones and is apparently a sedimentary talc interbedded with Permian and Triassic sedimentary rocks (Ferns and others, 1984). One sample (AUG-89) contained magnesite, talc, antigorite, and chromite.

G-7 Murdock Creek

Location: NE¼NW¼ sec. 35, T. 10 S., R. 34 E., 5,640-ft elevation, Bates NE quadrangle.

Description: A newly constructed spur road off of USFS Road 20-2055 cuts a 3-ft-wide zone of yellowish-white talc-tremolite schist exposed along the margins of a greenstone block in a matrix melange. The zone is adjacent to a small stock of Late Jurassic age that has converted the serpentinite matrix of the melange to talc olivinite. Tremolite was identified in sample AUG-87, which was examined in immersion oils, in thin section, and also by X-ray diffraction.

G-8 Greenhorn Creek

Location: NE¼SE¼ sec. 15, T. 10 S., R. 35 E., 5,680-ft elevation, Greenhorn quadrangle.

Description: Discontinuous lenses of massive limonitic talc-carbonate rock up to 25 ft thick are exposed in serpentinite along USFS Road 1035-750. Float of limonitic asbestos is also found along the road. A powdered talc sample that was examined in immersion oils did not contain amphibole or serpentine minerals.

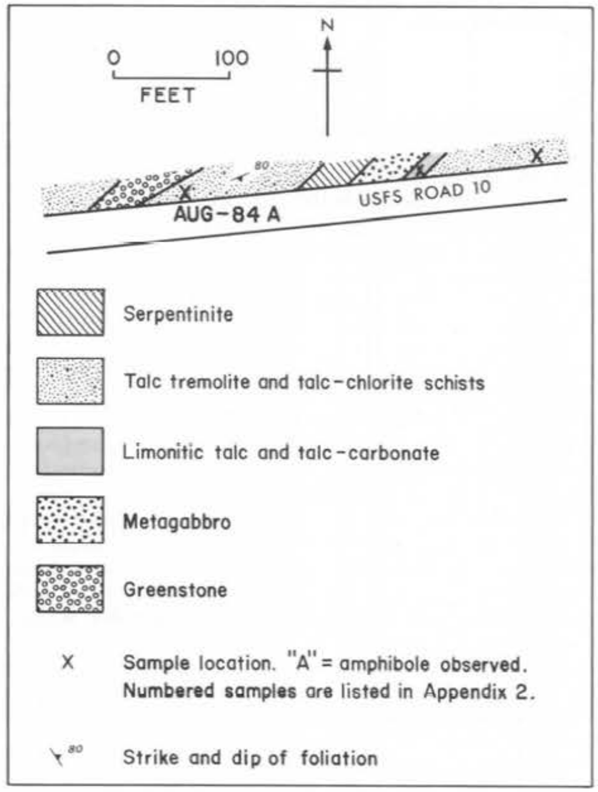

Figure 12. Sketch map of the O'Rouick Spring talc zone (G-4) where exposed along USFS Road 10.

G-9 Greenhorn district

Location: Greenhorn and Bates NE quadrangles.

Description: A large number of gold quartz veins in the old Greenhorn mining districts are surrounded by talc-carbonate alteration envelopes. Talc has been identified at the following mines and prospects:

Redstone	SW¼SW¼ sec. 33,	T. 9 S., R. 35 E.
Unknown	NE¼NW¼ sec. 8,	T. 10 S., R. 35 E.
Unknown	NE¼NW¼ sec. 8,	T. 10 S., R. 35 E.
Unknown	SW¼SE¼ sec. 8,	T. 10 S., R. 35 E.
Morning	SE¼SE¼ sec. 13,	T. 10 S., R. 35 E.
Windsor	NW¼SE¼ sec. 17,	T. 10 S., R. 35 E.
Kit Carson	SW¼SE¼ sec. 17,	T. 10 S., R. 35 E.
Diadem	NE¼NE¼ sec. 17,	T. 10 S., R. 35 E.
Psyche	SW¼NE¼ sec. 17,	T. 10 S., R. 35 E.
Banzette	SE¼NW¼ sec. 16,	T. 10 S., R. 35 E.
Snow Creek	NE¼SW¼ sec. 16,	T. 10 S., R. 35 E.
Roberts	NW¼NW¼ sec. 21,	T. 10 S., R. 35 E.
Unknown	SE¼NW¼ sec. 22,	T. 10 S., R. 35 E.
Unknown	SW¼NW¼ sec. 30,	T. 10 S., R. 35 E.
Best	NW¼NW¼ sec. 32,	T. 10 S., R. 35 E.
Unknown	SW¼NE¼ sec. 35,	T. 9 S., R. 35 E.
Unknown	SW¼NW¼ sec. 14,	T. 10 S., R. 35 E.
Don Juan	NW¼NE¼ sec. 15,	T. 10 S., R. 35 E.

Elkhorn Ridge area

The Elkhorn Ridge area (Plate 1) lies to the east of the Sumpter area and encompasses parts of the old Rock Creek, Cracker Creek, Baker, and Sumpter mining districts. The area is centered about the glaciated peaks of Elkhorn Ridge in the Wallowa-Whitman National Forest. The logging road network in this area is confined to timbered areas in the lower elevations. Access to the upper elevations is limited to a few old mine roads and trails. Geologic maps of the area include the 1:250,000-scale Canyon City and Baker quadrangles (Brown and Thayer, 1966; Brooks and others, 1976) and the 1:24,000-scale Bourne and Elkhorn Peak quadrangles (Brooks and others, 1982a; Ferns and others, 1987).

Previous mining activity was directed at lode gold and limestone deposits. The earliest report of talc is a 1963 Bureau of Mines laboratory report on samples submitted by R.H. Daley from the Union Creek Prospect (E-9). Brooks and others (1982a) and Ferns and others (1987) later identified a number of small talc occurrences that were primarily associated with lode gold prospects.

Elkhorn Ridge area talc occurrences are mainly small hydrothermal deposits in serpentinite slices along major vertical and thrust faults. Talc occurs in the form of massive, bluish talc and talc-carbonate rock in masses up to 5 ft wide that, together with talc-chlorite and talc-tremolite schists, form composite zones up to 75 ft wide. Most of the talc occurrences form linear, discontinuous zones along boundary faults between structurally complex packages of Elkhorn Ridge Argillite and metamorphosed volcanic and intrusive rocks of Permian and Triassic age (Ferns and others, 1987). These zones are often associated with small, high-grade gold deposits. Other talc zones form narrow selvages between serpentinite and greenstones along fault zones within the structurally complex greenstone packages.

E-1 Jevne Adit

Location: SE¼SE¼ sec. 32, T. 8 S., R. 36 E., 5,280-ft elevation, Bourne quadrangle.

Description: The Jevne Adit is a crosscut that was started but not completed in 1981 on the famous North Pole-Columbia Lode, the largest single gold vein in Oregon. Calder (1986), in a study of mineralization at the vein, reported a 115-ft-wide talc-carbonate zone located near the face of the Jevne Adit. The talc is reported to be fibrous, associated with dolomite and siderite, and free of asbestiform minerals.

E-2 Rock Creek

Location: SE¼SW¼ sec. 26, T. 8 S., R. 37 E., 7,300-ft elevation, Bourne quadrangle.

Description: Talc-carbonate float is scattered over a small area along the thrust fault separating metamorphosed intrusive rocks and underlying Elkhorn Ridge Argillite of Permian-Triassic age. The area lies within the contact aureole of the Bald Mountain Batholith of Late Jurassic age.

E-3 Avalanche

Location: SE¼SE¼ sec. 29, T. 8 S., R. 38 E., 5,920-ft elevation, Elkhorn Peak quadrangle.

Description: Limonitic talc-carbonate blocks up to 1 ft in diameter are scattered about the Pine Creek road where it crosses an avalanche fan. Although source outcrops were not found, talc float was traced upstream where it is apparently coming from one of the thrust faults separating metamorphosed intrusive rocks from greenstones. A sample (AUG-55) examined in thin section, in immersion oils, and by X-ray diffraction contained talc, magnesite, and chlorite.

E-4 Pine Creek

Location: NE¼NW¼ sec. 28, T. 8 S., R. 38 E., 6,400-ft elevation, Elkhorn Peak quadrangle.

Description: A 25-ft-wide zone of massive talc-carbonate rock lies between sheared argillite and a 30-ft-wide zone of talc-tremolite schist intercalated with sheared serpentinite. The zone is exposed along an abandoned logging road.

E-5 St. Louis

Location: SW¼NE¼ sec. 21, T. 9 S., R. 38 E., 5,800-ft elevation, Elkhorn Peak quadrangle.

Description: A caved adit lies below a glory hole where a 5-ft-wide zone of massive limonitic talc bordered by an 8-in.-wide quartz vein in argillite is exposed. The alteration zone follows the fault contact between metamorphosed intrusive rocks and Elkhorn Ridge Argillite. An analyzed sample (AUG-61) contains talc, magnesite, chlorite, and quartz.

E-6 Baboon Creek

Location: NE¼NW¼ sec. 29, T. 9 S., R. 38 E., 5,280-ft elevation, Elkhorn Peak quadrangle.

Description: USFS Road 6510 crosses a 20-ft-wide limonitic talc zone exposed along the fault between metamorphosed intrusive rocks and Elkhorn Ridge Argillite. Talc, chlorite, and quartz were identified by X-ray diffraction in a sample (AUG-62) from this zone.

E-7 Golden Eagle

Location: NE¼NE¼ sec. 19, T. 9 S., R. 38 E., 5,080-ft elevation, Elkhorn Peak quadrangle.

Description: A 20-ft-wide zone of sheared serpentine and talc in the fault between Elkhorn Ridge Argillite and metamorphosed intrusive rocks is exposed at the portal of an upper level adit. The zone contains a 3-ft-wide seam of white talc.

E-8 Mud Lake

Location: NW¼NE¼ sec. 26, T. 9 S., R. 38 E., 7,380-ft elevation, Elkhorn Peak quadrangle.

Description: Massive blue talc forms selvages up to 2 ft thick between serpentinite and blocks of greenstone, gabbro, and chert in a narrow mixed-rock zone. The mixed-rock zone is 400 ft across at the widest point and extends along strike for about 5,000 ft. Amphibole minerals were not detected in immersion oils in a white powder sample. Amphiboles were not observed associated with the talc alteration in the field. The mixed-rock zone probably contains no more than 1 percent talc by volume.

E-9 Union Creek

Location: SE¼NE¼ sec. 11, T. 10 S., R. 38 E., 4,700-ft elevation, Phillips Lake quadrangle.

History: Talc was first reported in this area by R.H. Daley in 1963. A letter to Daley from the U.S. Bureau of Mines reported that his two submitted talc samples were red in color when fired to 1,285 °C. Fired weight loss was reported at 5.04 to 5.13 percent and shrinkage at 6.55 to 7.31 percent (diameter) and 4.21 to 4.84 percent (thickness) (DOGAMI mine file, Baker Field Office).

Description: Talc zones up to 2 ft wide are exposed in a 70-ft-wide zone of sheared talc-chlorite schist and metagabbro along USFS Road 7220. A small cut above the road exposes a narrow stringer of talc. The one talc sample analysed by X-ray diffraction (AUG-58) contains trace amounts of quartz and amphibole. Crosscutting serpentine veinlets were recognized in thin section.

E-10 California Gulch

Location: NE¼NW¼ sec. 29, T. 10 S., R. 39 E., 4,000-ft elevation, Blue Canyon quadrangle.

Description: Small amounts of talc and talc tremolite schist occur as float in a mixed-rock zone exposed along the California Gulch road. The one sample (AUG-64) analyzed by X-ray diffraction and in immersion oils contained abundant tremolite.

E-11 Salmon Creek

Location: NE¼NE¼ sec. 18, T. 9 S., R. 39 E., 4,400-ft elevation, Wingville quadrangle.

Description: Small amounts of a sheared limonitic talc-chlorite schist are exposed in a prospect cut above a placer ditch on the south side of Salmon Creek. The float contains a minor amount of tremolite.

Dooley Mountain area

The Dooley Mountain area covers about 40 sq mi in south-central Baker County and is centered on the east-trending ridge lying between Burnt River and the South Fork of the Powder River (Plate 1). The region is mountainous and is covered with open stands of ponderosa pine. The talc occurs on private, Bureau of Land Management (BLM), and Wallowa-Whitman National Forest lands. Geologic maps that cover the area include the 1:250,000-scale Baker and Canyon City quadrangles (Brooks and others, 1976; Brown and Thayer, 1966).

Placer gold has been the main mineral product in the Dooley Mountain area, which encompasses parts of the Baker and Upper Burnt River mining districts. Talc was first identified by Moore (1937) during a study of asbestos deposits. Several attempts were later made to exploit talc occurrences near the head of Stices Gulch by W.B. Miles. Some carving-grade material from that area was reportedly used locally in fashioning small figurines.

The Dooley Mountain area talc deposits are apparently hydrothermal in origin. Talc alteration in the Dooley Mountain area is confined to narrow zones of talc-tremolite schist and talc-carbonate rock peripheral to serpentinite slices in mixed-rock zones (slab melanges) composed of greenstone, limestone, gabbro, and argillite and as serpentinite slivers intercalated with phyllites and cherts of the Burnt River Schist. The talc zones are dispersed about the margins of the Dooley Mountain Rhyolite, a Miocene rhyolite complex that may have been the source of the fluids that locally converted serpentine to talc. Anthophyllite asbestos veins containing fibers up to 6 in. in length often occur along contacts between the talc zones and Burnt River Schist phyllites. The western part of the Dooley Mountain area is shown in Figure 13.

D-1 Cow Creek

Location: NW¼SW¼ sec. 34., T. 11 S., R. 39 E., 4,960-ft elevation, Brannan Gulch quadrangle.

Description: A rusty, 3-ft-wide talc-carbonate zone is exposed along USFS Road 11-1135-380 (Figure 13). The zone lies between sheared talc-chlorite and talc-tremolite schists and makes up part of a mixed-rock zone.

D-2 Upper Cow Creek

Location: SW¼NW¼ sec. 34, T. 11 S., R. 39 E., 5,120-ft elevation, Brannan Gulch quadrangle.

Description: Talc-carbonate float lies along a fault contact between Burnt River Schist and a mixed-rock zone composed of slabs and slices of serpentinite, greenstone, and metagabbro.

D-3 Upper Pine Creek

Location: SW¼SE¼ sec. 34, T. 11 S., R. 39 E., 5,360-ft elevation, Brannan Gulch quadrangle.

Description: Prospect pits along USFS Road 11-1135 expose limonitic talc schists and fibrous anthophyllite asbestos. The talc-rich zone can be traced by float from a zone of anthophyllite asbestos-bearing serpentinite along a fault contact downhill to USFS Road 11-1135-380 at 5,100 ft, where a 15-ft-wide talc-carbonate zone is exposed. Anthophyllite apparently occurs only in the talc schists and serpentinites. Amphibole minerals were not detected by microscopic examination of sample AUG-56 in immersion oils of the talc-carbonate.

D-4 Asbestos 1

Location: SW¼SW¼ sec. 35, T. 11 S., R. 39 E., 5,160-ft elevation, Brannan Gulch quadrangle.

Description: A 40-ft-wide limonitic talc schist zone is exposed along USFS Road 11-1135-380. The west edge of the zone contains asbestiform anthophyllite float. A sample of talc schist (AUG-57) also contains anthophyllite.

D-5 Asbestos 2

Location: SW¼SW¼ sec. 35, T. 11 S., R. 39 E., 5,160-ft elevation, Brannan Gulch quadrangle.

Description: A wide zone of interlayered talc-tremolite and chlorite schists is exposed along USFS Road 11-1135-380 (Figure 14). The zone contains two seams of massive talc-carbonate rock 10 ft and 5 ft wide, respectively. Seams of asbestiform anthophyllite border the north and south margins of the zone.

D-6 Bald Mountain Spring

Location: SE¼NE¼ sec. 26, T. 11 S., R. 39 E., 6,100-ft elevation, Brannan Gulch quadrangle.

Description: Small amounts of talc-carbonate float were found among greenstone blocks. The talc zone is poorly exposed.

D-7 Bald Mountain

Location: SE¼SE¼ sec. 26, T. 11 S., R. 39 E., 6,400-ft elevation, Brannan Gulch quadrangle.

Description: Limonitic talc schist and talc-carbonate float occurs just west of the cattle guard on USFS Road 11. Discontinuous zones of talc schist up to 15 ft wide crop out on the ridge crest to the southeast. The talc zones make up part of a narrow, elongated mixed-rock zone that strikes N. 20° E. Amphibole minerals were not detected in immersion oils.

D-8 Gold Crater

Location: SE¼NW¼ sec. 25, T. 11 S., R. 39 E., 5,280-ft elevation, Brannan Gulch quadrangle.

Description: Limonitic talc float is scattered over a 35-ft interval on USFS Road 11-130-083. The float includes a pyrite-bearing talc-carbonate rock. The talc occurs in a northeast-trending mixed-rock zone that strikes parallel to the enclosing Burnt River Schist phyllites and cherts.

D-9 Upper Stices Gulch

Location: SW¼NE¼ sec. 25, T. 11 S., R. 39 E., 5,200-ft elevation, Brannan Gulch quadrangle.

Description: A 20-ft-wide zone of talc and talc-carbonate schist is exposed in a shear zone in tremolitic metagabbro along USFS Road 11-130-083. A sample of talc schist (AUG-72) that was examined in immersion oils, in thin section, and by X-ray diffraction did not contain amphibole minerals.

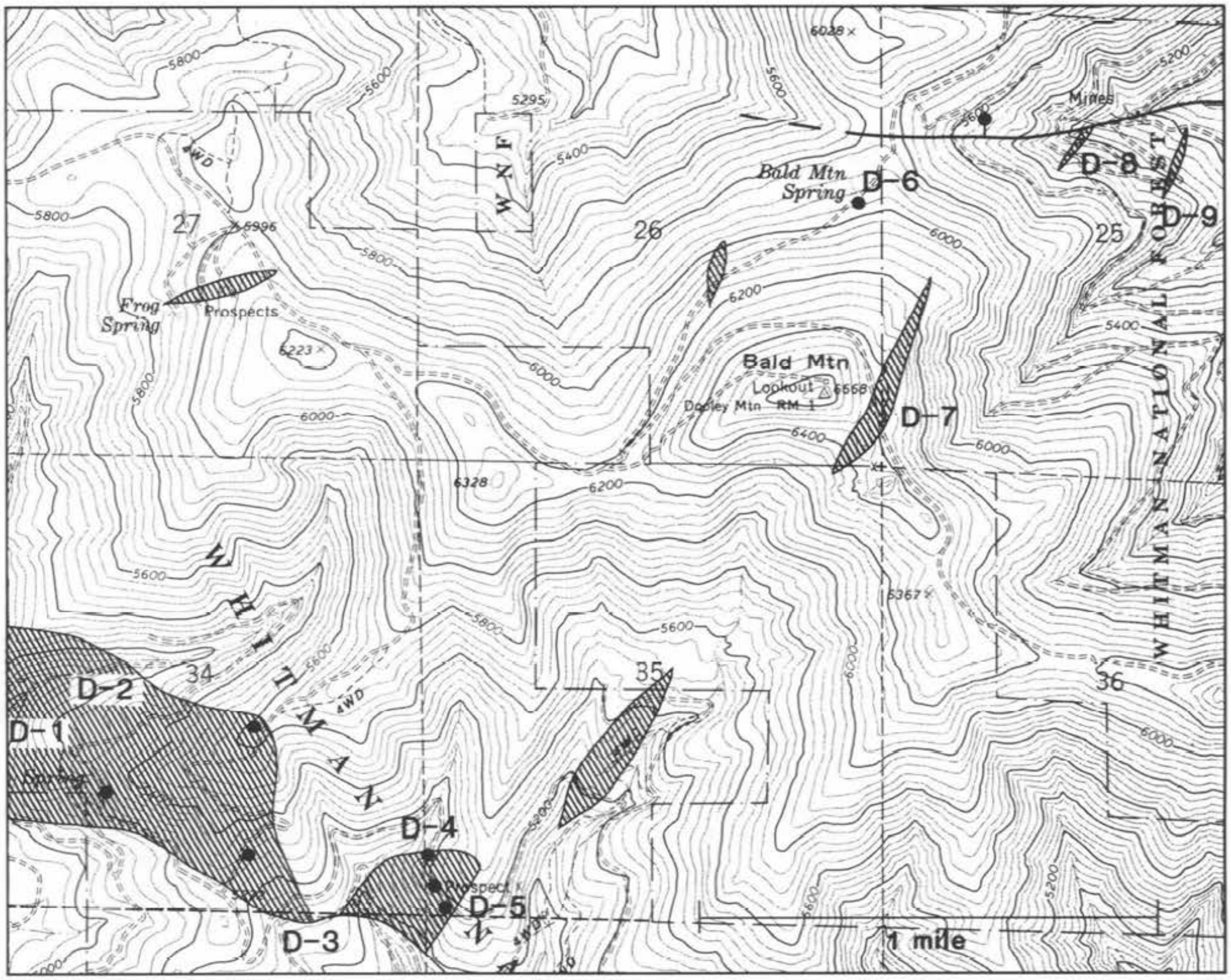

Figure 13. Talc occurrences near Pine Creek and Stices Gulch, Brannan Gulch quadrangle, western part of the Dooley Mountain area. Patterned areas are mixed-rock zones containing ultramafic rocks. Labeled localities are described in text.

D-10 Lower Stices Gulch (Harbo talc?)

Location: SE¼NE¼ sec. 25, T. 11 S., R. 39 E., 4,900-ft elevation, Dooley Mountain quadrangle.

Description: Pieces of talc schist and talc-carbonate rock are scattered over a 40-acre area of poor exposures along the south side of the north fork of Stices Gulch. Talc is also found on the dumps of old adits, shallow shafts, and prospect pits in this area. The area, which is covered by old placer workings, is apparently the area described as the Harbo talc claims by Wagner (1964), who reported limonitic talc in a large number of hand-dug pits and trenches. The talc float consists mainly of gray talc schist that does not appear to contain tremolite.

D-11 Juniper Hill Spring

Location: NW¼NW¼ sec. 14, T. 12 S., R. 40 E., 4,400-ft elevation, Dooley Mountain quadrangle.

Description: An 8-ft-wide zone of limonitic talc and talc-breccia is exposed in a new prospect cut. Fracture surfaces on the talc-breccia are coated by a green silicate mineral. The limonitic talc zone is alongside a 10-ft-wide zone of gray talc. The gray talc is separated from contorted carbonaceous schists veined with quartz by an asbestos-veined fault contact. A sample of the gray talc (AUG-88) that was examined under immersion oils, in thin section, and by X-ray diffraction proved to be a talc-chlorite-antigorite schist that did not contain asbestiform minerals.

D-12 McClellan Creek

Location: NE¼NE¼ sec. 15, T. 12 S., R. 40 E., 5,000-ft elevation, Dooley Mountain quadrangle.

Description: A small prospect pit situated along a contact between rhyolite and metagabbro exposes serpentinite with lenses of talc-tremolite schist and narrow veins of slip-fiber asbestos.

Basin Creek area

The old Mormon Basin mining district encompasses the Basin Creek area (Figure 15) in southern Baker and northern Malheur Counties. The area is mountainous and is covered by sagebrush and scattered stands of ponderosa pine and juniper. The area includes BLM and private lands. Geologic

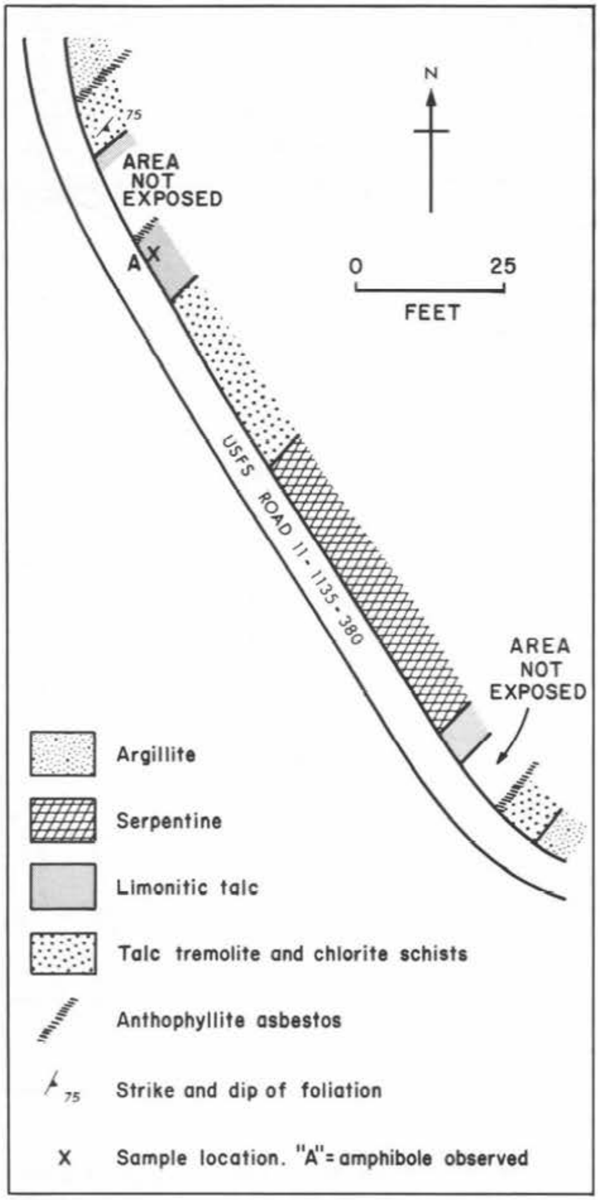

Figure 14. Sketch map of the Asbestos 2 talc zone (D-5) where exposed along USFS Road 11-1135-380.

map coverage includes the 1:250,000-scale Baker quadrangle (Brooks and others, 1976) and a sketch map of the Mormon Basin by Gilluly and others (1933), who first identified talc in this area. The mineralogy of some of the talc occurrences is described by Wolff (1965).

Talc deposits occur within a structurally complex zone that marks the contact between the Baker Terrane and the younger Jurassic sedimentary rocks of the Weatherby Formation (Figure 13). The zone is the western continuation of the Connor Creek Fault (Brooks, 1979c) and is marked by serpentinite slices and mixed-rock zones. Quartz diorites of Late Jurassic age have been intruded along the Connor Creek Fault. Serpentinites adjacent to the intrusions have been converted to talc-olivinite and anthophyllite-olivinite. Talc schists and massive talc-carbonate rock are found locally.

B-1 Spirit Ridge

Location: SE¼NW¼ sec. 19, T. 13 S., R. 42 E., 5,760-ft elevation, Bridgeport quadrangle.

Description: Float of limonitic white talc chips is scattered over a 30-ft-wide zone along the contact between mica schist and green talc-tremolite rock. The talc-tremolite rock grades into a core of massive talc-anthophyllite-olivinite.

B-2 Spirit Hill

Location: SW¼SW¼ sec. 20, T. 13 S., R. 42 E., 5,760-ft elevation, Bridgeport quadrangle.

Description: A 5-ft-thick lens-shaped body of talc schist is encased in argillite. Similarly shaped bodies of ultramafic rock are scattered between this location and B-1. These are generally narrow, discontinuous bodies of serpentinite or talc schist that are elongated parallel to the foliation of enclosing siliceous mica schists. The larger pods have talc-olivinite or anthophyllite-olivinite cores that are encased in talc and/or talc-tremolite rinds. Tremolite was identified by X-ray diffraction and in immersion oils in a sample (AUG-66) of talc rind.

B-3 City Gulch

Location: NW¼SW¼ sec. 20, T. 13 S., R. 42 E., 5,400-ft elevation, Bridgeport quadrangle.

Description: Abundant float of foliated blue talc schist is scattered over a 100-ft-wide area. The bed rock is poorly exposed but apparently contains pods of metagabbro and talc-tremolite rock. According to the map by Gilluly and others (1933), this is one of the larger talc masses on the west side of Basin Creek. Powders examined in immersion oils contained anthophyllite.

B-4 Rock Spring

Location: SW¼SE¼ sec. 20, T. 13 S., R. 42 E., 4,640-ft elevation, Bridgeport quadrangle.

Description: A 90-ft-wide zone of sheared black talc is poorly exposed along the Basin Creek road. The zone contains intermixed lenses of dark argillite and metagabbro. Tremolite and anthophyllite in powdered samples were identified by using immersion oils.

B-5 Upper Basin Creek

Location: NW¼SE¼ sec. 29, T. 13 S., R. 42 E., 4,480-ft elevation, Bridgeport quadrangle.

Description: A 15-ft-wide zone of limonitic talc schist is exposed in a severely disrupted zone where the Connor Creek Fault is cut by the Basin Creek road (Figure 16). Cummingtonite was detected with a microscope in a sample from this locality.

B-6 Lower Basin Creek

Location: SE¼SW¼ sec. 29, T. 13 S., R. 42 E., 4,520-ft elevation, Bridgeport quadrangle.

Description: An 8-ft-wide zone of white talc-tremolite schist is exposed along a fault zone in black argillite of the Jurassic Weatherby Formation. This fault parallels the Connor Creek Fault just to the north.

B-7 West California Mountain

Location: NE¼NW¼ sec. 28, T. 13 S., R. 42 E., 5,280-ft elevation, Bridgeport quadrangle.

Description: An ultramafic-matrix melange consisting of limonitic talc schist and talc-carbonate rock is exposed on

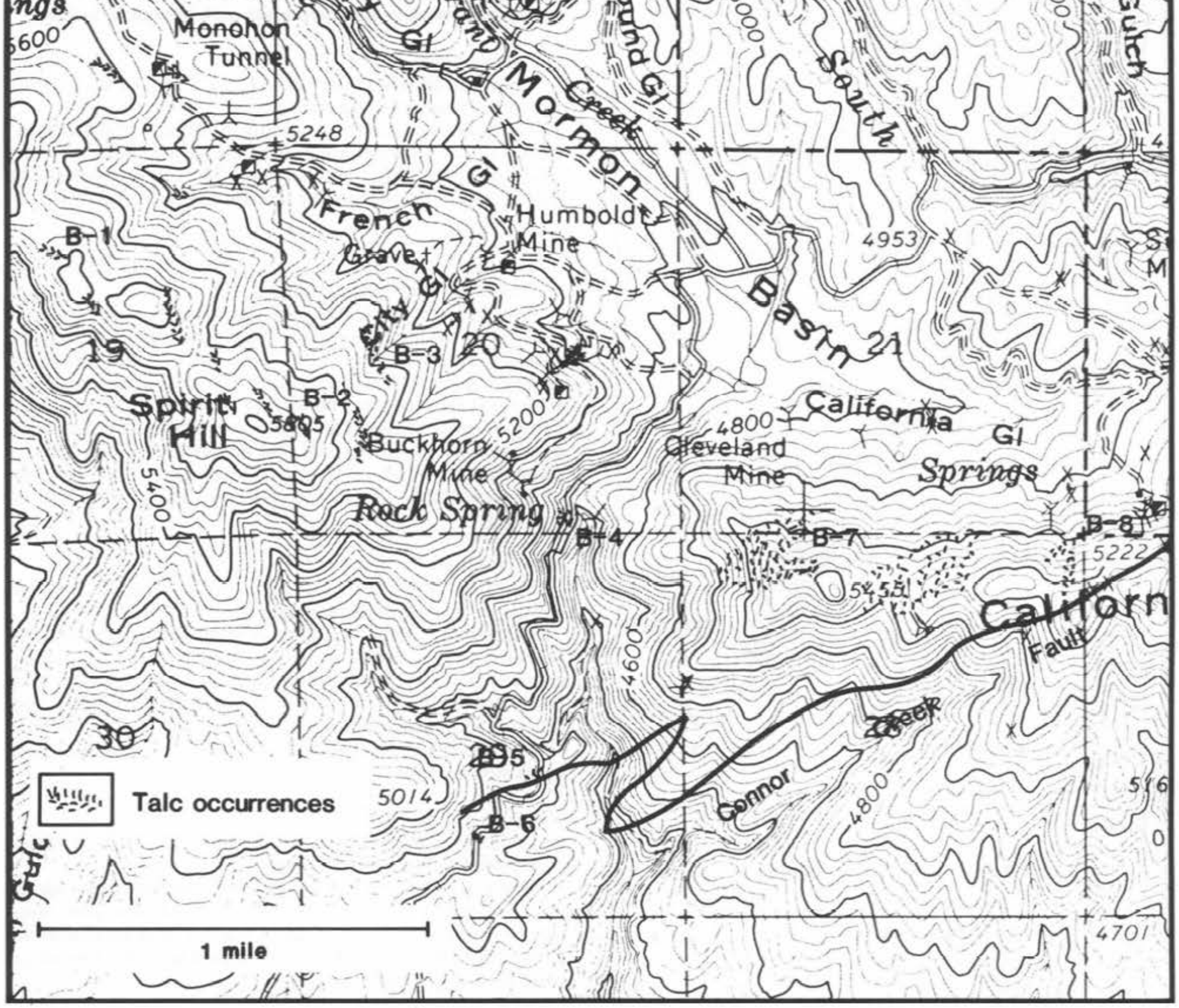

Figure 15. Talc occurrences in Basin Creek talc area, Bridgeport quadrangle. Labeled localities are described in text.

the west end of California Mountain. Talc float is scattered for a distance of about 350 ft among blocks and knockers of metagabbro and talc-tremolite rock. A sample of talc-carbonate rock (AUG-65) from the zone examined under the microscope contains talc, magnesite, chlorite, and antigorite.

B-8 California Mountain

Location: NE¼NE¼ sec. 28, T. 13 S., R. 42 E., 5,200-ft elevation, Bridgeport quadrangle.

Description: Black to dark-blue talc schist forms the matrix of a block melange located along the north side of the Connor Creek Fault. Blocks within the melange include anthophyllite-olivinites, metagabbro, greenstone, and limestone. The matrix includes areas of serpentinite veined by narrow talc-carbonate stringers.

Connor Creek area

The Connor Creek area, which also contains talc deposits associated with ultramafic melange and intrusions of Late Jurassic age, is located along the northeastern extension of the Connor Creek Fault. Most of the area is mountainous and covered with grass and sagebrush, but upper elevations are partially timbered. Both BLM and private lands make up the area. Geologic maps of the area include the 1:250,000-scale Baker quadrangle (Brooks and others, 1976) and the 1:62,500-scale Durkee, Huntington, and Mineral quadrangles (Prostka, 1967; Brooks, 1979a,b).

The Lower Burnt River and Connor Creek mining districts are included within the area. Talc was first identified on Sisley Creek by Jim McNab, who submitted samples in 1964 to the U.S. Bureau of Mines. Prostka (1967) later noted several small talc-tremolite schist localities. The southwestern part of the area was mapped by Brooks (1979), who first recognized the regional significance of the Connor Creek Fault.

The Connor Creek area is geologically similar to the Basin Creek area. Talc deposits are located in serpentinites emplaced in mixed-rock and melange zones along the Connor Creek Fault peripheral to the margins of quartz diorite intrusions of Late Jurassic age.

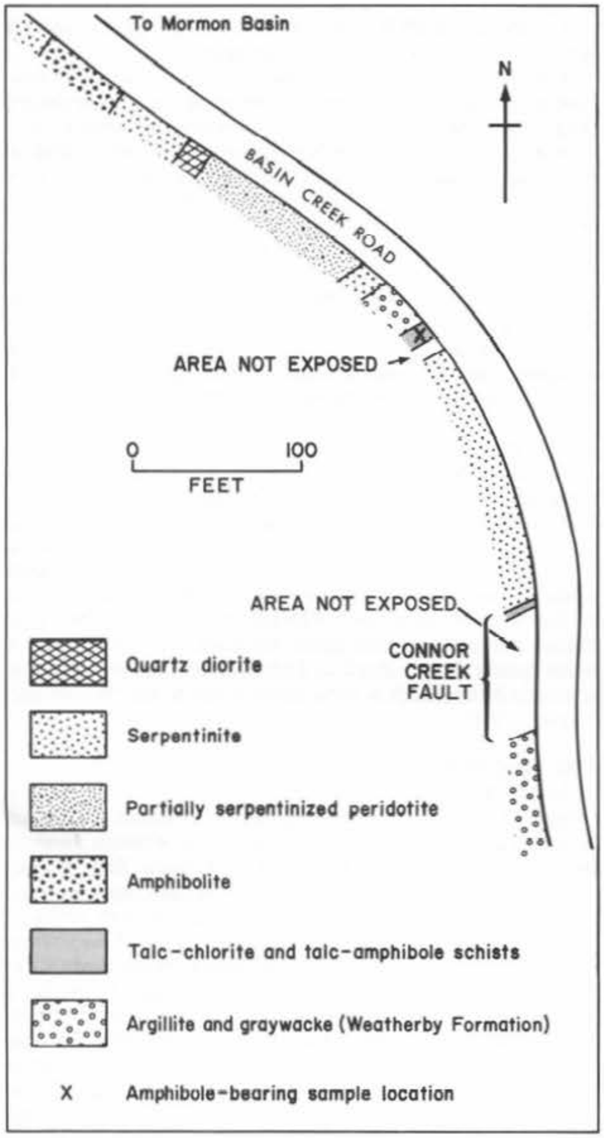

Figure 16. Sketch map of the road to Basin Creek (B-5). See Plate 1 and Figure 15.

C-1 Shirttail Creek

Location: NW¼NW¼ sec. 34, T. 12 S., R. 43 E., 4,560-ft elevation, Huntington quadrangle.

Description: Scattered pieces of limonitic talc veined with chalcedonic quartz occur in the base of a Tertiary gravel deposit. These gravels overlie a part of the Connor Creek Fault that has been invaded by granitic intrusions.

C-2 Weatherby School

Location: SE¼SW¼ sec. 17, T. 12 S., R. 44 E., 2,880-ft elevation, Durkee quadrangle.

Description: A 30-ft-wide zone of talc-rich serpentinite cut by drusy quartz veins is exposed along the Sisley Creek road. The zone is part of a larger outcrop of serpentinite that contains narrow seams of talc and talc-tremolite schist.

C-3 Gold Cliff Gulch (McNab prospect)

Location: NW¼NE¼ sec. 20, T. 12 S., R. 44 E., 3,040-ft elevation, Durkee quadrangle.

Description: An 8-ft-wide zone of talc-carbonate rock is exposed in an open cut on the south side of Gold Cliff Gulch. The talc partially replaces a 20-ft-wide body of serpentinite that is exposed across the gulch to the north. The center of the northern exposure of talc-carbonate rock contains ⅛-in. veinlets of drusy quartz (Figure 17). Talc and talc-carbonate float can be traced over the hill south of Gold Cliff Gulch to a large prospect cut at the 3,100-ft elevation. Olivine was identified by microscopic examination of a powdered sample of black talc exposed in this cut.

C-4 Sisley Creek

Location: NE¼NW¼ sec. 20, T. 12 S., R. 44 E., 2,800-ft elevation, Durkee quadrangle.

Description: A zone of sheared serpentinite containing seams of talc, talc-tremolite schist, and talc-carbonate rock is exposed on the east side of Sisley Creek. The talc seams attain maximum widths of 30 in. and form anastomosing networks that cut through and around ribs of sheared serpentinite. Amphibole (tremolite) was identified petrographically and by X-ray diffraction in a sample of white talc (AUG-78).

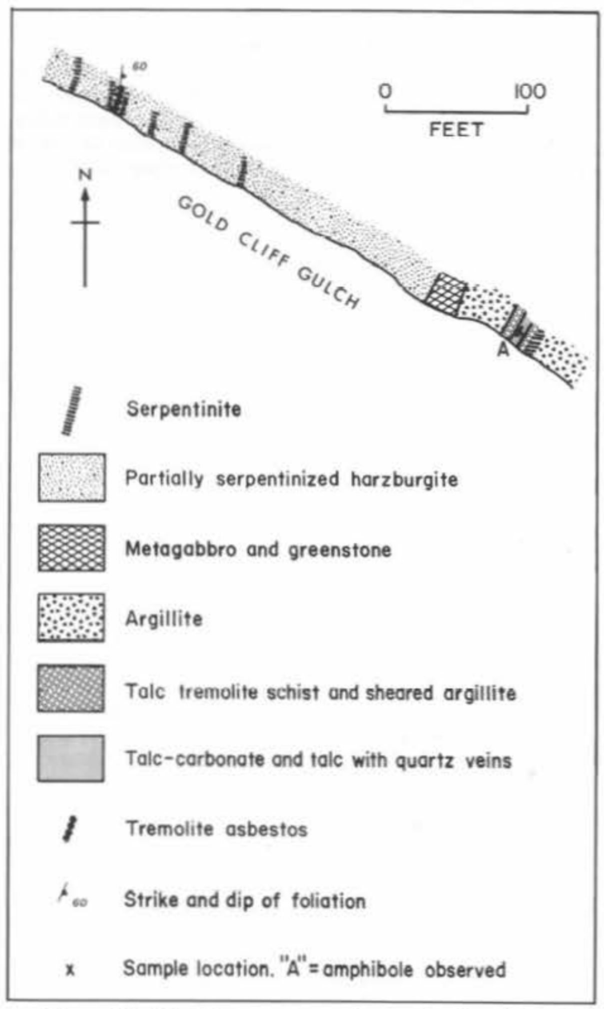

Figure 17. Sketch map along the north side of the Gold Cliff Gulch zone (C-3).

C-5 Morgan Creek

Location: NE¼SW¼ sec. 12, T. 12 S., R. 44 E., 5,160-ft elevation, Durkee quadrangle.

Description: A small amount of talc schist float is found east of the Lookout Mountain road on a low ridge of greenstone and metagabbro. Anthophyllite-olivinites are exposed on the Lookout Mountain Road to the west near the contact with a quartz diorite stock of Late Jurassic age.

C-6 Upper Hibbard Creek

Location: NE¼NE¼ sec. 12, T. 12 S., R. 44 E., 4,800-ft elevation, Durkee quadrangle.

Description: A 15-ft-wide zone of sheared tremolitic gray talc cutting massive serpentinite is exposed on the Hibbard Creek road.

C-7 Lower Hibbard Creek

Location: NW¼NW¼ sec. 8, T. 12 S., R. 45 E., 3,960-ft elevation, Mineral quadrangle.

Description: Small blocks of talc float are scattered over a quarter-mile interval along the Hibbard Creek road. The talc occurs as narrow selvages on the margins of large lensoid masses of silica-carbonate rock that grade outward from talc-carbonate rock to talc schist. The talc-carbonate selvages contain quartz.

Other eastern Oregon talc occurrences

Several other small, isolated talc occurrences that were observed during the course of this study are listed below. All of these occurrences are in serpentinite bodies near major gold districts. A search for talc occurrences in areas devoid of gold mineralization that were known to be underlain by serpentinite proved to be fruitless.

O-1 Freeway talc

Location: SE¼NW¼ sec. 33, T. 10 S., R. 42 E., 3,400-ft elevation, Oxman quadrangle.

Description: Several small bodies of massive gray talc and talc-tremolite rock are exposed along the north side of Interstate 84 north of Durkee Valley. The talc zones are up to 10 ft thick and are associated with veins and lenses of chalcedonic quartz. The talc zones partially replace serpentinite slabs that are intercalated with greenstones and argillites. Talc breccias along contacts between serpentinite and greenstone contain silica boxwork and fibrous tremolite asbestos. Small amounts of tremolite and anthophyllite were identified microscopically in powders in immersion oils and thin sections of samples AUG-67 and AUG-68.

O-2 Becker Creek

Location: SW¼NE¼ sec. 12, T. 14 S., R. 42 E., 4,100-ft elevation, Bridgeport quadrangle.

Description: Brooks (personal communication, 1986) reported float of dark-colored talc schist distributed over a wide area in a mixed-rock zone on Becker Creek. The occurrence is apparently similar to the Evans Gulch occurrence described below.

O-3 Evans Gulch

Location: NW¼SE¼ sec. 3, T. 13 S., R. 40 E., 4,420-ft elevation, Ironside quadrangle.

Description: Narrow, dark-colored talc schist bodies cut serpentinite along the contact separating a small exposure of serpentinite-matrix melange from the Jurassic Weatherby Formation. The bed rock is poorly exposed in this area west of the westernmost known continuation of the Connor Creek Fault.

O-4 Lower Grandview Mine

Location: NE¼NW¼ sec. 7, T. 14 S., R. 37 E., 5,640-ft elevation, Rastus Mountain quadrangle.

Description: The Lower Grandview is a small, active lode gold mine that lies within one of a series of wide, mineralized shear zones that follow the contact between the Jurassic sedimentary rocks of the Weatherby Formation and a mass of serpentinized peridotite to the north. The mine, located in the Upper Burnt River mining district south of Unity, exposes limonitic talcose gouge zones that contain free gold, pyrite, and chalcopyrite. According to Caffrey (1982), talc occurs in the shear zones as foliated masses of nearly pure talc, as silicified talc-serpentine gouge breccias, and as massive mottled talc-serpentine rock. Individual talc seams appear no greater than 2 in. thick in the active workings. A powdered sample from a massive iron-stained talc on the dump contained carbonate but no amphibole minerals.

O-5 Quartz Gulch

Location: SE¼NE¼ sec. 7, T. 14 S., R. 32 E., 4,440-ft elevation, Canyon Mountain quadrangle.

Description: Talc chips are scattered over a 50-ft-wide zone along the Quartz Gulch road. The talc chips lie between a zone of serpentinite and a fault contact with greenstone that is marked by a narrow breccia zone cemented by quartz and calcite. The talc zone lies upstream from the old Marysville placers and is in an area noted for pocket gold deposits. A small quartz diorite stock of Late Jurassic age intruded the serpentinite host rock several miles to the north (Brown and Thayer, 1966).

SOUTHWESTERN OREGON

In the Klamath Mountains Province of southwestern Oregon (Figure 1, Plate 3), serpentinite is found in the two belts of pre-Nevadan basement rocks, the Western Jurassic Belt and the Western Paleozoic and Triassic Belt, respectively (Irwin, 1960), and in the oldest of the Upper Jurassic and Lower Cretaceous post-Nevadan superjacent rocks of the Otter Point and Dothan Formations (Koch, 1966). Some of the southwestern Oregon talc occurrences are hydrothermally altered serpentinites located along or near thrust faults that mark major tectonic boundaries between the Western Jurassic Belt and the structurally overlying Western Paleozoic and Triassic Belt. Most of the hydrothermal talcs occur in ultramafic rocks adjacent to quartz diorite intrusions of Late Jurassic age that have invaded the Western Paleozoic and Triassic Belt rocks and, much like the northeastern Oregon occurrences, are usually located in areas of gold mineralization (e.g., the Greenback, Gold Hill, and Sucker Creek areas) (Plate 3).

Some of the larger southwestern Oregon deposits are the tectonically deformed and regionally metamorphosed serpentinite lenses on Elliott Creek Ridge. The metaserpentinite lenses are believed to have been detached from the base of an overthrust plate of high-grade Western Paleozoic and Triassic Belt rocks and incorporated into a lower Western Jurassic Belt plate made up of the schists of Condrey Mountain.

High-grade regionally metamorphosed ultramafic rocks that include talc-carbonate, talc-olivinite, and anthophyllite-olivinite occur in amphibolite facies metamorphic zones such as the May Creek Schist (Red Mountain-Upper Pleasant Creek area, Plate 3) in Douglas County and in the Western Paleozoic and Triassic Belt in southern Jackson County (Siskiyou Peak area, Plate 3).

Elliott Creek Ridge area

The Elliott Creek Ridge area contains the largest talc deposits identified by this study in southwestern Oregon. These deposits are now being mined for carving-grade soapstone by Steatite of Southern Oregon.

The area is located on the headwaters of the Applegate River in southern Jackson County about 1 mi north of the California State Line and is centered on the ridge between Squaw Creek and Elliott Creek in secs. 10 and 11, T. 41 S., R. 3 W., between the elevations of 4,200 and nearly 5,000 ft. The main part lies within the 1:24,000-scale Squaw Lake topographic quadrangle (Plate 4). The area, which is mountainous and covered with brush and timber, lies on a mixture of private and USFS lands. Geologic maps that cover the Elliott Creek Ridge area include the 1:250,000-scale Medford quadrangle (Smith and others, 1982) and the 1:96,000-scale Grants Pass and Medford quadrangles (Wells, 1940; Wells, 1956).

Talc schist and blocky, carvable soapstone have been known to occur at this locality for many years (Figure 18). Early-day prospectors and hikers carved their initials in blocks of talc exposed along the ridge trail. Local residents have reportedly used the soapstone for making fireplace and wood-stove flues.

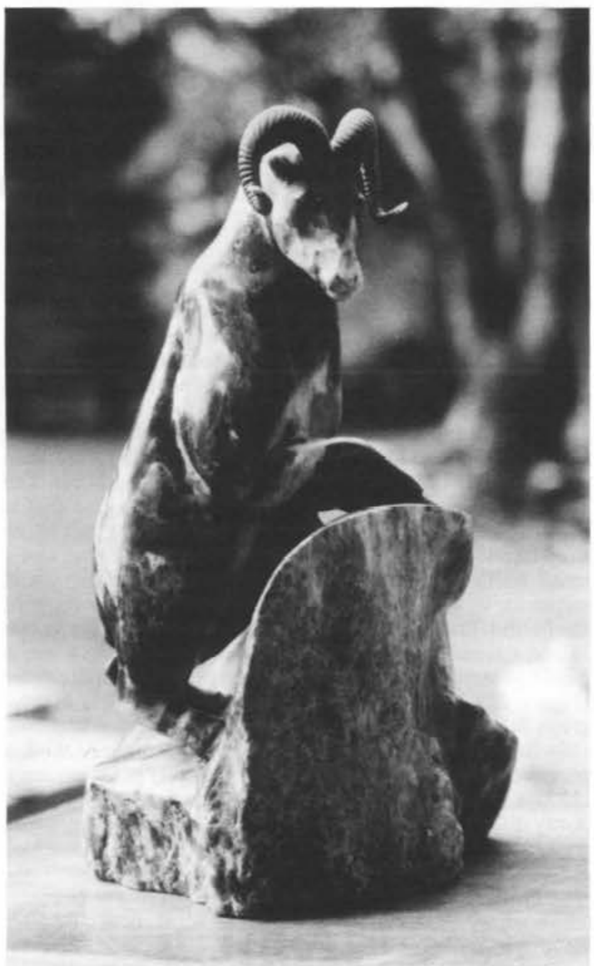

Figure 18. Figurine carved from Elliott Creek Ridge soapstone by Gene Drake.

Figure 19. Talc mining operation on Elliott Creek Ridge.

Claims were located by a group from Seattle in December, 1959 (unpublished DOGAMI-file report, Grants Pass office, 1959), but very little development and no production took place at that time. New claims were located on the deposits starting in 1974 by John Pugh (Steatite of Southern Oregon), and production of carvable soapstone followed from several shallow cuts distributed along the ridge. Total production to the end of 1986 was about 900 tons of trimmed and irregularly shaped large soapstone blocks. The soapstone has been mined from about 10 shallow cuts situated along the ridge (Figure 19, Plate 4). The deposit was previously described by Peterson and Ramp (1978).

Talc occurs as partial to complete replacement of several small lenticular bodies of metaserpentinite surrounded by highly contorted graphitic quartz-muscovite schists of Condrey Mountain. The schists of Condrey Mountain are mapped as an uparched portion of the lower plate unit of a major thrust that underlies regionally metamorphosed Permo-Triassic rocks of the Applegate Group and ultramafic to granitic igneous rocks of the upper plate (Hotz, 1967, 1971a). The Upper Jurassic Galice Formation (i.e., Western Jurassic Belt) has been suggested as a possible protolith of the schists of Condrey Mountain. The talc-bearing metaserpentinite occurs predominantly on and near the Elliott Creek Ridge crest as lenticular bodies that are infolded with the graphitic quartz muscovite schist (Figure 20). This appears to be a structural feature associated with the thrust, and the ultramafic stringers and lenses are believed to represent erosional remnants of the upper plate.

The individual small talc lenses that form the talc deposits and that occur for about 1½ mi along Elliott Creek Ridge are shown on Plate 4. Metaserpentinite with talc occurs down the south slope as low as the 3,870-ft elevation, as determined by altimeter. On the north slope, numerous float boulders of soapstone have been found in the large landslide deposit north of Summit Lake and extending down to Squaw Creek. This massive slide appears to have caused Squaw Lakes to form by damming of Squaw Creek.

In the area of active mining, lenticular talc lenses as much as 30 ft wide and more than 100 ft long have been exposed in shallow cuts. Many of the larger outcropping talc-bearing deposits are only partly altered to talc, and the remainder is a resistant antigorite, chlorite, talc metaserpentinite that usually stands in bold relief (see Figure 21). In some instances, the resistant foliated metaserpentinite appears to form a cap for the talc. The talc also occurs in thin tabular bodies along fractures in the metaserpentinite.

Figure 20. Talc pod in gray sericite schist, Elliott Creek Ridge.

Mineralogy of the soapstone is variable and includes a few areas of talc with abundant disseminated ankerite ($2CaCO_3 \cdot MgCO_3 \cdot FeCO_3$) in medium to coarse rhombohedral crystals as large as 1 in. across. Where devoid of carbonate, tremolite and/or anthophyllite may be present in the talc. In most of the samples examined, fibrous minerals appear to have been largely replaced by talc. Amphiboles were not detected by X-ray diffraction in massive talc samples. Chlorite is also present in most of the samples and occurs both mixed with the talc and as separate, relatively pure, massive lenticular bodies as much as 4 ft thick and 12 ft long. Trace amounts of pyrite are found in some of the deposits.

In addition to samples submitted for analysis (AUG-4, -5, -6, -7, -11, -12, and -30), twelve samples collected from the ridge have been examined under the microscope. The petrographic work was done to identify minerals other than talc (Table 2). Unlike most of the other Oregon talc deposits, the Elliott Creek Ridge occurrences formed in a thrust-fault metamorphic environment under elevated pressure and temperature and specific fluid-chemistry conditions. The reason for the deposits to be found exclusively in the metasedimentary phase of the schists of Condrey Mountain (gray graphitic quartz sericite schists) and not in the metavolcanic phase (green epidote, actinolite, chlorite, albite, quartz schists) is not apparent.

Williams area

The Williams area lies in southeastern Josephine County along the margins of the Grayback pluton of Late Jurassic age (Hotz, 1971b). Geologic map coverage is provided by the Josephine County map (Ramp and Peterson, 1979) and the 1:96,000-scale Grants Pass quadrangle (Wells, 1940) and the 1:250,000-scale Medford quadrangle map (Smith and others, 1982).

Several talc occurrences (Figure 22) have been found in altered ultramafic rock associated with Applegate Group metavolcanics and metasediments in the old Powell Creek (lower Applegate) mining district.

Although the talc deposits are as yet insufficiently explored and evaluated, the aerial distribution of talc alteration can possibly be shown to be within a specific distance of the Grayback pluton. The thermal effect of this large mass of diorite and gabbro has very probably shown itself in alteration of the surrounding ultramafic bodies. Further exploration of these ultramafic bodies will probably result in the discovery of other talc deposits.

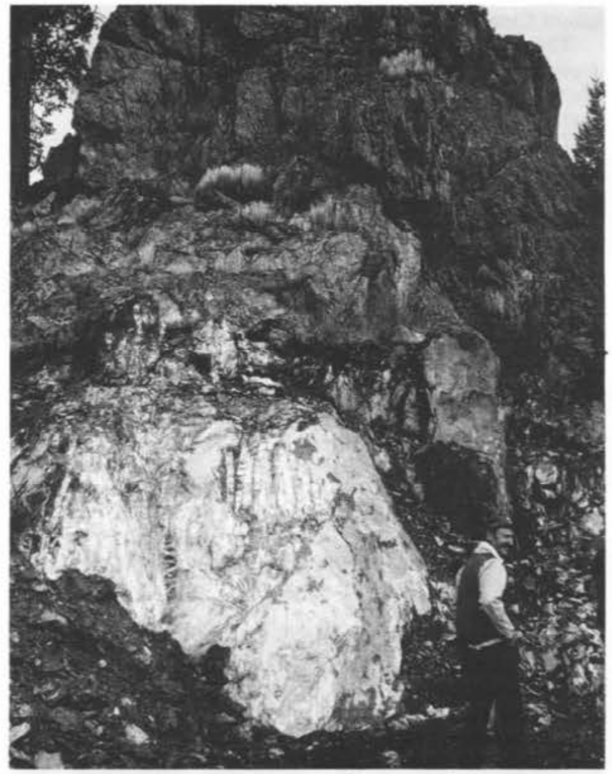

Figure 21. Metaserpentinite with talc and chlorite alteration standing in bold relief.

W-1 Powell Creek soapstone

Location: SE¼SW¼ sec. 17, T. 38 S., R. 5 W., elevation between 2,430 and 2,700 ft, Murphy quadrangle.

History: Talc (soapstone) was mined from this occurrence from 1967 to 1973(?) by Steatite of Southern Oregon, Inc. During that period, only about 5 tons of soapstone boulders were produced for carving purposes.

Description: The deposit can be reached by going up Powell Creek road for 3⅓ mi from the Water Gap road, then 0.8 mi up a BLM timber access road to the southeast. The soapstone occurs above the road in a landslide area that is about 150 to 250 ft wide and 600 ft long. The long axis of the slide trends about N. 58° E. and lies between the road and a small north-trending spur ridge. The slide contains mixed serpentinite, soapstone, argillite, and metavolcanic rocks of the Permo-Triassic Applegate Group. Much of the soapstone is iron stained and mixed with serpentine minerals; some is highly sheared. Impure boulders as large as 10 ft in diameter (Figure 23) have been extracted. Sample AUG-1, a pale-green foliated waxy rock with black streaks, contains talc, chlorite, and some asbestiform tremolite. Sample AUG-2, a massive olive-green talc-chlorite rock, locally contains more chlorite than talc, but no amphibole was detected by either X-ray diffraction or microscope examination. The powdered rock is a pale-greenish-gray color.

W-2 Powell Creek Road

Location: SE¼NW¼ sec. 25, T. 38 S., R. 6 W., 3,660-ft elevation, Williams quadrangle.

Description: Other narrow seams of talc in serpentinite occur along roads in the Powell Creek area. One locality is about 2 mi southwest of the mined site.

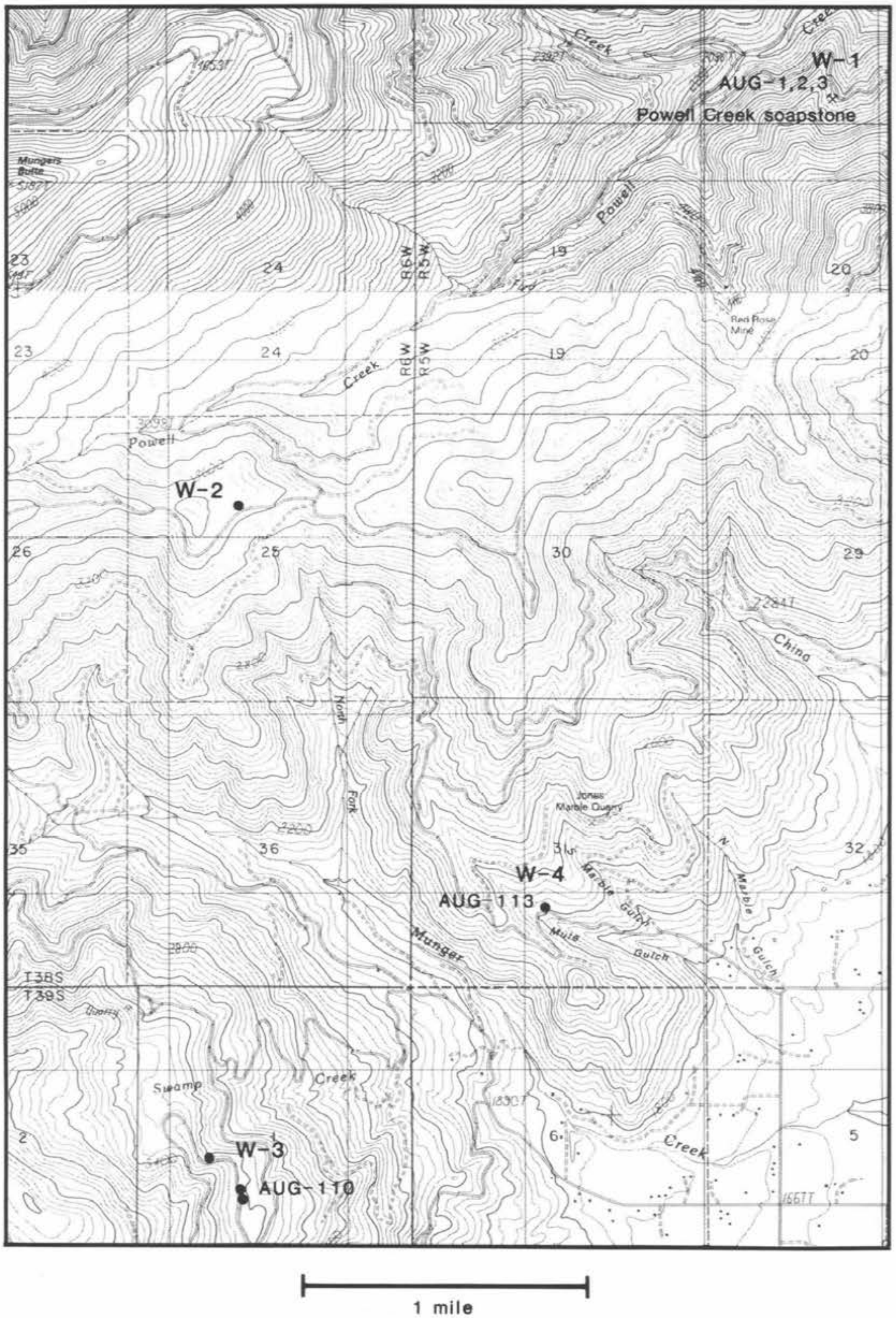

Figure 22. Talc occurrences in the Williams Creek talc area, Williams and Murphy quadrangle, Williams area. Labeled occurrences are described in text.

Figure 23. Talc pod in the Powell Creek occurrence, Williams area.

W-3 Cedar Flat talc

Location: NE¼SW¼ sec. 1, T. 39 S., R. 6 W., 3,240-ft elevation, Williams quadrangle.

Description: Gray to tan and iron-stained talc-carbonate rock that is in part foliated occurs as scattered float and sparse outcrops along the Cedar Flat road for about 100 ft. The enclosing rocks are Applegate Group metavolcanic rocks and less abundant serpentinite. The area appears to be a large landslide block with hummocky topography and a year-around pond below the road a short distance south of the talc occurrence.

Sample AUG-110 collected at the site has material of variable quality and appearance. Some of the talc contains minor serpentine with magnetite dust; some has minor pyrite altered to limonite. The powdered sample is light tan to greenish gray in color and contains some chlorite and minor tremolite.

W-4 Mule Gulch

Location: SE¼SW¼ sec. 31, T. 38 S., R. 5 W., 2,220-ft elevation, Williams quadrangle.

Description: Sample AUG-113 is talc-bearing serpentinite float. The powdered sample is a pale-gray-green color. It contains minor magnetite and fairly abundant tremolite.

Sucker Creek area

A few talc occurrences were pointed out in the Sucker Creek and Althouse Creek drainages in southern Josephine County by Russell J. Ralls, an independent geologist who has been working in the area. The geologic environment of the talc occurrences is much like that of the Williams area, i.e., small ultramafic bodies associated with the Permo-Triassic Applegate Group. The thermal effect of both small and large diorite and gabbro intrusives as well as the presence of high-angle faults mapped in the area have been important factors in localizing talc formation. The area includes the old Sucker Creek and Althouse Creek mining districts, which were noteworthy gold placer districts (Figure 24). Geologic map coverage is provided by the Josephine County map (Ramp and Peterson, 1979), the 1:96,000-scale Grants Pass quadrangle (Wells, 1940), and the Medford 1° by 2° quadrangle (Smith and others, 1982).

SC-1 Sucker Creek 1

Location: NE¼NE¼ sec. 13, T. 40 S., R. 7 W., 2,230-ft elevation, Oregon Caves quadrangle.

Description: A 40-ft-wide zone of massive talc-limonite rock and sheared iron-stained talc schist is exposed in altered serpentinite on the short connecting road between the upper Sucker Creek road and the China Garden road 200 ft west of the junction of the China Garden road with the main USFS Road 4612. The enclosing rocks of the Permo-Triassic Applegate Group are not well exposed but appear to be mainly argillite on the east side and metavolcanic rock on the west side of this small serpentinite body. Sample AUG-100 is a very fine-grained fibrous aggregate of talc, with minor amounts of antigorite and chlorite(?) whose powder is a pale-yellow or cream color. No amphibole or carbonate was detected by either X-ray diffraction or microscopic examination.

SC-2 Sucker Creek 2

Location: N½ sec. 32, T. 40 S., R. 6 W., 3,680-ft elevation, Oregon Caves quadrangle.

Description: Minor talc float also occurs at the 3,680- and 3,840-ft elevations along timber access Road 4703.

SC-3 Number Seven Gulch

Location: SE¼NE¼NE¼ sec. 23, T. 40 S., R. 7 W., 3,380-ft elevation, Oregon Caves quadrangle.

Description: A small lenticular(?) outcrop of foliated talc about 6 to 8 ft thick enclosed by weathered siltstone is poorly exposed on the curve of USFS Road 4703. The trend of the talc zone may be northeasterly. Sample AUG-104, which was taken from this exposure, contains talc, minor chlorite, and tremolite.

SC-4 Number Seven Gulch 2

Location: NW¼NW¼ sec. 24, T. 40 S., R. 7 W., 3,405-ft elevation, Oregon Caves quadrangle.

Description: A second, also poor exposure of talc occurs at the junction of USFS Roads 4703 and 042 about 280 ft east of locality SC-3. The apparent strike of foliation in this upper site is N. 20° E., and the dip is 55° NW. Although some of the talc from this upper exposure is a light-green, relatively pure-appearing talc, it also occurs with some porous iron-stained material as well as dark-green chlorite schist. Sample AUG-105 contains talc, minor chlorite, and serpentine with magnetite and a trace amount of very small fibers that may be tremolite(?).

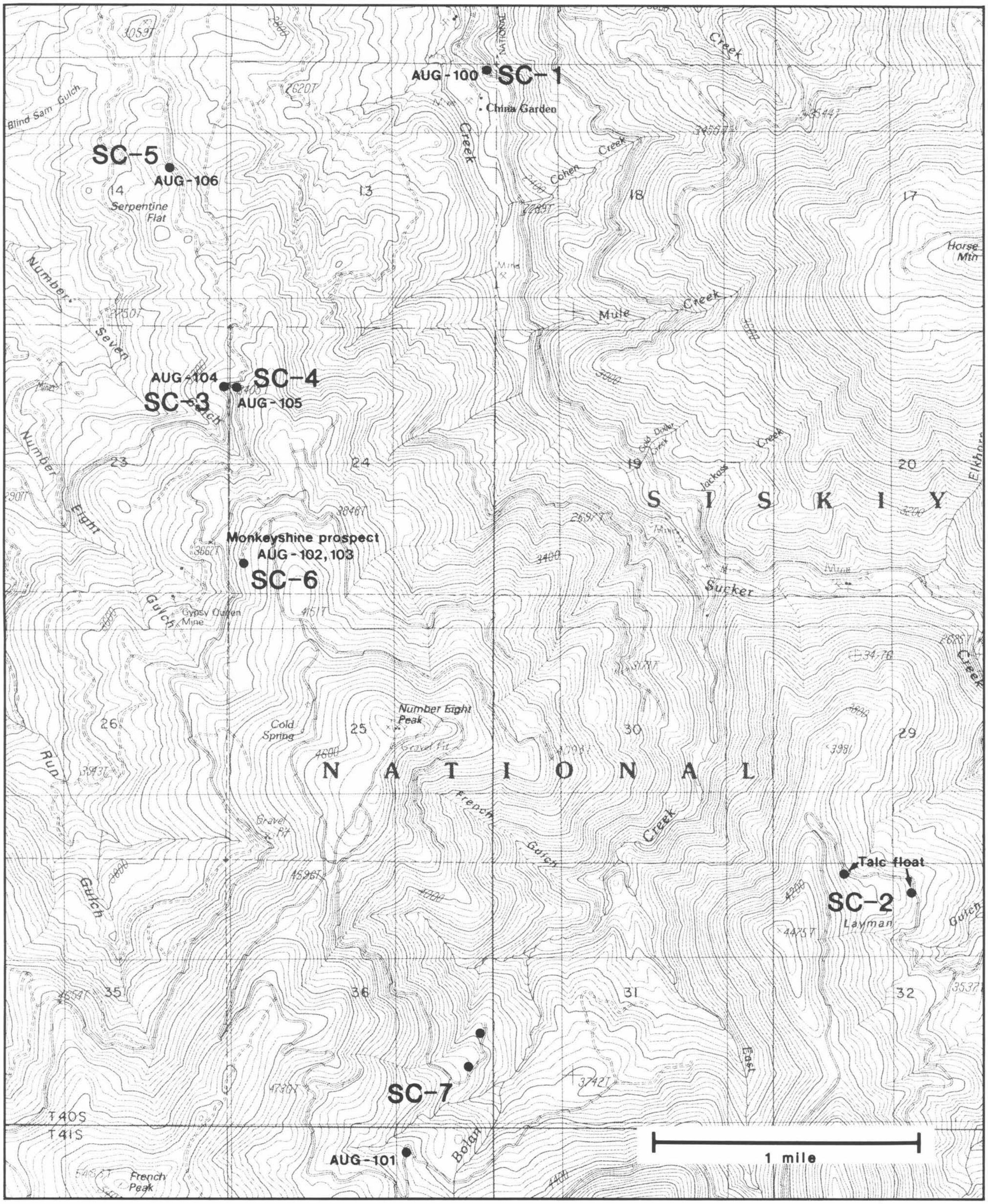

Figure 24. Sucker Creek talc area, Oregon Caves quadrangle. Labeled occurrences are described in text. SC = Sucker Creek.

SC-5 Serpentine Flat

Location: SE¼NE¼ sec. 14, T. 40 S., R. 7 W., 3,065-ft elevation, Oregon Caves quadrangle.

Description: Another poorly exposed narrow zone of sheared talc occurs on Road 042 at the head of a small landslide gully near Serpentine Flat. The sheared material (AUG-106) is a pale-brown mixture of talc and chlorite.

SC-6 Monkeyshine gold claim

Location: SW¼SW¼ sec. 24, T. 40 S., R. 7 W., 3,850-ft elevation, Oregon Caves quadrangle.

History and development: The property is a gold prospect. The claim location notice posted near the open cut and short adit is dated February 1984. Workings consist of a shallow excavation and 50-ft adit trending N. 80° E.

Description: Sheared iron-stained talc is exposed at the face of the 50-ft adit and in the surface cut about 30 ft north of the portal. A talc-bearing shear zone in the adit strikes approximately east and dips 30° S. The overlying rock appears to be metatuff and basalt, and the underlying rock appears to be serpentinite. There appear to be several directions of shearing. Sample AUG-102, which is from the adit, has abundant limonite in a highly sheared mixture of talc and chlorite. Sample AUG-103 is mostly talc, with minor chlorite and serpentine(?); when powdered, it is a yellowish-tan to white color. No amphibole was detected by microscopic examination or X-ray diffraction in either sample.

SC-7 Bolan Creek talc

Location: NW¼NE¼ sec. 1, T. 41 S., R. 7 W., 4,285-ft elevation, Oregon Caves quadrangle.

Description: Two bodies about 25 ft and 15 ft wide, respectively, of iron-stained, dark-green talc-carbonate rock separated by about 15 ft of highly sheared serpentinite are exposed in a road cut on the upper side of a switchback on USFS timber access Road 450. Sample AUG-101, which was collected from this site, is a dark-greenish-gray mixture of talc and carbonate (magnesite or ankerite), with minor chlorite, serpentine, and magnetite. No fibrous amphibole or serpentine was found in a powdered sample examined under the microscope and by X-ray diffraction. Similar-appearing talc was reported about 2,000 ft to the north-northeast along USFS Road 440 in the SE¼ sec. 36, T. 40 S., R. 7 W., but the locality was not visited.

Carberry Creek area

The Carberry Creek area, located in southeastern Josephine County and southwestern Jackson County, is also associated with old gold lode and placer workings in the Applegate Group. The local geology is similar to that of the Sucker Creek and Coyote Creek districts. Small, locally hydrothermally altered ultramafic slices are incorporated into the Applegate Group in an area known for small gold lode and placer deposits. Geologic map coverage of the area is provided by the 1:250,000-scale Medford quadrangle (Smith and others, 1982), the 1:96,000-scale Grants Pass quadrangle (Wells, 1940), and the Josephine County geologic map (Ramp and Peterson, 1979).

CC-1 Steve Fork soapstone

Location: Secs. 5 and 8, T. 41 S., R. 5 W., between 3,880- and 4,200-ft elevation, Grayback Mountain quadrangle.

History: In 1963 on the head of Steve Fork, William LaFaunce of Medford reportedly mined small amounts of block soapstone that he sold for carving purposes at his art store in Medford.

Description: The site of 1963 mining activity was not identified during a recent visit to the area, but numerous float boulders of talc-bearing altered ultramafic rock were seen in several places along Upper Steve Fork road from a point about 1 mi above the forks to about 1 mi north of the California border. Some of the talc-bearing rock appears to be from boulders occurring in glacial moraines as well as from altered ultramafic rocks exposed in the south half of sec. 5. The talc samples are light tan with black specks and streaks of magnetite. Much of the material contains tremolite and can be classed as a talc-tremolite schist. Some samples with limonitic spots that look like weathered olivine appear to be weathered talc-olivinite that contains some tremolite. No outcrops of talc-bearing rock were found, but widespread float probably indicates several small occurrences in the area.

Talc float has been seen in four other sites in the Carberry Creek drainage area:

- CC-2 Steves Peak Trail SW¼SW¼ sec. 18, T. 40 S., R. 4 W., 3,280-ft elevation
- CC-3 South Trail NE¼SW¼ sec. 19, T. 40 S., R. 4 W., 3,180-ft elevation
- CC-4 Cougar Ck. road NE¼NW¼ sec. 8, T. 41 S., R. 4 W., 3,500-ft elevation
- CC-5 Whiskey Peak NW¼SW¼ sec. 11, T. 41 S., R. 5 W., 5,800-ft elevation

Siskiyou Peak area

Talc alteration is found along the margins and within a number of ultramafic masses near the headwaters of the Little Applegate River on the western margin of the Ashland pluton. Locally, the geology is similar to other talc areas in the Western Paleozoic and Triassic Belt Applegate Group, i.e., talc associated with metamorphosed ultramafic slices that have been tectonically intercalated with metasedimentary and metavolcanic rocks and later invaded by granitic intrusions of Late Jurassic age. Unlike the Sucker Creek, Coyote Creek, and Carberry Creek areas, there has been only a little gold produced in this area. Geologic maps of the area include the 1:250,000-scale Medford quadrangle (Smith and others, 1982) and the 1,96,000-scale Medford quadrangle (Wells, 1956). Talc-carbonate alteration was first recognized in the Siskiyou Peak area at the Prater chromite prospect (Ramp, 1961, p. 91).

SP-1 Glade Creek

Location: NE¼NW¼ sec. 6, T. 40 S., R. 1 W., 3,270- to 3,315-ft elevation, Talent quadrangle.

Description: Talc schist float first occurs on the Glade Creek road-Brickpile Ranch road at about 750 ft north of the junction between the Glade Creek road and the Glade Creek-Brickpile Ranch road (Figure 25). A sample (AUG-94) of foliated talc schist that was collected along the road at various points contained talc, chlorite, and quartz. A 2-ft-thick seam of talc crops out on the upper east branch road about 110 ft south of the road junction. A sample of this light-tan, iron-stained, fine-grained talc contains carbonate, serpentine, chlorite, and magnetite.

A sheared, iron-stained talc zone in serpentinite is cut by the upper road about 55 ft to the south. The talc zone is about 12 ft thick and strikes about N. 45° E. and dips 75° SE. A chip sample (AUG-96) across the zone contains some serpentine. Sample AUG-97, a massive iron-stained talc with disseminated carbonate and minor chromite collected from a 2-ft-diameter float boulder about 6 ft south of the sheared talc zone, contains major amounts of massive serpentine. Another narrow, poorly exposed zone of iron oxide-stained talc schist that strikes about N. 30° E. and dips steeply west is cut by the upper road about 90 ft to the south.

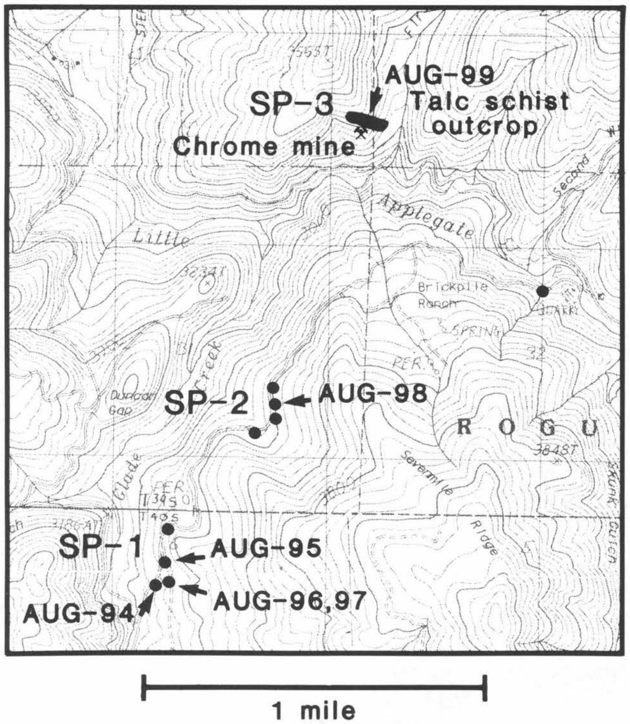

Figure 25. Talc occurrences on the Little Applegate River and Glade Creek, Siskiyou Peak and Talent quadrangles, Siskiyou Peak talc area. Labeled occurrences are described in text.

SP-2 Brickpile road

Location: SW¼SE¼ sec. 31, T. 39 S., R. 1 W., 3,400-ft elevation, Talent quadrangle.

Description: Minor talc float occurs in several places along the main Glade Creek-Brickpile Ranch road. The first occurs at the bend near the north line of sec. 6 about a tenth of a mile north from the road junction. About a third of a mile along the road, north from the boundary between secs. 6 and 31, is a 4-ft boulder of rusty talc and a small landslide area. About a tenth of a mile farther north is an outcrop and concentration of rusty talc-carbonate float that extends for about 250 ft along the road. Sample AUG-98 from this area contains major amounts of carbonate, minor serpentine, and trace amounts of tremolite(?). The only other talc seen between this point and the Little Applegate River crossing was a minor amount in float in a small gully about 700 ft west of the bridge across the Little Applegate River.

SP-3 Prater chromite-talc

Location: SW¼SW¼ sec. 29 and SE¼SE¼ sec. 30, T. 39 S., R. 1 W., 3,050- to 3,300-ft elevation, Talent quadrangle.

Description: The talc-carbonate schist at the Prater chromite deposit (Ramp, 1961, p. 91) can be reached by driving northwest on the timber access road about a tenth of a mile from the bridge in sec. 32, then left on a jeep trail for less than half of a mile across Second Water Gulch and the Little Applegate River to the diversion dam for the Sterling Ditch (Figure 25). From this point, the route is down the ditch to First Water Gulch, then up the slope northwest to the deposit at about 3,200-ft elevation. The foliated talc-bearing zone appears to be about 35 ft thick and at least 500 ft long. The zone strikes about N. 60° E. and dips 45° N. The talc zone lies just above and to the north of the old chromite pit. A powdered sample (AUG-99) contains abundant carbonate, probably ankerite, minor chlorite and serpentine(?), and minor chromite and magnetite. A very minor amount of tremolite(?) in the form of needle-shaped crystals was identified under the microscope but was not detected by X-ray diffraction analysis.

SP-4 Bratcher soapstone

Location: NW¼NW¼ sec. 18, T. 39 S., R. 1 E., 3,700-ft elevation, Ashland quadrangle (not shown on Plate 3 because it is slightly east of the area covered by the map).

History: The deposit was developed and mined for a brief period in 1964 by L.A. Bratcher of Ashland and Tom Carrithers of Santa Cruz, California. Total production was small.

Description: The main cut is about 40 ft south and 400 ft west of the quarter corner of secs. 7 and 18. The deposit is reached via the Ashland Mine road and a branching unimproved road to the southeast up the ridge. The distance to Ashland from the mine is about 4½ mi. The soapstone, largely talc with minor serpentine and some tremolite, occurs as selvages and lenses as much as 8 ft thick at various places along the margins of pegmatitic and diorite dikes that penetrate a serpentinite roof pendant. The serpentinite body appears to be about 1,000 ft wide and 2,000 ft long. Minor vermiculite was noted along the eastern margin of the roof pendant, which is surrounded by granodiorite and quartz diorite. A 1964 sketch map of the open cut geology is shown in Figure 26.

SP-5 Dutchman Peak Saddle

Location: S¼NE¼ sec. 1, T. 41 S., R. 2 W., 7,100-ft elevation, Siskiyou Peak quadrangle.

Description: A small amount of talc occurs along contacts between metaserpentinites and metasediments in an area surrounded by quartz diorite about 4,000 ft S. 48° E. from the Dutchman Peak Lookout. The ultramafic rock area appears to be about 60 ft wide. Small boulders of talc no larger than 1 ft by 10 in. in size are scattered over an area of about 50 by 150 ft. The talc boulders appear to represent about 2 percent of the surface-rock rubble. A 15- by 50-ft outcrop of brown-weathering metaserpentinite on the northeast side of the ridge strikes N. 45° W. and dips 50° NE. Most of the talc float appears to be on the northeast side of the ridge. Foliation in the metasedimentary rock exposed on the ridge about 60 ft north of the talc occurrence strikes about N. 15° E. and dips 50° W.

The light-greenish-gray to tan talc is off white to cream colored when powdered. Sample AUG-20 contains trace amounts of chlorite and tremolite, as determined by X-ray diffraction. Minor amounts of nonfibrous tremolite were detected under the microscope.

SP-6 Wrangle Gap

Location: SE¼NW¼ sec. 32, T. 40 S., R. 1 W., 6,500-ft elevation, Siskiyou Peak quadrangle.

Description: A talc occurrence reported near Wrangle Gap has not been examined or sampled. The talc occurs in a shear zone mapped by Wells (1956) that cuts anthophyllite-olivinites on the south side of Red Mountain.

SP-7 Doe Peak 1

Location: SW¼SE¼ sec. 12, T. 41 S., R. 1 W., 4,550-ft elevation, Siskiyou Peak quadrangle.

Description: Talc occurs with small bodies of serpentinite and associated amphibolite in an area surrounded by diorite

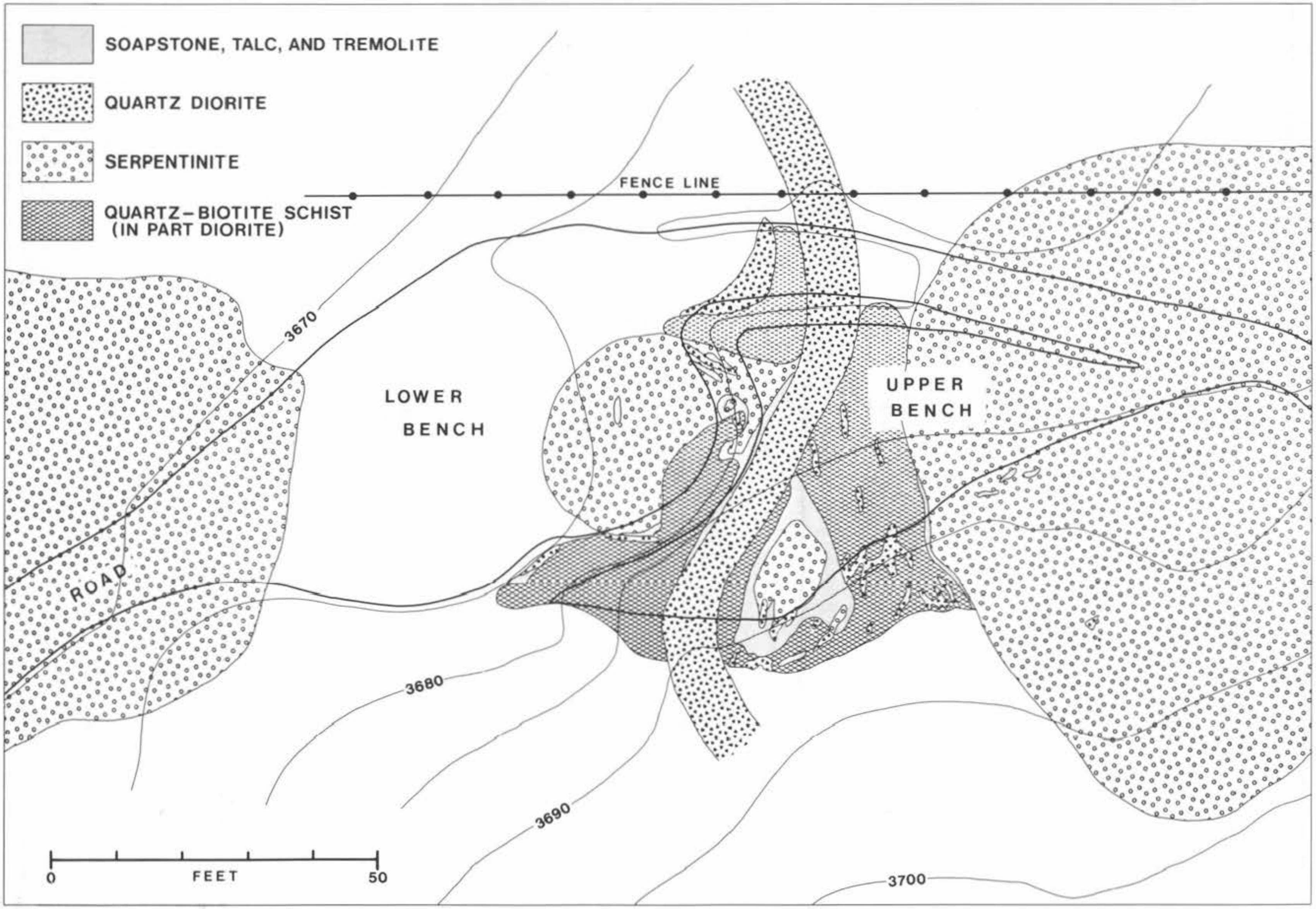

Figure 26. Map of the Bratcher soapstone deposit (SP-4), Siskiyou Peak talc area. Map made by Len Ramp, August 19, 1964.

of the Ashland pluton along USFS Road 41S10 about 1.1 mi from the main road (Figure 27). The distribution and size of talc float suggest that these occurrences are small. Exposures are poor. A pale-green, foliated platy talc with minor and very finely disseminated magnetite (AUG-107) consists mostly of talc with trace amounts of chlorite and fibrous tremolite. Another variety of talc float is a compact, matted mixture of platy and fibrous talc that is a dull greenish-gray to yellowish-gray or cream color when weathered and that also contains minor disseminated magnetite and tremolite.

SP-8 Doe Peak 2

Location: SW¼ sec. 13, T. 41 S., R. 1 W., 4,460- to 4,500-ft elevation, Siskiyou Peak quadrangle.

Description: Minor talc float occurs along the point of a ridge on the spur road about 1¾ mi from the main road. Two varieties found here include an iron-stained, mottled porous talc with disseminated carbonate and a more compact, banded pale-greenish-gray variety. Both varieties contain minor tremolite. Sample AUG-108 was collected from a group of large ultramafic boulders (1½ to 2½ ft in diameter) in a wide spot about 600 ft farther down the road. Although many of these boulders have been partly altered to talc, some appear to have just talc selvages. The talc is a pale-olive-green compact massive variety that is partly iron stained. Although the source of the boulder pile was not apparent, it was undoubtedly produced during road construction.

Talc-bearing float boulders are scattered over an area about 400 to 500 ft farther down the road where the road bends to the northwest and starts to climb at about the 4,475-ft elevation. The talc is a tan talc-chlorite schist with carbonate clots and abundant tremolite. The ultramafic rocks in this area are associated with amphibolite, minor quartzite, quartz-mica schist, and marble that belong to the Applegate Group. Talc appears to have formed mainly along the contacts of amphibolite and ultramafic rocks. The predominant surrounding rock type in the area is quartz diorite. Other areas of talc alteration probably occur in the region in similar geologic environments. Further prospecting of this area would probably lead to the discovery of additional talc deposits.

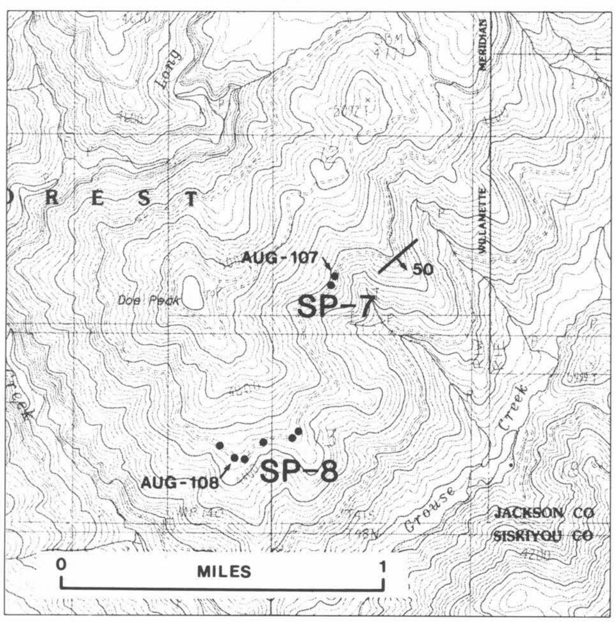

Figure 27. Talc occurrences near Doe Peak, Siskiyou Peak quadrangle, Siskiyou Peak talc area. Labeled occurrences are described in text.

Red Mountain-Upper Pleasant Creek area

The Red Mountain-Upper Pleasant Creek area is part of an area of high-grade metamorphic rocks in southern Douglas County and northern Jackson County. The area lies between the South Umpqua and Rogue Rivers and encompasses parts of the old Gold Hill, Riddle, and Tiller-Drew mining districts. The Red Mountain area is best reached via Highway I-5 to the small community of Azalea, then up the Upper Cow Creek road to Applegate Creek, then up the Red Mountain Road for 4¾ mi. The area is mountainous and heavily timbered. Geologic maps of the area include the 1:250,000-scale Medford quadrangle (Smith and others, 1982), the Douglas County map (Ramp, 1972), and the 1:48,000-scale Wimer quadrangle (Page and others, 1977).

Rocks in this area comprise part of the May Creek Schist and are part of the Western Paleozoic and Triassic Belt of the Klamath Mountains Province. The rocks have been subjected to regional tectonic metamorphism as well as thermal metamorphism from intrusion of diorite plutons.

The talc and talc-carbonate rocks in the area are altered serpentinites. Those in the Upper Pleasant Creek Group (R-6 through R-9) are separated a short distance from the main serpentinite mass and may have formed in a major fault zone. However, existing geologic mapping in this area is not detailed enough to confirm this relationship. Additional exploration in the Red Mountain-Upper Pleasant Creek area should result in the finding of other talc deposits.

R-1 Callahan Creek occurrence

Location: E¼ corner sec. 36, T. 31 S., R. 3 W., 3,200-ft elevation, Cedar Springs Mountain quadrangle.

Description: Small areas of talc alteration occur along the south margin of a small serpentinite inclusion in the large, elongated quartz diorite body that extends south-southwest from the Tiller area to the West Fork Evans Creek drainage. The serpentinite body is exposed in a road rock quarry and appears to be about 200 ft in diameter. Irregular zones of foliated talc about 1 to 3 ft thick occur along the south edge of the serpentinite. The powdered talc is scaly and fibrous under the microscope. Some of material has abundant tremolite, while other samples appear to be devoid of fibrous amphibole. All of the material contains minor chlorite and magnetite.

R-2 Red Mountain 1

Location: NW¼SW¼ sec. 23, T. 32 S., R. 3 W., 3,760- to 3,875-ft elevation, Cedar Springs Mountain quadrangle.

Description: Talc-carbonate rock first occurs as float along the road at about the 3,760-ft elevation. Minor amounts of talc float can be traced uphill to the small spur ridge top where a 4-ft block of talc carbonate rock crops out at about 3,875 ft (Figure 28). The enclosing rocks are partly serpentinized peridotite and metaserpentinite. The talc-carbonate appears to occur in small lenticular bodies that trend about N. 10° W.

R-3 Landslide

Location: SE¼SW¼ sec. 23, T. 32 S., R. 3 W., 4,000-ft elevation, Cedar Springs Mountain quadrangle.

Description: Numerous large talc-carbonate boulders from 1 to 3 ft in diameter occur in a landslide on the Red Mountain road about 0.9 mi south of R-2 at about the 4,000-ft elevation. The slide area appears to be about 150 to 200 ft

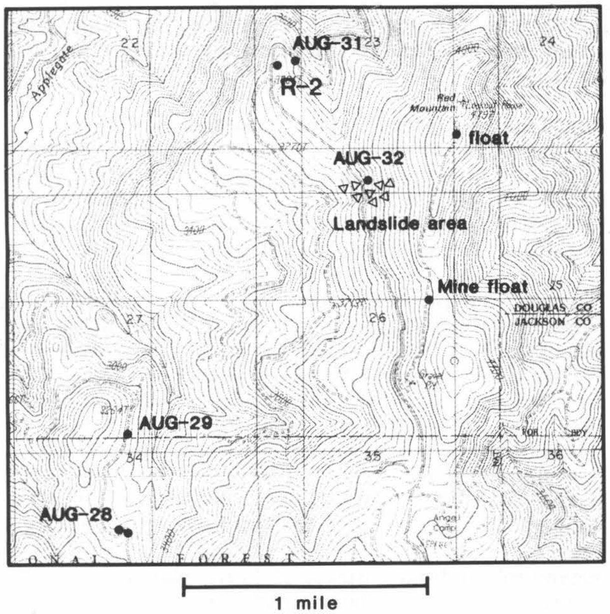

Figure 28. Talc occurrences near Red Mountain, Cedar Springs Mountain and Skeleton Mountain quadrangles, Red Mountain-Upper Pleasant Creek talc area. Labeled occurrences are described in text.

wide and extends upslope for several hundred feet. Sample AUG-32 contains talc, minor chlorite, serpentine, magnetite, carbonate, and olivine.

R-4 Red Mountain lookout

Location: SE¼ sec. 23, NE¼ sec. 26, T. 32 S., R. 3 W., 4,500- to 4,790-ft elevation, Cedar Springs Mountain quadrangle.

Description: Minor amounts of talc also occur as float along the road in the saddle about 4,500 ft south of the site of the former Red Mountain lookout station and along the road about 800 ft south of the former lookout site. Several additional, very small areas of talc alteration occur in the ultramafic rocks along the trail a short distance north of the former lookout.

R-5 Upper Applegate Creek 1

Location: SE¼NW¼ sec. 34, T. 32 S., R. 3 W., 3,370-ft elevation, Skeleton Mountain quadrangle.

Description: Talc alteration occurs on a USFS timber access road north of Panther Peak. The most southerly exposure is on a sharp bend in the road around the nose of a small ridge at a point 4½ mi east of Goolaway Gap on a dead-end timber access road. This occurrence of talc and fibrous tremolite alteration is in metaserpentinite surrounded by decomposed diorite and associated with amphibolite. Where cut by the road in the sharp bend, the metaserpentinite zone appears to be about 160 ft wide, as measured in an east-west direction. Due to thick brush and lack of exposure, it is unclear whether the zone extends any distance to the north or south. About 30 percent of the metaserpentinite is altered to talc and tremolite. A few boulders of apparently massive talc up to 2 ft in diameter were seen, but the larger boulders appear to have a serpentinite core. A composite sample of this occurrence chipped from large boulders and pieces of float (AUG-28) contains abundant radiating fibrous amphibole.

R-6 Upper Applegate 2

Location: SE¼SW¼ sec. 27, T. 32 S., R. 3 W., 3,270-ft elevation, Cedar Springs Mountain quadrangle.

Description: A second area of talc and tremolite alteration is exposed about 2,000 ft down the road to the north near the SE corner SW¼ sec. 27, just to the north of the Douglas/Jackson County line. Here a roadcut exposes amphibolite, talc-tremolite schist, metaserpentinite, and diorite. The ultramafic rocks make up about 30 ft of the exposure along the north-northeast-trending road. A random chip sample (AUG-29) from this exposure contains talc, asbestiform tremolite veinlets, chlorite or serpentine(?), and minor magnetite.

R-7 Upper Pleasant Creek Group

Location: NW¼NE¼ sec. 35, T. 33 S., R. 4 W., 2,680-ft elevation, King Mountain quadrangle.

Description: Narrow zones of talc-carbonate rock are exposed along BLM timber access roads in the headwaters of Pleasant Creek, northern Jackson County (Figure 29). The first outcrop is on BLM Road 33-4-26 near the north edge of the NE¼ of sec. 35. This exposure appears to be a fault wedge about 30 ft wide and 15 ft high. The east edge is marked by a fault striking approximately north and dipping 80° W. The surrounding rocks are mainly fine-grained amphibolite. A northeast-trending shear plane appears to cut off the talc to the west. This shear dips about 50° SE and is poorly exposed. Talc-bearing phyllite float occurs on the west side of the talc body. The talc-carbonate rock weathers to an iron-stained mottled surface. Some pieces of float contain shrew burrows (Figure 30). Talc and tremolite were identified in sample AUG-21 by petrographic and X-ray diffraction analyses. Sample AUG-24 contains talc and carbonate.

R-8 Upper Pleasant Creek 2

Location: SE¼NE¼ sec. 35, T. 33 S., R. 4 W., 2,890-ft elevation, King Mountain quadrangle.

Description: Small exposures of talc (AUG-22) also occur on the ridge at the 2,890-ft elevation about 750 ft S. 35° E. of the roadcut exposure and at sample site AUG-23, located at the 2,910-ft elevation 850 ft to the south. The limited extent of float indicates that these bodies are probably discontinuous and relatively narrow.

R-9 Upper Pleasant Creek 3

Location: SE¼NW¼ sec. 35, T. 33 S., R. 4 W., 2,560-ft elevation, King Mountain quadrangle.

Description: Sample AUG-25 was collected from a small roadcut exposure of sheared iron-stained talc and talc tremolite schist.

R-10 Upper Pleasant Creek 4

Location: SE¼SW¼ sec. 23, T. 33 S., R. 4 W., 3,260- to 3,400-ft elevation, King Mountain quadrangle.

Description: Two roadcut exposures at 3,260-ft and 3,400-ft elevations (samples AUG-26 and AUG-27, respectively) are probably on the same zone. A 12- to 15-ft-thick zone of sheared talc schist strikes about N. 30° W. and dips 55° SW. Petrographic and X-ray diffraction studies indicate that AUG-26 contains talc and tremolite, while sample AUG-27 contains abundant carbonate and perhaps some tremolite (tentatively identified in powders but not identified by X-ray diffraction analysis).

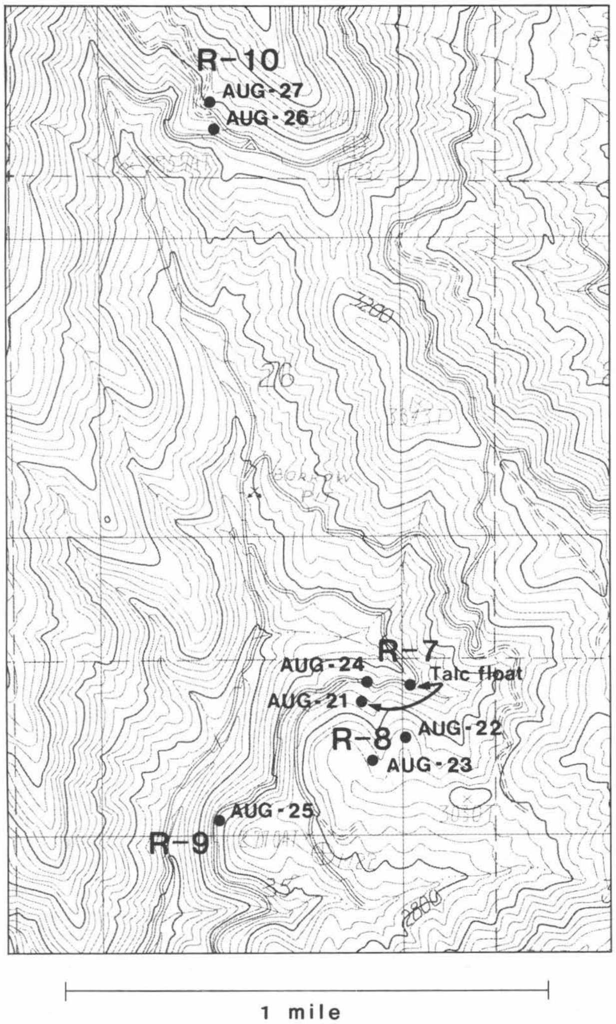

Figure 29. Talc occurrences on Pleasant Creek, King Mountain quadrangle, Red Mountain-Upper Pleasant Creek talc area.

R-11 Jamison Gulch

Location: SW¼ sec. 10, T. 34 S., R. 4 W., Wimer quadrangle.

Description: Boulders of talc have been reported in Jamison Gulch, a tributary of Pleasant Creek about 3 mi southwest. Samples have not been collected from this reported site, which lies in a shear zone mapped by Page and others (1977).

Greenback area

Varying degrees of talc alteration in serpentinites have been noted at several sites associated with gold mineralization in the headwaters area of Coyote Creek in Josephine County. Here serpentinites are localized along the tectonic contact between the Western Jurassic Belt and the Western Paleozoic and Triassic Belt (Ramp and Peterson, 1979), which has also been locally invaded by dioritic intrusions of Late Jurassic age. The area encompasses part of the old Greenback mining district and is essentially unexplored for talc. Geologic maps for the area include the Josephine County map (Ramp and Peterson, 1979), part of the 1:62,500-scale Glendale quadrangle (*in* Ramp and Peterson, 1979), and the Medford 1° by 2°quadrangle (Smith and others, 1982).

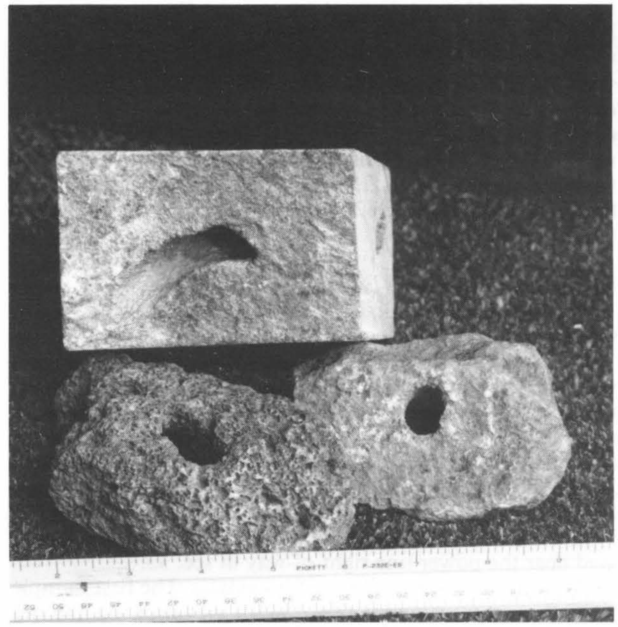

Figure 30. Shrew burrows in soapstone.

Talc and talc-bearing serpentinite occur at the following gold mines in the Greenback area:

Oro Grande Mine	SE¼ sec. 28, T. 33 S., R. 5 W.
King Midas	NE¼ sec. 28, T. 33 S., R. 5 W.
Marshal Mine (Dorothea)	SW¼ sec. 22, T. 33 S., R. 5 W.
Golden Ring	SW¼ sec. 14, T. 33 S., R. 5 W.
Sunset Mine	NW¼ sec. 14, T. 33 S., R. 5 W.

A powdered sample of iron-stained, sheared, pale-green waxy talc from the Marshall Mine examined under the microscope contained scaly talc, antigorite, and minor chlorite(?); fibrous amphiboles were not identified. This talc is in a mineralized sheer zone that strikes to the east and dips steeply to the north. The talc-bearing zone is locally as much as 2 ft thick.

Myrtle Creek area

Minor talc occurrences have been reported a short distance northwest and north of the town of Myrtle Creek in Douglas County. This area is covered by the Douglas County geologic map (Ramp, 1972).

Small pieces of a waxy yellowish-green talc occur as float near the railroad tracks along the northwest contact of the northeast-striking serpentinite band in SE¼NE¼ sec. 19, T. 29 S., R. 5 W. The talc reported on the ridge between Clark Branch and Richardson Creek near the north edge of sec. 4, T. 29 S., R. 5 W., has not been seen by the writers. Further investigation of the area may result in discovery of other talc occurrences.

Coast Range thrust area

Small lenticular serpentinite bodies that frequently contain small areas of talc alteration occur along the so-called Coast Range thrust fault zone that marks the boundary between the Dothan Formation and the Rogue and Galice Formations of the Western Jurassic Belt. This is a major tectonic boundary that separates the Dothan Formation, which is underthrust on the west, from the overlying volcanic rocks and sediments of the Western Jurassic Belt on the east (Ramp, 1972). The area includes part of the old Riddle mining district in Douglas County. Geologic maps covering the area include the 1:250,000-scale Medford quadrangle (Smith and others, 1982) and the Douglas County map (Ramp, 1972).

CR-1 Canyonville talc (Lilja and Moyer)

Location: S½ sec. 33, T. 30 S., R. 5 W., 1,565-ft elevation, Canyonville quadrangle.

Description: The talc occurrences are located about 1 mi west of Canyonville on private land. Narrow stringers of talc occur within and along the contact of a northeast-trending serpentinite belt about 300 ft wide. The serpentinite lies along a thrust fault separating the Dothan Formation and the Riddle Formation of the lower plate from the upper plate Rogue Volcanics. The right-lateral, east-trending Canyonville fault, which probably cuts off the serpentinite, is situated near the power line right-of-way in sec. 33.

Two samples were collected for analysis. The first, sample AUG-8, was from about the 1,565-ft elevation on the old Canyon Mountain access road along the contact of serpentinite with altered volcanic rocks. The sample is a gray-green talc-chlorite schist. The second sample (AUG-9) was taken about 1,000 ft north of the first at about the 1,100-ft elevation and is gray-green talc from serpentinite exposed along an old logging spur road a short distance south of the power line right-of-way. Treasher (1941) described one 3-ft-thick pod of "high-grade" talc exposed in a small cut.

Both samples were analyzed petrographically and by X-ray diffraction and were found to contain abundant chlorite and tremolite. Sample AUG-9 appears in thin section to be a matted, fibrous schist consisting of chlorite, talc, and tremolite.

CR-2 Silver Peak talc (Black Hawk gold claim)

Location: NW¼SW¼ sec. 23, T. 31 S., R. 6 W., 3,000-ft elevation, Quines Creek quadrangle.

History: This site was on the Black Hawk claim owned by Carl D. Cassidy when sampled in August 1959. An 8-ft chip sample described as iron-stained talc schist assayed 0.03 oz/ton gold and no silver. The deposit is also believed to be part of the old Golden Gate Mine group of claims described by Shenon (1933).

Description: Talc schist associated with sheared serpentinite is exposed in a shallow excavated area about 100 ft in diameter and up to 20 ft deep along Silver Peak road about 7 mi from Shoestring road. The occurrence appears to be in the Coast Range thrust fault zone that separates the underlying Dothan Formation and the overlying island-arc and marine volcanic rocks including basalt flows and dacitic tuffs of the Rogue Formation. Locally, a narrow zone of sheared serpentinite occupies the fault zone, which strikes about N. 45° to 55° E. and dips 50° SE. Talc schist with included magnetite dust and minor pyrite occurs with the serpentinite. A sample of talc schist and talcose serpentinite was collected from debris scattered around the pit. Powdered talc examined under the microscope contains scales and shreds of a yellowish-brown to pale-greenish-gray talc with minor mixed serpentinite minerals. No asbestiform minerals were identified.

CR-3 Panther Creek talc

Location: NW¼NE¼ sec. 5, T. 32 S., R. 6 W., 2,500-ft elevation, McCullough Creek quadrangle.

History and development: The talc alteration was encountered at and near an old gold prospect worked in the 1930's by George Slade. The dump from a short, partly caved adit is located at about the 2,500-ft elevation, and an upper caved adit or trench is about 25 ft higher. The workings are near the southeast edge of a small clearcut.

Description: The Coast Range thrust fault crosses Panther Creek at about the 2,480-ft elevation. It is poorly exposed but appears to strike about N. 55° E. and dip 40° to 60° SE. Talc alteration is associated with small, probably lenticular bodies of serpentinite. A few chunks of foliated serpentinite with some mixed talc are found on the lower dump. Scattered pieces of iron-stained mottled gray talc-carbonate with abundant limonite spots and some disseminated magnetite were collected on a small, steep, northerly-trending ridge. This ridge is just north of the prospect along the fire-break trail on the northeast edge of the clearcut. This material shows more complete talc alteration than samples collected from the dump. Both samples contain some tremolite.

CR-4 Cow Creek talc

Location: NE¼NE¼ sec. 33 and SE¼SE¼ sec. 28, T. 32 S., R. 7 W., 1,220- to 1,500-ft elevation, Rabbit Mountain quadrangle.

Description: Talc was reported near the southeast portal of Southern Pacific Tunnel 6 in NE¼ sec. 33, T. 32 S., R. 7 W., by Black (1979, p. 13). The talc alteration occurs in a small northeast-trending body of serpentinite about 400 ft thick, as measured along the railroad. The serpentinite is enclosed in metavolcanic rocks of the Rogue Formation. A few large blocks of serpentinite with talc-carbonate alteration were noted in the fill material over the culvert for the unnamed gully west of Cook Creek. Several specimens of attractive waxy green talc with imbedded pyrite cubes up to 1 in. across were reportedly found along the Southern Pacific Railroad a short distance south of Tunnel 6. A few loose boulders of talc-carbonate rock with leached pyrite occur along the railroad.

Fresh cuts along Cow Creek road about 600 ft to the northeast expose a band of talc about 2 ft thick striking about N. 30° E. and dipping 35° SE. that is exposed in the road cut about 260 ft north of milepost 27. A sample of pale-green waxy talc from a 6-in. seam (AUG-10) that was examined petrographically and by X-ray diffraction contained minor chlorite, antigonite, dolomite, and tremolite(?).

Galice area

The Galice area encompasses parts of the noted Galice mining district. Although only one talc deposit is described from this area, small amounts of talc are known to occur in sheared serpentinites along several north-northeast-trending faults mapped in the area by Wells and Walker (1953). The more favorable sites for talc are probably in serpentinites along margins of the Briggs Creek amphibolite and in areas of small diorite and gabbro bodies.

GA-1 Peavine soapstone

Location: SW¼NW¼ sec. 35, T. 34 S., R. 8 W., 1,800-ft elevation, Galice quadrangle.

History: The deposit was located as a mining claim during the late 1970's by Tim Bley and Kathleen Groom, who dug a small quantity of soapstone for carving purposes. The deposit was examined by consulting geologists Geoffry Garcia and Charlotte Kautzer in 1979, who prepared a report for the owners.

Description: Minor talc alteration occurs in serpentinite along a contact trending N. 25° E. between Briggs Creek amphibolite and metamorphosed siltstones and graywackes of the Galice Formation. A 3-ft zone of impure soapstone striking about N. 25° E. and dipping vertically is exposed in a cut measuring about 10 by 6 by 8 ft along the old Peavine Road at 1,850 ft, as determined by altimeter. The enclosing rocks are deeply weathered and appear to be amphibolite, sandstone, and shale. Weathered slaty siltstone is exposed to the east, and abundant amphibolite float is seen up the road to the west. Similar impure massive soapstone is exposed in the gully a short distance south at about 1,800 ft, as determined by altimeter. Friable talc schist is reported to occur elsewhere along this trend. A 1-ft-thick stringer of massive tremolite with talc is reportedly exposed along the road about 400 ft east of the above described zone. This stringer trends about N. 45° E. A sample of talc (AUG-16) collected for analysis from the upper zone proved to be a mixture of talc, chlorite, and small amounts of magnetite.

Pearsoll Peak area

The Pearsoll Peak area lies along the Illinois River near the northern extensions of the Josephine Peridotite. The area is mountainous and covered with dense forest and brush. The geologic map showing the greatest detail for the area is the 1:24,000-scale map of the southeast quarter of the Pearsoll Peak quadrangle (Ramp, 1984).

Talc alteration occurs in various geologic environments in the Pearsoll Peak area. Talc occurrences are always associated with serpentinites. Favorable sites are zones of faulting and intense shearing, contact zones (especially with younger intrusives), and some chromite deposits such as the Prospectors Dream, Uncle Sam, and Twin Cedars, where interstitial micaceous talc occurs in both disseminated and massive chromite (Ramp, 1984).

Although no systematic search has been made for talc occurrences in this area, no obviously large deposits were recognized during the course of mapping.

Illinois River talc occurrences

Location: SE¼SE¼ sec. 29 and NW¼NW¼ sec. 33, T. 37 S., R. 9 W., 1,300- to 1,420-ft elevations, Pearsoll Peak quadrangle.

Description: Apparent hydrothermal alteration of ultramafic rocks has produced minor talc along faulted contacts with volcaniclastic rocks, hornblende diorite, and amphibolite. Sample AUG-17 is float from the Illinois River road about 200 ft north of the section line between secs. 29 and 32 and from just below the road to the west and south about 200 ft. Sample AUG-18 is similar-appearing limonitic gray talc float from the road about 100 to 300 ft north of the junction with the Deep Gorge Mine road. Sample AUG-19 is gray talc float from an old road about 100 ft lower and 300 ft south of the junction of Deep Gorge Mine road with Illinois River road. Very little talc could be found in place, and the source of talc float is probably from narrow veins and selvages.

Each of the samples contains fairly abundant chlorite and can be classed as talc-chlorite schist, which when powdered is a pale-greenish-gray to greenish-tan color. Sample AUG-17 contains minor amounts of carbonate, and AUG-18 has minor amounts of tremolite. All samples are also slightly magnetic due to small amounts of included magnetite dust.

Powers-Agness fault zone area

The Powers-Agness fault zone area is located in eastern Curry County and southeastern Coos County near the juncture of the Rogue and Illinois Rivers. The area is rugged, densely covered with brush and timber, and difficult of access. Geologic maps of the area include the Powers quadrangle map (Baldwin and Hess, 1971) and the Curry County and Coos County maps (Baldwin and others, 1973; Ramp and others, 1977).

Highly sheared and altered serpentinite occurs along the north-trending Powers-Agness fault zone, where it has been drawn into the fault from various ultramafic bodies which the fault displaced. A few small intrusive bodies of diorite and related rocks are also mapped in this area in southern Coos County (Baldwin and others, 1973).

A-1 Rock Creek chlorite

Location: Secs. 18 and 19, NW¼NW¼ sec. 30, T. 33 S., R. 11 W., and SE¼ sec. 24, T. 33 S., R. 12 W., Illahe quadrangle.

Description: Boulders, cobbles, and pebbles of massive chlorite are scattered along Rock Creek from a point across from the mouth of Sand Creek in the NW¼NW¼ sec. 30, where a large serpentinite rock slide enters the creek. The slowly moving slide introduces a fresh supply of chlorite to the stream annually. Boulders of compact, massive chlorite up to 4 ft in diameter occur in Rock Creek immediately below the toe of the slide. Serpentinized harzburgite is attached to some of the boulders. At Rock Creek Forest Campground, which is about ¾ mi downstream from the slide, chlorite boulders represent about 1 percent of the gravel deposit.

The chlorite is quite compact, and rounded cobbles are found for several miles down the south fork of the Coquille River. The color of the chlorite varies from a pinkish or purplish tan to light gray. Sample AUG-109, collected from various compact grayish-blue boulders in the creek, consists mainly of chlorite, as determined by X-ray diffraction.

The source for the Rock Creek boulders was not discovered. Chlorite and talc float were found in the vicinity of Azalea Lake, which is in the slide area, and on the old road above the lake. An old bulldozer cut at an elevation of 1,080 ft, as determined by altimeter, and located S. 63° W. from Azalea Lake has considerable weathered serpentinite and some talc-carbonate alteration.

The color of the powdered material of sample AUG-109 is dull white. No fibrous material was seen in the initial examination, although a small amount of cummingtonite(?) was found in another boulder.

The chlorite, which can be cut with a band saw, would apparently make excellent marking crayons. This area may warrant further prospecting for both talc and chlorite.

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APPENDIXES

APPENDIX 1. AMPHIBOLE IDENTIFICATION METHODS

No distinction was made in this study between fibrous and nonfibrous varieties of amphiboles. Samples were first visually screened in the field. About half of each sample deemed suitable for further study was sent to the lab for further processing. Powders from the retained samples were obtained by drilling with a hand drill, and billets from selected samples were sent out for thin-sectioning.

The authors visually checked the retained samples for amphiboles in three stages. First, the samples were examined under the binocular microscope. Second, powders were examined in immersion oils under the petrographic microscope. Third, selected thin sections were examined under the petrographic microscope. The authors' identifications were checked by the Department's industrial minerals specialist, Ron Geitgey, who examined X-ray diffraction charts obtained on the Department lab samples. Results of the amphibole identification procedures are presented in the text and in Appendixes 2 and 4.

Oregon talc sample descriptions and petrography

Occur. no.	Lab no.	Lithology	Talc area	Deposit name	Quadrangle	Location 1/4	1/4	Sec.	T	R	Elev. (ft)	Sample type	Amphibole (if present)	Carbonate (if present)	Other silicates
S-1	AUG- 34	Gray talc schist	Sumpter	Upper Corral Cr. 2	Mt. Ireland	NE	NW	1	9S	35½E	5320	Grab at 50'	Tremolite, anthophyllite	---	---
S-1	AUG- 44	Talc carbonate	Sumpter	Upper Corral Cr. 1	Mt. Ireland	NE	NW	1	9S	35½E	5280	Grab at 325'	---	Carbonate	---
S-1	AUG- 41	Talc carbonate	Sumpter	Upper Corral Cr. 1	Mt. Ireland	NE	NW	1	9S	35½E	5280	Grab at 250'	---	---	---
S-1	AUG- 42	Talc carbonate	Sumpter	Upper Corral Cr. 1	Mt. Ireland	NE	NW	1	9S	35½E	5280	Grab at 275'	---	Carbonate	---
S-1	AUG- 45	Talc schist	Sumpter	Upper Corral Cr. 1	Mt. Ireland	NE	NW	1	9S	35½E	5280	Grab at 342'	---	---	Chlorite
S-1	AUG- 43	Talc carbonate	Sumpter	Upper Corral Cr. 1	Mt. Ireland	NE	NW	1	9S	35½E	5280	Grab at 300'	---	---	---
S-1	AUG- 38	Gray talc schist	Sumpter	Upper Corral Cr. 1	Mt. Ireland	NE	NW	1	9S	35½E	5280	Grab at 138'	Tremolite, cummingtonite	---	---
S-1	AUG- 33	Orange talc schist	Sumpter	Upper Corral Cr. 2	Mt. Ireland	NE	NW	1	9S	35½E	5320	Grab at 16'	Tremolite	---	---
S-1	AUG- 36	Gray talc schist	Sumpter	Upper Corral Cr. 1	Mt. Ireland	NE	NW	1	9S	35½E	5280	Grab at 0'	Tremolite	---	---
S-1	AUG- 40	Talc carbonate	Sumpter	Upper Corral Cr. 1	Mt. Ireland	NE	NW	1	9S	35½E	5280	Grab at 225'	---	Carbonate	---
S-1	AUG- 37	Weathered talc schist	Sumpter	Upper Corral Cr. 1	Mt. Ireland	NE	NW	1	9S	35½E	5280	Grab at 70'	---	---	---
S-1	AUG- 35	Gray talc schist	Sumpter	Upper Corral Cr. 2	Mt. Ireland	NE	NW	1	9S	35½E	5320	Grab at 100'	Tremolite	---	---
S-1	AUG- 39	Gray talc schist	Sumpter	Upper Corral Cr. 1	Mt. Ireland	NE	NW	1	9S	35½E	5280	Grab at 152'	Tremolite, cummingtonite	---	---
S-1	AUG- 46	Talc carbonate	Sumpter	Upper Corral Cr. 1	Mt. Ireland	NE	NW	1	9S	35½E	5280	Grab at 350'	---	---	---
S-2	AUG- 52	Talc carbonate	Sumpter	Lower Boundary Cr.	Mt. Ireland	SW	NW	12	9S	35½E	4860	Grab at 50'	---	Carbonate	---
S-2	AUG- 53	Talc carbonate	Sumpter	Lower Boundary Cr.	Mt. Ireland	SW	NW	12	9S	35½E	4860	Grab at 375'	---	Carbonate	---
S-2	AUG- 50	Talc carbonate	Sumpter	Lower Boundary Cr.	Mt. Ireland	SW	NW	12	9S	35½E	4860	Grab at 0'	---	Carbonate	---
S-2	AUG- 54	Talc carbonate	Sumpter	Lower Boundary Cr.	Mt. Ireland	SW	NW	12	9S	35½E	4860	Grab at 400'	---	Carbonate	---
S-2	AUG- 79	Serpentine	Sumpter	Lower Boundary Cr.	Mt. Ireland	SW	NW	12	9S	35½E	4860	Grab at 75'	---	---	---
S-2	AUG- 51	Talc carbonate	Sumpter	Lower Boundary Cr.	Mt. Ireland	SW	NW	12	9S	35½E	4860	Grab at 25'	---	Carbonate	---
S-6	AUG- 49	Talc carbonate	Sumpter	Upper Boundary 2	Mt. Ireland	NE	SE	1	9S	35½E	5520	Grab at 75'	---	Carbonate	---
S-6	AUG- 48	Talc carbonate	Sumpter	Upper Boundary 2	Mt. Ireland	NE	SE	1	9S	35½E	5520	Grab at 58'	---	Carbonate	---
S-6	AUG- 47	Talc schist	Sumpter	Upper Boundary 2	Mt. Ireland	NE	SE	1	9S	35½E	5520	Grab at 10'	---	Carbonate	Chlorite
S-7	AUG- 71	Talc carbonate	Sumpter	Upper Boundary 1	Mt. Ireland	NE	SE	1	9S	35½E	5260	Grab	---	Carbonate	---
S-8	AUG- 59	Talc carbonate	Sumpter	Boundary Cr. placer ditch	Mt. Ireland	SE	SE	1	9S	35½E	5340	Grab	---	---	---
S-10	AUG- 69	Talc carbonate	Sumpter	West Fork 2	Mt. Ireland	NE	NE	7	9S	36E	5640	Grab	---	Carbonate	---
S-11	AUG- 83	Talc tremolite schist	Sumpter	Middle Fork 1	Mt. Ireland	NW	NW	8	9S	36E	5400	Grab	Tremolite	---	---
S-12	AUG- 82	Talc amphibolite	Sumpter	West Fork 3	Mt. Ireland	NE	NE	7	9S	36E	5720	Grab	Tremolite	---	---
S-13	AUG- 70	Talc carbonate	Sumpter	Middle Fork 2	Mt. Ireland	SW	SW	5	9S	36E	5600	Grab	---	---	---
S-16	AUG- 60	Talc carbonate	Sumpter	East Fork 2	Mt. Ireland	NW	NE	8	9S	36E	5600	Grab	---	Carbonate	---
S-24	AUG- 93	Talc schist	Sumpter	Bear Meadow road	Mt. Ireland	NW	SE	19	9S	36E	5440	Grab	---	Carbonate	---
S-25	AUG- 73	Talc schist	Sumpter	Blue Springs	Mt. Ireland	SE	NW	27	9S	36E	5700	Grab	---	---	---
S-26	AUG- 75	Talc carbonate	Sumpter	Weaver Mine road	Mt. Ireland	NW	SE	27	9S	36E	5580	Grab	---	Carbonate	---
S-28	AUG- 77	Talc carbonate	Sumpter	West Bear Canyon	Bourne	SW	NE	24	9S	36E	4760	Grab	---	Carbonate	Quartz
S-30	AUG- 74	Talc carbonate	Sumpter	East Bear Canyon	Bourne	SW	SW	19	9S	37E	4700	Grab	---	---	Quartz
S-31	AUG- 63	Talc schist	Sumpter	Sawmill Gulch	Sumpter	NW	SW	6	10S	37E	4920	Grab	---	---	Chlorite, serpentine
S-32	AUG- 76	Talc schist	Sumpter	Sumpter highway	Sumpter	SE	SE	4	10S	37E	4320	Grab	---	Carbonate	---
S-34	AUG- 90	Talc schist	Sumpter	Lake Creek	Desolation Butte	NW	SW	19	8S	35E	4080	Grab	---	---	---
S-34	AUG- 91	Talc carbonate	Sumpter	Lake Creek	Desolation Butte	NW	SW	19	8S	35E	4080	Grab	---	Carbonate	---
S-35	AUG- 92	Talc carbonate	Sumpter	Indian Creek	Desolation Butte	NE	NE	30	8S	35E	4240	Grab	---	Carbonate	Serpentine
G-1	AUG- 85	Talc schist	Greenhorn	Welch Creek	Dale	SW	SW	17	8S	33E	4600	Grab	Tremolite	---	---
G-2	AUG- 86	Talc schist	Greenhorn	Deep Creek	Susanville	NE	NE	6	10S	32E	4840	Grab	Anthophyllite	---	Chlorite
G-4	AUG- 84	Talc schist	Greenhorn	O'Rouick Spring	Desolation Butte	NE	NW	4	9S	34E	5680	Grab at 350'	Tremolite	---	---
G-6	AUG- 89	Talc carbonate	Greenhorn	China Diggings	Bates NW	NE	SW	29	10S	34E	4400	Grab	---	Carbonate	---
G-7	AUG- 87	Talc tremolite schist	Greenhorn	Murdock Creek	Bates NE	NE	NW	35	10S	34E	5640	Grab	Tremolite	---	---
E-3	AUG- 55	Talc carbonate	Elkhorn Ridge	Avalanche	Elkhorn Peak	SE	SE	29	8S	38E	5920	Float	---	Carbonate	---
E-5	AUG- 61	Talc carbonate	Elkhorn Ridge	St. Louis	Elkhorn Peak	SW	NE	21	9S	38E	5800	Grab	---	Carbonate	---
E-6	AUG- 62	Talc schist	Elkhorn Ridge	Baboon Creek	Elkhorn Peak	NE	NW	29	9S	38E	5280	Grab	---	---	Quartz, chlorite
E-9	AUG- 58	Talc schist	Elkhorn Ridge	Union Creek	Phillips Lake	SE	NE	11	10S	38E	4700	Grab	---	---	Quartz
E-10	AUG- 64	Talc schist	Elkhorn Ridge	California Gulch	Blue Canyon	NE	NW	29	10S	39E	4000	Float	Tremolite	---	---
D-3	AUG- 56	Talc schist	Dooley Mountain	Upper Pine Creek	Brannan Gulch	SW	SE	34	11S	39E	5360	Grab	---	Carbonate	---
D-4	AUG- 57	Talc schist	Dooley Mountain	Asbestos 1	Brannan Gulch	SW	SW	35	11S	39E	5160	Grab	Anthophyllite	---	Chlorite
D-9	AUG- 72	Talc schist	Dooley Mountain	Upper Stices Gulch	Brannan Gulch	SW	NE	25	11S	39E	5200	Grab	---	---	Serpentine
D-11	AUG- 88	Talc schist	Dooley Mountain	Juniper Hill Spring	Dooley Mtn	NW	NW	14	12S	40E	4400	Grab	---	---	Chlorite, serpentine
B-2	AUG- 66	Black talc schist	Basin Creek	Spirit Hill	Bridgeport	SW	SW	20	13S	42E	5760	Grab	Tremolite	---	---
B-7	AUG- 65	Talc carbonate	Basin Creek	West California Mtn.	Bridgeport	NW	NE	28	13S	42E	5280	Grab	---	Carbonate	---
C-4	AUG- 78	Talc schist	Connor Creek	Sisley Creek	Durkee	NE	NW	20	12S	44E	2800	Grab	Tremolite	---	---
O-1	AUG- 80	Serpentine w/chalcedony	Other E. Oreg. talc occur.	Freeway	Oxman	SE	NW	33	10S	42E	3360	Grab	---	Quartz	---
O-1	AUG- 81	Serpentine w/chalcedony	Other E. Oreg. talc occur.	Freeway	Oxman	SW	NW	33	10S	42E	3400	Grab	---	Quartz	---
O-1	AUG- 68	Talc schist	Other E. Oreg. talc occur.	Freeway	Oxman	SW	NW	33	10S	42E	3400	Grab	Anthophyllite, [illegible]lite	Carbonate	---
O-1	AUG- 67	Talc schist	Other E. Oreg. talc occur.	Freeway	Oxman	SE	NW	33	10S	42E	3360	Grab	Anthophyllite	---	Chlorite
--	AUG- 4	Gray-green talc	Elliott Cr. Ridge	Elliott Creek	Squaw Lake	NE	SE	10	41S	3W	4880	Grab	---	---	---
--	AUG- 5	Talc-chlorite schist	Elliott Cr. Ridge	Elliott Creek	Squaw Lake	NE	SE	10	41S	3W	4880	Grab	---	---	---

Occur. no.	Lab no.	Lithology	Talc area	Deposit name	Quadrangle	Location 1/4	1/4	Sec.	T	R	Elev. (ft)	Sample type	Amphibole (if present)	Carbonate (if present)	Other silicates
--	AUG- 6	Talc-carbonate	Elliott Cr. Ridge	Elliott Creek	Squaw Lake	NE	SE	10	41S	3W	4880	Grab	---	---	---
--	AUG- 7	Talc-carbonate	Elliott Cr. Ridge	Elliott Creek	Squaw Lake	NE	SE	10	41S	3W	4880	Grab	---	---	---
--	AUG- 11	Talc-carbonate	Elliott Cr. Ridge	Elliott Creek	Squaw Lake	NW	SE	11	41S	3W	4750	Grab	---	---	---
--	AUG- 12	Pink-banded talc schist	Elliott Cr. Ridge	Elliott Creek	Squaw Lake	NW	SE	11	41S	3W	4830	Grab	---	---	---
--	AUG- 13	Talc-sericite schist	Elliott Cr. Ridge	Elliott Creek	Squaw Lake	NW	SW	11	41S	3W	4965	10' channel	---	---	---
--	AUG- 14	Tremolitic talc	Elliott Cr. Ridge	Elliott Creek	Squaw Lake	NE	SE	10	41S	3W	4885	Grab	---	---	---
--	AUG- 15	Chlorite schist	Elliott Cr. Ridge	Elliott Creek	Squaw Lake	NE	SE	10	41S	3W	4885	Grab	---	---	---
--	AUG- 30	Chloritic talc	Elliott Cr. Ridge	Elliott Creek	Squaw Lake	NW	SE	10	41S	3W	4585	Grab	---	---	---
--	AUG- 17	Talc	Pearsoll Peak	Illinois River	Pearsoll Peak	SE	SE	29	37S	9W	1410	Grab	---	Carbonate	Chlorite
--	AUG- 18	Talc	Pearsoll Peak	Illinois River	Pearsoll Peak	NW	NW	33	37S	9W	1415	Grab	Tremolite	---	Chlorite
--	AUG- 19	Talc	Pearsoll Peak	Illinois River	Pearsoll Peak	NW	NW	33	37S	9W	1320	Grab	---	---	---
W-1	AUG- 3	Limonitic talc	Williams	Powell Creek soapstone	Murphy	SE	SW	17	38S	5W	2630	4' channel	---	---	---
W-1	AUG- 1	Green talc-tremolite	Williams	Powell Creek soapstone	Murphy	SE	SW	17	38S	5W	2535	Grab	Tremolite	---	Chlorite
W-1	AUG- 2	Brown talc	Williams	Powell Creek soapstone	Murphy	SE	SW	17	38S	5W	2525	Grab	---	---	Chlorite
W-3	AUG-110	Limonitic talc	Williams	Cedar Flat talc	Williams	NE	SW	1	39S	6W	3240	Grab	Tremolite	---	Chlorite, serpentine
W-4	AUG-113	Talc serpentinite	Williams	Mule Gulch	Williams	SE	SW	31	38S	5W	2220	Grab	---	---	---
SC-1	AUG-100	Limonitic talc	Sucker Creek	Sucker Creek 1	Oregon Caves	NE	NE	13	40S	7W	2230	Grab	---	---	Chlorite, serpentine
SC-3	AUG-104	Dirty talc	Sucker Creek	No. 7 Gulch	Oregon Caves	NE	NE	23	40S	7W	3380	Grab	Tremolite	---	Chlorite
SC-4	AUG-105	Talc	Sucker Creek	No. 7 Gulch 2	Oregon Caves	NW	NW	24	40S	7W	3405	Grab	Tremolite?	---	Chlorite, serpentine
SC-5	AUG-106	Talc	Sucker Creek	Serpentine Flat	Oregon Caves	SE	NE	14	40S	7W	3065	Grab	---	---	Chlorite
SC-6	AUG-103	Limonitic talc	Sucker Creek	Monkeyshine	Oregon Caves	SW	SW	24	40S	7W	3850	Grab	---	---	Chlorite
SC-6	AUG-102	Limonitic talc	Sucker Creek	Monkeyshine	Oregon Caves	SW	SW	24	40S	7W	3850	Grab	---	---	Chlorite
SC-7	AUG-101	Limonitic talc carbonate	Sucker Creek	Bolan Creek talc	Oregon Caves	NW	NE	1	41S	7W	4285	Grab	---	Magnesite?	Chlorite, serpentine
SP-1	AUG- 96	Talc schist	Siskiyou Peak	Glade Creek	Talent	NE	NW	6	40S	1W	3310	12' chip	---	---	Serpentine
SP-1	AUG- 94	Talc schist	Siskiyou Peak	Glade Creek	Talent	NE	NW	6	40S	1W	3300	Grab	---	---	Chlorite
SP-1	AUG- 95	Talc carbonate	Siskiyou Peak	Glade Creek	Talent	NE	NW	6	40S	1W	3315	2' grab	---	Carbonate	Chlorite
SP-1	AUG- 97	Talc schist	Siskiyou Peak	Glade Creek	Talent	NE	NW	6	40S	1W	3310	Grab	---	Carbonate	---
SP-2	AUG- 98	Talc	Siskiyou Peak	Brickpile road	Talent	SW	SE	31	39S	1W	3400	Grab	Tremolite	Carbonate	Serpentine
SP-3	AUG- 99	Talc carbonate	Siskiyou Peak	Prater chromite-talc	Talent	SE	SE	30	39S	1W	3250	Grab	Tremolite	Carbonate	Chlorite, serpentine
SP-5	AUG- 20	Talc	Siskiyou Peak	Dutchman Peak Saddle	Siskiyou Peak	SE	NE	1	41S	2W	7100	Grab	Tremolite	---	Chlorite
SP-7	AUG-107	Talc	Siskiyou Peak	Doe Peak 1	Siskiyou Peak	SW	SE	12	41S	1W	4550	Grab	Tremolite	---	Chlorite
SP-8	AUG-108	Iron-stained talc	Siskiyou Peak	Doe Peak 2	Siskiyou Peak	NE	SW	13	41S	1W	4490	Grab	Tremolite	---	---
R-2	AUG- 31	Talc carbonate	Red Mtn.-Upper Pleasant Cr.	Red Mtn. 1	Cedar Springs Mtn.	NW	SW	23	32S	3W	3800	Grab	---	---	---
R-3	AUG- 32	Talc carbonate	Red Mtn.-Upper Pleasant Cr.	Landslide	Cedar Springs Mtn.	SE	SW	23	32S	3W	4000	Grab	---	Carbonate	Chlorite, serpentine, olivine
R-5	AUG- 28	Talc tremolite	Red Mtn.-Upper Pleasant Cr.	Upper Applegate Cr. 1	Skeleton Mtn.	SE	NW	34	32S	3W	3370	Grab	Anthophyllite	---	---
R-6	AUG- 29	Talc-tremolite	Red Mtn.-Upper Pleasant Cr.	Upper Applegate Cr. 2	Cedar Springs Mtn.	SE	SW	27	32S	3W	3270	Grab	Tremolite	---	Chlorite, serpentine
R-7	AUG- 21	Tremolitic talc	Red Mtn.-Upper Pleasant Cr.	Upper Pleasant Cr. Group	King Mtn.	NW	NE	35	33S	4W	2720	Grab	Tremolite	---	---
R-7	AUG- 24	Talc carbonate	Red Mtn.-Upper Pleasant Cr.	Upper Pleasant Cr. Group	King Mtn.	NW	NE	35	33S	4W	2680	Grab	---	Carbonate	---
R-8	AUG- 22	Rusty talc	Red Mtn.-Upper Pleasant Cr.	Upper Pleasant Cr. 2	King Mtn.	SE	NE	35	33S	4W	2890	Grab	---	---	---
R-8	AUG- 23	Rusty talc	Red Mtn.-Upper Pleasant Cr.	Upper Pleasant Cr. 2	King Mtn.	SE	NE	35	33S	4W	2910	Grab	---	---	---
R-9	AUG- 25	Rusty talc schist	Red Mtn.-Upper Pleasant Cr.	Upper Pleasant Cr. 3	King Mtn.	SE	NW	35	33S	4W	2560	Grab	Tremolite	---	---
R-10	AUG- 26	Talc tremolite schist	Red Mtn.-Upper Pleasant Cr.	Upper Pleasant Cr. 4	King Mtn.	SE	SW	23	33S	4W	3260	Grab	Tremolite	---	---
R-10	AUG- 27	Talc-carbonate	Red Mtn.-Upper Pleasant Cr.	Upper Pleasant Cr. 4	King Mtn.	SE	SW	23	33S	4W	3400	12' chip	Tremolite?	Carbonate	---
CR-1	AUG- 9	Talc	Coast Range thrust	Canyonville talc	Canyonville	NW	SE	33	30S	5W	1100	Grab	Tremolite	---	Chlorite
CR-1	AUG- 8	Talc schist	Coast Range thrust	Canyonville talc	Canyonville	SW	SE	33	30S	5W	1565	Grab	Tremolite	---	Chlorite
CR-3	AUG-112	Talc carbonate	Coast Range thrust	Panther Creek	McCullough Creek	NW	NE	5	32S	6W	2540	Grab	---	---	---
CR-3	AUG-111	Talc serpentinite	Coast Range thrust	Panther Creek	McCullough Creek	NW	NE	5	32S	6W	2440	Grab	---	---	---
CR-4	AUG- 10	Talc	Coast Range thrust	Cow Creek	Rabbit Mtn.	SE	SE	28	32S	7W	1500	Grab	Tremolite?	Carbonate	Chlorite, serpentine
GA-1	AUG- 16	Talc	Galice	Peavine soapstone	Galice	SW	NW	35	34S	8W	1850	Grab	---	---	Chlorite
A-1	AUG-109	Gray "talc"	Powers-Agness fault zone	Rock Creek chlorite	Illahe	SE	NW	19	33S	11W	1160	Grab	---	---	Chlorite

APPENDIX 3. X-RAY DIFFRACTION PROCEDURES AND INTERPRETATION

All samples were ground to less than 80 mesh and prepared as powder pack mounts for analysis on a Scintag/USA automated X-ray diffraction (XRD) instrument with nickel filtered copper radiation. The samples were scanned from 2° to 65° 2 Θ at a rate of 2° 2 Θ per minute under the supervision of J.W. Husler, Department of Geology, University of New Mexico. Background corrections were made, and a peak-finding program was applied to the raw data. Sample mineralogy was identified from the resulting tabulation of peak positions and intensities by Ron Geitgey, Oregon Department of Geology and Mineral Industries.

The reported amounts of the various minerals that are present in the samples are estimates based on their respective peak heights. Peaks at about 14 angstroms and 7 angstroms were interpreted as indicating the clinochlore group, but no attempt was made to distinguish the various members of that group. The serpentine minerals antigorite and chrysotile were indistinguishable from each other and difficult to identify positively if present in small amounts with large amounts of the clinochlore group. The presence of a member of the amphibole group, usually tremolite, was indicated by a peak between about 8.2 and 8.5 angstroms. Anthophyllite could be distinguished when present in sufficient amounts.

APPENDIX 4. X-RAY DIFFRACTION RESULTS

X-ray diffraction mineralogy, Oregon talc samples

Sample no.	Talc	Chlorite	Serpentine	Amphibole	Quartz	Dolomite	Magnesite	Comments
AUG- 1	M	m	---	m	---	---	---	---
AUG- 2	M	m	---	---	---	---	---	---
AUG- 3	M	m	---	---	---	---	---	---
AUG- 4	M	tr	---	---	---	---	---	---
AUG- 5	tr	M	---	---	---	---	---	---
AUG- 6	M	m	---	---	---	---	---	---
AUG- 7	M	M	---	---	---	---	---	---
AUG- 8	m	M	---	M	m	---	---	---
AUG- 9	M	M	---	M	---	---	---	---
AUG- 10	M	m	m	---	---	tr	---	---
AUG- 11	M	---	---	---	---	m	m	---
AUG- 12	M	m	---	---	---	---	---	---
AUG- 13	M	M	---	---	---	---	---	---
AUG- 14	M	M	---	---	m	---	---	---
AUG- 15	---	M	---	---	---	---	---	---
AUG- 16	M	m	---	---	---	---	---	---
AUG- 17	M	tr	tr	---	---	tr	---	---
AUG- 18	M	tr	---	---	---	---	---	---
AUG- 19	M	m	---	---	---	---	---	---
AUG- 20	M	tr	---	tr	---	---	---	---
AUG- 21	M	m	---	tr	---	---	---	---
AUG- 22	M	m	---	tr	---	tr	---	Anthophyllite
AUG- 23	M	tr	---	---	---	tr	---	---
AUG- 24	M	tr	---	---	---	---	m	---
AUG- 25	M	m	---	---	---	---	---	---
AUG- 26	M	tr	---	tr	---	---	---	Tremolite and anthophyllite
AUG- 27	M	m	---	---	---	---	tr	---
AUG- 28	M	tr	---	m	---	---	---	Anthophyllite
AUG- 29	M	m	---	m	---	---	---	Anthophyllite
AUG- 30	M	m	---	---	---	---	---	---
AUG- 31	M	tr	tr	---	---	---	m	---
AUG- 32	M	tr	---	---	---	---	m	---

Sample no.	Talc	Chlorite	Serpentine	Amphibole	Quartz	Dolomite	Magnesite	Comments
AUG- 33	M	tr	---	---	m	---	---	Magnetite (tr)
AUG- 34	M	tr	---	tr	tr	---	---	---
AUG- 35	M	tr	---	---	---	---	---	---
AUG- 36	M	M	---	M	---	---	---	---
AUG- 37	M	M	---	M	---	---	---	---
AUG- 38	M	m	---	m	---	---	---	---
AUG- 39	m	M	---	m	---	---	---	---
AUG- 40	M	m	---	---	---	---	m	---
AUG- 41	M	tr	---	---	---	---	tr	---
AUG- 42	M	tr	---	---	---	tr	tr	---
AUG- 43	M	m	---	---	---	---	---	---
AUG- 44	M	m	---	---	---	---	---	---
AUG- 45	tr	M	---	---	---	---	tr	---
AUG- 46	M	tr	---	---	---	---	tr	---
AUG- 47	M	m	---	---	---	tr	---	---
AUG- 48	M	tr	---	---	---	tr	---	---
AUG- 49	M	tr	---	---	---	---	---	---
AUG- 50	M	tr	---	---	---	---	M	---
AUG- 51	M	tr	---	---	---	---	M	---
AUG- 52	M	tr	---	---	---	---	m	---
AUG- 53	M	tr	---	---	---	---	M	---
AUG- 54	M	m	---	---	---	---	tr	---
AUG- 55	M	m	---	---	---	tr	m	---
AUG- 56	M	tr	---	---	---	---	---	---
AUG- 57	M	tr	---	---	---	---	---	---
AUG- 58	M	tr	---	tr	tr	---	---	---
AUG- 59	M	tr	m	---	---	---	---	---
AUG- 60	M	tr	tr	---	---	---	m	---
AUG- 61	M	m	---	---	---	---	m	---
AUG- 62	M	tr	---	---	tr	---	---	---
AUG- 63	M	m	---	tr	---	---	---	---
AUG- 64	M	m	---	tr	---	---	---	---
AUG- 65	M	tr	---	---	---	---	m	---
AUG- 66	M	m	---	tr	---	---	---	---
AUG- 67	M	tr	---	---	---	---	---	---
AUG- 68	M	tr	---	---	---	---	---	---
AUG- 69	M	tr	---	---	---	tr	m	---
AUG- 70	M	tr	---	---	---	---	---	---
AUG- 71	M	tr	---	---	---	---	m	---
AUG- 72	M	tr	---	---	---	---	---	---
AUG- 73	M	tr	---	---	---	---	---	---
AUG- 74	M	m	---	---	M	---	---	---
AUG- 75	M	---	m	---	---	---	---	---
AUG- 76	M	tr	---	---	---	---	---	---
AUG- 77	m	m	---	---	M	m	M	---
AUG- 78	M	---	---	tr	---	---	---	---
AUG- 79	---	---	M	---	---	---	---	Magnetite (tr)
AUG- 80	m	---	---	---	M	---	---	---
AUG- 81	m	tr	---	---	M	---	---	---
AUG- 82	M	M	---	M	---	---	---	Goethite (m)
AUG- 83	M	M	---	M	tr	---	---	---
AUG- 84	M	M	---	m	---	---	---	---

Sample no.	Talc	Chlorite	Serpentine	Amphibole	Quartz	Dolomite	Magnesite	Comments
AUG- 85	---	M	---	M	---	---	---	---
AUG- 86	M	m	---	tr	---	---	---	Anthophyllite
AUG- 87	M	tr	---	m	---	---	---	---
AUG- 88	M	tr	tr	---	---	---	---	---
AUG- 89	M	m	---	---	---	---	M	---
AUG- 90	M	m	---	---	---	---	---	Calcite (tr)
AUG- 91	M	tr	---	---	---	---	M	---
AUG- 92	M	M	m	M	m	---	---	---
AUG- 93	M	tr	---	---	---	---	---	---
AUG- 94	M	m	---	tr	tr	---	---	---
AUG- 95	M	m	m	---	---	---	tr	Magnetite (tr)
AUG- 96	M	tr	---	---	---	---	---	---
AUG- 97	M	tr	M	---	---	---	---	---
AUG- 98	M	tr	---	---	---	---	M	---
AUG- 99	M	tr	---	---	---	---	M	---
AUG-100	M	tr	tr	---	---	---	---	---
AUG-101	M	tr	tr	---	---	---	M	---
AUG-102	M	m	---	---	---	---	---	---
AUG-103	M	tr	---	---	---	---	---	---
AUG-104	M	tr	---	m	---	---	---	---
AUG-105	M	tr	---	---	---	---	---	---
AUG-106	M	tr	---	---	---	---	---	---
AUG-107	M	tr	---	tr	---	---	---	Anthophyllite
AUG-108	M	tr	m	tr	---	---	---	---
AUG-109	---	M	---	tr	---	---	---	Anthophyllite
AUG-110	M	tr	---	tr	---	tr	tr	---
AUG-111	M	tr	---	tr	---	M	M	---
AUG-112	M	tr	---	tr	---	---	---	---
AUG-113	M	---	---	tr	---	---	---	---

M = Major amount
m = Minor amount
Tr = Trace

APPENDIX 5. LABORATORY SAMPLE PREPARATION METHODS

Samples received in the Department lab were crushed to minus ¼-in. mesh in a Braun chipmunk crusher. All of each crushed sample was then ground to about 95 percent minus 80 mesh in a Braun disc pulverizer using plain carbon steel plates. The ground sample was split into two halves using a steel Jones splitter.

One split was bagged and stored, while the other half was homogenized by rolling on a rubberized rolling cloth. Material from the rolled half was separated into three fractions for various laboratory analyses. Fifteen to 20 grams were removed by spatula and bagged for XRD analyses. Half of the remaining material was bagged for Au + Pt + Pd analyses, and the remaing material was bagged for whole-rock chemistry and brightness tests. When the rolled split was larger than 300 grams, this half was split an additional number of times to obtain a working sample of about 300 grams, with the excess material added to the saved, unhomogenized half.

APPENDIX 6. GOLD, PLATINUM, AND PALLADIUM ANALYTICAL METHODS AND ABUNDANCES

Routine analyses were performed by Nuclear Activation Services (NAS) of Ann Arbor, Michigan, and quality-control check analyses for gold were made by Bondar-Clegg of North Vancouver, British Columbia (BC). Both labs determined by fire assay (FA) preconcentration of the precious metals followed by analyses in acid solution by direct current plasma (DCP). Both labs used a 20-gram sample for the FA process.

Reported detection limits were as follows:

Gold (Au)	(NAS)	1 part per billion	(1 ppb)
Gold (Au)	(BC)	1 part per billion	(1 ppb)
Platinum (Pt)	(NAS)	10 parts per billion	(10 ppb)
Palladium (Pd)	(NAS)	2 parts per billion	(2 ppb)

Gold, platinum, and palladium abundances, Oregon talc samples

Sample no.	Au (ppb)	Pt (ppb)	Pd (ppb)	Sample no.	Au (ppb)	Pt (ppb)	Pd (ppb)	Sample no.	Au (ppb)	Pt (ppb)	Pd (ppb)
AUG- 1	2	10	2	AUG- 51	<2	10	4	AUG-101	<2	10	<2
AUG- 2	3	10	3	AUG- 52	<2	<10	2	AUG-102	180	20	4
AUG- 3	2	20	4	AUG- 53	<2	30	10	AUG-103	170	<10	<2
AUG- 4	5	10	5	AUG- 54	<2	20	6	AUG-104	<2	10	5
AUG- 5	<2	10	3	AUG- 55	5	20	4	AUG-105	<2	10	<2
AUG- 6	25	10	6	AUG- 56	<2	<10	5	AUG-106	<2	10	<2
AUG- 7	<2	10	4	AUG- 57	<2	<10	7	AUG-107	<2	<10	<2
AUG- 8	<2	10	3	AUG- 58	<2	<10	2	AUG-108	9	10	<2
AUG- 9	<2	<10	<2	AUG- 59	<2	<10	<2	AUG-109	<2	10	4
AUG- 10	3	10	<2	AUG- 60	<2	<10	2	AUG-110	<1	30	19
AUG- 11	6	<10	<2	AUG- 61	<2	<10	6	AUG-111	<1	<10	4
AUG- 12	<2	10	<2	AUG- 62	12	<10	4	AUG-112	6	10	5
AUG- 13	<2	10	<2	AUG- 63	<2	<10	3	AUG-113	<1	10	2
AUG- 14	<2	10	<2	AUG- 64	<2	<10	3	AUG-114	<1	<10	<2
AUG- 15	<2	10	<2	AUG- 65	<2	10	4	AUG-115	170	<10	4
AUG- 16	13	<10	2	AUG- 66	4	10	4	AUG-116	<1	<10	<2
AUG- 17	<2	<10	<2	AUG- 67	3	10	5	AUG-117	<1	20	17
AUG- 18	<2	10	3	AUG- 68	<2	10	4	AUG-118	2	<10	2
AUG- 19	<2	<10	<2	AUG- 69	<2	10	4	AUG-119	240	<10	3
AUG- 20	<2	<10	<2	AUG- 70	<2	10	3	AUG-120	<1	30	23
AUG- 21	<2	10	7	AUG- 71	<2	10	3	AUG-121	<1	<10	3
AUG- 22	<2	10	5	AUG- 72	5	10	4				
AUG- 23	<2	10	7	AUG- 73	<2	10	5				
AUG- 24	<2	10	5	AUG- 74	3	10	5				
AUG- 25	<2	<10	5	AUG- 75	<2	10	6				
AUG- 26	<2	10	9	AUG- 76	<2	10	5				
AUG- 27	2	10	4	AUG- 77	<2	10	5				
AUG- 28	<2	<10	<2	AUG- 78	<2	10	3				
AUG- 29	<2	<10	<2	AUG- 79	10	10	4				
AUG- 30	<2	<10	3	AUG- 80	<2	<10	2				
AUG- 31	<2	<10	4	AUG- 81	<2	<10	3				
AUG- 32	22	10	5	AUG- 82	<2	10	2				
AUG- 33	<2	<10	4	AUG- 83	<2	10	8				
AUG- 34	<2	10	3	AUG- 84	<2	30	23				
AUG- 35	<2	10	4	AUG- 85	<2	<10	<2				
AUG- 36	<2	10	<2	AUG- 86	<2	10	3				
AUG- 37	<2	10	3	AUG- 87	<2	<10	4				
AUG- 38	<2	10	4	AUG- 88	2	10	6				
AUG- 39	<2	10	3	AUG- 89	<2	<10	3				
AUG- 40	<2	<10	2	AUG- 90	<2	<10	2				
AUG- 41	<2	10	7	AUG- 91	<2	<10	2				
AUG- 42	<2	10	5	AUG- 92	<2	10	6				
AUG- 43	<2	10	3	AUG- 93	<2	10	4				
AUG- 44	<2	10	4	AUG- 94	<2	<10	<2				
AUG- 45	<2	<10	<2	AUG- 95	2	10	<2				
AUG- 46	<2	10	5	AUG- 96	9	<10	<2				
AUG- 47	<2	10	4	AUG- 97	<2	10	<2				
AUG- 48	<2	<10	<2	AUG- 98	1000	<10	<2				
AUG- 49	<2	10	4	AUG- 99	<2	10	<2				
AUG- 50	<2	10	5	AUG-100	<2	10	<2				

Replicate analyses

Blind ID	Actual ID
AUG-114	AUG- 10
AUG-115	AUG-102
AUG-116	AUG- 20
AUG-117	AUG- 53
AUG-118	AUG- 55
AUG-119	AUG- 98
AUG-120	AUG- 84
AUG-121	AUG- 30

APPENDIX 7. WHOLE-ROCK CHEMISTRY METHODS AND RESULTS

X-ray fluorescence (XRF) analyses were performed by X-ray Assay Laboratories (XRAL) of Don Mills, Ontario, through its American laboratory, Nuclear Activation Services (NAS) of Ann Arbor, Michigan. A single quality-control check analysis was performed by Geochemical Services Inc. (GSI) of Torrance, California.

XRAL used a fused button for its analyses (1.3 grams of sample roasted at 950 °C for 1 hour, fused with 5 grams of lithium tetraborate, and melt cast into a button). Loss on ignition (LOI) was determined by the roasting.

GSI used a pressed pellet technique.

Whole-rock analyses, Oregon talc samples

Oxides	Units	AUG-4	AUG-7	AUG-10	AUG-27	AUG-33	AUG-34	AUG-35	AUG-40	AUG-41	AUG-42	AUG-43	AUG-44	AUG-56	AUG-99	AUG-107
SiO_2	(wt. %)	58.5	50.9	59.1	47.3	76.0	56.0	56.6	41.3	52.7	51.5	51.5	51.8	56.1	31.2	28.7
Al_2O_3	(wt. %)	0.89	5.15	0.18	1.70	0.77	1.91	1.47	1.57	1.44	0.99	3.89	3.13	1.35	0.14	22.1
CaO	(wt. %)	0.01	0.25	0.27	0.56	0.11	0.42	0.10	0.65	0.07	0.59	0.07	0.05	0.10	0.19	3.41
MgO	(wt. %)	29.9	28.4	31.2	29.0	14.9	25.7	28.1	32.3	27.8	28.5	30.0	29.4	28.4	36.0	26.2
Na_2O	(wt. %)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.03	<0.01
K_2O	(wt. %)	0.01	0.01	0.01	0.01	0.02	0.04	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01
Fe_2O_3	(wt. %)	5.08	7.55	3.82	8.98	3.48	8.32	6.37	7.25	8.83	8.89	6.71	8.15	6.79	7.36	6.13
MnO	(wt. %)	0.05	0.17	0.02	0.15	0.02	0.10	0.05	0.17	0.15	0.14	0.09	0.07	0.12	0.12	0.02
TiO_2	(wt. %)	0.04	0.05	0.04	0.07	0.05	0.13	0.06	0.13	0.06	0.04	0.07	0.07	0.06	0.03	1.57
P_2O_5	(wt. %)	0.01	0.01	0.01	0.01	0.02	0.04	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.21
LOI	(wt. %)	5.31	7.08	5.62	10.5	3.47	5.70	5.54	16.5	7.16	8.62	7.54	7.23	7.08	24.3	11.8
Total	(wt. %)	100.2	99.90	100.4	98.80	99.00	98.80	98.70	100.3	98.70	99.70	100.3	100.4	100.4	100.2	100.2
Elements																
Ba	(ppm)	10	20	<10	20	150	40	30	50	70	70	30	40	40	10	70
Cr	(ppm)	2520	2550	1210	3180	1140	2940	2220	2550	3310	2980	2800	3190	2270	5250	250
Nb	(ppm)	10	10	<10	20	<10	<10	10	10	20	10	<10	10	20	10	20
Rb	(ppm)	10	<10	<10	10	<10	<10	10	<10	<10	<10	10	<10	<10	<10	10
Br	(ppm)	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	90
Y	(ppm)	<10	<10	20	<10	<10	10	<10	<10	<10	<10	<10	<10	<10	<10	40
Zr	(ppm)	<10	<10	<10	<10	<10	30	<10	<10	<10	<10	<10	<10	<10	<10	50

APPENDIX 8. REFLECTANCE READINGS

The tests were perfomed by the Department laboratory using a Photovolt model 577 reflection meter equipped with a "T" search unit. The instrument was calibrated using the manufacturer's instructions, with the supplied black cavity used to set the zero offset calibration and a standard plaque used to set the second calibration point. Values for the standard plaque were: amber - 88.5, blue - 85.0, and green - 88.5.

The analytical procedure was as follows: The instrument was calibrated for the appropriate filter channels using the black cavity (ZERO) and standard plaque. The calibration curve was checked by using standards. If either the black cavity or standard plaque read more than 0.2 outside of the standard value, the instrument was recalibrated. When it was calibrated correctly, five samples were read, and then standards were checked again. Short-term stability was good enough that recalibration and rereading of samples were rarely needed.

Samples were prepared by placing in a special glass cuvette enough powdered sample to compact into a layer about an eighth of an inch thick. The powdered sample was compacted with a wood cylinder slightly smaller than the inside diameter of the cuvette. Because the talc powder adhered so tightly to the interior surface, it was necessary to clean the cuvette by washing it in a slightly soapy solution, rinsing in two separate distilled water baths, rinsing in acetone, and drying on a slightly warm hot plate between each reading.

The reflection readings given on the next page should be considered as only approximations. The presence of particles larger than the preferred particle size likely reduced reflection readings.

*Reflectance readings, Oregon talc samples**

Sample no.	Amber	Blue	Green	Sample no.	Amber	Blue	Green	Sample no.	Amber	Blue	Green
AUG- 1	70.5	70.0	70.7	AUG- 41	44.0	27.5	39.5	AUG- 81	54.7	44.9	53.2
AUG- 2	50.0	32.6	45.3	AUG- 42	43.9	26.7	39.0	AUG- 82	53.0	37.6	48.8
AUG- 3	43.5	26.0	39.1	AUG- 43	52.2	38.2	48.8	AUG- 83	53.6	42.8	51.6
AUG- 4	76.7	72.8	76.5	AUG- 44	52.8	36.1	48.6	AUG- 84	59.2	53.5	58.1
AUG- 5	52.8	49.0	53.5	AUG- 45	48.8	45.0	49.4	AUG- 85	66.0	64.9	66.3
AUG- 6	53.6	41.6	51.1	AUG- 46	42.1	26.6	37.6	AUG- 86	64.2	57.4	63.1
AUG- 7	50.4	42.8	49.0	AUG- 47	52.6	41.5	50.2	AUG- 87	67.3	55.1	64.9
AUG- 8	61.5	54.2	61.0	AUG- 48	64.5	58.9	63.6	AUG- 88	52.1	32.6	47.8
AUG- 9	63.5	61.8	63.8	AUG- 49	54.8	40.6	52.1	AUG- 89	54.4	38.3	49.8
AUG- 10	73.0	72.5	72.8	AUG- 50	48.4	31.2	44.0	AUG- 90	64.1	60.6	63.4
AUG- 11	54.0	38.5	50.1	AUG- 51	43.7	28.0	39.1	AUG- 91	56.8	45.1	53.7
AUG- 12	67.2	61.8	66.8	AUG- 52	50.6	34.2	46.5	AUG- 92	52.5	41.0	50.1
AUG- 13	51.0	42.4	49.4	AUG- 53	54.8	36.3	50.0	AUG- 93	56.5	42.8	53.3
AUG- 14	73.4	70.4	73.4	AUG- 54	62.3	43.7	58.1	AUG- 94	67.0	61.2	65.9
AUG- 15	53.6	49.1	54.4	AUG- 55	60.0	44.8	56.2	AUG- 95	53.9	32.9	49.0
AUG- 16	51.1	36.7	47.8	AUG- 56	56.2	41.8	52.8	AUG- 96	46.1	23.9	40.4
AUG- 17	31.5	19.3	26.8	AUG- 57	54.6	42.7	52.1	AUG- 97	42.5	22.8	37.4
AUG- 18	46.3	26.8	41.1	AUG- 58	64.1	61.1	63.1	AUG- 98	50.7	33.1	46.2
AUG- 19	57.9	50.2	56.9	AUG- 59	53.4	39.4	50.1	AUG- 99	55.9	41.0	52.1
AUG- 20	59.9	47.1	57.3	AUG- 60	41.7	26.6	37.3	AUG-100	45.7	24.3	39.9
AUG- 21	41.1	22.8	36.0	AUG- 61	55.7	39.9	51.8	AUG-101	46.2	36.5	43.8
AUG- 22	47.6	26.6	43.1	AUG- 62	59.4	36.7	54.0	AUG-102	48.3	24.8	42.7
AUG- 23	42.6	23.0	36.8	AUG- 63	60.5	52.0	58.9	AUG-103	70.4	49.2	65.6
AUG- 24	49.6	30.0	45.0	AUG- 64	65.3	62.0	64.6	AUG-104	57.7	44.8	54.7
AUG- 25	48.9	27.2	44.0	AUG- 65	52.4	38.8	48.9	AUG-105	60.1	41.1	55.5
AUG- 26	56.4	39.0	52.7	AUG- 66	49.8	39.0	47.2	AUG-106	60.6	48.0	57.6
AUG- 27	41.6	22.8	36.8	AUG- 67	75.3	71.5	74.4	AUG-107	68.2	62.2	67.0
AUG- 28	57.9	45.8	55.2	AUG- 68	73.9	70.9	73.0	AUG-108	55.2	40.2	52.5
AUG- 29	69.8	63.6	69.0	AUG- 69	52.8	38.1	48.9	AUG-109	70.9	66.3	70.1
AUG- 30	70.6	67.1	70.2	AUG- 70	54.0	36.7	49.9				
AUG- 31	46.5	38.6	45.0	AUG- 71	51.0	33.2	46.0				
AUG- 32	53.4	43.5	51.5	AUG- 72	54.0	34.1	49.0				
AUG- 33	62.6	49.1	60.0	AUG- 73	63.2	46.8	60.0				
AUG- 34	52.7	32.6	48.3	AUG- 74	41.4	23.7	37.1				
AUG- 35	65.4	58.0	64.0	AUG- 75	54.0	38.4	51.2				
AUG- 36	36.4	28.0	35.6	AUG- 76	66.6	52.7	63.3				
AUG- 37	51.6	43.3	50.4	AUG- 77	51.6	40.9	48.8				
AUG- 38	59.0	46.8	56.3	AUG- 78	76.8	73.6	76.1				
AUG- 39	58.8	52.4	58.4	AUG- 79	45.8	39.1	44.8				
AUG- 40	54.4	40.3	50.8	AUG- 80	55.9	55.2	55.9				

*Blue reading is the brightness reading. Typical dry brightness of the talc used for mineral pigments is 70-95.

APPENDIX 9. DISPERSION STAINING MICROSCOPY

Marija Janko of the Occupational Health Laboratory, Workers' Compensation Department, State of Oregon, kindly analyzed the six Oregon talc samples listed below for asbestos using Occupation Health Laboratory methods. This required counting approximately 1,000 points under the petrographic microscope, identifying asbestos by dispersion staining microscopy techniques.

Dispersion staining microscopy results

AUG- 7: 1 fiber per 1,022 points, <0.1% fibrous tremolite
AUG-27: 0 fibers
AUG-32: 0 fibers
AUG-34: 1 fiber per 1,012 points, <0.1% fibrous tremolite
AUG- 5: 0 fibers
AUG-99: 0 fibers

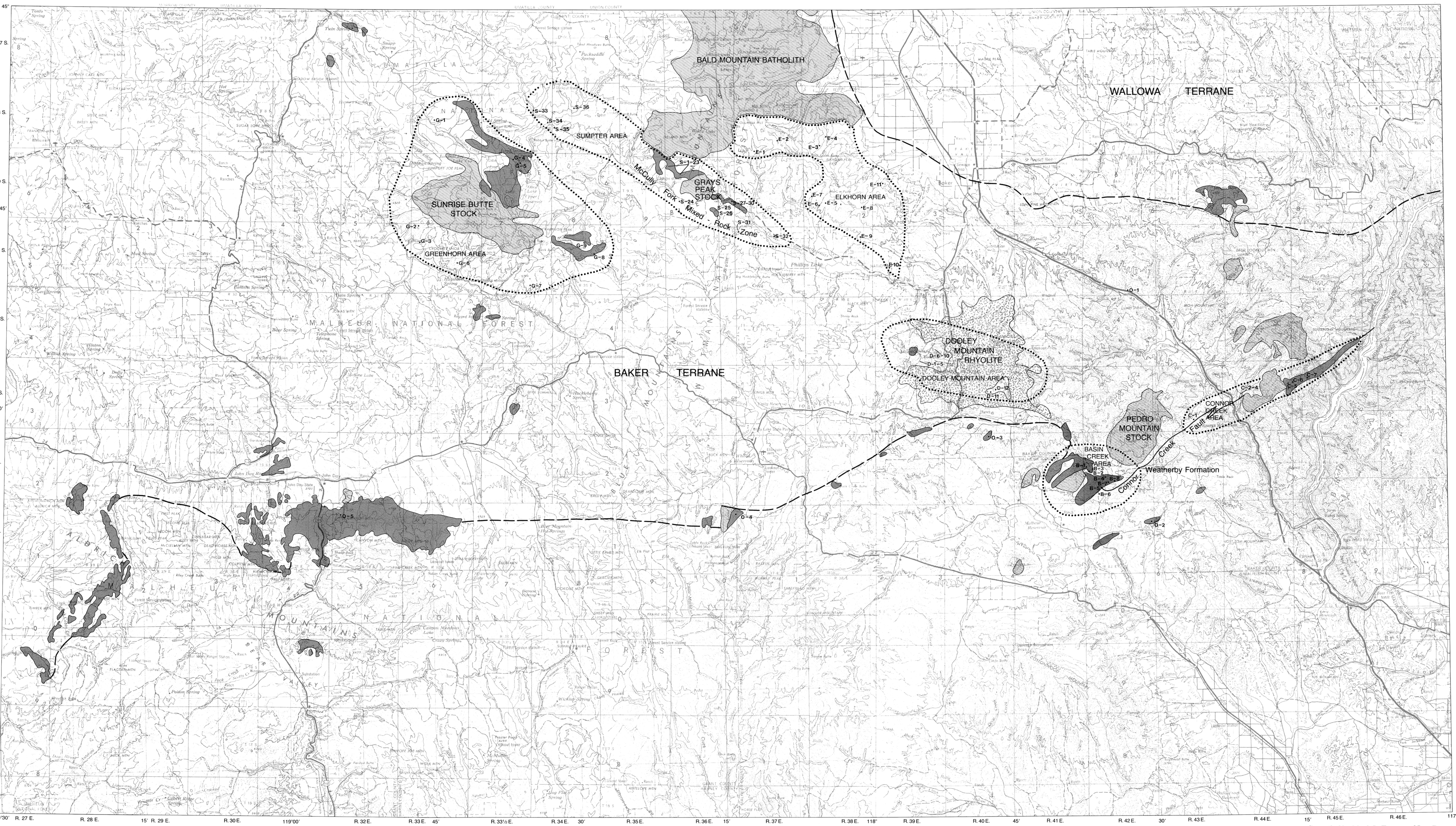
STATE OF OREGON
DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES
DONALD A. HULL, STATE GEOLOGIST

TALC AREAS AND OCCURRENCES MAP OF NORTHEASTERN OREGON

1988

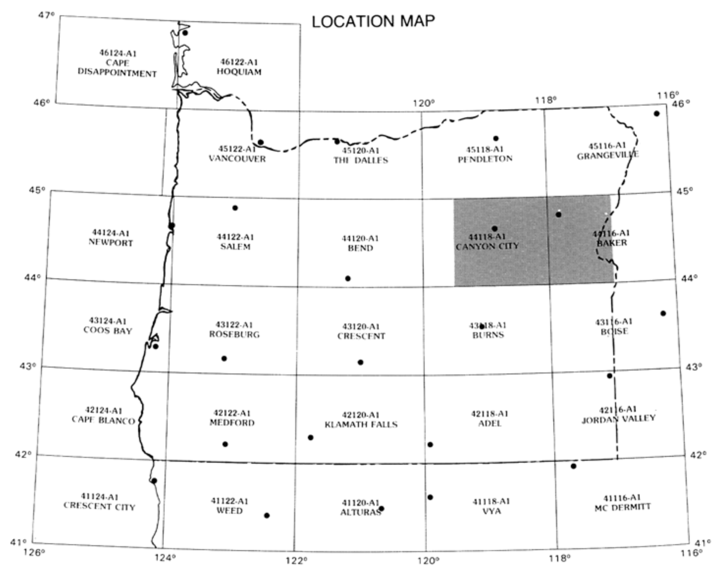
Sp. P. 18
Investigations of Talc in Oregon
By Mark L. Ferns and Len Ramp

Plate 1



Base map by the Army Map Service with revision by the U.S. Geological Survey.
From portions of Baker and Canyon City 1° × 2° sheets
Transverse mercator projection

LOCATION MAP



Scale 1:250,000

5 0 5 10 15 20 Statute Miles
5 0 5 10 15 20 25 30 Kilometers
5 0 5 10 15 Nautical Miles

CONTOUR INTERVAL 200 FEET

Compiled by Mark L. Ferns and Len Ramp,
Oregon Department of Geology and Mineral Industries

EXPLANATION

- Miocene rhyolite
- Granitic intrusion of late Mesozoic or early Cenozoic age
- Ultramafic rock — Serpentinite includes some rock with additional alteration and a few areas of mafic rock. Some small slivers of serpentinite are not shown
- Fault
- Terrane boundary
- Boundary of talc area discussed in text
- S-32 Numbered locality described in text — Prefix indicates area. O = other area

Sources of data: east half, Brooks and others (1976); west half, Brown and Thayer (1966); locations of ultramafic rock, Ramp (1978)

STATE OF OREGON
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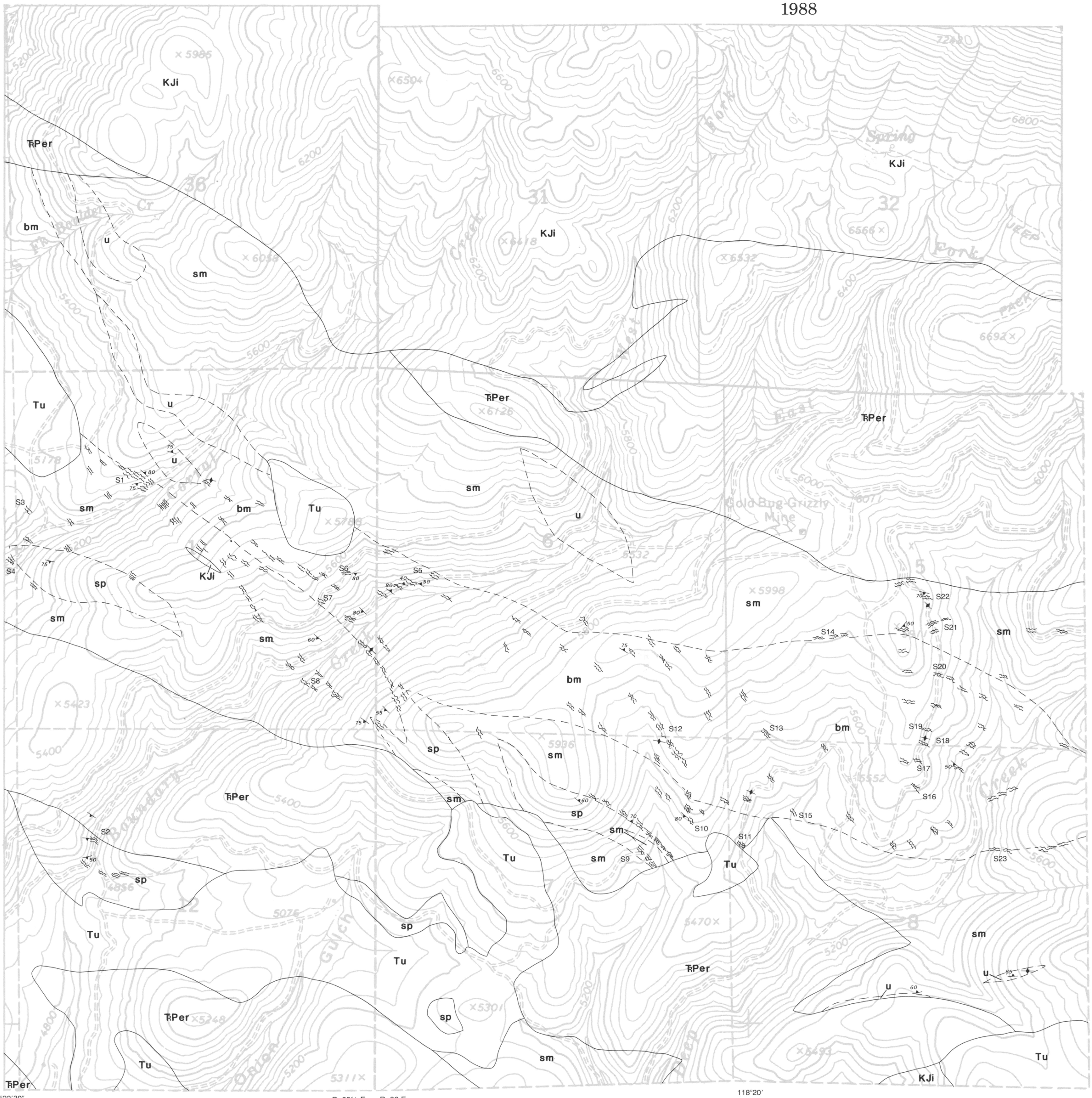
MAP SHOWING DISTRIBUTION OF TALC ZONES IN THE BOULDER CREEK AND CORRAL CREEK DRAINAGES, SUMPTER AREA, GRANT COUNTY, OREGON

1988

Sp. P. 18
Investigations of Talc in Oregon
By Mark L. Ferns and Len Ramp
Plate 2



Base map from U.S. Geological Survey, enlarged portion of Mt. Ireland 7½' quadrangle

EXPLANATION

Contact — Dashed where approximately located

Tu	**Tertiary rocks,** undifferentiated
KJi	**Bald Mountain Batholith and related rocks**
TrPer	**Elkhorn Ridge Argillite**
	McCully Fork mixed-rock zone
sm	Slab melange with little recognizable matrix
bm	Block melange with recognizable matrix
u	Metamorphosed serpentinite (enstatite- and talc-olivinites)
sp	Antigorite serpentinite
	Talc and talc-carbonate rock

50 **Strike and dip of foliation**

Strike of vertical foliation

S23 **Locality discussed in text**

Source of data: Ferns and others (1982)

Scale 1:12,000

0 ½ 1 MILE

CONTOUR INTERVAL 40 FEET

LOCATION MAP

Compiled by Mark L. Ferns,
Oregon Department of Geology and Mineral Industries

STATE OF OREGON
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DONALD A. HULL, STATE GEOLOGIST

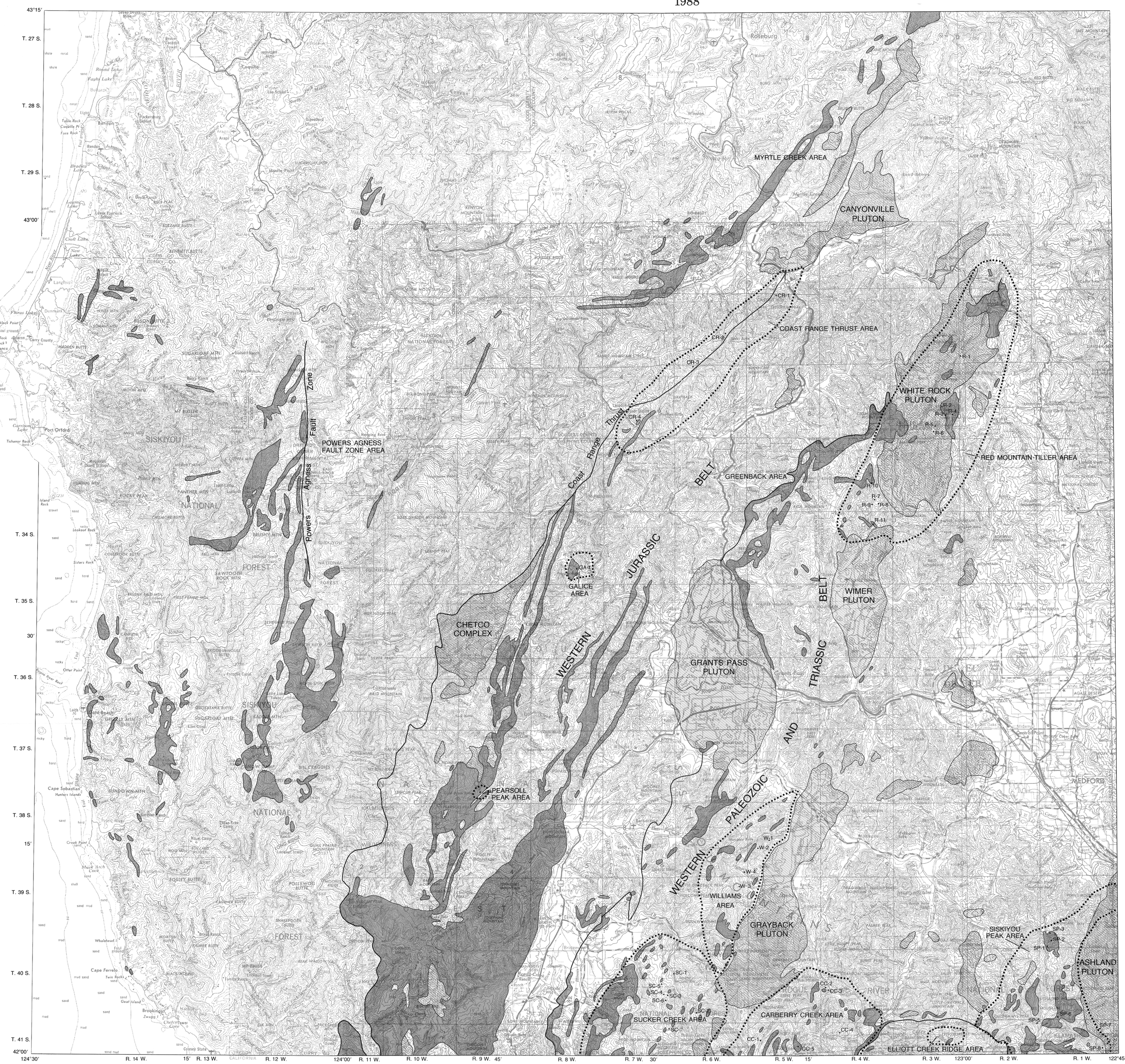
Talc Areas and Occurrences Map of Southwestern Oregon

1988

Sp. P. 18

Investigations of Talc in Oregon
By Mark L. Ferns and Len Ramp

Plate 3



EXPLANATION

Granitic intrusion of late Mesozoic age

Ultramafic rock — Serpentinite includes some rock with additional alteration and a few areas of mafic rock. Some small slices of serpentinite are not shown

Fault

Boundary of talc area discussed in text

.W-3 **Locality discussed in text** — Prefix indicates area. Number is keyed to discussion in text

Sources of data: Page and others (1983), Ramp (1972, 1978), and Smith and others (1982)

Compiled by Len Ramp and Mark L. Ferns, Oregon Department of Geology and Mineral Industries

Scale 1:250,000

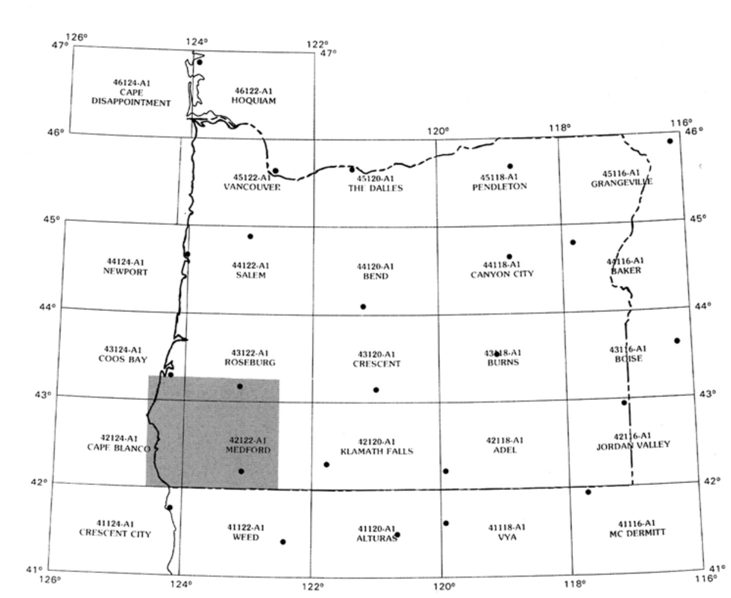
5 0 5 10 15 20 Statute Miles

5 0 5 10 15 20 25 30 Kilometers

5 0 5 10 15 Nautical Miles

CONTOUR INTERVAL 200 FEET

Base map by the Army Map Service with revision by the U.S. Geological Survey
From portions of Medford, Roseburg, and Coos Bay sheets
Transverse mercator projection



LOCATION MAP

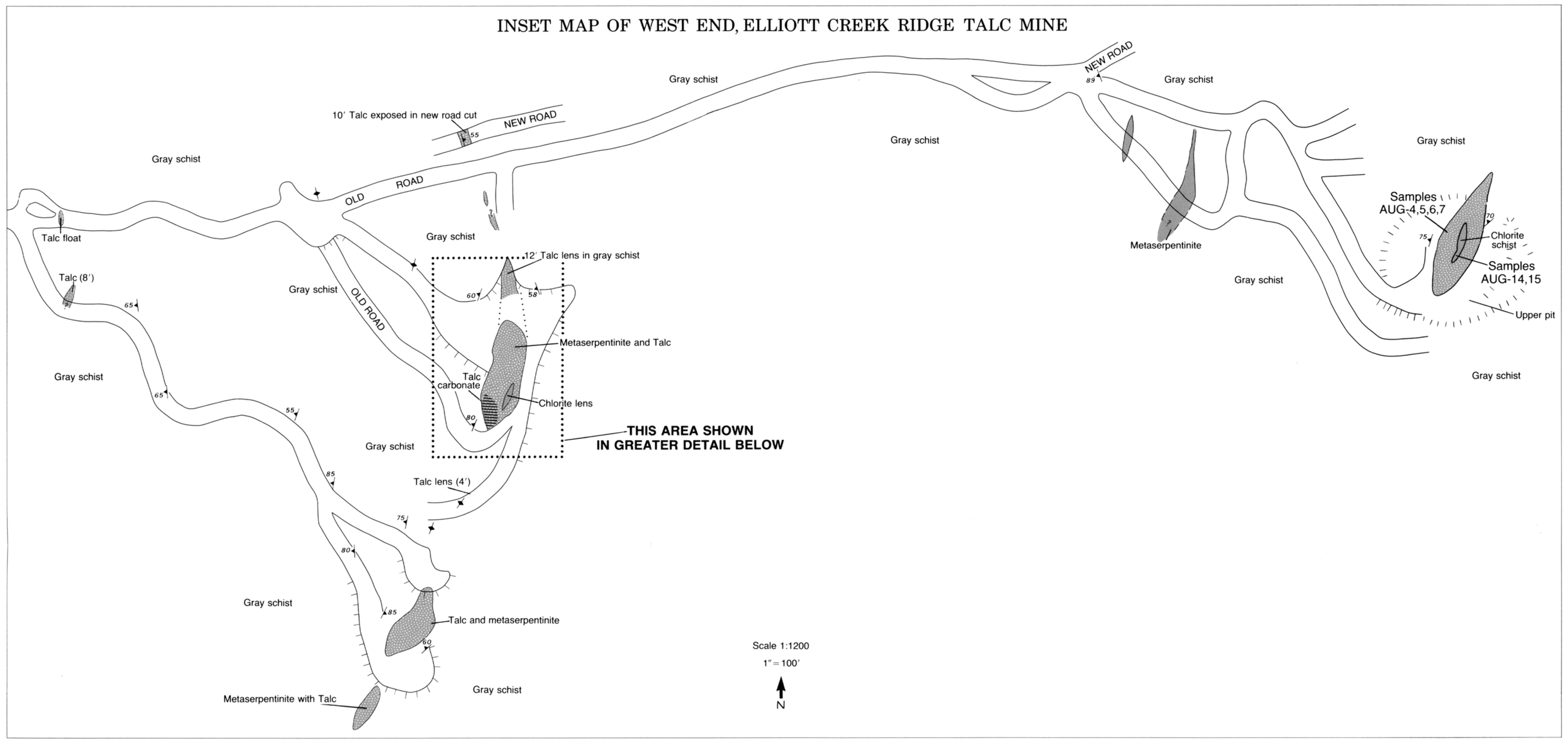
STATE OF OREGON
DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES
DONALD A. HULL, STATE GEOLOGIST

Talc Deposit Map of Elliott Creek Ridge, Jackson County, Oregon

1988

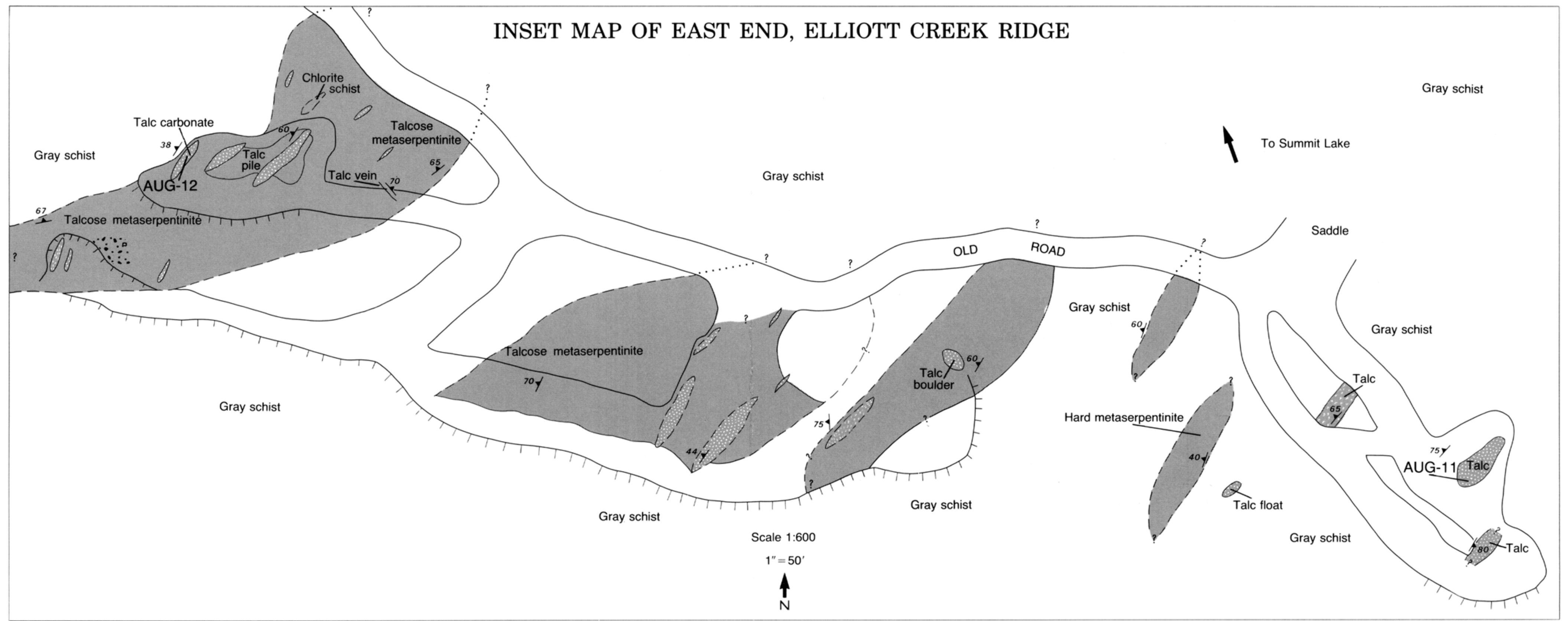
Sp. P. 18
Investigations of Talc in Oregon
By Mark L. Ferns and Len Ramp
Plate 4

INSET MAP OF WEST END, ELLIOTT CREEK RIDGE TALC MINE



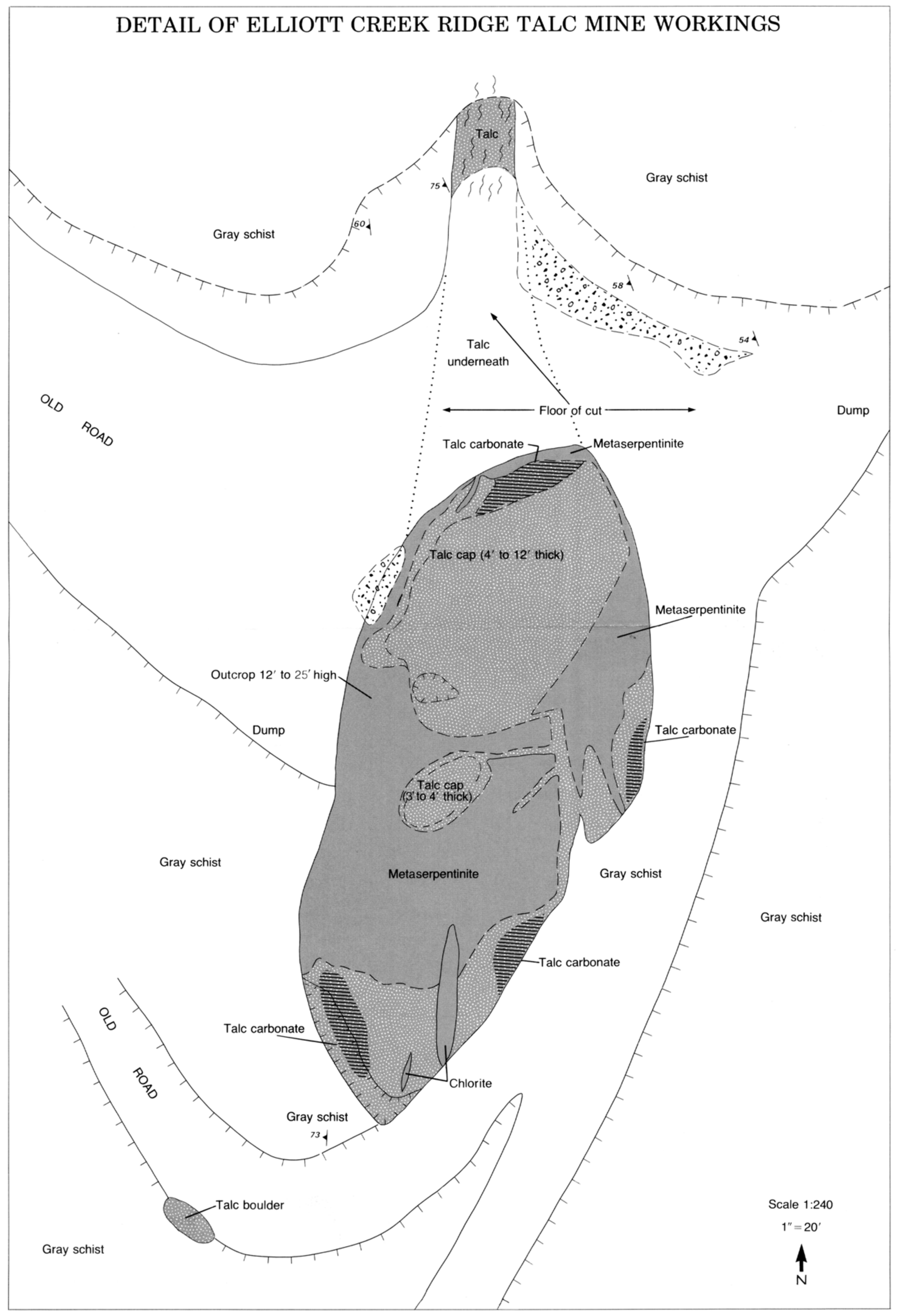
By Len Ramp and Patrick K. Starnes
Field work completed in 1986

INSET MAP OF EAST END, ELLIOTT CREEK RIDGE



By Len Ramp and Patrick K. Starnes
Field work completed in 1986

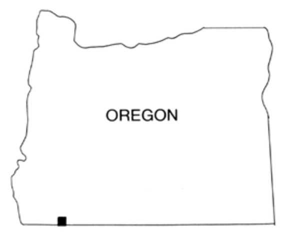
DETAIL OF ELLIOTT CREEK RIDGE TALC MINE WORKINGS



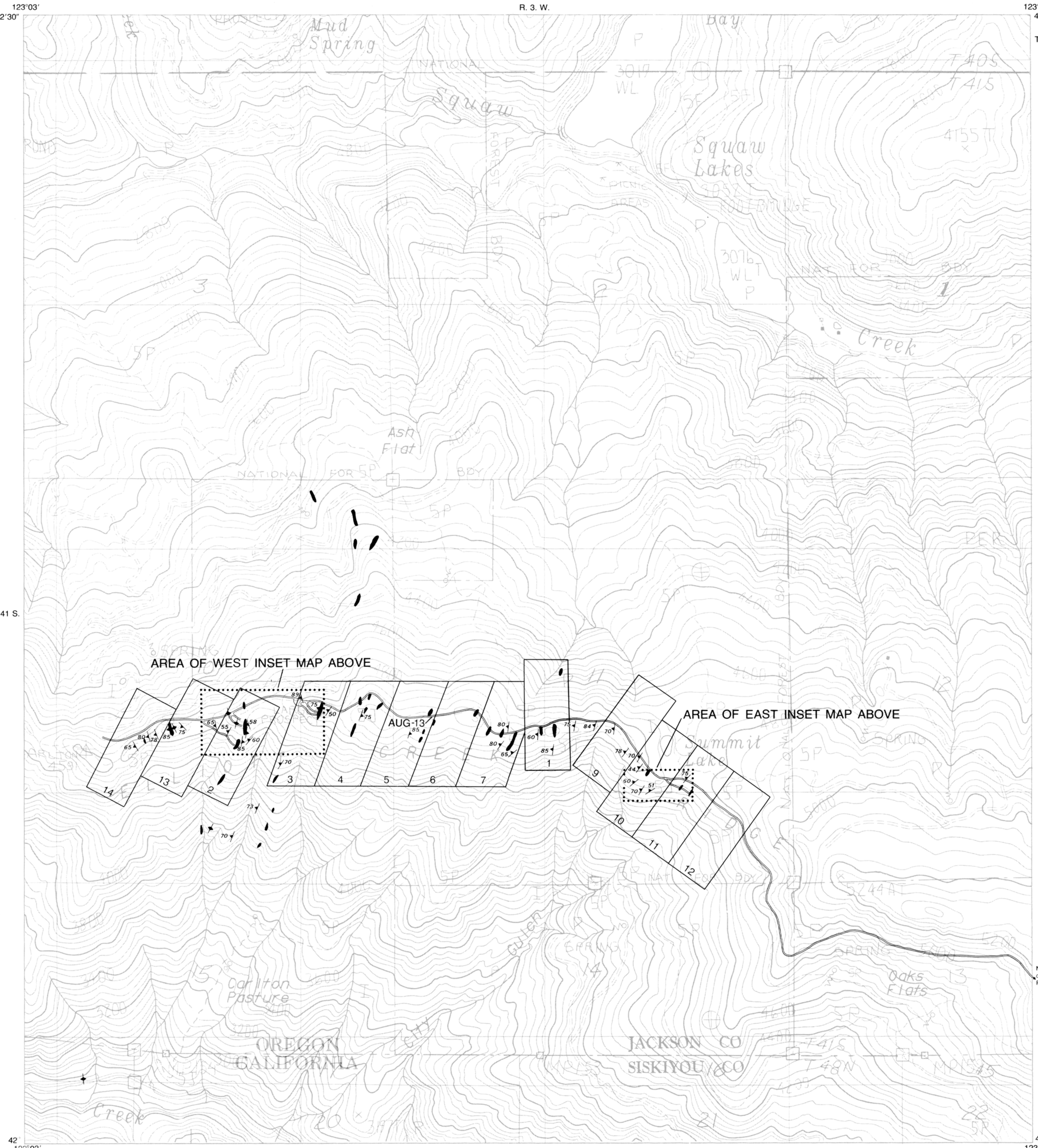
By Len Ramp and Patrick K. Starnes
Field work completed in 1986

EXPLANATION OF MAP SYMBOLS (including inset maps)

- Talc
- Talc-carbonate
- Metaserpentinite or chlorite as labeled
- Gray schist of Condrey Mountain as labeled
- Talc/metaserpentinite/chlorite bodies
- Strike and dip of foliation
- Strike of vertical foliation
- Shear zone
- Mine waste pile
- Edge of bench or cut
- 14 Mining claim boundaries (approximate) — Numbers refer to Hard Pull Group claim
- AUG -15 Sample



LOCATION MAP



Base map by U.S. Geological Survey.
Enlarged version of Squaw Lakes, OR 7½' quadrangle, provisional edition of 1983

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