levels of both the Stank and the Humboldt ore bodies." On the 300 level in the Stank mine, the molybdenite is associated with very dark brown andradite(?) garnet which is uncommon elsewhere in the deposit.

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Item 55

K-AR DATES ON GRANODIORITE AND RELATED SCHEELITE-BEARING QUARTZ VEINS AT TUNGSTEN, PERSHING COUNTY, NEVADA

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At Tungsten, in the central Eugene Mountains of Pershing County, Nevada, a series of granodiorite intrusives have cut sedimentary rocks of the upper Triassic Raspberry Formation. Locally, the Raspberry Formation is composed of shale (regionally metamorphosed to slate and schist) and thin-bedded limestone. Near contacts with granodiorite, the sedimentary rocks have been further metamorphosed to hornfels and tactite. Tungsten mineralization, in the form of scheelite, is associated with at least one of the granodiorite intrusives, and has formed mineable concentrations in certain zones within the tactite bodies.

Nine samples of granodiorite and quartz vein material were selected for K-Ar age dating to aid in determining age relationships between the scheelite occurrences and the granodiorite masses. Although ranging in age from late Cretaceous to early Tertiary, the dates allow separation of the rocks sampled into four distinct age groups.

Of the samples taken, the oldest date obtained was from a dacite dike cut in a core hole southeast of the old town of Tungsten (Sample no. 1: 101 ± 4 m.y.). The geologic relationship of this rock to the rocks seen in outcrop at Tungsten is yet to be determined.

In the next youngest age group are included the Olsen stock (Sample no. 2: 88.9 ± 3.2 m.y.). The Olsen stock forms the largest intrusive outcrop in the Tungsten area, and the Northwest dike is one of a series of northwest trending dikes which outcrop in the area west of the Olsen and Springer stocks. Krueger and Schilling (1971) obtained a date of 90 ± 2.7 m.y. from a sample taken from the western margin of the Springer stock, indicating that a portion of the Springer stock must also be included in this age group.

The third and largest sample grouping includes an additional sample of the Springer stock (Sample no. 5: 78.4 ± 2.9 m.y.), the Forge stock (Sample no. 4: 78.9 ± 2.9 m.y.), the Uncle Sam stock (Sample no. 7: 74 ± 2.8 m.y.), the Springer quartz veins (Sample no. 6: 76 ± 2.7 m.y.), and the Sutton quartz veins (Sample no. 8: 72 ± 2.6 m.y.). Both the Springer and Uncle Sam stocks lie to the immediate south of the large Olsen stock, near the center of the Tungsten district. The Forge stock is about two miles south of Tungsten.

Only one sample falls within the last and youngest age group. The Southwest stock (Sample no. 9: 66.5 ± 2.5 m.y.), which outcrops about one mile southwest of the central Tungsten area, is assigned to early Tertiary age.

With the exception of Sample no. 1, all intrusives sampled are known to have scheelite-bearing tactite bodies associated with them. The principal scheelite concentrations at Tungsten, however, occur near the margins of the Springer stock. Age dates indicate that the Springer, Uncle Sam, and Forge stocks are essentially the same age (within the limits of the laboratory procedure), and that the scheelite-bearing quartz veins which cut both the Springer stock and the Sutton tactite bodies are also of this same general age. The cross-cutting relationship of these quartz veins to both the Springer granodiorite and the mineralized tactites indicates that although they are generally the same age as the Springer-Uncle Sam granodiorite, the veins and their contained scheelite are relatively younger than the intrusive mass.

From this information, it is inferred that at least a portion of the scheelite mineralization at Tungsten post-dates the solidification of the source intrusive, and this late-stage mineralization is believed to have enriched the primary tactite ore bodies.

SAMPLE DESCRIPTIONS

✓ NM-5 Dike — K-Ar — (biotite) 101 ± 4 m.y.
Altered dacite porphyry dike (drill hole in sec. 2, T. 33 N., R. 34 E.; Pershing Co., NV). Analytical data: K = 2.468%; $*Ar^{40}$ = 0.01823 ppm. Dated by: Geochron Laboratories, Inc., for Refractory Metals Products Department, General Electric Co.; mineral separates prepared by: Geochron Laboratories. Collected by: J. V. Tingley.

✓ Northwest dike — K-Ar — (muscovite) 88.9 ± 3.2 m.y.
Greisenized granite porphyry (SE¼SE¼SW¼ sec. 27, T. 34 N., R. 33 E.; Pershing Co., NV). Analytical data: K = 8.341%; $*Ar^{40}$ = 0.05421 ppm. Dated by: Geochron Laboratories, Inc., for Refractory Metals Products

Department, General Electric Co.; mineral separates prepared by: Nevada Bureau of Mines and Geology. Collected by: J. V. Tingley.

3. Olsen stock K-Ar Sec 38 P Garside (biotite) 86.8 ± 3.2 m.y.
Biotite granodiorite (NW¼SW¼SW¼ sec. 26, T. 34 N., R. 33 E.; Pershing Co., NV). Analytical data: K = 7.049%; $*Ar^{40}$ = 0.04471 ppm. Dated by: Geochron Laboratories, Inc., for Refractory Metals Products Department, General Electric Co.; mineral separates prepared by: Nevada Bureau of Mines and Geology. Collected by: J. V. Tingley.

4. Forge stock K-Ar (biotite) 78.9 ± 2.9 m.y.
Biotite granodiorite (SW¼NE¼SW¼ sec. 38, T. 34 N., R. 33 E.; Pershing Co., NV). Analytical data: K = 6.920%; $*Ar^{40}$ = 0.03979 ppm. Dated by: Geochron Laboratories, Inc. for Refractory Metals Products Department, General Electric Co.; mineral separates prepared by: Nevada Bureau of Mines and Geology. Collected by: J. V. Tingley.

5. Springer stock K-Ar (biotite) 78.4 ± 2.9 m.y.
Biotite granodiorite (SW¼NW¼NW¼ sec. 35, T. 34 N., R. 33 E.; Pershing Co., NV). Analytical data: K = 6.127%, $*Ar^{40}$ = 0.03503 ppm. Dated by: Geochron Laboratories, Inc., for Refractory Metals Products Department, General Electric Co.; mineral separates prepared by: Geochron Laboratories. Collected by: J. V. Tingley.

6. Springer quartz veins K-Ar (adularia) 76 ± 2.7 m.y.
Quartz-adularia veins with scheelite crystals, veins cut Springer granodiorite SE¼NW¼ sec. 35, T. 34 N., R. 33 E.). Analytical data: K = 12.667%, $*Ar^{40}$ = 0.07014 ppm. Dated by: Geochron Laboratories, Inc., for Refractory Metals Products Department, General Electric Co.; mineral separates prepared by: Nevada Bureau of Mines and Geology. Collected by: J. V. Tingley.

7. Uncle Sam stock K-Ar (biotite) 74 ± 2.8 m.y.
Biotite granodiorite (E½SW¼SW¼ sec. 26, T. 34 N., R. 33 E.; Pershing Co., NV). Analytical data: K = 6.644%, $*Ar^{40}$ = 0.03579 ppm. Dated by: Geochron Laboratories, Inc., for Refractory Metals Products Department, General Electric Co.; mineral separates prepared by: Geochron Laboratories. Collected by: J. V. Tingley.

8. Sutton quartz veins K-Ar (adularia) 72.0 ± 2.6 m.y.
Quartz-adularia veins with scheelite, veins cut scheelite-bearing tactite (W½NW¼SW¼ sec. 35, T. 34 N., R. 33 E.). Analytical data: K = 10.992%; $*Ar^{40}$ = 0.05762 ppm. Dated by: Geochron Laboratories, Inc., for Refractory Metals Products Department, General Electric Co.; mineral separates prepared by: Nevada Bureau of Mines and Geology. Collected by: J. V. Tingley.

9. Southwest stock K-Ar (biotite) 66.5 ± 2.5 m.y.
Biotite granodiorite (W½NW¼SE¼ sec. 35, T. 34 N., R. 33 E.; Pershing Co., NV). Analytical data: K = 5.986%; $*Ar^{40}$ = 0.02894 ppm. Dated by: Geochron Laboratories, Inc., for Refractory Metals Products Department, General Electric Co.; mineral separates prepared by: Nevada Bureau of Mines and Geology. Collected by: J. V. Tingley.

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EUGENE MOUNTAINS, PERSHING COUNTY

Nevada-Massachusetts Deposit

The Nevada-Massachusetts (Tungsten, Mill City) deposit is on the east flank of the Eugene Mountains in Secs. 26, 27, 34, and 35, T. 34 N., R. 34 E., in the north central part of Pershing County. The deposits are accessible by an 8-mile paved road extending north from Mill City on U. S. Highway 40-95.

Schilling, Mo

The Tungsten deposits were discovered in 1917. In 1918, the Nevada-Humboldt Tungsten Mines Co. and the Pacific Tungsten Co. each built mills. In 1926, the present owners, the Nevada-Massachusetts Co. acquired the property of both companies. Production has been almost continuous from 1932 through 1957; the property has been one of the largest tungsten producers in the United States, both in terms of total and yearly production.

There are two tungsten-bearing zones. The western belt includes, from south to north, the Codd, Stank, Yellow Scheelite, Keyes, Hard Luck George, Springer, and Humboldt workings. In recent years, mining operations along this belt have been conducted as one unit through the Stank and Humboldt shafts. There are over 12 miles of underground workings, as well as extensive open pits.

A second belt 2,000 feet to the east, including the Sutton, North Sutton, Baker, and Uncle Sam workings, parallels the Stank-Humboldt belt. Workings along this eastern belt are less extensive. Kerr (1934) contains geologic maps of the workings.

The Rocks. Triassic phyllite and interbedded limestone, generally striking N. 0°-20° E. and dipping 70° W. east of the Stank thrust fault and 65° E. west of the fault, are intruded by granodiorite and later aplite and pegmatite dikes and quartz veins. Dikes of hornblende andesite cut the other rocks.

A body of granodiorite underlies the area, croping out mainly north and east of the tungsten deposits, but also is exposed to a more limited extent elsewhere. Dikes and small masses of granodiorite, and end-stage aplite and

Fig. __. Geologic Map of the Nevada-Massachusetts tungsten deposits.

pegmatite, extend out from the stock. Mining operations have shown that the shape of the stock is irregular, and that the sedimentary cover is much thicker than the outcrop pattern would suggest. The granite contact commonly dips steeply in the vicinity of the tungsten deposits. Isotopic age dating indicates that the granodiorite is about 90 m.y. old (Krueger & Schilling, 1971 ~~in press~~).

Structures. The post-depositional Stank thrust fault, which cuts diagonally northwest across the south part of the area, is the most prominent structural feature. Other smaller faults cut and offset the rocks. Many of these were formed during the intrusion of the granodiorite, before the deposition of the tungsten. Most of the other faults have been formed by regional deformation after the tungsten had been deposited.

Contact Metamorphism. Along the granodiorite contact, the phyllites have been contact-metamorphosed to olive-green to light gray, hard, hornfels, consisting of a fine-grained mosaic of quartz and actinolite or locally biotite, with minor cordierite, apatite, zircon, rutile, and pyrite. Black bands in the hornfels consist of hornblende crystals in quartz.

The limestone beds are altered to tactite consisting of garnet (andradite and grossularite), quartz, calcite, and epidote, and varying amounts of idocrase, actinolite, tremolite, and wollastonite. Late quartz veins fill tension fractures in the tactite and adjoining hornfels.

Tungsten Mineralization. Scheelite occurs as white, anhedral to subhedral crystals, from less than a millimeter to several centimeters in diameter, disseminated in varying amounts through the tactite. Locally it is abundant enough to form high-grade ore bodies. The most productive area has been west

of the granodiorite stock where several, north-trending, 1- to 8-foot beds

Fig. __. Geologic cross-section through Stank Hill.

of limestone, separated by up to 200 feet of hornfels, form the Stank-Humboldt belt. A second less-productive zone consisting of two, 3- to 5-foot limestone beds 30 to 50 feet apart, occurs east of the Stank-Humboldt belt, and is known as the Sutton belt. Kerr (1946, p. 187) states that: "Locally, over a few feet, the ore distribution ... is often extremely erratic. Where stratum is not completely replaced [tactized] the ore may have accumulated along the footwall ... while elsewhere ore may occur along the hanging wall. Even ... in the vicinity of high-grade scheelite deposition, blocks of unreplaced limestone as much as 20 feet across are found." It is not clear how much scheelite actually is present in the hornfels. Some scheelite also is present in quartz veins which fill tension fractures in the tactite and extend up to several hundred feet out into the surrounding hornfels. Most of the scheelite in the tactite and veins fluoresces bluish-white; yellow-fluorescing scheelite has been reported in a few small areas.

Sulfide Mineralization. Small cubes of pyrite are disseminated through quartz and the other contact-metamorphic minerals making up the tactite; pyrite also is present in the late-stage, quartz veins. Traces of pyrrhotite, chalcopyrite, stibnite, and bismuthinite(?) are present, mainly in the veins. Molybdenite is more abundant than the other sulfides; it occurs disseminated in the tactite, and alone or with other sulfide minerals and/or quartz filling fractures in the garnet, epidote, and scheelite. Kerr (1934, p. 30) states that "molybdenite is found in a small concentration a few feet long and about six inches in width occurring on the 300 level on the Stank mine just north of the shaft ...[and] is widely distributed in small amounts in the lower