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(14)
Item 5

[redacted] CHURCHILL COUNTY, NEVADA, (WITH PARAGENETIC AND GEOTHERMOMETRY DATA, AND THEIR BEARING ON THE GENESIS OF SCHEELITE)

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Location

The [redacted]s located in Fondaway Canyon on the western slope of the Stillwater Range, 80 kilometers (50 miles) south of Lovelock and 69 kilometers (43 miles) north of Fallon in Churchill County, Nevada. The l[redacted]are 800 meters up Fondaway Canyon and the up[redacted]gs are 800 meters further up the wash along its north side. A m[redacted]e is located along the range front, [redacted]of the mouth of the canyon. The mine is situated in Section 1, T.22 N., R.33 E., and Section 6, T.22 N., R.34 E., MDB&M, and is shown on the Dixie Hot Springs 15-minute topographic quadrangle map. Its longitude is 118° 12' 30" and the latitude is 38° 18' 12". It can be reached by taking U.S. 50 east for 8 kilometers (5 miles) from Fallon to the Stillwater turnoff, thence 17.7 kilometers (11 miles) on a paved road through the community of Stillwater, past the Stillwater National Wildlife Refuge headquarters, and thence north on a graded dirt road along the eastern side of the Carson Sink to the mouth of Fondaway Canyon.

Production and History

The Quick-Tung mine has produced over [redacted] of[redacted]al) through 1976 from two deposits located 800 meters apart (George Fisk, personal communication). Gold has been recovered recently from a small pilot heap-leach pad. The [redacted]ery was made at the site of the upper workings [redacted] and the first production was reported in 1958 (Davis and Ashizawa, 1959). Production continued after the price supports were removed until the price dropped to $12.00 per unit, with the concentrates being shipped 161 kilometers to the Nevada Scheelite mill near Rawhide, Nevada. [redacted]ty has been [redacted]ss [redacted]very except for this short period. Most of the ore has been mined by the owners, George Fisk and associates, of Fallon, Nevada, and the ore has been trucked to Fallon for milling at their plant. The property was under lease to Cr[redacted]1970, during which time the [redacted]ed. Several truckloads of molybdoscheelite-bearing magnetite ore, mined from the workings along the range front, were shipped to mine operators in the Buena Vista Hills, 32 kilometers to the north.

Previous Work

The Stillwater Range was mapped by Page (1965), and later modified by Willden and Speed (1974) in the Churchill County report. Lawrence (1962) mapped the Quick-Tung mine in 1960 during a study of the antimony deposits of Nevada. Sigurdson (1974) described the geology, paragenesis, and geothermometry of the deposit as a part of his doctoral thesis. Sigurdson and Lawrence (1976) re-

Geology

[redacted] did a remarkable job of geological mapping in the Stillwater Range between 1956 and 1961. The [redacted] rocks in the vicinity of the Quick-Tung mine described by Page were U[redacted]e derived from marine muds. This rock is gray-black, and weathers to pale gray, greenish gray, or light tan. Interbedded with the slate and phyllite were thin beds of fine-grained feldspathic quartzite from 30 to 90 centimeters thick, and gray-weathering limestone beds from 30 to 150 centimeters in thickness, with occasional limestone beds up to 15 meters in thickness. His [redacted]er [redacted] which he showed in depositional contact with the underlying Upper Triassic slate and phyllite. He compared the section at the mouth of Fondaway Canyon with a similar section two miles north of White Cloud Canyon that was studied in detail by Young (1963) and found to be Lower Jurassic (Hettangian stage) in age. The youngest rocks at the mine were found to be Jurassic(?) quartzite. Page described this as follows:

> *A distinctive allochthonous quartzite occurs in remnants of the Boyer thrust sheet at the mouth of Cottonwood Canyon and elsewhere. It varies from black to white and from thin-bedded to massive, but in other respects it is remarkably uniform. The sand is well sorted, fine to very fine grained, and is mainly angular to subrounded. Quartz predominates to the exclusion of all other clastic components except rare specks of tourmaline and zircon. Interstitial carbonate, chalcedonic silica, and chlorite are locally present, and some of the rock is calcareous sandstone rather than quartzite. The formation is at least 500 feet thick and is not interrupted by shale intercalations. The age is not definitely known because fossils are lacking, but R. C. Speed (personal communication, 1964) recently found Jurassic basalt apparently resting concordantly on the quartzite 3 to 4 miles north of Dixie Meadows. This suggests, but does not prove, a Jurassic age for the quartzite.*

[redacted] (1974) s[redacted] in this area a[redacted] "with so[redacted]one, but a quartzite formation and a shale and limestone formation, both of Jurassic age, lies at the mouth of Fondaway Canyon". They describe the quartzite as follows:

> *The quartz arenite is fine grained; the mean grain size ranges from 0.1 to 0.2 mm, the sorting is good, and the average roundness is 5 on the scale of Krumbein and Sloss (1963). Detrital components are at least 98 percent quartz; the matrix is principally dolomite, although X-ray analysis indicates small quantities of kaolinite. The rock is bedded in ½- to 6-inch layers defined by variations of mean grain size. Current structures are absent. The maximum stratigraphic thickness is about 500 feet.*

[redacted] (1969, p. 2572) [redacted] "by lithology and stratigraphic position". He believed that "the distribution of the quartz arenite indicates an intimate tectonic relationship with the Middle Jurassic gabbroic complex", which indicates that area (Speed, 1976, personal communication).

Intrusives

A [redacted] is exposed 1[redacted] Canyon, and granitic float found recently on a ridge 800 meters south of the lower workings indicates that this intrusive probably lies at a shallow depth beneath Fondaway Canyon. This granite varies in texture from medium to coarse-grained, and is composed of microcline, oligoclase, quartz, biotite, hornblende, magnetite, and traces of zircon, [redacted] and allanite. It was [redacted]d [redacted]h as the bordering sediments are domed upward and faulting is present along some of the margins. Although no radiometric age date has been obtained for the pluton, similar granitic intrusions 65 kilometers to the south in the Sand Springs Range give potassium-argon age dates of 66 ± 4 million years, 76 ± 2 million years, and 79.6 million years (Schilling, 1965, p. 23 and 25). The most plausible estimate of the age of this pluton is late Cretaceous.

[redacted]e at least as far as the lower and upper Quick-Tung workings. The diabase is deformed within the granitic pluton and was probably introduced before the pluton was completely crystallized. Several silicic dikes extend up to 1.7 kilometers from the granitic pluton. Numerous aplite dikes occur interbedded with the Triassic phyllite in Shady Run Canyon about 1.69 kilometers south of Fondaway Canyon. The presence of these dikes is further evidence of the presence of the granitic pluton beneath Fondaway Canyon.

Structure

[redacted]), the [redacted]t [redacted] an area of [redacted]s. Several small remnants occur in the Stillwater Range. They indicate that the quartzite at the mouth of Fondaway Canyon was transported from the northeast by the Boyer thrust fault, and subsequently downdropped along a normal fault, with the Jurassic shale and limestone moving upward along a high-angle thrust fault relative to the quartzite. Field evidence collected in recent studies by the present authors does not support these conclusions and age relationships.

[redacted]s

The [redacted]rs to be the [redacted]k in the vicinity of the mine, and is [redacted] to be a[redacted]c and p[redacted]. No fossils were found in the q[illegible]ite, but structurally it is considered virtually an i[redacted]and p[redacted]. This quartzite strikes northwesterly and dips to 35° southwesterly. Along the western flank of Quartzite Hill the [redacted]e and [redacted]ite at a low angle, and also strike northwesterly but dip 20° to 30° to the southwest, however, the reefal carbonate and the interbedded phyllite show a depositional contact along a buttress unconformity on the eastern flank of Quartzite Hill. Here, f[redacted]orated [redacted]e as angular inclusions. This contact is extremely irregular in detail, indicating deposition of the limestone on an old surface which had previously been subjected to extensive subaerial erosion. On the south side of Fondaway Canyon, the basin facies of

interbedded limestone and shale also show a buttress unconformity against the quartzite on South Quartzite Hill.

Further [redacted] ted the presence of a [redacted] x that is [redacted] (Fig. [redacted]). The [redacted] ore of the reef can be [redacted] t the lower workings, the upper workings, and along the [redacted] ide of the [redacted] just south of the upper workings. Although highly recrystallized, the porous nature of the core appears to be shown by extreme variations in grain size. Breccia is common, especially in the lower workings. The [redacted] of the reef is [redacted] in thickness and up to 100 meters wide. [redacted] fore-reef facies [redacted] are found on the eastern flank of the reef. Marginal-slope facies are well preserved along the south side of the canyon below the lower workings, and typical fore-reef debris and calcarenite are found approximately 60 meters west of the lower workings. One of the lower carbonate beds here in the basin facies is fossiliferous and contains what appears to be a true oyster and an echinoid. The reefal carbonate also contains indications of algal stromatolite banding but recrystallization has prevented positive identification even in thin section studies.

The [redacted] which was mapped by Page (1965) as Lower Jurassic in age, and is also interbedded with a phyllite along its eastern contact which has been described as Upper Triassic in age. Because of these relationships and similar lithology the present authors regard them as part of the same unit in this immediate area in Fondaway Canyon. Tentative data from the echinoid and the oysters in the basin facies of the reef would indicate a probable Middle Jurassic age for these rocks. Detailed stratigraphic and paleontological data will be presented in a forthcoming paper.

Quartzite similar to those in Fondaway Canyon occurs 35 kilometers to the north in Cottonwood Canyon. This unit was mapped as the Havallah Formation of Permian age by Mueller in 1951. Speed (1969, p. 2572) included these rocks in his new Boyer Canyon Formation of Middle Jurassic age. At this time we do not and cannot challenge the age relationship of the Boyer Canyon Formation at any other occurrence except at the mouth of Fondaway Canyon.

Mineralization

The [redacted] near the exposed [redacted] luton consist of [redacted] te. Two other deposits, the [redacted] and [redacted] ings, are found at distances of 800 to 1,600 meters from the nearest granitic exposures and [redacted] te. The magnetite deposits appear to be genetically related to the cinnabar-stibnite deposits through their common association with scheelite. [redacted] its [redacted] its. In addition, gold and stibnite have been mined from a prospect in the phyllite 300 meters east of the upper workings, and stibnite only has been mined from prospects 600 meters further to the east. [redacted] s be[redacted] in the wash next to the south block of the main reef.

Contact Deposits

[redacted] te are closely [redacted] eds [redacted] t, and extend [redacted] least 300 meters. Molybdoscheelite was the first mineral to form in the limestone and shale. It occurs

as small irregular pods and grains in magnetite and seldom exceed 5 mm in size. The later-formed magnetite has replaced much of the earlier molybdoscheelite, [redacted] z, but the remaining portions of the earlier minerals indicate that large euhedral to subhedral crystals of molybdoscheelite were present. A few small, [redacted] crystals are closely associated with the molybdoscheelite. Microprobe analysis of the molybdoscheelite gave an average value of 15.3 percent molybdenum oxide, 62.5 percent tungsten oxide, and 22.4 percent calcium oxide by weight. It fluoresces a strong yellow color.

[redacted] e formed after the molybdoscheelite and appear to mark the onset of the magnetite stage of deposition. The magnetite forms massive aggregates of small equant crystals. The aggregates are porous and rather friable because of weathering. It is partly altered to hematite in some areas and specular hematite is found in the calcite marble near the contact. Small crystals of cassiterite are associated with the magnetite and occur as subhedral crystals along fractures in quartz and along the boundaries of magnetite. It is transparent, light to dark brown, and occasionally shows irregular brown zoning.

Upper Quick-Tung Mine

The original discovery was made at the top of the upper workings. Fisk (1960, personal communication) found [redacted] scheelite after following float up the wash. It occurs in the highly porous recrystallized limestone of the [redacted] core of the reef. Here the [redacted] least 300 meters vertically [redacted] eters [redacted] to the bottom of the present workings. The total thickness is unknown. Quartz mineralization [redacted] strong, especially around the periphery of the reefal structure. Scheelite is concentrated in a 1.8 to 3.6 meter wide shear zone in the core of the reef. It is disseminated as pods, grains, and euhedral crystals that fluoresce a strong blue color. The scheelite is light gray to creamy white in color and is difficult to see in the host rock without a blacklight. Some of the crystals are up to 60 mm across, but are usually less than 5 mm. Samples nearer the surface contain cinnabar, stibnite and valentinite. Quartz and scheelite generally preceded the cinnabar-stibnite-valentinite mineralization. Stibnite and cinnabar fill fractures in the scheelite. Small veinlets of pyrite transect muscovite and calcite, and are replaced by stibnite around the margins. Valentinite usually occurs as a secondary mineral in other districts, but at the upper Quick-Tung workings it is found in vugs intergrown with stibnite, and scheelite and stibnite crystals are perched on valentinite crystals. Since scheelite and stibnite are usually primary in origin, the valentinite is regarded as primary. There are occasional calcite-quartz veinlets containing scheelite, cinnabar, stibnite, and valentinite. These are regarded as a late stage deposition. A small amount of tetrahedrite is also found in the quartz veinlets. Azurite, malachite, stibiconite, and kermesite have formed secondarily after tetrahedrite and stibnite.

Lower Quick-Tung Mine

The [redacted] workings of the Quick-Tung mine are [redacted] the core of the [redacted] where much of the reefal rock is breccia which appears to be principally primary in origin, although it may be partially structural. Quartz mineralization is much weaker than in the upper workings. The limestone is nearly pure white with small patches of black carbonaceous material. The scheelite is dark gray and occurs as irregular pods, veinlets, and grains disseminated in the carbonate rock. Cinnabar and stibnite are associated with the scheelite.

Geothermometry

Sigurdson (1974) studied the mineral paragenesis and fluid inclusion geothermometry of four tungsten deposits in the western United States for his doctoral research. This work was suggested and accomplished under the supervision of Edmond F. Lawrence. The Quick-Tung mine was studied in detail in this investigation, and the resulting data have been summarized as follows:

Mineral	Location	Homogenization Temperature	Corrected Temperature
Cassiterite	Contact	535°C	560° ± 30°C
Fluorite	Contact	371°	406° ± 20°C
Scheelite	Upper workings	325°C	340° ± 20°C
Quartz associated with scheelite	Upper workings	325°C	340° ± 20°C
Quartz genetically associated with stibnite and cinnabar	Upper workings	365°C	380° ± 20°C
Cinnabar (one secondary inclusion)	Lower workings	254°C	

The study of paragenesis and temperature of deposition at Quick-Tung was begun in an effort to show that scheelite in association with low-temperature minerals such as cinnabar and stibnite could itself be a low-temperature mineral. The results indicate the opposite; the low-temperature minerals associated with scheelite appear to have formed at high temperature.

Conclusions

1. There is no evidence for the presence of the Boyer [illegible] in the vicinity of the Quick-Tung mine.

2. The quartzite (quartz arenite) is older than the overlying interbedded shale and reefal limestone, and is at least early Middle Jurassic and possibly as old as Permian in age.

3. Part of the [illegible] Jurassic phyllite unit in the immediate vicinity of the upper workings has been interpreted as a part of the interbedded shale and reefal limestone unit at the mouth of Fondaway Canyon. Preliminary data from fossils indicate that these rocks are probably Middle [illegible]

4. A re[illegible] sequence with typical reef core, fore-reef, marginal slope, and basin facies is interbedded with marine muds, now shales and phyllites.

5. The [illegible], 1,000 meters north of the mouth of Fondaway Canyon, probably extends under Fondaway Canyon at a fairly shallow depth.

6. Sc[illegible] have been dep[illegible], or possibly slightly different solutions.

7. [illegible] (SiO_2), which is usually considered to be a secondary mineral, a[illegible]y origin at the Quick-Tung mine.

8. E[illegible] has been deposited at a temperature of 340° ± 20°C while quartz veins containing later stibnite and cinnabar have been deposited at a slightly higher temperature of 380° ± 20°C.

9. Cassiterite, which is spatially associated with molybdoscheelite near the granitic contact was deposited at 560° ± 30°C.

10. The [illegible] indicate that this deposit is xenothermal or telescoped.

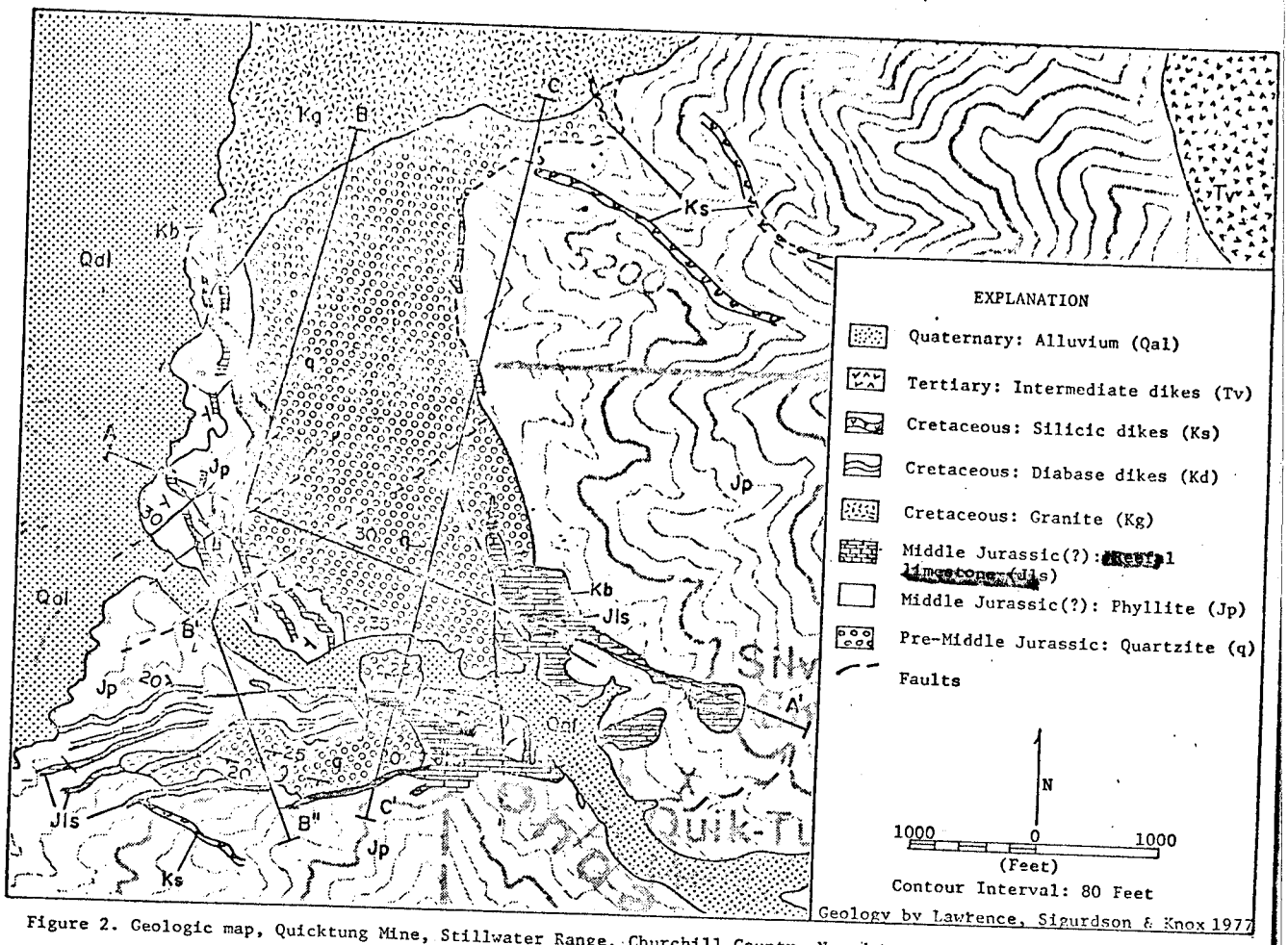

Figure 2. Geologic map, Quicktung Mine, Stillwater Range, Churchill County, Nevada

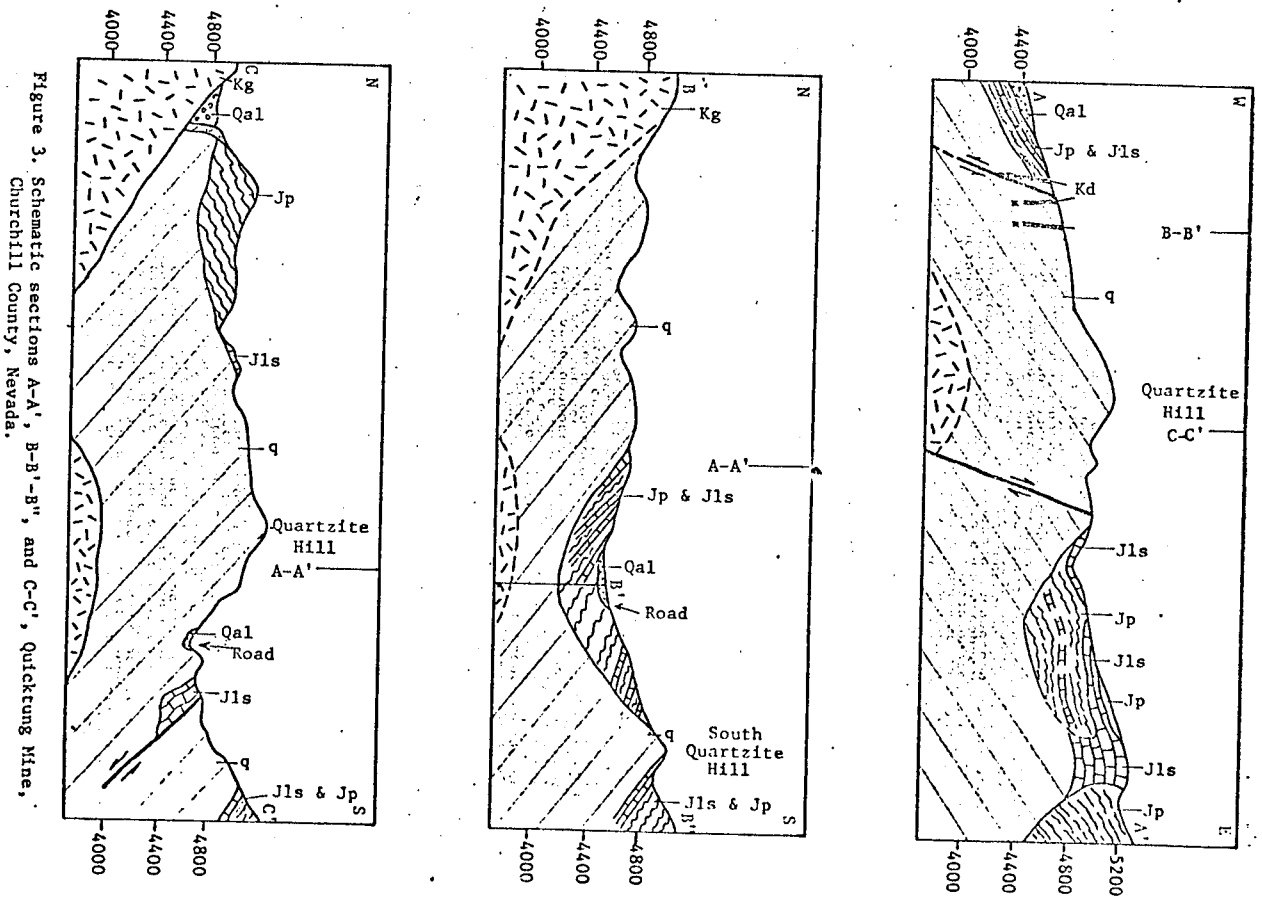

Figure 3. Schematic sections A-A', B-B'-B", and C-C', Quicktung Mine, Churchill County, Nevada.

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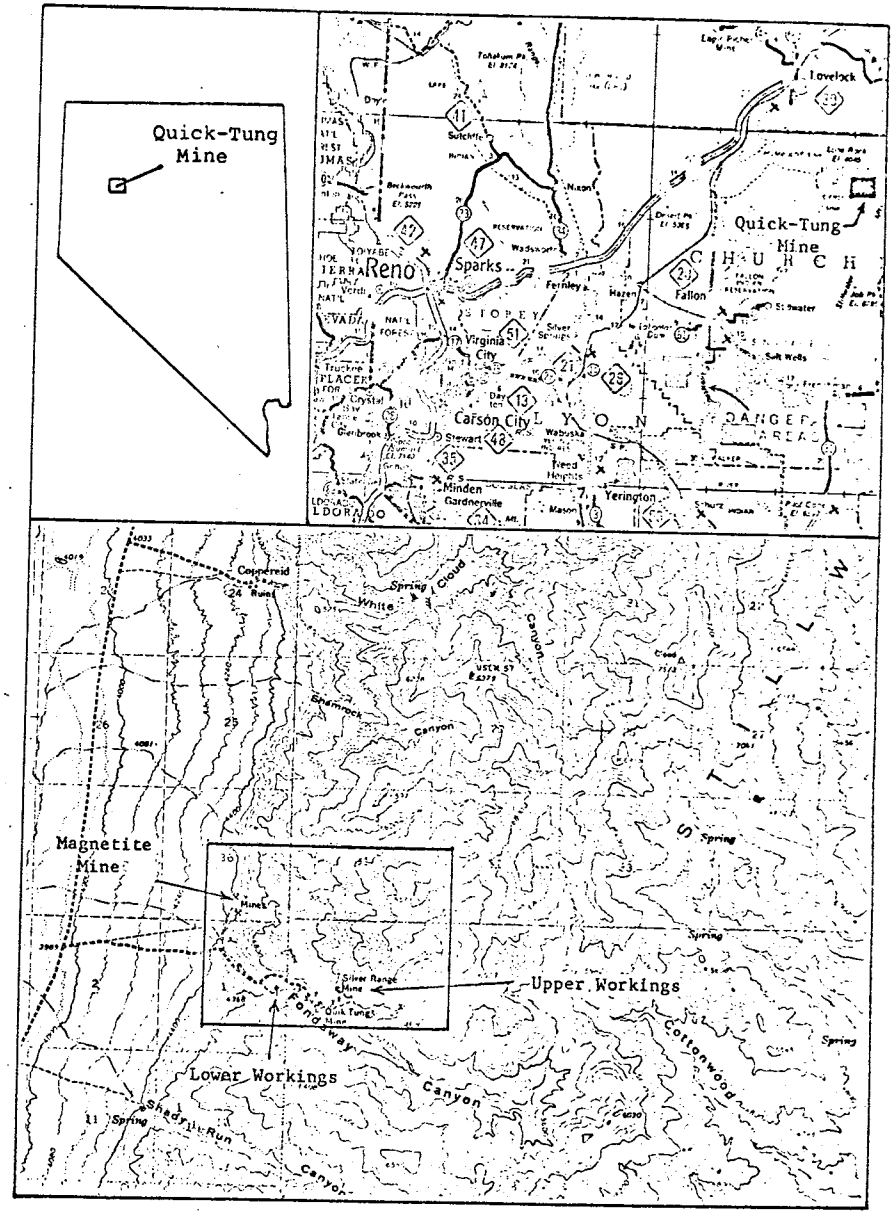

Figure 1. Index map, Quick-Tung Mine, Stillwater Range, Churchill County, Nevada

(Continued from page 349)

US and International Mineral News Briefs

United States

United Nuclear Corp. has contracted to sell 480 816 kg (1,060,000 lb) of uranium to an unidentified foreign utility. Deliveries will be made during 1978 at an average price of $44.35 per lb. The company said it believes the order involves one of the largest short-term sales of uranium overseas by a US producer in several years.

Bennett Petroleum Corp. announced that several 91-m-deep (300-ft) exploratory drillholes on 90 unpatented mining claims in southwestern Utah produced values of 1700 g (60 oz) of silver per ton and 2.3 kg (5 lb) of uranium per ton. The company is negotiating with others to obtain exploration commitments leading to a 50% interest in the properties.

Officials of Nuclear Power & Energy Co., Lander, Wyo., and Cobb Nuclear Corp., Albuquerque, announced that the 4.3-m-diam (14-ft) concrete-lined shaft currently being sunk on Section 12 in New Mexico's Ambrosia Lake District has been successfully completed to a depth of 203 m (666 ft). In addition to sinking the shaft, Nuclear Power & Energy provided supervision and services for the installation of the headframe, hoist, related surface facilities, and completed a mining station and measuring pocket at the 180-m (590-ft) level of the shaft. The company will also drive a 2 × 3.7-m (7 × 12-ft) drift from the 590-ft level approximately 275 m (900 ft) long to intercept uranium ore zones.

Ralph M. Parsons Co., Pasadena, has been awarded an overall project management contract by Occidental Oil Shale Inc. for Oxy's C-b shale oil venture in Rio Blanco County, Colo. The facility will utilize Oxy's modified in situ method for shale oil recovery, and is designed to produce an estimated 9000 m³ (57,000 bbl) per day of crude oil. The venture is the result of a partnership agreement between Occidental Oil Shale and Ashland Colorado, Inc.

Ranchers Exploration and Development Corp.'s Johnny M uranium mine operated at near-capacity during the last quarter of 1977, according to company president Maxie L. Anderson. Output was announced at approximately 109 000 kg (240,000 lb) during the final quarter, compared with 87 000 kg (191,000 lb) during the third quarter. This is approaching rated capacity for the mine, which is jointly owned with HNG Oil Co.

Bucyrus-Erie has sold five 60-R Series blasthole drills at a total price of $4 million to Kudremuch Iron Ore Co. Ltd. for use at an Indian open-pit iron ore mine presently under development. The project will produce more than 7.5 million metric tons of iron-ore concentrate annually under full production, with the concentrate being pumped in slurry form to a nearby seaport for shipment to Iran. Canadian Met-Chem Consultants Ltd., Montreal, designed the mine and will provide construction and operational supervision for the next three years after which the Indian government will manage the project.

Intercoast Energy Inc., Sacramento, has acquired the Little Joe mill under lease with an option to purchase from Bullion Monarch Co. The mill, located near Austin, Nev., is a 450-t/d (500-stpd) facility designed to handle gold, silver, tungsten, and molybdenum ore. It will be operated by a subsidiary of Intercoast Energy, Mineral Investments Inc., and will process tungsten ore from the company's properties as well as performing custom milling for other mining companies.

A spokesman for the Edison Electric Institute recently told the Senate Energy Committee that the federal government's uranium enrichment program lacks proper management. R. W. Bostian, manager of system results and fuel management for Duke Power Co. and chairman of the institute's Nuclear Fuel Committee, observed during testimony before the Senate committee, "As we look at the government enrichment operation, we wonder who is providing the normal board of director control function over this mammoth business which obtains its revenues from the electricity-consuming public."

He asked, "How are the interests of the utility customers protected from unilateral management decisions that are shielded within a segment of the huge Department of Energy."

The federal program is expected to generate revenues of $1 billion in 1979 and as much as $3 million annually within the next ten years.

Newmont Mines Ltd. announced on behalf of itself and Asarco Inc. that operations at the jointly-leased Grandue mine will be suspended on June 30, 1978. The drifting and drilling program presently underway at the mine to further define ore grade drillhole intersections will be completed in May 1978. An evaluation of the results of this program will be completed by early fall.

A federal judge has refused to dismiss an $800-million lawsuit against six phosphate firms accused of illegally mining publicly owned phosphate and uranium in two Florida counties. The companies involved, including American Cyanamid Co., W. R. Grace & Co., USS Agrichemicals, International Minerals and Chemical Corp., and Agrico Chemical Co., were told by a federal judge that their claim that they were not aware of the specific areas involved was insufficient to dismiss the suit. However, US District Court Judge William Stafford extended the time the six companies have to reply to the charges.

QUICK-TUNG MINE

Other names	Shady Run
Location	Long. 39° 47', Lat. 118° 13'.
Ownership	George Fisk (1960).
Discovery	
Antimony Production	None.
Geologic type	

The Quick-Tung mine is in the Shady Run mining district along the west flank of the Stillwater Range in Fondaway Canyon, 43 miles northeast of Fallon (see Army Map Service, Reno quadrangle map NJ 11-1).

The mineral deposits in Fondaway Canyon were prospected by the Zinn brothers in the early eighties (Lincoln, 1922, p. 9). Schrader (1920, p. 306) reports antimonical silver ore in the mines of Big Elk Canyon just south of Shady Run. The Quick-Tung mine is being operated (1960) as a tungsten mine, and the ore is being shipped to the Nevada Scheelite Corp.

The mine is developed by several short adits and shallow shafts. At the upper workings a 40-foot shaft has been sunk along a contact between limestone and shale. The brown to black shale is thin-bedded. Both it and the limestone strike east-west and dip steeply north. The limestone is in a fault block; it has been recrystallized, and is cut by numerous irregular veinlets of quartz up to 24 inches wide.

Scheelite occurs in high-grade pods associated with quartz adjacent to the contact. Stibnite and valentinite (?) are closely associated with the scheelite in the shaft, some pods being up to 3 inches across. Pyrite is common in the scheelite area. In the hillside above the shaft, stibnite occurs as blebs, small pods, and scattered crystals in irregular masses and veinlets of quartz. Similar occurrences of stibnite are scattered throughout the outcroping of limestone. Some lenses are up to 6 inches wide and 48 inches long. No scheelite was observed in these surface occurrences.

The stibnite has been partially altered to yellow and white oxides. The fibrous to resinous white oxide commonly forms pseudomorphs after stibnite. Cinnabar occurs 1/4 mile to the west.

Insufficient exploration has been done to properly evaluate this deposit as a source of antimony.

Quik-Tung

Churchill

1. Schilling (1963)
2. Schilling (1964)
3. Willden and Speed (1968)
4. Tingley (1963) p. 23, Fig. 9, 33
5. Speed and Jones (1969)
6. Page (1965)
7. Schrader (1947)
8. Lustey and Nichols (1972)
9. Dixie Hots Springs 15' topo.
10. Filice (1967)

Quick

Year	% WO_3	CRUDE ORE S.T.	PRODUCED UNITS (R) (S)	Source + Remarks	
1957		NPR			
1958	5.0	56	196	USBM	Geo. Fish
1959	1.25	600	773	"	" ± 6
1960	4.58 est.	400	1,283		
	5.0 est	18	40 est		Ray Clemmons
1961	6.0	300	928	"	Fish
1962	3.0 est	350	650	"	Fish

NPR

1968	N/A	2,238	763	"	Quicksilver Mines Co.
1969	N/A	300	1,324	"	"
1970	0.6	7,500	1,765	"	