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10. MINERAL ASSEMBLAGE OF A PYROMETASOMATIC DEPOSIT NEAR TONOPAH, NEVADA

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Pyrometasomatic deposits in a limestone environment commonly contain andradite and pyroxene (Knopf, 1942, p. 63). A deposit in Paymaster Canyon, about 31 miles southwest of Tonopah, Nevada, is typical in this respect, although the pyroxene is an uncommon manganoan hedenbergite, heretofore found principally in a group of pyrometasomatic zinc deposits that extends from New Mexico to the central part of old Mexico (Allen and Fahey, 1957). The Paymaster deposit also contains an apparently rare zincian nontronite.

The deposit was first examined by J. E. Carlson and R. M. Smith of the U.S. Geological Survey, and a study of one of their specimens led to the identification of the manganoan hedenbergite. Additional samples, on which this preliminary report is based, were collected principally for a detailed study of the hedenbergite and for the identification of the associated minerals. Because of limited sampling, the mineral assemblage described here is probably incomplete.

The Paymaster deposit is on the west side of Paymaster Canyon, in sec. 2, T. 1 N., R. 40 E., Esmeralda County, and about a mile south of a contact, shown by Ball (1907, plate 1), between Cambrian sedimentary rocks and the granite of Lone Mountain. The deposit is a dikelike body about 10 to 15 feet wide, and is exposed for about two hundred feet at the surface. It extends along a fault separating Cambrian limestone from Cambrian shale, strikes N. 80° E., and is nearly vertical.

The mineralized zone, where it is exposed in a prospect pit, consists principally of massive dark-green quartz-hedenbergite rock and massive olive quartz-andradite rock. Masses of soft yellow zincian nontronite, as much as 1 or 2 feet across, occur along an irregular limestone contact. The nontronite also forms envelopes around small hedenbergite veins, and pseudomorphs after coarsely bladed clusters of hedenbergite. Some small blocks of limestone appear to be completely enclosed by the rock of the mineralized zone and show sharp contacts with it. The contact between the shale and the hedenbergite and andradite rocks appears sharp, and some of the dark-olive shale is bleached white owing to the destruction of chlorite. Both the hedenbergite rock and the andradite rock contain quartz, sphalerite, galena, magnetite, and calcite, but sphalerite and galena are more abundant in the hedenbergite rock. There is a noteworthy absence of pyrite and other iron sulfides.

The minerals of the deposit have been identified principally by X-ray diffraction and X-ray spectrographic techniques. Table 10.1 shows X-ray diffraction data of the manganoan hedenbergite and of johannsenite, the calcium-manganese analogue of hedenbergite. The johannsenite specimen was kindly lent by D. F. Hewett and is part of one of the type johannsenite specimens (no. 6) described by Schaller (1938). The X-ray data of the two minerals are very similar, but they differ markedly in composition. The johannsenite contains about 23 percent MnO and 5 percent FeO (Schaller, 1938, p. 580), whereas the manganoan hedenbergite contains about 9 percent MnO and 26 percent FeO, as determined by X-ray spectrography. Composition and other properties will be fully reported when the work on the manganoan hedenbergite is finished.

Table 10.1.—*X-ray diffraction data of manganoan hedenbergite and johannsenite*

Wide range diffractometer, Ni-filtered Cu-radiation (λ=1.54050 Angstrom units)

Manganoan hedenbergite [a]		Johannsenite [b]	
d [c]	I	d [c]	I
6. 58	25	6. 59	15
4. 76	45	4. 77	35
4. 51	10	4. 54	10
4. 28	5	4. 27	10
3. 34	10	3. 34	20
3. 27	20	3. 28	25
3. 001	100	3. 012	100
2. 910	10	2. 915	15
2. 587	15	2. 595	15
2. 552	20	2. 550	30
[d]2. 381	15	[d]2. 380	10
[d]2. 342	5	[d]2. 343	5
[e]2. 238	5	[d]2. 233	5
2. 181	10	[e]2. 184	10
2. 149	10	2. 155	15
2. 124	10	2. 128	15
Other peaks not measured			

[a] Paymaster Canyon, sec. 2, T. 1 N., R. 40 E., Esmeralda County, Nevada.
[b] Venetia, Italy. Collected by D. F. Hewett. Type specimen no. 6 (Schaller, 1938).
[c] Silicon used as a reference internal standard. Measured in angstroms.
[d] Peak poorly defined.
[e] Broad peak.

lead producer between 1870 and 1920. Most of the ore bodies mined were in or near fault zones that cut carbonate rocks. Lone Mountain, a block of carbonate rocks bordered on the northeast, east, and southeast by rocks of the upper plate, has yielded a small tonnage of zinc carbonate ore from bodies in Devonian limestone. The rocks in the Eureka district may not have been completely covered by the upper plate, but they appear to have been domed like those in the windows along the belt to the northwest. More than $52,000,000 in silver, gold, lead, and zinc ore was produced in this district, mostly between 1870 and 1900; it came chiefly from the Eldorado and Hamburg dolomites, of Cambrian age.

Other windows in the Shoshone Range that contain ore deposits are the Gold Acres window in breccia along the thrust, and the Lewis and Hilltop districts in the upper plate rocks. The Gold Acres window contains the Goldacres mine, which has yielded a significant production in gold beginning in 1934. The ore is mostly in the brecciated zone along the Roberts Mountains thrust (Keith Ketner, oral communication). The Lewis and Hilltop districts are in clastic and volcanic rocks of the upper plate, presumably not far from the thrust. The Battle Mountain district northwest of the Shoshone Range, is also in this belt. It is mainly underlain by western assemblage rocks of early Paleozoic age, presumably exposed by warping of the kind indicated by windows to the southeast.

LYNN-PINYON BELT

The Lynn-Pinyon belt (fig. 9.1) includes the Lynn and Carlin windows in the Tuscarora Mountains and the Pinyon window (formerly called the Bullion window) in the Pinyon Range. The Lynn window contains the Lynn district, which produced a small quantity of gold ore, mostly from veins that cut siliceous shale and chert in the upper plate of the Roberts Mountains thrust. The Bootstrap mine, at the north end of the district and just north of the Eureka County line, has produced gold ore from silicified zones along the thrust, from the carbonate rocks in the lower plate, and from altered dikes that cut these rocks. The Carlin window contains several properties that have yielded small tonnages of silver and copper ores and barite. The Copper King mine is near the window, but is in the upper plate and about 200 feet above the thrust. The Pinyon window contains the Railroad district, which has yielded a small amount of silver-lead and copper ore from veins and replacement ore bodies in carbonate rocks.

The Mineral Hill and Union districts, in carbonate rocks of the lower plate, south of the Pinyon window in the Sulphur Spring Range, have yielded silver-lead-zinc ore. These districts lie between the Shoshone-Eureka and Lynn-Pinyon belts, and possibly are on a separate, less distinct, belt.

ORIGIN AND HISTORY OF THE WINDOWS

The windows are the result of doming of the Roberts Mountains thrust. Part of the doming may have occurred during or shortly after thrusting, but part of it may have occurred much later. Evidence that some doming occurred shortly after the thrusting is found in the north end of the Monitor Range, where coarse clastic rocks of Permian age containing carbonate boulders (eastern assemblage) rest on rocks of the upper plate, and on the south side of Lone Mountain, where similar clastics may rest on rocks of both the upper and the lower plate. The doming was later intensified during the emplacement of igneous bodies in late Mesozoic and early Tertiary time and during the uplift of the ranges in the Tertiary.

The alinement of the windows indicates that the doming occurred in zones of structural weakness in which movement has taken place intermittently. We do not yet fully understand the nature of the deformation or know the precise date of its beginning, but clearly the zones of weakness and the windows along them are penetrated by conduits along which igneous rocks and related ore-bearing fluids rose. The zones probably penetrate to great depths within the crust, and they possibly date back to Precambrian time.

SUGGESTIONS FOR PROSPECTING

In prospecting within the windows and near them, a special effort should be made to explore the lower units in the carbonate sequence, such as the Eldorado and Hamburg dolomites, for lead-zinc-silver ore bodies in promising structural settings such as fault intersections. The rocks of the upper plate close to the thrust may also be locally mineralized, especially near intrusive bodies.

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