CIRCULAR 33

POSSIBILITIES FOR DISCOVERY OF ADDTIONAL LEAD-SILVER ORE IN THE PALOMAS CAMP AREA OF THE PALOMAS (HERMOSA) MINING DISTRICT, SIERRA COUNTY, NEW MEXICO

A Preliminary Statement by *Richard H. Jahns*
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THE REGENTS

INTRODUCTION

Palomas Camp, in the Palomas (Hermosa) mining district of northwestern Sierra County, New Mexico, was a small but flourishing center of silver mining during the period 1880-1900. The estimated total value of precious metals produced from mines at this camp, including the output from intermittent operations since 1900, is approximately $1.5 million. The ore occurs mainly as small but high-grade masses, thinly tabular to podlike in form, that are distributed along fractures, faults, and some bedding planes in sedimentary rocks of Paleozoic age.

The Palomas district lies immediately east of the Black Range, in an area of considerable local relief. It is 27 airline miles west of Truth or Consequences, on the Rio Grande, and 63 airline miles north of Deming. It can be reached by automobile over 24 miles of fair to poor road from Winston, which is connected with Truth or Consequences by 39 miles of good road. The Palomas Camp area, less than a square mile in extent, lies in the short, steep-walled canyon of Palomas Creek at altitudes of 5,900 to 7,000 feet. The creek drains eastward toward the Rio Grande, and has a small permanent flow within the canyon.

The geology and ore deposits of the district have been briefly described by Gordon[1], by Harley[2], and in numerous private reports by other geologists and mining engineers. The district was investigated in detail by the writer during the period 19511953 under the auspices of the New Mexico Bureau of Mines and Mineral Resources. Henry L. Jicha, Jr. and Alfred T. Miesch participated in the project during the field season of 1952, and William R. Muehlberger assisted in the mapping of outlying areas during the season of 1953. A detailed report outlining the results of these studies is now in preparation, but this brief preliminary statement is aimed at calling attention more promptly to possibilities for discovery of additional ore in the Palomas Camp area.

1. Lindgren, Waldemar, Graton, L. C., and Gordon, C. H. (1910) The ore deposits of New Mexico, U. S. Geol. Survey Prof. Paper 68, 266-268.
2. Harley, G. T. (1934) The geology and ore deposits of Sierra County, New Mexico, New Mex. School of Mines, State Bur. Mines and *Min.* Res., Bull. 10, 90-98.

Gordon,[1] by Harley,[2]

GEOLOGIC SETTING

General features

The Palomas district occupies a part of an elongate, fault-bounded uplift that borders the Black Range on the east. This structurally and topographically high block trends north, is 1½ to 4 miles wide, and consists of Paleozoic sedimentary rocks from which a once-continuous cover of younger volcanic rocks has been partially stripped by erosion. None of this cover is preserved in the Palomas Camp area, where the older rocks have been raised to exceptionally high structural levels by a combination of warping and transverse faulting.

The canyon of Palomas Creek provides an excellent section of the entire uplifted block, here about 2½ miles wide. The block is bordered on the west by andesitic and latitic volcanic rocks of Cretaceous or Tertiary age, and on the east by conglomerate and associated basalt, both of Quaternary age. Its internal structure is complicated by numerous steeply dipping faults of moderate to large displacement. Many of these breaks trend north to north-northwest, and many others east to east-northeast.

Stratigraphy

Approximately 1,300 feet of stratified Paleozoic rocks is spectacularly exposed on the canyon walls in the Palomas Camp area. The lower part of this section, about 550 feet thick, comprises dolomites of Ordovician and Silurian age and overlying calcareous siltstones and subordinate dolomites of Devonian age (pl 1A). The upper and much thicker part, which is exposed in a series of cliffs and benches, comprises limestones and subordinate clastic rocks of Mississippian and Pennsylvanian age. An additional several hundred feet of younger Pennsylvanian and Permian rocks crops out farther north, in the rugged area beyond the canyon rim.

Nearly all of the ore mineralization is confined to the dolomites that lie beneath the shaly Devonian strata.

No igneous rocks crop out in the area, but several thin dikes of monzonite and monzonite porphyry are exposed in the underground mine workings. They appear to have been emplaced along faults and zones of shearing, and in general trend east-northeast.

Structure

The stratified rocks have been gently upwarped in the Palomas Camp area, and their crudely radial dips outline a dome whose broad crest lies between the bottom and the south rim of the canyon (pl 2). Steeply to moderately offdipping normal faults fringe this crest and effectively define the area of greatest known mineralization. This area is roughly oval in outline, has a major diameter of 1/2 mile and a minor diameter of 2/5 mile, and is bordered by the following main faults:

1. The Pelican fault on the west. Strikes north-northwest, dips about 80 degrees east-northeast, and has 200 to 330 feet of throw. Continues beyond the north rim of the canyon, but bends sharply eastward to join the Cliffs fault on the south wall of the canyon.
2. The Cliffs fault on the south. Strikes northeast, dips 70 to 85 degrees southeast, and has 60 to 110 feet of throw. Bends northward to join the Palomas Chief fault in the vicinity of the canyon bottom.

3. The Palomas Chief fault on the east. Strikes north, dips 40 to 80 degrees east, and bas a maximum throw of at least 250 feet. Displaces a prominent zone of low-angle faulting, is cut by several steeply dipping faults with east-northeast trend, and joins the Kendall fault in an area of very complex structure on the north wall of the canyon.
4. The Kendall fault on the north. Strikes west to west-southwest, dips 70 to 85 degrees north, and has 50 to 80 feet of throw. Butts into the Pelican fault on the north wall of the canyon.

In many places these faults actually are well-defined zones, 10 feet to nearly 100 feet wide, in which numerous individual breaks branch and rejoin in braidlike fashion. Nearly all of the displacements reflect purely dip-slip movement, and most of the fault surfaces show abrupt bends as traced along their strike.

The principal fault-bounded block is itself sliced by numerous steeply dipping breaks that trend northeast to east-northeast. Most prominent among these is the Mexican fault, whose trace lies in the canyon bottom west of Palomas Camp and on the north wall of the canyon northeast of the camp (pl 1). It dips 65 to 85 degrees southeast and has 40 to 70 feet of normal throw.

Scores of essentially vertical faults, with displacements that rarely exceed 10 feet, cut across the main uplifted block in a north to north-northwest direction. Much of the metalization in the block has been localized along these small but important breaks, some of which are shown as lines of short dashes in Plate 1.

ORE MINERALIZATION

Most of the ore in the Palomas Camp area occurs either (1) as small tabular shoots and podlike masses along fractures and minor faults that are members of the north- to north-northwest-trending group noted immediately above, or (2) as stringers, pods, and irregular disseminations in the part of the Fusselman formation that lies immediately beneath the fine-grained and relatively impervious strata of the Onate formation (pl 1A).

The latter type of mineralization is very widespread, has been given much attention in previous mining and prospecting, and has been emphasized in all earlier reports on the district. It is plain, however, that most of the largest and richest ore bodies thus far

mined are of the fracture- and fault-controlled type, and that they represent mineralization whose vertical range extends from the Fusselman formation through the older sedimentary formations to the deepest levels of exposure. Some of the ore bodies are essentially continuous over this range, whereas others seem to have been developed mainly in

certain parts of the Fusselman and Montoya sections (pl 1A). Nearly all of them plunge very steeply down the dip of the controlling faults. This type of occurrence probably contributed far more ore to the total output of the camp than did the "stratigraphically controlled" deposits in the Fusselman formation.

In general the ore bodies are thin and discontinuous in detail, but many of them are very rich. Most of the material recovered from past operations was of shipping grade, and emphasis was placed on its precious-metal values to the near exclusion of lead, zinc, and other metals. Surface oxidation is prominent in many of the deposits, and secondary enrichment has raised the grade of their near-surface parts. The primary, or hypogene, ores are themselves moderately rich in much of the district, and previous mining in several of the deposits was terminated more because of difficulties with water than because of serious downward decrease in degree of mineralization.

The ore minerals and associated products of wall-rock alteration have been described in considerable detail by Jicha.[3] The chief primary ore minerals are galena, sphalerite, and chalcopyrite, and associated with them are less abundant argentite, polybasite, pyrargyrite, pyrite, and tetrahedrite. Secondary minerals include argentite, chalcocite, covel lite, cuprite, native silver, silver halides, and carbonates of copper, lead, and zine. The gangue consists mainly of talc, with subordinate but widespread calcite, quartz, clay minerals, and barite.

Wall-rock alteration is prominent along most of the ore bodies, but rarely extends far from them. The chief alteration minerals are talc, formed by replacement of the dolomites, and coarsely crystalline calcite, formed by highly selective replacement of chert in the dolomites. The talc is creamy white to dark gray, and has a tallowlike appearance. Where it occurs in large quantities it is an excellent indication of nearby ore. Some talc forms concentrically layered masses with cores of ore minerals or unreplaced dolomite.

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3. Jicha, H. L., Jr. (1954) Paragenesis of the ores of the Palomas (Hermosa) district, southwestern New Mexico, Econ. Geol., v 49, 759-778. (Reprinted as Circular 27, New Mexico Bureau of Mines and Mineral Resources, November 1954.)

In general the ore that occurs along the north- to north-northwest-trending faults shows little evidence of disturbance by later movements along these breaks. Several of the principal ore bodies have been dislocated, however, by faults that lie athwart their general trend. Not all of the offset segments of these bodies appear to have been located and worked out during previous episodes of mining.

FUTURE POSSIBILITIES

Ore Above Creek Level

For all practical purposes, the ore that lies above creek level in the Palomas Camp area is confined to the structural block outlined by the Pelican, Cliffs, Palomas Chief, and Kendall faults, as the amount of mineralization in the rocks stratigraphically above the Fusselman formation is trivial. This uplifted block has been extensively explored above the water table in the Pelican, Hummingbird, Cliff, and Palomas Chief properties (pl 1), and further work there is not likely to expose additional high-level ore bodies of large size. On the other hand, much unexplored ground appears to remain above creek level in both the Eagle and Nana properties.

The extensive workings of the Eagle mine have been developed in the upper part of the Fusselman formation, and in a general way they conform to the contour of the Fusselman-Onate contact. Several steeply dipping zones of fracture-controlled mineralization have been followed downward by means of winzes and underhand stopes, but few of these workings seem to have penetrated the pre-Fusselman rocks. Downward extension of this type of exploration should be considered in any future development of the property, as good ore is known to occur along similar steeply dipping zones at levels beneath the Fusselman formation in the adjoining Pelican and Palomas Chief mines.

The Mexican stope, at the north end of the Eagle mine, is the only one on the property that has been developed over a large vertical range. It is a very steeply inclined slot, 100 to 180 feet long, that extends downward from the Fusselman-Onate contact for slightly more than 100 feet into dolomites of the Montoya formation. It outlines the position of an unusually continuous ore body from which large quantities of high-grade material have been taken. This ore body strikes slightly west of north, and is cut off on the south by the Mexican fault, which here strikes east-northeast, dips 50 to 85 degrees south-southeast, and has about 50 feet of normal throw. The offset segment of the ore body evidently lies in unmined ground, and probably would be penetrated by a 75-foot exploratory crosscut driven east-northeastward along the hanging-wall side of the fault from the tunnel that taps the lower part of the Mexican stope at its southern end. This appears to be an attractive prospect for additional ore.

The workings of the Nana mine are principally in the Fusselman formation, and have been developed along a blanketlike series of rich but discontinuous ore bodies that lie immediately beneath the Onate formation. Several short wines have been sunk on steeply dipping ore shoots that trend north to north-northwest and intersect the main tunnel at low angles. A 30-foot winze exposes similar shoots at the inner end of the main tunnel, approximately 360 feet south-southeast of the mine portal. This inner winze is in severely fractured ground that lies immediately northwest of the junction of the Pelican and Cliffs faults (pl 1).

A strikingly similar structural situation exists at the Hummingbird mine, immediately west of Palomas Camp, where the trend of the Pelican fault bends abruptly from west-northwest to north-northwest. Several rich and closely spaced ore bodies have been found in this mine, chiefly along steeply dipping minor faults and shear zones in the Montoya limestone immediately northeast of the bend in the Pelican fault (pl 1). The mineralization evidently was localized in this formation more because of the manner in which the rocks behaved under stress than because of notable differences in their composition as compared with that of stratigraphically adjacent formations.

Similar mineralization might well be present in the Montoya strata immediately north of the major structural bend outlined by the junction of the Pelican and Cliffs faults, and this potential target for exploration from the present Nana mine workings merits serious consideration. The top of the Montoya formation should lie about 100 feet beneath the inner end of the Nana tunnel, and might best be reached by extending the present innermost winze vertically downward. If the formation is strongly mineralized in this block of ground, further exploration could be directed laterally and downward along any ore-bearing fractures and shear zones encountered in the winze.

Ore Below Creek Level

Only a few mine workings in the Palomas Camp area extend to points below the level of the canyon bottom. Chief among these is the 175-foot Pelican shaft, which is collared in the Percha shale just west of the Pelican fault (pl 1) and is bottomed in beds that probably lie between the Fusselman and Montoya formations. A 130-foot crosscut, driven east-northeastward through Fusselman dolomites at the 140-foot level, penetrates the Pelican fault and ends beyond the fault in white dolomites of the upthrown block. These dolomites almost certainly are a part of the El Paso formation, which does not crop out in the district but is known to underlie the Montoya formation in many other parts of southern New Mexico.

Ore "of good milling grade" is reported to have been encountered in drifts extended along the Pelican fault from the crosscut noted above, which would seem to establish the existence of mineralization in parts of the section several tens of feet stratigraphically below the deepest levels of mine workings that are currently accessible. This is compatible with reports of ore in several deep winzes elsewhere in the Pelican property. These partly flooded winzes probably are bottomed in the lower part of the Montoya section.

Little systematic information on grade of the deeper ores has been recorded, but Harley[4] states that the primary ore in the district "seems to be nearly as rich in lead as is any of the oxidized ore. Silver tends to concentrate in the oxidized zone and in the zone of secondary enrichment, but when it is considered that the silver is associated with the primary lead and copper sulfides, and in view of the sorting practice . . . . in the district, it seems reasonable to believe that a primary ore containing 25 ounces or more of silver to the ton might be expected from deeper workings. Add to this, 22 per cent lead, 8 per cent zinc, 1 per cent copper, and small amounts of gold, and in spite of the small and scattered nature of the ore bodies, there appears to be a reasonable chance . . . " for profitable operations based on a "properly managed exploration campaign."

Similar conclusions seem warranted by the more recent mapping and detailed study of the mines, although the above estimates of ore grade may be somewhat optimistic. Certainly any future attempt at deeper-level mining in the area should be based upon the treatment of mill-grade ore, the discovery of which probably will attend careful

4. Harley, G. T., op. cit., 97.

exploration of the steeply dipping zones of mineralization already described. Adequate pumping facilities will be required for the handling of water below creek level, and the results of exploration are likely to be discouraging in much of the ground that lies stratigraphically between the Fusselman and Montoya formations.

Dump Material and Stope Fill

There is little doubt that substantial amounts of mill-grade ore are present in the finer-grained parts of many dumps and in the widely distributed fill in the underground workings, inasmuch as nearly all previous mining in the area has been aimed at the extraction of silver-bearing ore of shipping grade. Harley[5] estimates that about 5,000 tons of ore had been shipped from the area prior to 1934, and that "there was left behind 50,000 tons of dump rock and scope fill, which would make an excellent grade of mill ore for an efficiently operated plant of suitable size." This tonnage estimate appears to be of the correct order of magnitude, but meaningful data on grade of the material are lacking.

Several of the larger dumps that are low on the north wall of the canyon have been sampled one or more times during the past thirty years. The results have been disappointing, in part because few attempts were made to screen out the relatively barren coarse-grained material prior to sampling, and in part because these dumps consist chiefly of rock derived from long access tunnels that were driven through essentially barren ground. Future attention might best be focused on the numerous dumps that lie

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5. Harley, G. T., op. cit., 97.

higher on the canyon wall, as these are much closer to once-productive stopes and hence are likely to contain larger percentages of mineralized rock.

The accumulations of underground fill offer the most attractive possibilities for mill feed of satisfactory grade, and most of them are at least in part accessible for examination and sampling by venturesome persons. The removal of this material would present some mechanical problems, however, and would require rehabilitation of several access tunnels. Certainly this should not be attempted in advance of adequate sampling, itself no mean task.

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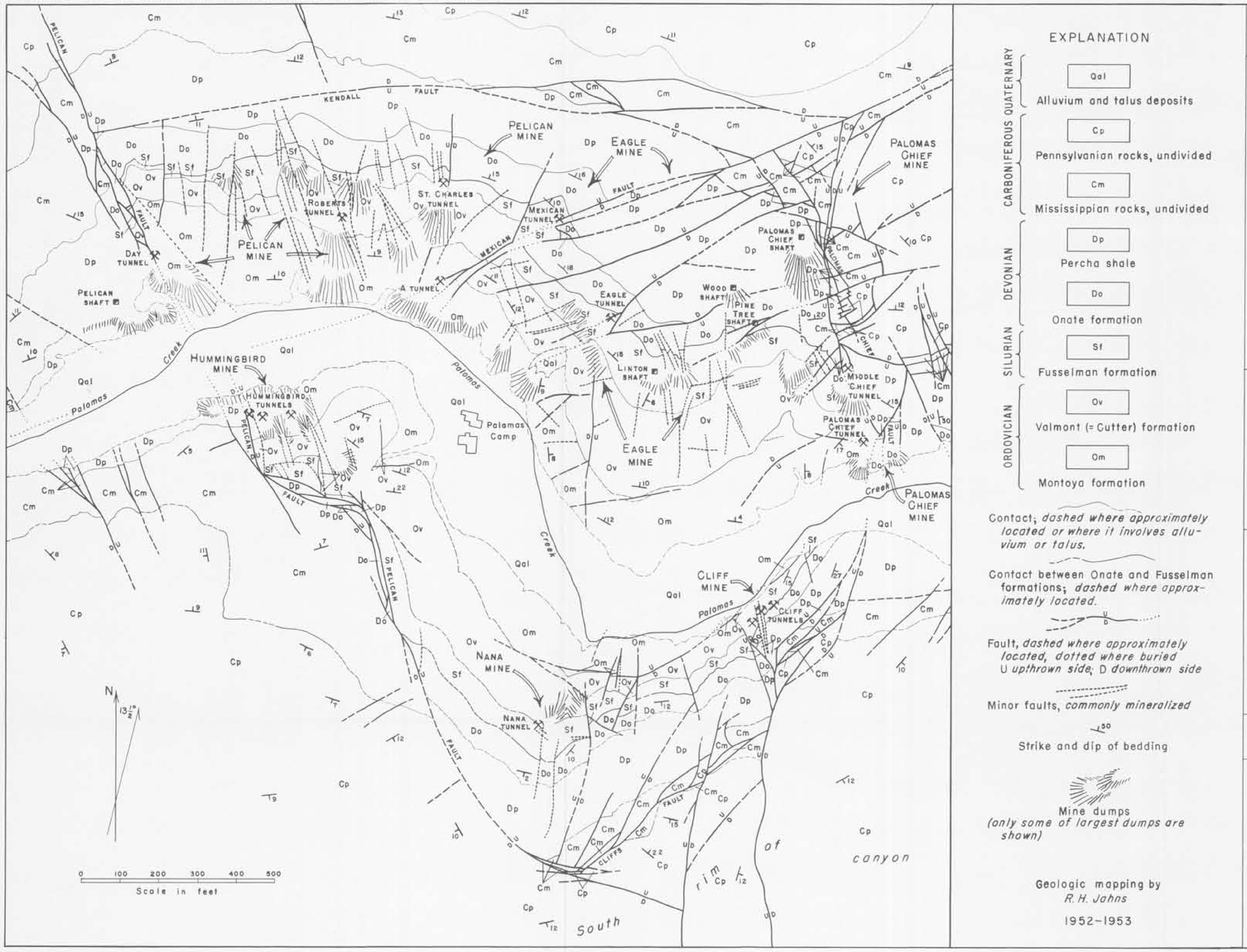
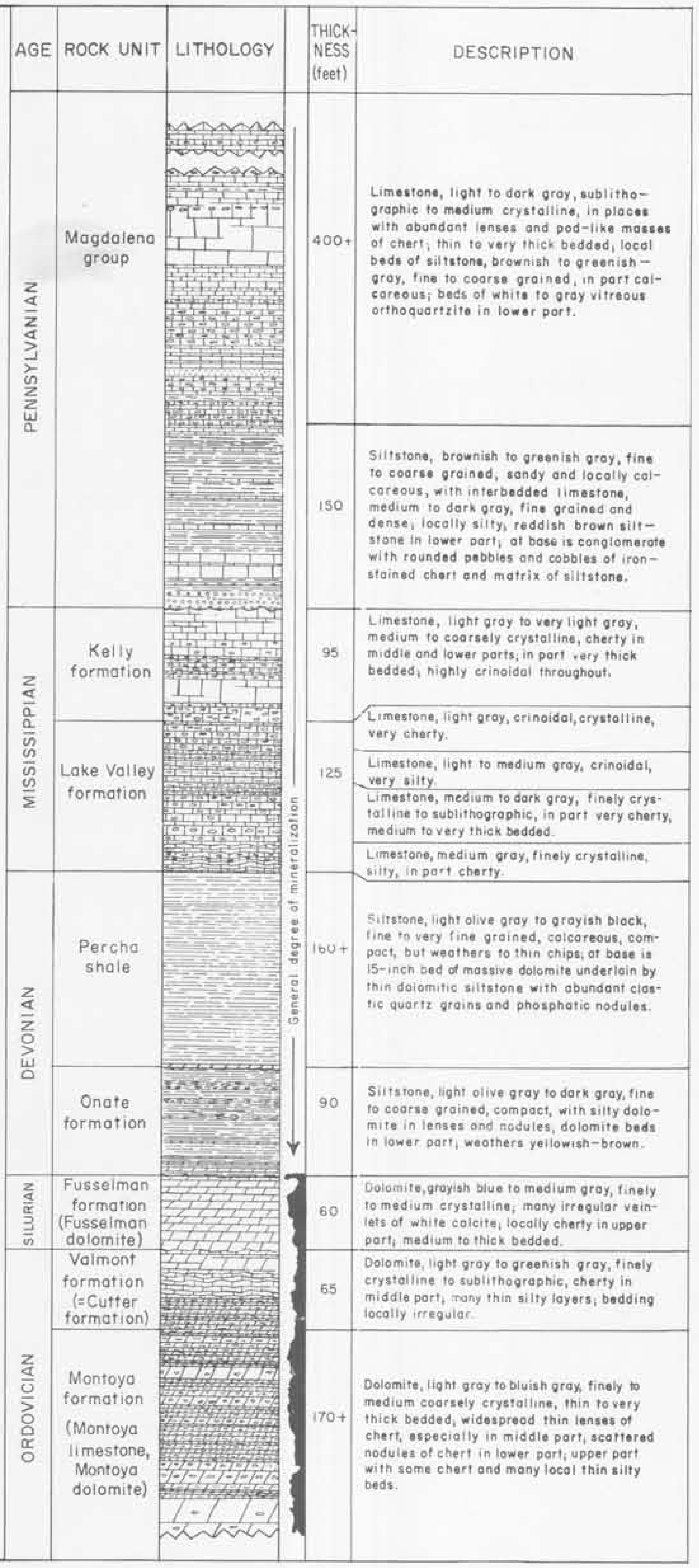


PLATE I Simplified geologic map of the Palomas Camp area, Palomas (Hermosa) district, New Mexico



AGE	ROCK UNIT	LITHOLOGY	THICKNESS (feet)	DESCRIPTION
PENNSYLVANIAN	Magdalena group		400+	Limestone, light to dark gray, sublithographic to medium crystalline, in places with abundant lenses and pod-like masses of chert; thin to very thick bedded; local beds of siltstone, brownish to greenish-gray, fine to coarse grained, in part calcareous; beds of white to gray vitreous orthoquartzite in lower part.
			150	Siltstone, brownish to greenish gray, fine to coarse grained, sandy and locally calcareous, with interbedded limestone, medium to dark gray, fine grained and dense; locally silty; reddish brown siltstone in lower part; at base is conglomerate with rounded pebbles and cobbles of iron-stained chert and matrix of siltstone.
MISSISSIPPIAN	Kelly formation		95	Limestone, light gray to very light gray, medium to coarsely crystalline, cherty in middle and lower parts; in part very thick bedded; highly crinoidal throughout.
	Lake Valley formation		125	Limestone, light gray, crinoidal, crystalline, very cherty. Limestone, light to medium gray, crinoidal, very silty. Limestone, medium to dark gray, finely crystalline to sublithographic, in part very cherty, medium to very thick bedded. Limestone, medium gray, finely crystalline, silty, in part cherty.
DEVONIAN	Percha shale		160+	Siltstone, light olive gray to grayish black, fine to very fine grained, calcareous, compact, but weathers to thin chips; at base is 15-inch bed of massive dolomite underlain by thin dolomitic siltstone with abundant clastic quartz grains and phosphatic nodules.
	Onate formation		90	Siltstone, light olive gray to dark gray, fine to coarse grained, compact, with silty dolomite in lenses and nodules, dolomite beds in lower part; weathers yellowish-brown.
SILURIAN	Fusselman formation (Fusselman dolomite)		60	Dolomite, grayish blue to medium gray, finely to medium crystalline; many irregular veinlets of white calcite; locally cherty in upper part; medium to thick bedded.
ORDOVICIAN	Valmont formation (=Cutter formation)		65	Dolomite, light gray to greenish gray, finely crystalline to sublithographic, cherty in middle part; many thin silty layers; bedding locally irregular.
	Montoya formation (Montoya limestone, Montoya dolomite)		170+	Dolomite, light gray to bluish gray, finely to medium coarsely crystalline, thin to very thick bedded; widespread thin lenses of chert, especially in middle part; scattered nodules of chert in lower part; upper part with some chert and many local thin silty beds.

PLATE IA Generalized columnar section of stratified rocks exposed on north side of canyon, Palomas Camp area, Palomas (Hermosa) district, New Mexico.