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Strata-bound, silver-bearing iron, lead, and zinc sulfide deposits in Silurian and Ordovician rocks of allochthonous terranes, Nevada and northern Mexico

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ABSTRACT

Allochthonous terranes in northern Nevada contain strata-bound sulfide deposits at two horizons in Silurian and Ordovician siliceous sedimentary rocks. The most intensively mineralized horizon and most extensive deposit is at the base of the Silurian. Another less extensive deposit is in the lower Middle Ordovician. Spectrographic analyses of gossan from the basal Silurian horizon indicate anomalously high values of lead and zinc; and in about 40 percent of the samples, silver values are anomalously high. Subsurface samples contain the primary minerals pyrite, galena, and sphalerite. The basal Silurian deposits are in thick-bedded chert that is overlain by micaceous siltstone. They are underlain by a thick-bedded black chert unit of Late Ordovician age. The basal Silurian gossan has been identified also in southwestern Nevada and in northern Mexico in stratigraphic sequences very similar to that of northern Nevada.

INTRODUCTION

Geologic and geochemical reconnaissance in the northern Adobe Range, Elko County, Nevada in 1967 revealed anomalously high values of lead and zinc in gossans in lower Paleozoic allochthonous rocks of the western or siliceous facies (Ketner, 1970). The lead-zinc anomalies coincide with thrust faults in some places and were originally thought to be genetically associated with the faults. Later after more detailed mapping and acquisition of much more paleontological control it became evident that the anomalies are associated with a certain stratigraphic horizon, the base of the Silurian rather than with faults, and that this horizon is similarly mineralized in several different mountain ranges of northern Nevada. Recently the same zone in similar rocks was found to be mineralized in southwestern Nevada and in northern Mexico. Elsewhere, Lower Silurian rocks of the Road River Formation in the Selwyn basin of northwestern Canada are strongly mineralized with lead, zinc, and silver (Carne and Cathro, 1982) and uppermost Ordovician beds in the Trail Creek area of Idaho are mineralized (Carter and Churkin, 1977, fig. 2). In northern Nevada lower Middle Ordovician rocks of the western facies are mineralized also but less extensively and intensively than those of the basal Silurian. The purpose of the present report is to call attention to the existence of such deposits in Nevada and Mexico and to suggest guides to prospecting.

Geologic investigations in Mexico were undertaken in February and March, 1983 in cooperation with the Consejo de Recursos Minerales by agreement with the Mexican Ministry of Patrimonio y Fomento Industrial.

STRATIGRAPHIC NOMENCLATURE

As lithic, stratigraphic, and paleontologic data accumulate it is becoming more and more evident that many widely used stratigraphic terms such as Vinini, Valmy, Elder, Slaven etc. applied to lower Paleozoic western facies rocks in Nevada are too loosely defined and their ages are too uncertainly established to be useful in mapping or in discussions of the stratigraphy and structure. Therefore in the present report informal lithic descriptions are used instead.

STRATIGRAPHIC SEQUENCE--NORTHERN NEVADA

The stratigraphic sequence in allochthonous lower Paleozoic rocks of northern Nevada has been outlined previously (Ketner, 1977, 1980). New data confirm the previously outlined sequence and supply additional detail as follows. In the area between the southern Tuscarora Mountains and the HD Range (fig. 1) the lower half of the Ordovician (Lower to lower Middle) is composed of detrital limestone, bedded chert, shale, siltstone, and quartz sandstone. The limestone beds, which decrease in abundance upward, range from micrite to coarse calcirudite. Many calcarenite beds are composed almost entirely of redeposited fragments of the problematic alga Nuia. Chert and quartz clasts are abundant. Bedded chert commonly is silty to sandy. The detrital grains in the chert are rounded quartz, angular chert, carbonate, siliceous spicules and phosphate. The shale tends to be either very siliceous or very calcareous rather than argillaceous. Commonly it is very silty and contains abundant graptolites. Siltstone is composed mainly of quartz fragments. Sparse feldspar grains are mainly microcline and sodic plagioclase. Sandstones are medium to coarse grained and composed almost entirely of well-rounded quartz grains. Minor constituents are shale clasts and limy or dolomitic cement. No feldspathic graywacke derived from andesitic terranes has been found.

The upper half of the Ordovician (upper Middle to Upper) is less calcareous and generally finer grained. Invariably the upper half of the Ordovician consists of a fine-grained shale unit hundreds of meters thick overlain by a thick-bedded black chert unit tens of meters thick. In some exposures the shale unit includes siltstone beds, fine-grained limestone beds, thin quartz sandstone or quartzite beds, and a few chert beds. The shale is black in fresh exposures and is rich in graptolites. In many exposures, a small amount of fine-grained limestone immediately underlies, or is interbedded with, the black chert unit. Graptolites of latest Ordovician age are sparingly present in shaly interbeds of the black chert unit.

The basal Silurian consists of a thick bedded chert unit a few meters to a few tens of meters thick containing sparse Lower Silurian graptolites. In some exposures individual beds as much as 3 meters thick consist of white, relatively coarse grained chert similar to the novaculite of Texas and Arkansas. Above the basal chert sequence are beds of shale, chert that may be black but tends to be light colored, and predominant pale green, yellow-weathering, micaceous, feldspathic siltstone and fine-grained sandstone. White mica and microcline are abundant constituents of this unit and in many exposures the siltstone beds are graded and contain sole marks indicative of turbidite deposits. In one exposure platy limestone similar to that of the

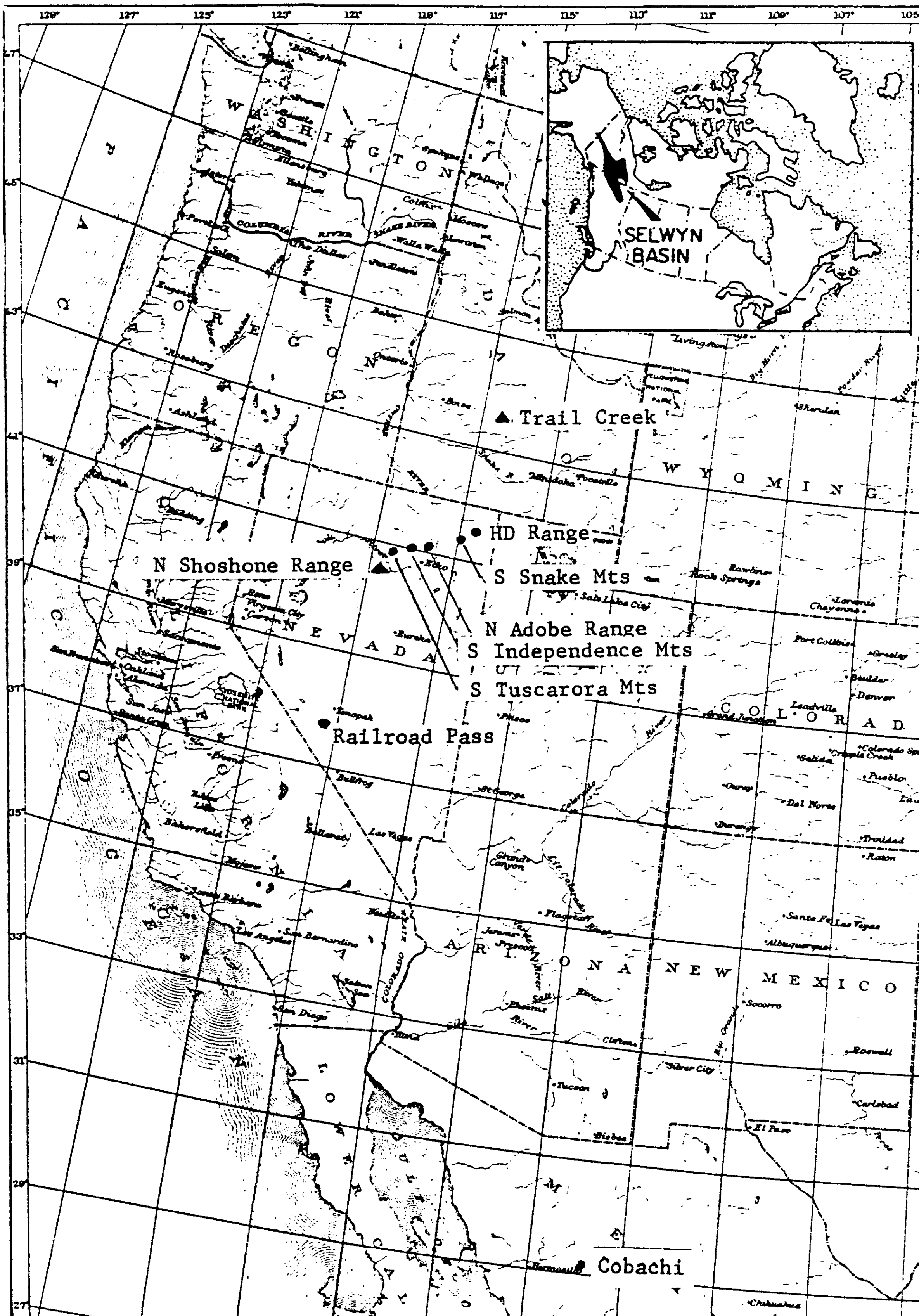

Figure 1. Index map showing locations of exposures of gossans in basal Silurian allochthonous rocks in Nevada and Mexico (round dots). Locations of the Selwyn Basin (inset), the northern Shoshone Range, and the Trail Creek area are also indicated.

Roberts Mountains Limestone is present. Uppermost Silurian beds have not been identified.

Unconformably above the Silurian and Ordovician beds are Upper Devonian beds of varied composition and, less commonly, poorly exposed Lower to Middle Devonian beds. The Upper Devonian consists of chert, limestone, shale, siltstone, sandstone, conglomerate, and bedded barite. The chert commonly contains abundant plant spores. The limestone contains abundant quartz sand grains and all gradations between limestone and pure quartz sandstone can be observed. Chert-grain siltstone, sandstone, and chert pebble conglomerate are common and these normally contain a very small percentage of fine-grained, dark colored igneous rock clasts of basic to intermediate composition. Quartzite clasts are rare. Barite is thin to thick bedded, and commonly contains rounded grains of quartz, angular to rounded clasts of chert, and sparse clasts of basic to intermediate igneous rocks. Brachiopods are sparse to abundant in many exposures.

Outstanding characteristics of the Ordovician to Devonian sequence in the area between the southern Tuscarora Mountains and the HD Range are: an abundance of siliceous and calcareous detrital constituents; presence of highly mature quartz sandstone; scarcity of constituents derived from andesitic terranes, scarcity of igneous extrusives or contemporaneous intrusives of any type, and complete absence of oceanic crustal terrane. Stratigraphic sequences in siliceous allochthonous terranes in other parts of Nevada (Gilluly and Gates, 1965) and in Idaho (Carter and Churkin, 1977) and northern Mexico (Noll, 1981) differ in some respects but have many elements in common with the sequence in northern Nevada just described.

THE GOSSANS

There are two strata-bound gossans in surface exposures of the sequence: one of extremely widespread distribution at the base of the Silurian and one of relatively restricted distribution in the lower Middle Ordovician. The first crops out in the southern Tuscarora Mountains, southern Independence Mountains, northern Adobe Range, southern Snake Mountains, HD Range, in southwestern Nevada near Railroad Pass, and in northern Mexico near the village of Cobachi, Sonora. The second is known to crop out in the southern Independence Mountains and in the southern Snake Mountains.

The upper, more extensive, of the two gossans occurs almost entirely within the Lower Silurian chert unit. In some areas the uppermost part of the Upper Ordovician black chert unit may be mineralized also. (In Idaho lowermost Silurian beds have not been identified but the uppermost Ordovician beds are mineralized (Carter and Churkin, 1977, fig. 2). In Nevada the gossan consists of discolored chert, chert containing scattered angular to rounded cavities, boxwork, iron oxide accumulations, and iron oxide- or quartz-cemented collapse breccia. Colors typically include bright blue green, bright red, and caramel brown. Some exposures exhibit unusual patterns such as black and white zebra stripes. Various oxidation states of iron account for the green, red, and brown colors. Spectrographic analysis of the gossan indicates anomalous values of lead, zinc, and silver. Average lead content in 100 samples of gossan from the northern Adobe Range is more than 2000 ppm; zinc content more than 1300; silver content is erratic but 40 percent of the samples are anomalously high. Barium content is normal for unmineralized chert. Subsurface samples from two areas show the primary iron mineral to be pyrite and the primary lead and zinc minerals to be galena and sphalerite. Galena was seen in one natural outcrop. The lithic nature and metal content of the lower, less extensive, of the two gossans is poorly known because it is poorly exposed and requires trenching or drilling for proper study. The basal Silurian gossan is well developed and well exposed in the Northern Adobe Range (Ketner and Ross, 1983) especially near the southern boundaries of secs. 17 and 18, T. 38 N., R. 56 E. In the Blue Basin quadrangle of the southern Independence Mountains the gossan is exposed just below the Silurian siltstone in a lithic unit labled Oc (Ketner, 1974) which includes the uppermost Ordovician black chert unit and the lowermost Silurian chert unit. In the HD Range it occurs in the basal Noh Formation of Riva (1970).

ORIGIN OF THE SULFIDE ZONES

There seems to be no connection between igneous rocks and the strata-bound sulfide deposits. No igneous rock whatever is exposed precisely at the mineralized horizons. Thin bodies of basic to intermediate igneous bodies at other stratigraphic positions are mainly dikes and sills of probable Mesozoic age.

The very widespread occurrence of the basal Silurian gossan at a single horizon suggests an exhalative origin similar to that offered for the contemporaneous deposits of the Selwyn Basin (Carne and Cathro, 1982). In the Selwyn Basin, as in Nevada, there is no clear connection with igneous rocks. The host rock of the Lower Silurian deposits of the Selwyn Basin, unlike Nevada and Mexico, is shale rather than chert.

MINERAL PRODUCTION

In only one location, the northern Adobe Range, Nevada, is there a record of production from the basal Silurian gossan and nowhere is there a record of production from the lower Middle Ordovician gossan. About 500 tons of oxidized lead ore was mined in the northern Adobe Range (George Chapin, oral commun., 1981).

It seems possible, however, that some lead-zinc-silver deposits in Ordovician and Silurian allochthonous terranes of Nevada previously assumed to be of epigenetic origin and related to igneous intrusives could actually be strata-bound deposits or epigenetic deposits remobilized from strata-bound deposits. Many of the lead-silver deposits of the northern Shoshone Range, for example, are in allochthonous host rocks of Ordovician and Silurian age. (Gilluly and Gates, 1965). The basal Silurian beds in all of the siliceous allochthonous terranes in Nevada should be identified and prospected. The surface expression of the basal Silurian is easily recognized throughout a large area in Nevada for it commonly consists of conspicuous outcrops of white or strongly colored chert adjacent to prominent exposures of thick-bedded black chert. Where chert is absent or inconspicuous the mineralized zone should be sought above a thick black shale unit and below a thick micaceous feldspathic siltstone unit.

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