Merrimac - (Lone Mtn. Dist) Elko Co. 70

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Item 30

MEMORANDUM

July, 1985

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SUBJ: Sleeper [redacted] NV - Progress Report

SUMMARY

The Sleeper project is 25 miles north-northwest of Elko in the southern Independence Mountains. Ordovician and Lower Silurian siliceous assemblage rocks host three horizons of SEDEX Pb-Zn mineralization in the area, of which the middle ("DIV") and upper ("MCC") are exposed in the prime target area north of Lone Mountain. Tertiary volcanic rocks cover the permissive section over a large area in the western part of the prospect. The mineralized horizons have been broadly folded and cut by high-angle faults of several ages. Silicified zones beneath the horizons and cross-cutting Ag-Pb-Zn veins at the Rip Van Winkle mine may represent exhalative vents. Of seven holes drilled in 1984, four cut the DIV sulfide horizon. The zone ranged from 21.6 to 64.5 feet thick, and contained significant but not ore grade mineralization. Sulfide textures and Sr isotopes strongly suggest the sulfide-barite mineralization is syngenetic; Pb isotopes yielded ambiguous results.

Well developed geologic and geochemical gradients help to focus exploration for higher grade SEDEX mineralization. Drilling has been recommended to test four targets on the DIV zone within, southwest, northwest, and north of the 1984 drill area, as well as two targets on the untested MCC horizon. Further evaluation of the five HEM anomalies within the Sleeper block is warranted. Sediment-hosted gold potential in the area was negatively evaluated by Freeport and Newmont's past exploration. Grid sampling eliminated potential for a volcanic-hosted gold target near the Rip Van Winkle mine.

INTRODUCTION

The Sleeper project is in the Merrimac district of the southern Independence Mountains, 25 miles north-northwest of Elko. The project is centered on the prominent topographic landmark of Lone Mountain (elevation 8780 feet). Good gravel roads provide access from state highways 225 and 226 to both the north and south ends of the block.

Our 1983 HEM survey highlighted the Lone Mountain area. Follow-up by H. G. Brown in the spring of 1984 discovered the stratiform gossans in the Vinini Formation. Brown recommended acquisition in his memo of 5/14/84, and we staked 208 claims over open ground in the northern portion of the prospect in May and June. Much of the critical acreage was acquired through our lease of the Kirkwood Oil and Gas (Nammco) holdings (415 claims) in July, 1984. Subsequent acquisition of claims or fee lands from Oro Nevada Exploration, 25 Corporation, Canyon Resources, and Nevis Land Company, along with staking of an additional thirty claims, have secured our position. We now have adequate land to test all the known targets. Acquisition of the fee lands belonging to

Van Norman Ranches in Sections 23 and 25, T38N-R53E, may be warranted in the future, pending results of our next phase drilling. Table 1 summarizes our assessment and contractural obligations on the project.

Sleeper lies within a major province of shale-hosted stratiform sulfide-barite occurrences in the southern Independence Mountains and vicinity. Nine such occurrences are known within a forty-mile-long belt from the Garamendi mine on the northeast to the Queen Ann mine to the southwest. Our work to date suggests that Sleeper, along with Texasgulf's Blue Basin prospect just to the southwest, represents one of the most permissive environments within this belt.

GENERAL GEOLOGY

Paleozoic rocks of siliceous (Western), transitional, and carbonate (Eastern) assemblages, along with Tertiary volcanic and intrusive rocks, underlie the Lone Mountain area. Lovejoy (1959) considered the transitional and carbonate facies rocks to structurally underlie the siliceous facies rocks along a major thrust fault, presumably the Roberts Mountains thrust. Our mapping north of Lone Mountain suggests, however, that the carbonate and transitional assemblages overlie the siliceous rocks along a low-angle structure. We interpret the contact, at least north of Lone Mountain, as a post-Antler gravity slide similar to that documented in the Roberts Mountains and Mount Hope area (Winterer, 1968; Riedell, 1982, p. 3).

Intermediate to felsic intrusive rocks cut both siliceous and carbonate-transitional assemblage rocks. The Nannie's Peak quartz monzonite forms the backbone of Lone Mountain and has yielded a 12 m.y. age (Lovejoy, 1959, p. 553). Probably related dikes and plugs of quartz diorite, quartz latite, and quartz porphyry crop out widely in the area. Tertiary felsic to intermediate volcanic rocks, considered Miocene by Lovejoy, conceal the Paleozoic rocks widely to the north, west, and south of Lone Mountain. Tertiary and Ouaternary alluvium and colluvium underlie the eastern edge of the prospect.

Detailed mapping by J. F. McKnight and myself has been limited to the north and west sides of Lone Mountain. We have emphasized the stratigraphy and structure of the siliceous facies rocks, as these host the known SEDEX mineralization. Ordovician shale, chert, siltstone, limestone, and quartzite of the Vinini Formation, and unnamed Silurian(?) chert and siltstone, make up the exposed section. Mapping and core logging have led to recognition of a detailed stratigraphic breakdown of these rocks, as described in Table 2. Figure 1 proposes tentative correlations between this section and that at the nearby Blue Basin, Elreka, and Garamendi SEDEX prospects. These correlations hinge on the stratigraphic equivalency of the very distinctive carbonaceous mudstone unit (Ovm at Sleeper, Ovs at Elreka and Blue Basin). Note the suggestion of a northeastwardly shift of exhalative activity with time, and the decrease in the turbidite component of the section both with time and from southwest to northeast.

Within the mapped area, the Lone Mountain slide block consists of Roberts Mountains and Nevada Formations. Dark gray, carbonaceous, platy silty limestone of the Roberts Mountains is conformably overlain by the more resistant and massive, light gray to buff limestones and dolomites of the Nevada. Jasperoid locally replaces both units, and several competitors have tested these rocks for disseminated gold targets. The Roberts Mountains Formation is bleached and recrystallized in an aureole up to 1200 feet wide surrounding the Nannie's Peak intrusive. Small copper-silver-mineralized skarns locally replace the limestone near the quartz monzonite contact.

J. F. McKnight has mapped the Tertiary section west and northwest of Lone Mountain, and recognizes the units described in Table 3. Because the upper ash-flow tuffs commonly rest directly on Vinini, the volcanic rocks were clearly erupted onto a surface of considerable relief. Vinini Formation probably underlies the volcanics over a wide area surrounding the Rip Van Winkle mine, but thicknesses of the Tertiary cover may be substantial.

Recognition of detailed stratigraphy within both the siliceous facies rocks and the Tertiary section has facilitated unraveling of the complex structure of the area. The rocks were subjected to folding (probably associated with the Late Paleozoic Antler orogeny), and both Paleozoic and Tertiary high-angle faulting. Mapping has delineated broad northeastwardly plunging folds within the siliceous assemblage rocks, upon which are juxtaposed complex minor folds observable at outcrop scale. Numerous high-angle faults cut the sedimentary and volcanic rocks, and trend mostly northerly, northwesterly, and northeasterly. Northeast (longitudinal) and northwest (transverse) trends dominate the Vinini outcrops. These faults repeat the lower, or DIV sulfide zone numerous times: drill evidence suggests attenuation of this horizon, implying normal movement. Apparent contrasts in thicknesses of Ordovician section across some of these structures suggest that they may be reactivated Ordovician growth faults. Northerly trending faults are relatively more common in areas of Tertiary exposure, and therefore this trend was probably the predominant one during the Tertiary (Basin - Range?) episode of faulting. Ketner (1974) documented eastward-vergent thrusting in Paleozoic siliceous facies rocks just southwest of the Sleeper block, but there is no evidence for such structures north of Lone Mountain.

BASE METAL MINERALIZATION

Stratiform sulfide (SEDEX) horizons

Stratiform, sediment hosted Pb-Zn sulfide (SEDEX) mineralization occurs at three known stratigraphic intervals within the siliceous facies section in the Independence Mountains (Fig 1). The upper two of these, the Divide ("DIV") and McClellan Creek ("MCC") horizons, crop out widely north of Lone Mountain. The lowest, or Lone Mountain Creek ("LMC") sulfide zone is absent here. The LMC horizon crops out conspicuously at Blue Basin, just southwest of Sleeper. Our claim block covers the northern end of these exposures, but they have not yet been adequately mapped or sampled.

North of Lone Mountain, the DIV zone appears to be continuous over an area 10,000 feet east-west by 6,000 feet north-south. It curves around the northeast-plunging anticline, and is repeated continually by normal faults. It pinches out toward the southeast, but passes under volcanic cover to the west and probably extends downdip under younger Paleozoic rocks to the north and northeast. Commonly, it is the upper, more siliceous exhalites within the unit that crop out. These generally contain <10 wt% sulfides and weak base metals. The poorly exposed lower half of the DIV zone includes significant amounts of banded semi-massive to massive sulfides and yields the highest metal values. Near the western limit of its exposed extent (near the NE corner of section 33), the DIV horizon crops out only as a massive, sulfide-poor silica exhalite over 30 feet thick. Slumping precludes determining whether these siliceous rocks cap massive sulfide gossans or merely represent a barren lateral correlative of the DIV horizon.

Gossan samples from the DIV zone are strongly anomalous in base metals. Maximum values are 7.84% Pb, 2.64% Zn, and 7.8 g/T Ag; Cu does not exceed 155 ppm. The strongest anomalies cluster in the NE-1/4 of section 34, where the gossans commonly contain >1% Pb or Zn. Pb/Zn ratios are highest (averaging >0.5) in this same area, and decrease northeastwardly to <0.1 near the center of section 26. The more siliceous DIV exhalites in the northwest part of the prospect are more erratically mineralized. Canyon Resources (1984) obtained values of up to 0.87% Zn and 0.30% Pb, but most samples contain <0.1% Pb or Zn.

The MCC horizon crops out generally north of the DIV zone. Mapping and sampling to date suggest that the MCC zone is less continuous, thinner, and lower grade than the lower horizon. Surface exposures typically consist of 15-30 feet of limonitic chert to silica exhalite, with minor true gossan. Both geologically and geochemically the most impressive exposures are in section 25, where three stacked zones of interbedded gossan, gossanous chert, and hematitic ironstone occur over 200 feet of section. Samples from this area contain up to 0.39% Zn and 0.14% Pb. The MCC horizon projects under volcanic rocks to the west and under Tertiary sediments to the east. Its northern extent is not yet defined by mapping; it probably occurs in the N-1/2 of section 26.

Silicified zones

Zones of weak to intense silicification replace the carbonaceous mudstone, the mixed carbonate and clastic unit, and locally the laminated shale, siltstone, and chert in the southwestern part of the drilled area and near and west of the Rip Van Winkle mine. They are clearly related to northeast- and north-trending normal faults. The silicified zones form bold outcrops that contrast with the nonresistant unaltered rocks. Where alteration is most intense, complete flooding by microcrystalline to sucrosic silica has produced a rock similar in appearance to bedded chert. Because the silicic rocks clearly grade into unaltered Vinini near the edges of these bodies, however, we believe the silica is secondary and not primary.

Sulfide and metal contents of the silicified zones are variable. In the drilled area northwest of Lone Mountain and west of the Rip Van Winkle mine, they contain 0.5-3% limonites after sulfides (averaging 1-1.5%), and weakly anomalous Pb, Zn, Ag, and Cu. A sample from a small, highly sulfidic zone 500 feet southwest of ESL-3 contained 5.70% Pb, 0.50% Zn, 4.1 g/T Ag, and 30 ppm Cu. More commonly, however, these zones yield ≤335 ppm Pb, ≤325 ppm Zn, ≤170 ppm Cu, and ≤2.2 g/T Ag. Silicified mudstone at and just north of the Rip Van Winkle mine contains up to 5% goethite and jarosite after disseminated and fracture-controlled sulfides, and abundant barite veinlets. Outside of the obvious mineralized structures of the Rip Van Winkle mine (described below), maximum values in this area are 435 ppm Pb, 205 ppm Zn, 8.1 g/T Ag, and 65 ppm Cu.

Several lines of evidence suggest that the silicification is of Ordovician age:

1. With rare exceptions (e.g., southwest of ESL-3), silicification affects only rocks below the DIV horizon.

2. Unaltered ash-flow tuffs rest directly on silicified Vinini south of ESL-1. The tuffs are locally "case-hardened" along faults further southwest, but this is attributed to remobilization of silica by warm Tertiary ground water.

The abrupt decrease in the silicified zones stratigraphically above the DIV zone suggests that silicification is somehow related to the exhalative activity that produced the bedded DIV sulfides. It is therefore proposed that the silicified zones represent the effects of Ordovician hot springs, some of which may have acted as feeders for the stratiform mineralization. The controlling northeast-striking structures are probably therefore of Ordovician ancestry. The variable sulfide and metal contents in the silicified zones suggest that both "black smokers" and "white smokers" were present.

Brief examination of other SEDEX prospects in the Independence Mountains suggests that this abundant footwall silicification is unique to the Sleeper area. This fact, along with the relatively high Pb contents of the explored sulfide horizons, suggests that Sleeper occupies a position more proximal to exhalative source vents than most other SEDEX occurrences in the area.

Rip Van Winkle mine

The Rip Van Winkle mine has been the major metal producer of the Merrimac district. Lovering and Stoll (1943), Smith and Trengrove (1949), and Granger (1957) described the deposit and gave production figures, so only a summary of the geology is presented here. Mineralization occurs as (1) steep Pb-Zn-Ag sulfide veins cutting Vinini Formation and igneous breccias, probably our lower ash-flow tuff; and (2) zinc-rich bedded "replacement" ore in Vinini calcareous sediments. The latter ore type could represent SEDEX mineralization: it would probably correlate with the LMC horizon, because carbonaceous mudstone crops out at the surface. The cross-cutting vein mineralization could represent feeder mineralization to the Sleeper exhalative sulfides, as silicification similar to that just described surrounds the Rip Van Winkle veins. The epigenetic mineralization clearly cuts Tertiary rocks, however, and structural or chemical remobilization is required if an Ordovician age is proposed. J. F. McKnight discussed this question at greater length in his quarterly report of 12/21/84.

Samples from the Rip Van Winkle dumps contain up to 4.98% Zn, 3.51% Pb, and 579 g/T Ag. These compare favorably with average grades from the height of production in the 1940's, listed by Dueuvel (1975) as 3.28% Zn, 4.54% Pb, and 392 g/T Ag. The high Ag and high Pb/Zn ratios are permissive evidence for the hypothesis that the Rip Van Winkle mineralization represents an Ordovician feeder vent.

Drilling results

Exxon completed seven diamond drill holes, totalling 3614.5 feet, between August 9 and October 17, 1984 (Table 4). The holes were located to test the DIV horizon downdip from exposed gossans. Four holes cut nearly complete sections of the DIV zone ranging from 21.6 to 64.5 feet thick, with significant although not ore-grade Pb-Zn mineralization (see Table 4). Due to structural complexities unrecognized at the time of drilling, three holes failed to penetrate the sulfide zone. These holes cut the upthrown blocks of normal faults, and therefore penetrated primarily footwall section. Nevertheless, ESL-7 cut strongly anomalous Zn in carbonaceous mudstone.

ESL-1 through -4 yielded valuable information on the nature of the DIV sulfide zone, which is documented in the detailed drill logs. Figure 2 is a simplified lithologic and assay log of the excellent section in ESL-3. It clearly illustrates the silicic and pyritic nature of the upper half of the sulfide zone, that portion that forms the well exposed silica exhalites. The lower half of the DIV horizon contains more semi-massive to truly massive sulfides and higher Pb and Zn values; it hosts the better mineralized intercepts. Pyrite, galena, and beige sphalerite are the only sulfide minerals observed in the drill holes. The sulfides are finely interbedded with chert, mudstone, calcarenite, siltstone, sedimentary breccia and diamictite. Fragmental sedimentary rocks comprise a major portion of the DIV section, and suggest a tectonically active regime during sedimentation. These rocks are typically polymict, with clasts of chert, calcarenite, mudstone, and semi-massive to massive pyrite and sphalerite in a muddy or silty matrix that is commonly calcareous and pyritic.

Evidence observable in drill core strongly favors a synsedimentary origin for sulfide mineralization. The finely interbedded sulfides and clastics, the intimately banded pyrite, galena, and sphalerite (e.g., ESL-3, 246.5-251.5 ft.), and the rounded clasts of pyrite and sphalerite within the sedimentary breccias (ESL-3, 238-241.4 ft.) are virtually irrefutable evidence for syngenesis. The mapped continuity of the DIV horizon at the same stratigraphic position supports this contention. Locally cross-cutting sulfide mineralization (especially galena) is present, but is attributed to diagenetic remobilization.

The zone of surface oxidation is thin in all drill holes, ranging from 45 to 110 feet deep. Only in ESL-1 has oxidation encroached on the top of the DIV horizon.

Downhole histograms (see drill hole data packages) document well-zoned geochemical patterns related to the DIV sulfide horizon. The proximal elements Cu and Ag accumulated in the footwall mudstones, with Cu particularly enriched in ESL-3 and -5. Mn and Ba attain their highest levels in the sulfide horizon but show pronounced halos in the hangingwall rusty siltstone. The distributions and intensities of these minor elements are comparable to those documented in major SEDEX ore deposits worldwide.

Pb and Sr isotope analyses

Isotope analyses of the Sleeper mineralization have been obtained through A. E. Bence of the Geologic Research Department. Pb isotope determinations were made on galena from stratiform DIV mineralization in holes ESL-1 and -3, and from dumps at the Rip Van Winkle mine. Sr isotopic analyses were made on a sample of stratiform barite from the trench 350 feet south of ESL-6 (station SL-109), which overlies the DIV horizon. Bence's memos of 3/29/85 and 6/5/85 present the data and discuss possible interpretations.

The Sr data plot on the seawater Sr curve and are compatible with a Middle Ordovician (i.e., synsedimentary) age. The Rip Van Winkle leads yield Late Jurassic ages on the Stacey and Kramers two-stage lead growth curve. The galena is therefore probably epigenetic and unrelated to the DIV stratiform mineralization. Note, however, that the material sampled was probably from the crosscutting Pb-rich mineralization, and these conclusions may not apply to the stratiform Zn mineralization at the Rip Van Winkle. The data do, however, cast doubt on the Rip Van Winkle veins as an exhalative vent.

Pb isotope values from the stratiform mineralization provide significant difficulties in interpretation. Both samples yield anomalous negative model ages on the Stacey and Kramers two-stage curve. I have proposed that three-stage modelling, using geologic constraints specific to the host basin, may be more applicable to the Sleeper data than the Stacey and Kramers model, which attempts to approximate Pb isotope evolution worldwide. As an analogy, Godwin and Sinclair (1982) have shown that a locally derived three-stage curve is necessary to model the isotopic data from the Selwyn Basin deposits. Calculations show that a similar three-stage model can give Ordovician model ages for the Sleeper data points. Specifically, by initiating a third stage at 1.45 b.y. (the age of likely crustal lead sources, the Proterozoic granites of southeastern Nevada) and assuming a μ of 16.5, the ESL-3 point yields a conformable age of 0.47 b.y. The isotopic data are therefore compatible with a syngenetic origin. Bence acknowledges that such an interpretation is plausible, but has expressed concern that the high μ in this model implies a shallow, highly differentiated lead source of small volume that would be unlikely to yield a major SEDEX deposit. I disagree, because Godwin and Sinclair (1982) call on just such a source for the Selwyn deposits based on their Pb isotope data.

Geologic and geochemical patterns

Compilation of data from surface mapping, sampling, and drilling shows well developed geologic and geochemical gradients within the Sleeper system. The following have the greatest significance for future exploration of the property:

A. Within the stratigraphic section as a whole:

1. The laminated shale, siltstone, and chert unit appears to thicken dramatically eastwardly across the fault 2500 feet northwest of ESL-6, and remains thick to the east. This fault may therefore be a basin-margin structure.

2. Mapping and drilling show the carbonaceous mudstone to thicken both northeastwardly and west-southwestwardly from the area near ESL-4, suggesting sedimentary basins in both directions.

B. Within the DIV horizon:

1. The thickness of exhalative sulfides increases westwardly toward ESL-3, and stacking of sulfide beds below the DIV zone occurs only in this area. The horizon pinches out southeastward of ESL-2 and -4.

2. Pb and Zn grades in gossans and drill holes, Pb/Zn ratios in surface samples, and the intensity of the footwall Cu anomaly in drill holes all increase southwestwardly toward ESL-1 and -3.

3. Associated stratiform barite, which normally lies peripheral to Pb-Zn sulfides in these systems, occurs only near the northeastern exposed limits of the DIV zone.

4. Related footwall silicified zones, possibly representing exhalative vents for the DIV sulfides, are present only southwest of ESL-1 and -3.

C. Within the MCC zone:

1. Stacking of sulfide beds occurs near the east end of exposure, in section 25.

2. Pb and Zn in surface samples increases toward to east, an area also characterized by high Pb/Zn ratios.

Based on these lines of evidence, it is possible to tentatively infer the Ordovician basin configuration for the immediate area. A northeasterly- to north-northeasterly-trending second-order basin is suggested. The fault 2500 feet northwest of ESL-6, and the structure 400 feet southeast of ESL-4 and 700 feet southeast of ESL-1 may represent basin-bounding structures on the northwest and southeast, respectively. Note that this trend parallels the belt of SEDEX and bedded barite deposits throughout the southern Independence Mountains and vicinity. Within this second-order basin, thickening of the section suggests that third-order basins occur to the northeast and southwest of the area drilled in 1984. Gradients within the DIV horizon suggest that it accumulated primarily in the southwestern of the two sub-basins, proximal to its exhalative sources represented by the silicified zones here. The MCC zone is best developed in the northeast basin, and may have been sourced in this area.

GOLD TARGETS

Due to its location in a gold-rich geologic province, the presence of favorable host rocks, and the local abundance of epithermal alteration related to hypabyssal intrusive rocks, the Sleeper area has potential for both Carlin-type and volcanic-hosted disseminated gold deposits. Newmont recognized this fact, and explored the area north of Lone Mountain in 1964-65. They drilled 30 rotary holes, primarily in the Vinnini Formation. Gold assays were very low, with maximum values of about 1 g/T. Interestingly, hole L-25, located just southwest of ESL-1, cut visible galena.

Freeport optioned the Kirkwood/Nammco ground between 1978 and 1980. Extensive mapping and sampling defined two areas of Au- and As-anomalous jasperoids in the Roberts Mountains and Nevada Formations, north and south of Lone Mountain. Thirty-three holes were drilled in the southern target (sections 23, 24, and 25, T37N-R53E). These holes intercepted spotty gold values ranging up to 4.5 g/T, but averaged no more than 1.3 g/T over mineable thicknesses. Six holes tested the jasperoids in section 36, T38N-R53E, at the north end of Lone Mountain, but were nearly barren of gold. In his final report of 2/2/81, E. J. Collord concluded that grades of gold were too low for an economic Carlin-type deposit. After evaluation of Freeport's drilling data, I concur with this assessment.

Our evaluation of precious metal potential has been largely limited to an area of altered tuffs near the Rip Van Winkle mine. Both lower and upper ash-flow tuffs are argillized and cut by a stockwork of limonite-coated fractures over a wide area. B. J. Klud completed a soil grid over the altered zone in late 1984, with very disappointing results. The maximum gold value was 0.08 g/T, and nearly all samples contain <0.02 g/T. As part of our SEDEX exploration, we have analyzed all surface and downhole samples for gold, and virtually all are at background levels.

GEOPHYSICS

The 1983 Geoterrex helicopter EM survey of the southern Independence Mountains covered the Sleeper area. Flight lines were east-west, spaced 1000 feet apart. R. K. Edquist discussed the results of the survey and catalogued the high priority anomalies is his memo of 9/84. Two first-priority and three second-priority conductors lie wholly or partially within the Sleeper block, and these are described below.

With rare exceptions, the exposed SEDEX gossans at both Sleeper and Blue Basin do not yield HEM anomalies. In fact, the highly carbonaceous and pyritic facies host rocks are notable in their lack of response relative to the surrounding Tertiary sediments and volcanics. Perhaps, because of the occurrence of sulfides in thin bands interbedded with the host sedimentary rocks, the sulfide zones may not be sufficiently massive to be conductive. One or more ground EM lines over ESL-1 and -3, for which we have downhole sulfur analyses, are recommended to explore this possibility. Using this test case, it may be possible to "fine-tune" our geophysical target criteria.

Lone Mountain zone (priority 1)

A very strong, slightly arcuate north-south-trending HEM anomaly 4.2 miles long lies west of the summit ridge of Lone Mountain, nearly entirely within the Sleeper block. The anomaly is mostly along the western and northwestern contacts of a belt of Roberts Mountains Formation, parallel to the dike-like body of Nannie's Peak quartz monzonite. Three traverses across the anomalous zone show the rocks to be silty limestone and shale without visible mineralization. To the east, zones of marble, calc-silicate hornfels, and goethite stain become more abundant toward the Nannie's Peak intrusion. Portions of the anomaly occur over massive dolomites of the Nevada Formation and Tertiary welded ash-flow tuffs; these are unaltered and barren except for minor goethite on fractures. Because of the unimpressive nature of the exposures in the anomalous zone, only three samples have been analyzed. One soil sample contained 640 ppm Zn, but otherwise the maximum values were 195 ppm Zn, 50 ppm Pb, and 0.9 ppm Ag.

The laminated limestones of the Roberts Mountains Formation regionally average 0.30-0.35% organic C (Mullens, 1980). H. G. Brown observed that the HEM-anomalous zone lies just west (outwards) of the recrystallized aureole of the Nannie's Peak intrusive: Within the aureole, the Roberts Mountains is commonly bleached, suggesting that the carbon has been liberated and mobilized outwards. The HEM anomaly may, therefore, be due to mobilization and thermal upgrading of indigenous carbon from the Roberts Mountains Formation. Accumulation of the organic material immediately outside the metamorphic aureole would explain the marked parallelism of the HEM anomaly and the Nannie's Peak quartz monzonite.

The barren outcrops, weak geochemistry, and alternative explanation for the HEM response suggest that the Lone Mountain anomaly is not associated with significant SEDEX mineralization. Nor is there geologic evidence for Carlin-type gold mineralization, although the setting is favorable. Because of the strength of the conductor, and the limited sampling to date, however, several more sample traverses across the zone are warranted. In addition, one or more lines of ground EM in-house, followed by bench testing of samples from the anomaly, might determine whether the Lone Mountain zone results from upgraded carbon or in fact is indicative of buried sulfide mineralization.

Zone 19 (priority 1)

This zone, 4200 feet long, is just inside the southwestern edge of the block. It generally follows a west-dipping thrust fault that juxtaposes the mixed carbonate and clastic unit at the base of the Vinini over the overlying mudstone. The anomaly lies just east, or stratigraphically below, exposures of the LMC horizon which are more properly part of the Blue Basin system. The conductor may possibly reflect the DIV zone concealed beneath the thrust. A thorough examination of the area is warranted.

Zone 18 (priority 2)

Previously called the Cold Creek zone, this anomaly is 8000 feet along and lies mostly just within the southern border of the block. Vinini mudstone underlies the area, and poorly exposed gossan is present. Three samples collected by Ron Edquist contained 130-600 ppm Zn and $\leq$45 ppm Pb. The rocks may be stratigraphically equivalent to those hosting the Blue Basin horizons, but lie on the next lower thrust plate.

Zone 20 (priority 2)

This zone straddles the contact between the Nevada and Roberts Mountains Formations at the north end of Lone Mountain. It lies just southwest of Freeport's northern gold target. We have not examined the area.

Zone W (priority 2)

Edquist attributed these sharp, low conductivity anomalies to culture, and they occur directly over a fence line. They closely follow exposures of the MCC zone, however. One sample of siliceous exhalite contained 0.21% Zn.

CONCLUSIONS

Geologic mapping and first-pass drilling have discovered and traced significant sediment-hosted massive sulfide mineralization at Sleeper. The geologic setting is highly favorable for the development and preservation of SEDEX deposits, and numerous manifestations of a well developed SEDEX hydrothermal system are present in the immediate area. Two discrete sulfide horizons are widely exposed north of Lone Mountain, and a third zone is locally present in the southwestern part of the prospect. Only the middle, or DIV zone has been drill tested. The four holes through this horizon cut up to 64.5 feet of stratiform sulfides, and all penetrated "mineable" thicknesses (9-19.4 feet) containing approximately 2% Zn and 0.5% Pb. Locally, the mineralization attains nearly ore grade; ESL-3 cut 3.4 feet of 5.49% combined Pb+Zn.

The well developed geologic and geochemical gradients cited above greatly help to focus exploration for higher grade mineralization. Consideration of these patterns suggests six target area where thicker, higher grade SEDEX mineralization may occur. My memo of 6/12/85 proposed eight drill sites to test these areas. The targets are as follows, with the applicable drill sites noted:

1. Within the area of present drilling, remaining potential exists primarily between ESL-1 and -3, the best 1984 holes. Thick exposures of the DIV zone, with highly anomalous Pb and Zn, are present over 1600 feet of strike length between these two holes. High Pb/Zn ratios, silicified feeder zones, and stacked sulfide beds upgrade the area. ESL-7 was designed to test the area, and although it did not penetrate exhalative sulfides, it intercepted marked Zn anomalies in the footwall mudstone. Potential of this target is limited to approximately 4 $\overline{M}$t, and it would not by itself support a mining operation. (Sites A and B).

2. Proximal SEDEX mineralization may underlie volcanic cover near the Rip Van Winkle mine. The LMC zone may be present in the lower mine workings, as discussed above. A deep drill hole into one of the adjacent downdropped blocks might cut both the DIV and LMC horizons. Even if the Rip Van Winkle mineralization is unrelated to the exhalative sulfides, the Pb- and Ag-anomalous silicified zones suggest a proximal setting. The thickness of the volcanics is unknown and could be substantial. (Site C).

3. The anomalously thick DIV siliceous exhalites northwest of the 1984 holes may cap correspondlingly thick stratiform sulfides. If so, slumping of the siliceous rocks completely conceals the true gossans. Geochemistry of the cherty exhalites is erratic. The abundance of footwall silicification in section 33 and the less intense postmineral faulting upgrade the area. On the negative side, the area may lie on the upthrown side of a major basin-bounding fault, and the thick silica exhalites may represent a barren peripheral exhalative facies. (Sites D and F).

4. The prime target on the untested MCC horizon is where it consists of thicker, stacked gossans near the eastern end of its exposed length. Although exposures of the horizon are discontinuous, Pb and Zn geochemistry and high Pb/Zn ratios upgrade the area. (Site E; note that encouraging results from this hole would require acquisition of the Van Norman lands covering the strike extension to the east).

5. A lower priority target on the MCC zone occurs 1.5 miles west in section 27, where the horizon coincides with HEM anomaly W. Zn is strongly anomalous but Pb is weak. Like sites D and F, this target may lie outside the permissive sub-basin. (Site G).

6. A conceptual target lies in the downdropped block 1000 to 2500 feet northwest of ESL-6. No exhalative sulfides are exposed; but the dramatic thickening in the laminated shale, siltstone, and chert across the west bounding fault suggests that this block may represent a potent basinal trap. The DIV horizon should lie at depth.

Remaining gold potential is minimal. Previous work by EMC, Freeport, and Newmont has negatively evaluated the gold targets. Unless one of the HEM anomalies develops into a gold play, no further work is warranted except for routine analysis of all samples for gold.

RECOMMENDATIONS

1. Extend detailed mapping and gossan geochemical sampling over the remaining areas of siliceous facies rocks within the claim block. These include the north half of section 26, T38N-R53E, where the MCC horizon is probably exposed, and the Cold Creek area in the southwestern part of the block. The latter are a would best be covered in conjunction with the Blue Basin area if Texasgulf's ground can be acquired.

2. Complete more detailed examination and sampling of the HEM anomalies within the block.

3. Complete one or more lines of ground EM over the DIV horizon near ESL-1 and ESL-3 to determine more precisely the geophysical response of known mineralization.

4. Drill up to eight core and (or) reverse-circulation holes to test the remaining target areas described above, and any others that are developed out of the remaining ground evaluation. The timing of assessment obligations and the geographic constraints on work commitments must be borne in mind.

5. Pending the results of drilling of site E, acquisition of the Van Norman Ranch lands to the east may be warranted, as the MCC horizon extends eastward under Tertiary gravels onto these lands.

6. No property should be dropped until mapping and sampling are complete over both the Sleeper property and all available ground covering the Blue Basin system. A thorough compilation of data from these two systems should be made simultaneously, because they may be intimately related. Such a compilation may define additional untested targets in the area.

/ep

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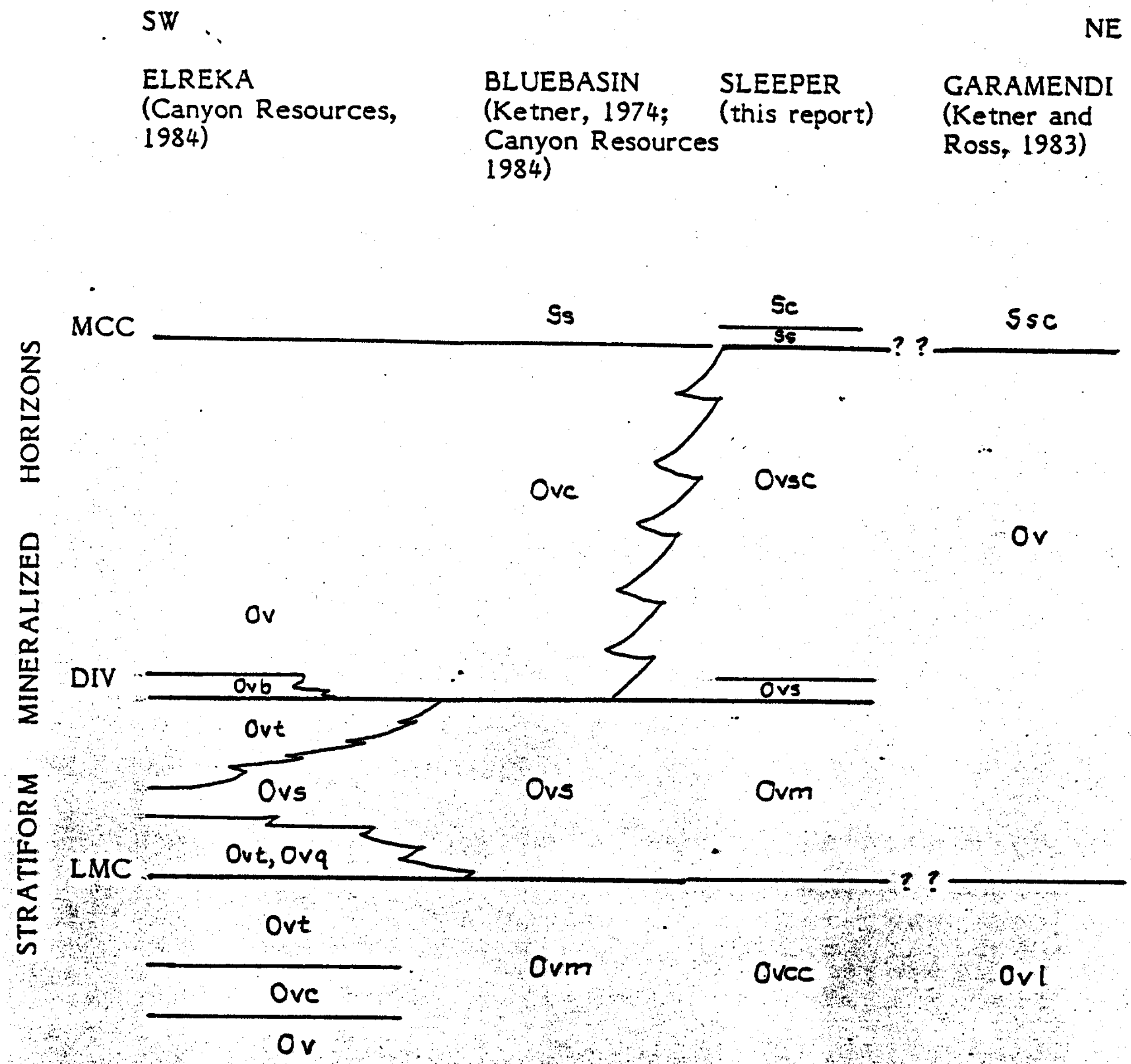

Figure 1. Tentative correlations of stratiform sulfide horizons and subdivisions of the siliceous facies rocks at Sleeper with those at other SEDEX prospects in the Independence and Adobe Ranges. Formational symbols used are those of the various authors; see references cited for lithologic details.

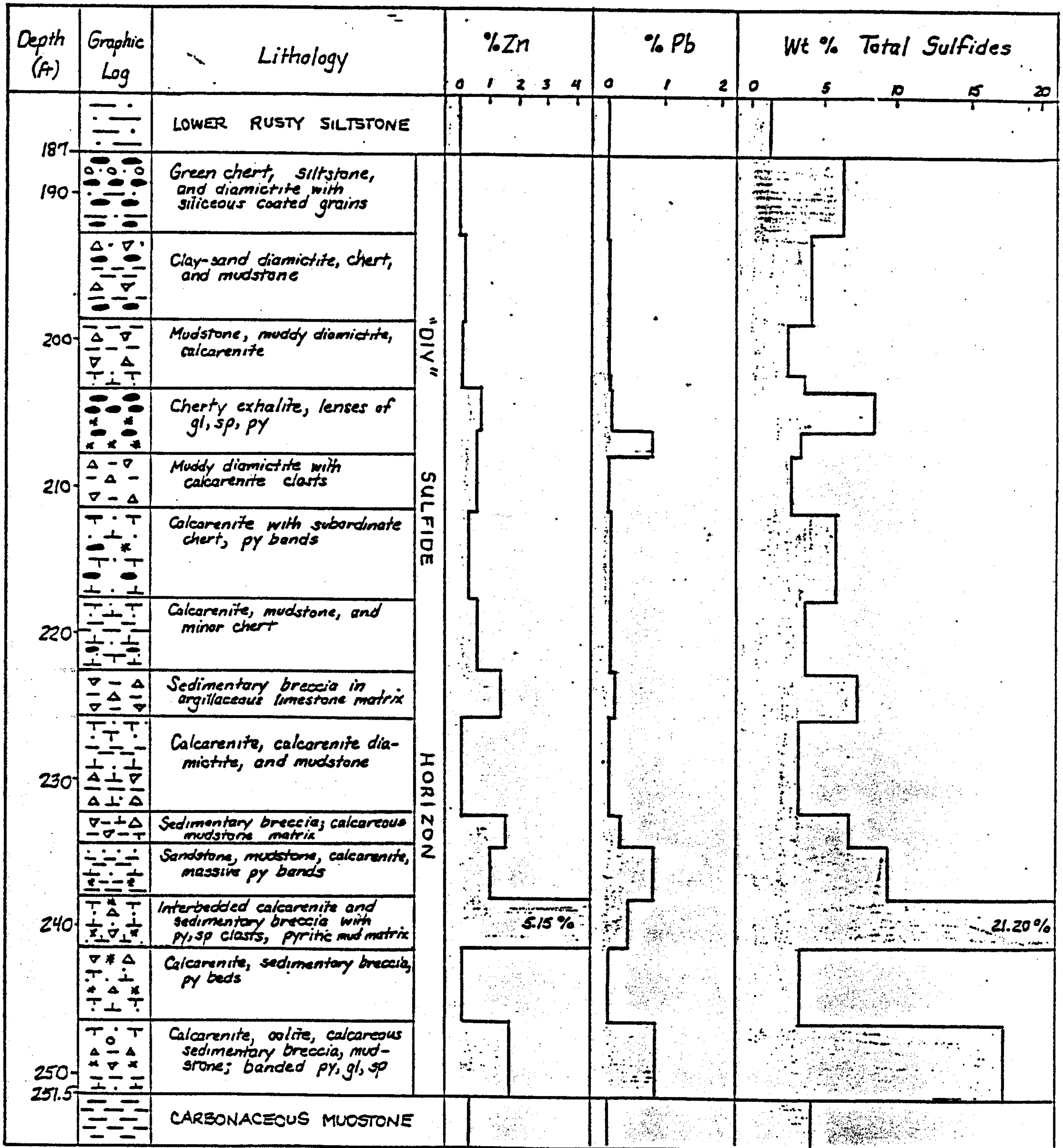

Figure 2. Detailed geologic and assay logs through the DIV horizon in hole ESL-3. Lithology simplified from core-logging by H. G. Brown.

Table 1. EXPLORATION OBLIGATIONS, SLEEPER PROJECT

Party	Type Interest	Assessment Required by 9/1/85	Work Commitment	Anniversary Date	Remarks
EMC	208 "ZZ" claims	$20,800*	--------	--------	
Kirkwood Oil/Nammco	415 claims	$40,900*	--------	variable	Includes underlying leases with Oldham, Hogle, Wilcox, et al
Oro Nevada Exploration	36 claims	$ 3,600	--------	10/28/85	
Canyon Resources	108 claims	$10,800	$30,000 by 5/86	5/86	Work commitment includes Elreka prospect. $15K must be on Canyon claims, $15K may be within 1 mile
25 Corporation	fee lands	--------	$40,000 by 3/19/86	3/86	Work commitment includes $20K minimum on their ground, $20K within 1.5 miles. We can avoid the commitment by dropping by 3/19/86
Nevis Land Company	fee lands	--------	--------	5/86	

*Satisfied by 1984 drilling program

Table 2. DETAILED STRATIGRAPHY OF THE SILICEOUS ASSEMBLAGE ROCKS IN THE SLEEPER AREA

	SYMBOL	UNIT	LITHOLOGY	APPROXIMATE THICKNESS (ft)
SILURIAN? unnamed	Sc	CHERT	Dark gray to black medium- to thick-bedded chert. Commonly poorly exposed, weathering to abundant float chips of chert without the shale and siltstone typical of Ovsc.	Unknown; top not exposed
	Ss	UPPER RUSTY SILTSTONE	Gray pyritic siltstone, weathering to rusty tan float chips. Absent in northwestern part of prospect.	0 - 100
ORDOVICIAN Vinini Formation	MCC	"McCLELLAN CREEK" HORIZON	Interbedded stratiform sulfides, siliceous exhalite, sulfidic chert, and hematitic ironstone. Where thickest, in northeastern part of prospect, consists of three stacked sulfide horizons separated by siltstone.	15 - 200
	Ovsc Ovum	LAMINATED SHALE, SILTSTONE, AND CHERT	Medium to dark gray, thin bedded to laminated shale and siltstone, with variable amounts of interbedded dary gray chert; chert most abundant near middle of unit. The abundance of shales and siltstones, which weather to thin gray chips, distinguishes Ovsc from Ovc. Ovum, the UPPER MIXED UNIT, forms a subunit within the upper half of the Ovsc section. It consists of interbedded limestone, calcareous sandstone, and chert.	600 - 2000(?)
	Ovs	LOWER RUSTY SILTSTONE	Gray pyritic siltstone, weathering rusty tan, with rare interbedded chert. Absent in northwestern part of prospect.	35 - 85
	DIV	"DIVIDE" HORIZON	Interbedded stratiform sulfides, silica exhalite, mudstone, calc-arenite, and diamictite. Grades into and locally overlain by bedded barite.	20 - 65
	Ovm	CARBONACEOUS MUDSTONE	Dark brown-gray gritty mudstone, highly carbonaceous and commonly rich in graptolites. Weathers a distinctive mottled light to medium gray. Outcrops show faint partings, whereas in drill core the rock appears massive. Thin discontinuous beds (or slump blocks?) of dark gray silty limestone, and thin beds of stratiform sulfides, locally occur near the top of the unit. The lighter gray weathering color, lack of laminae, and equant (as opposed to platy) float pieces distinguish the unit from Ovsc.	100 - 400
	LMC	"LONE MOUNTAIN CREEK" HORIZON	Interbedded stratiform sulfides, silica exhalite, c hert, shale, and conglomerate. Present only southwest of the Rip Van Winkle mine; drill holes through the same stratigraphic interval north of Lone Mountain show no significant exhalitive sulfides.	10 - 20
	Ovcc	MIXED CARBONATE AND CLASTIC ROCKS	Interbedded sandstone, siltstone, calcareous siltstone, shale, and chert; predominantly turbiditic in origin. Minor greenstone lenses.	Unknown; base not exposed

Table 3. DETAILED STRATIGRAPHY OF TERTIARY ROCKS IN THE SLEEPER AREA

(J. F. McKnight pers. commun.)

Symbol	Unit	Lithology	Subunits
Ta	ANDESITE	Dark andesite flows	
Ttu	UPPER ASH-FLOW TUFF	Rhyolitic ash-flow tuffs, generally fragment-poor and partially welded. Thin lenses of conglomerate and air-fall tuff	ATud, densely welded unit ATug, granophyrically crystallized unit ATu, undifferentiated upper tuff
Ttl	LOWER ASH-FLOW TUFF	Rhyolitic ash-flow tuffs, generally densely welded and rich in fragments of Vinini Formation. Thin lenses of air-fall tuff	ATls, "stony" (devitrified) unit ATl, undifferentiated lower tuff

Table 4. 1984 DRILL HOLES, SLEEPER PROJECT

Hole No.	Coordinates (approx.)	Elev. (ft.~)	Incln'n	Bearing	T.D. (ft.)	Intercepts (ft.)	
ESL-1	2,327,863N-387,358E	6860	-90°	-----	525	75.5-116.5:	41 ft. of 1.06% Zn, 0.30% Pb*
						95-111:	16 ft. of 2.24% Zn, 0.52% Pb
						95-96.5:	1.5 ft. of 4.04% Zn, 2.30% Pb
ESL-2	2,328,760N-388,419E	6845	-60°	S40°W	485	293-325.5:	32.5 ft. of 1.14% Zn, 0.28% Pb*
						305-318:	13 ft. of 1.98% Zn, 0.34% Pb
						317-318:	1 ft. of 9.90% Zn, 0.49% Pb
ESL-3	2,328,888N-385,431E	6680	-60°	S35°E	568	187-251.5:	64.5 ft. of 0.80% Zn, 0.18% Pb*
						232.1-251.5:	19.4 ft. of 1.77% Zn, 0.47% Pb
						238-241.4:	3.4 ft. of 5.15% Zn, 0.34% Pb
ESL-4	2,329,490N-389,275E	6840	-60°	S40°W	519	206.4-228:	21.6 ft. of 1.01% Zn, 0.27% Pb*
						216-225:	9 ft. of 2.14% Zn, 0.53% Pb
						220.8-225:	4.1 ft. of 2.99% Zn, 0.81% Pb
ESL-5	2,332,164N-391,084E	7020	-60°	S15°E	622.5	Did not intersect DIV zone	
ESL-6	2,331,133N-390,079E	6900	-65°	S10°E	409	Did not intersect DIV zone	
						133-140:	7 ft. of 0.10% Zn
ESL-7	2,328,625N-387,633E	6680	-75°	S50°W	486	Did not intersect DIV zone	
						60-120:	60 ft. of 0.21% Zn, 266 ppm Pb
						60-70:	10 ft. of 0.53% Zn

*Entire DIV horizon