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CONTENTS

THE GLORY OF GOD IS INTELLIGENCE

Cover: Rafted or foreign cobble that settled into what were soft underlying sediments. From outcrop immediately east of the Sandy Creek Crossing on Blind Trail Wash Road, Garfield County, Utah. Photo courtesy Sidney M. Petersen and Robert T. Pack.

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CONTENTS

Structure and Alteration as a Guide to Mineralization in the Secret Canyon Area, Eureka County, Nevada*

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ABSTRACT.—The stratigraphic column in the Secret Canyon area consists of a thick Cambrian-Ordovician section of alternating carbonates and shales. These rocks are in fault contact with Mississippian through Permian age clastics and limestones. Cretaceous sediments and Tertiary volcanics overlie all of these with sharp angular discordance.

Rocks of the area are cut by numerous northerly-trending faults which are in turn cut by a conjugate system of northeasterly- and northwesterly-trending strike-slip faults. The northeasterly-trending faults are well developed and have right-lateral displacement. The northwesterly-trending faults are poorly developed, and offset is left lateral. It appears that, although conjugate fractures were initiated, continued deformation occurred only along northeasterly-trending faults.

Ore deposits are largely limited to occurrence within the massive brittle rock of the Eldorado Dolomite, Hamburg Dolomite, and Eureka Quartzite. Ore deposits in the Eldorado Dolomite and Eureka Quartzite are structurally controlled. Ore bodies in the Hamburg Dolomite show both stratigraphic and structural influence. Chances for the discovery of important new ore bodies in the Hamburg and Eldorado Dolomites appear to be good, but new ore bodies in the Eureka Quartzite are likely to be of limited size. The age of mineralization is thought to be middle Cretaceous.

INTRODUCTION

Rocks of the Secret Canyon area have been intensely prospected for minerals during the past one hundred and thirty years. The Secret Canyon area (fig. 1), located on the southern border of the Eureka mining district, contains many of the same formations which were major producers of gold and silver farther north within the Eureka district. Despite this legacy, the production of the area has been limited.

The present study investigates the metals potential of the Secret Canyon area by detailed mapping of structure and alteration. The geologic and alteration map (fig. 2) accompanying this paper summarizes the pertinent field and laboratory data. For mapping, a topographic base with a scale of 1:6,000 and aerial photos with approximately the same scale were used. In addition to surface data, assay and lithologic information were available from several drill holes in the vicinity of the Hoosac Mine. Other subsurface control was obtained by underground mapping in the Geddes-Bertrand mine and in a small adit on Hamburg Ridge. This information has aided in structural interpretation and resolution of ore controls.

Previous Work

The earliest geologic expedition into the Eureka mining district was directed by Clarence King (1877), but the first detailed study of the district was begun in 1880 by the U.S. Geological Survey. Arnold Hague directed the study and subsequently published a monograph (1892) on the geology of the district. Walcott published a monograph (1884) on the paleontology of the district, and Curtis produced a monograph (1884) on the district's ore deposits.

Walcott (1908), and later Wheeler and Lemmon (1939), revised Hague's stratigraphy of the Cambrian by redefining and subdividing the original units. Nolan and others (1956) further refined the pre-Tertiary stratigraphy, describing and naming new formations and members.

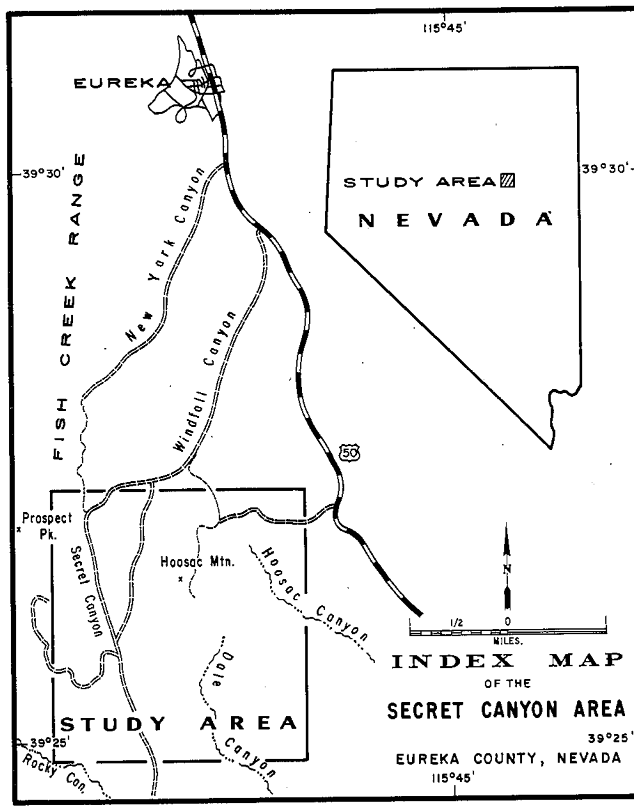

FIGURE 1.—Index map of the Secret Canyon area, Eureka County, Nevada.

The Tertiary volcanic rocks centered on the southeast corner of the Secret Canyon area have been the subject of several recent studies. Gromme and others (1972) and Blake and others (1975) have dated and correlated the various flow units. The northern third of the study area has been mapped by Nolan (1962) as part of a geologic map of the Eureka mining district. The entire study area was mapped by Nolan and others (1974) at a scale of 1:31,680 as part of the geologic map of the Pinto Summit Quadrangle. Mapping completed during the present study is at a scale of 1:6000 and shows greater structural detail.

ROCK FORMATIONS

General Statement

The early work of Hague (1883, 1893) and Walcott (1884) in the Eureka district has been the basis for subsequent stratigraphic work in the north-central Basin and Range. Type localities of several formations discussed in this study are within

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or in close proximity to the borders of the mapped area, and consequently much detailed stratigraphic work has been done in the area. In this paper local variations within the formations will be noted, but the reader is referred to the references cited for more complete regional stratigraphic descriptions. Figure 3 is a summary stratigraphic column of formations present in the Secret Canyon area.

Cambrian System

Eldorado Dolomite

The Eldorado Dolomite is the host for several major ore bodies in the Eureka district to the north. Within the Secret Canyon area, the Geddes-Bertrand mine has workings in the formation, which is present in a broad band along the west side of the mapped area (fig. 2).

The Eldorado Dolomite is almost entirely massive, but locally bedding can be seen. Lenses of thin-bedded limestone are most common near the upper and lower contacts of the formation. The dolomite is frequently intensely fractured giving rise to calcite or, in areas of alteration, silica boxworks. Nolan (1962) described two types of dolomite: a medium- to fine-bedded, finely crystalline, dark gray variety and a massive coarse-crystalline light gray type. The latter type is most prevalent in the study area. Upper and lower contacts of the Eldorado Formation are conformable. The formation is approximately 760 m thick.

Geddes Limestone

The Geddes Limestone, first mapped separately by Wheeler and Lemmon (1939), has its type locality at the Geddes-Bertrand mine in Secret Canyon (fig. 2). The formation is a dark blue limestone with beds 8 to 45 cm thick. In places, abundant black chert occurs as lenses and discontinuous bands up to 3 cm thick. Calcite-filled fractures are common. Weathering yields platy fragments, and the formation is less resistant to erosion than the Eldorado Dolomite. Wheeler and Lemmon (1939) measured 101 m of the unit at the type locality.

Secret Canyon Shale

The Secret Canyon Shale forms a classic strike valley which extends the entire length of the study area. Nolan and others (1956) divided the formation into two members: the lower shale member and an upper unit, the Clarks Spring Member.

The shale member is rarely exposed and weathers to produce yellow brown flakes in a deep soil. Wheeler and Lemmon (1939) measured 154 m of the member at the head of Secret Canyon. Nolan and others (1956) believe that the true thickness is closer to 68 m.

The Clarks Spring Member is a thin-bedded limestone with thin argillaceous partings. Its contact with the shale member is gradational, and interdigitation of the two lithotypes occurs through a 10-m interval. The upper contact with the Hamburg Dolomite is also gradational. In the upper portion of the Clarks Spring Member, the limestone becomes more massive.

The Clarks Spring Member is often tightly folded. The member also displays variable thickness ranging from 162 m, measured by Wheeler and Lemmon (1939), to 46 m measured by Nolan and others (1956). These variations in thickness of the Secret Canyon Shale have been attributed to thrust faults.

Hamburg Dolomite

The Hamburg Dolomite is exposed along the length of Hamburg Ridge, which forms the eastern wall of Secret Canyon. The formation is the host for the gold ores of the Windfall and Rustler mines.

The Hamburg Dolomite is dark gray, sugary, and in places mottled, and like the Eldorado Dolomite, is intensely fractured. Weathered surfaces are rough and knobby. Nolan (1962) estimates the thickness of the formation to be 305 m.

Dunderberg Shale

The Dunderberg Shale crops out in the saddle between Hoosac Mountain and Hamburg Ridge and discontinuously along the east flank of Hamburg Ridge. The formation is composed of thick beds of brown paper shale separated by thin beds of blue gray, nodular limestone. The unweathered formation exposed in the Rustler mine is massive, dark gray to blue mudstone.

Wheeler and Lemmon (1939) measured 104 m of Dunderberg Shale in the area of the Rustler mine, and Nolan (1962) cites a thickness of 81 m from measurements made near the Windfall mine.

Windfall Formation

Exposures of the Windfall Formation are in the form of isolated patches which occur in the saddle between Hamburg Ridge and Hoosac Mountain and along the west side of Dale Canyon (fig. 2). Nolan and others (1956) identified two members: the lower Catlin Member, and the upper Bullwacker Member.

The Catlin Member is composed of alternating units of massive limestone and thin-bedded platy and sandy limestone. On the west slope of Hoosac Mountain the massive limestone of the Catlin Member has been highly silicified. The thinner-bedded limestones of the member are unaltered and weather to a light gray color, with abundant calcite stringers.

The Bullwacker Member is a thin-bedded limestone with beds ranging from 2 to 25 cm thick. It has yellow brown sandy horizons which weather to produce light gray platy fragments. Infrequent calcite stringers and worm burrows are also found. Exposure is generally poor, and the member forms smooth slopes covered by platy limestone fragments. Nolan and others (1956) cite thicknesses of 75 m for the Catlin Member and 122 m for the Bullwacker Member.

Ordovician System

Pogonip Group

In the vicinity of Eureka, the Pogonip Group includes beds between the Windfall Formation and the Eureka Quartzite. No attempt was made to map separately the three formations of the Pogonip Group defined by Merriam (1963) because the area of outcrop is limited and exposures are poor (fig. 2). Within the Secret Canyon area, the Pogonip Group crops out in a north-south belt along the west side of Hoosac Mountain and along the east side of Hamburg Ridge. Between the Geddes-Bertrand mine and Rocky Canyon and on southern Hamburg Ridge the formation also crops out as part of the Dougout Tunnel thrust plate.

The Pogonip Group is largely a thick-bedded limestone. Along the outcrop band west of Hoosac Mountain only these more massive beds are exposed, and little stratigraphic detail is available. The Pogonip Group-Eureka Quartzite contact is widely reported to be unconformable, but the relationship was not established in the Secret Canyon area. The Pogonip Group is 488 m thick on the north side of Windfall Canyon, 300 m less than its regional thickness.

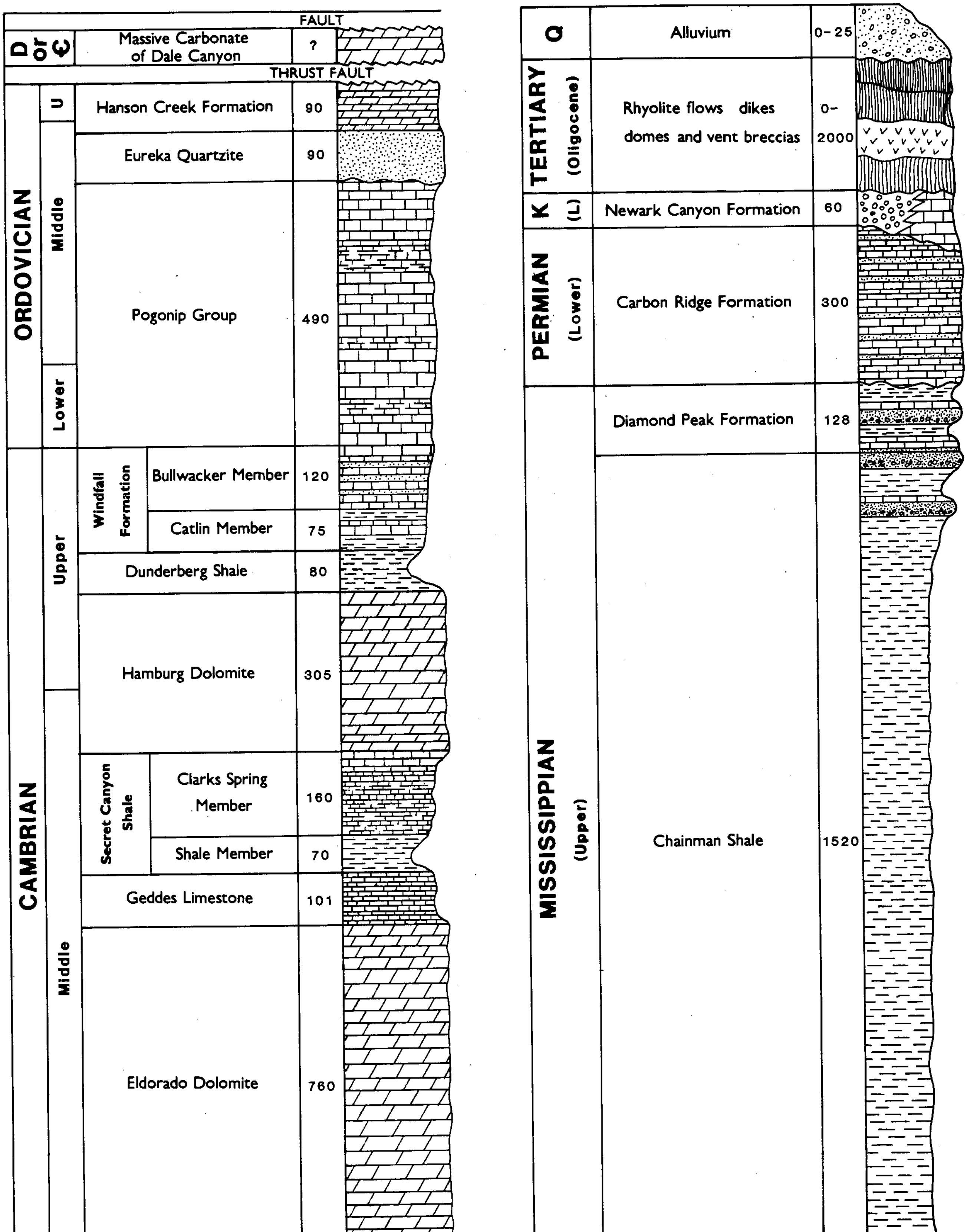

FIGURE 3.—Summary stratigraphic column of rocks in the Secret Canyon area. Thicknesses are in meters.

Eureka Quartzite

The Eureka Quartzite is in thrust contact with both the Eldorado and Hamburg Dolomites. Klippen composed of Eureka Quartzite occur on both the east and west sides of southern Secret Canyon. Larger allochthonous outcrops of the formation occur in a discontinuous band trending north-south over the summit of Hoosac Mountain.

The Eureka Quartzite is a white vitreous quartzite which is everywhere fractured. Locally, jointing patterns are well expressed, but no bedding attitudes could be obtained. The formation produces prominent cliffs and is devoid of vegetation. True thicknesses of the Eureka Quartzite are difficult to obtain, but Nolan (1962) cites a thickness of 90 m as approximately correct.

Hanson Creek Formation

The only known outcrop of the Hanson Creek Formation in the Secret Canyon area is on the northeast corner of Hoosac Mountain (fig. 2). Here the formation, downdropped by faulting, lies in contact with the Eureka Quartzite. The areal extent of the Hanson Creek Formation is very limited within the mapped area.

The formation is a black to dark gray pervasively fractured dolomite. Weathering produces very delicate silica boxworks. The Hanson Creek Formation is 90 m thick in lower New York Canyon.

Massive Carbonate of Dale Canyon

Along the eastern slope of southern Hamburg Ridge are outcrops of a massive brecciated and silicified dolomite. The unit is of unknown age but has the appearance of both the Eldorado Dolomite and the Hamburg Dolomite. The rock is also reported to have affinities for Devonian age rocks not exposed in the mapped area.

Mississippian System

Chainman Shale

Within the Secret Canyon area, rocks of Silurian and Devonian age are not exposed, and Mississippian strata are in fault contact with Cambrian and Ordovician rocks across the north-south-trending Hoosac Fault. The Chainman Shale crops out along the east slope of Hoosac Mountain where it is in fault contact with the Eureka Quartzite (fig. 2). The formation also occurs in discontinuous, poorly exposed patches in Hoosac Canyon. The formation is a black to dark gray fissile shale which forms smooth soil-covered slopes. Within the upper Chainman Shale, massive beds of gritstone and sandstone form resistant ridges. The Chainman Shale is 1,524 m thick in the lower reaches of Secret Canyon, but fault duplication seems likely within the section.

Diamond Peak Formation

The Diamond Peak Formation is composed of alternating light gray, coarsely crystalline limestone and conglomerate or gritstone units commonly separated by thin shale beds. A distinctive feature of the clastic units is the occurrence of brightly colored chert fragments derived from the Vinini Formation. The lenticular nature of individual clastic beds is readily apparent. The Diamond Peak Formation, 128 m thick in southern Secret Canyon, is overlain unconformably by Permian, Cretaceous, and Tertiary rocks.

Permian System

Carbon Ridge Formation

Within the mapped area the Carbon Ridge Formation crops out in a narrow band which extends from the summit of Hoosac Mountain north into Wildfall Canyon (fig. 2). The formation is completely brecciated and heavily silicified. The Carbon Ridge Formation is faulted into contact with the Eureka Quartzite and is overlain unconformably by the Newark Canyon Formation.

Cretaceous System

Newark Canyon Formation

The Newark Canyon Formation crops out sporadically over the summit of Hoosac Mountain and in small patches in Hoosac Canyon (fig. 2). On the east side of Hoosac Mountain, north of the Hoosac Mine, the formation is a moderately well consolidated conglomerate with a red calcareous matrix which supports well-rounded quartzite and limestone clasts. Clasts range from 1 to 25 cm across. Low on the north slope of Hoosac Mountain, the Newark Canyon Formation occurs as a freshwater limestone, medium bedded and light gray with chert stringers.

The Newark Canyon Formation rests with marked angular unconformity across an erosional surface of considerable relief, which contains rocks ranging in age from Ordovician to Permian.

Tertiary Igneous Rocks

The volcanic center south of Eureka, part of which is in the mapped area, has been the object of considerable recent study. Nolan (1974) mapped these volcanic rocks in detail. Blake and others (1971, 1975) have worked on their geochronology, stratigraphy, and petrology. The stratigraphic units delineated by these workers were used in this study, and the reader is referred to them for detailed descriptions of the various volcanic units mapped here.

GEOLOGIC STRUCTURE

General Statement

The Secret Canyon area is divided by the Hoosac fault into two blocks of contrasting structural style. West of the Hoosac fault in the Prospect Ridge antiform, as defined by Nolan and others (1974), structural features include four anticlinally folded thrust plates and numerous normal and strike-slip faults which cut rocks largely of Cambrian and Ordovician age. Detailed structural work of the present study has revealed the existence of a large number of faults within the Prospect Ridge antiform. The majority of these faults occur within the massive dolomites and quartzite of the Eldorado Dolomite, the Hamburg Dolomite, and the Eureka Quartzite (fig. 2). The shales and thin-bedded limestones which occur between these massive, highly faulted formations are folded, often tightly, but are relatively free of faults.

East of the Hoosac fault within the Richmond Mountain synform, also described by Nolan (1974), strata dominantly of Carboniferous and Permian age have been folded into a broad syncline. The Richmond Mountain block is structurally less complex, although thrust and normal faulting have occurred to a limited extent. Within the mapped area the Richmond Mountain block is largely occupied by an intrusive rhyolite dome and extrusive rhyodacite.

Northerly-Trending Faults

Rocks within the mapped area are cut by three major northerly-trending fault systems: the Jackson-Lawton-Bowman fault system, the Geddes-Bertrand fault system, and the Hoosac fault system (fig. 2). Numerous other northerly-trending faults are found on the west slope of Hoosac Mountain and along the length of Hamburg Ridge south of the Rustler pit.

Jackson-Lawton-Bowman Fault System

The Jackson-Lawton-Bowman fault system, so named for the three principal branches of the fault which occur 10 km north of the Secret Canyon area, extends southward along the west wall of Secret Canyon and terminates west of the Geddes-Bertrand mine (fig. 2). Detailed mapping completed during the present study shows that the expression of this fault system ranges from three or four parallel fault trends to a poorly defined single fault zone. These faults are commonly marked by a zone of breccia as wide as 10 m, and the occurrence of travertine and massive coarsely crystalline calcite. The fault planes are often remarkably smooth (fig. 4). The presence of travertine is indicative of the development of caves along the faults. Similar cave development is intimitely associated with faults and ore bodies within the Eldorado Dolomite, north of the Secret Canyon area.

FIGURE 4.–A smooth fault surface cropping out on the west wall of Secret Canyon along the Jackson-Lawton-Bowman fault. Rock exposed above the fault plane in a hanging wall is silicified breccia.

On the eastern, or downthrown, side of the fault which is generally occupied by Geddes Limestone, breccia is less common, and the medium-bedded limestone tends to deform plastically, resulting in tight drag folds with fold axes oriented roughly parallel to fault trends. There is, however, a narrow breccia zone within the Geddes Limestone. The striking contrast in style of deformation between the highly brecciated brittle Eldorado Dolomite and the breccia-free, plastic Geddes Limestone is in evidence along the length of the Jackson-Lawton-Bowman fault.

The Jackson-Lawton-Bowman fault system has dips ranging from 50° to 70° east and stratigraphic displacement as great as 130 m. A short distance south of the Geddes-Bertrand mine, the Jackson-Lawton-Bowman fault ends abruptly in a rhyolite dike (fig. 2). South of the rhyolite dike another northerly-trending fault begins. This fault has stratigraphic displacement which is probably greater than 130 m, but its sense of displacement is reversed or down to the west. The relationship between these two faults with opposite senses of displacement is unclear. It is probable that the adjustment required for these two faults to coexist occurred along the easterly-trending fault which separates them (fig. 2).

Geddes-Bertrand Fault

Another northerly-trending fault, here named the Geddes-Bertrand fault for the excellent exposures which occur in and near the Geddes-Bertrand mine, occurs east of, and is parallel to, the southern portion of the Jackson-Lawton-Bowman fault. Between the two faults in the area of the Geddes-Bertrand mine are numerous subparallel branching faults. Only the most prominent of them are shown in figure 2. The area is highly brecciated and also highly mineralized. These fractures could have acted to relieve stress in the block between the Jackson-Lawton-Bowman and Geddes-Bertrand faults. Stratigraphic displacement on the Geddes-Bertrand fault is less than 100 m. The Geddes-Bertrand fault dips between 50° and 60° to the east and has a normal sense of displacement.

At the Geddes-Bertrand mine, the Geddes-Bertrand fault is expressed as a sharp, narrow ridge of silicified breccia. The fault plane, in this area, is smoother and planar. Worthy of note is the occurrence of horizontal striations along the Geddes-Bertrand fault, suggesting that in places the most recent motion along the fault was strike-slip, even though the apparent stratigraphic offset was dominantly vertical.

Hoosac Fault

The Hoosac fault extends from Dale Canyon north over the east side of Hoosac Mountain into Windfall Canyon and continues north of the study area. On the north slope of Hoosac Mountain the fault brings the Permian Carbon Ridge Formation into contact with the Ordovician Eureka Quartzite. Exposure is limited in this area, but outcrops tend to be selectively preserved along the fault because of the extensive silicification of breccias in both hanging-wall and footwall formations.

East of the Hoosac fault and approximately parallel to it is another silicified brecciated band of Carbon Ridge Formation (fig. 2). The brecciated nature of these outcrops supports the idea that this is another fault zone along the major Hoosac trend.

Along the east side of Hoosac Mountain and in Dale Canyon, the Hoosac fault is scantily exposed, and isolated patches of Mississippian rocks which are part of the hanging wall are the only means of inferring the position of the fault. Hague

(1892) estimated that the Hoosac fault had 400 m of stratigraphic displacement.

Other Northerly-Trending Faults

Other northerly-trending faults occur between Hamburg Ridge and the summit of Hoosac Mountain, and also along the length of Hamburg Ridge. On southern Hoosac Mountain, a short distance southeast of the Hoosac mine, two sets of roughly northerly-trending faults mapped in the present study merge to create a series of tight V's which open alternately to the north and south. This group of faults has made the area susceptible to intrusion by rhyodacite.

Thrust Faults

Dougout Tunnel Thrust

The Prospect Ridge antiform has three major thrust zones. Outcrops of the highest and presumably the youngest of these, the Dougout Tunnel thrust, occurs in the southwest corner of the mapped area. Two klippen of the thrust occur on southern Hamburg Ridge (fig. 2). The Pogonip Group and Eureka Quartzite are the only formations within the Secret Canyon area which occur on the thrust plate.

Other Probable Thrusts

An apparent zone of thrusting occurs in Upper Cambrian rocks on southern Hamburg Ridge. Here the Dunderberg Shale has been completely eliminated, and the Windfall Formation is appreciably thinned (fig. 2). Exposures in the area are poor, but this thinning appears to be structural rather than stratigraphic.

The Massive Carbonate of Dale Canyon, which crops out along the eastern slope of southern Hamburg Ridge (fig. 2), has presumably been emplaced by thrusting. Nolan (1974), citing relationships not within the mapped area, has included these rocks as part of the Dougout Tunnel thrust plate, and believes that the carbonate unit may be composed of thrust fragments of Hamburg Dolomite and younger formations.

Strike-Slip Faults

The rose diagram for normal faults of the Secret Canyon area (fig. 5) shows that, although northerly-trending faults have the greatest frequency, northeasterly- and northwesterly-trending fault sets also have well-developed trends. The strongest of these have the average directions: north 68° east, north 38° east, north 23° west, and north 64° west.

During mapping, measurements of strike and dip of fault planes and trend and plunge of fault plane lineations were made at 44 locations within the Secret Canyon area. The dip of measured fault planes was as low as 45°, but most faults had dips greater than 70°. The plunge along striations was generally close to horizontal, but could be as great as 50°. Figure 6 shows three corrugated fault surfaces with near-horizontal striations. This type of fault surface is common along strike-slip faults.

Where determinable, it was found that the northeasterly-trending faults were right-lateral strike-slip and northwesterly-trending faults were left-lateral strike-slip. This relationship is believed to represent a conjugate strike-slip fault system. Figure 5 shows the northeasterly- and northwesterly-trending faults which are interpreted to be part of the conjugate fault system.

The northeasterly strike-slip faults commonly show mappable offset, but the northwesterly strike-slip faults rarely show any apparent offset. It appears that, although east-west compressional stress produced a conjugate fracture system, adjustment occurred mostly along the northeasterly fractures, leaving the northwesterly fractures poorly developed.

Folds

The medium- and thin-bedded formations within the Secret Canyon area have all experienced some degree of folding. Folding has occurred in the Geddes Limestone, in the Secret Canyon Shale, in the Dunderberg Shale, and in thin-bedded strata of the Hamburg Dolomite. In the Secret Canyon Shale, it is widespread. Folds are often asymmetrical and range from open to tight. Deformation is thought to be related to thrust faults, because the Secret Canyon Shale has acted as a glide plane for thrusting at other locations near Eureka. Similar folding also attributed to thrust faults occurs in the Dunderberg Shale.

The folding observed within the Geddes Limestone and the Hamburg Dolomite seems to be related to drag caused by normal faults. Fold axes parallel normal faults and intersect strike-slip faults at small angles.

Age of Structural Features

Many of the relationships crucial to the determination of the sequence of structural events included in this section are found outside the Secret Canyon area. For a more regional view of structural history, the reader is referred to Nolan (1962), Nolan and others (1974), and Roberts and others (1958).

Paleozoic

Conformable deposition of a thick Cambrian and Lower Ordovician section, at Eureka, was followed by a widespread unconformity presumably related to broad, gentle upwarping. This unconformity occurs at the base of the Ordovician Eureka Quartzite. No faulting appears to have been related to this event.

The next structural event recorded in the rocks of Secret Canyon is of latest Paleozoic age. This youngest and strongest Paleozoic disturbance is evidenced by the marked angular unconformity at the base of the Permian Carbon Ridge Formation. Nolan (1962) reports only minor amounts of faulting associated with this event. He has postulated that this pre-Carbon Ridge event was related to the Roberts Mountain thrust which extended to at least the western border of the Eureka district. The Roberts Mountain thrust is a feature of the Antler orogeny which is thought to have ended by Early Pennsylvanian time (Roberts and others 1958). In the mapped area Pennsylvanian rocks are absent, and the Permian Carbon Ridge Formation rests directly on the Mississippian Diamond Peak Formation.

Mesozoic

The major structural features of the Secret Canyon area deform the Carbon Ridge Formation but do not affect the Cretaceous Newark Canyon Formation. Nolan (1962) suggested that this post-Carbon Ridge pre-Newark Canyon event was also related to the Antler orogeny. This relationship requires an extreme stretch of Antler time. If the observed Mesozoic deformation is of Antler age, the orogeny had an early weak pulse and a late much stronger one. H. J. Bissell (personal communication) has suggested that the Newark Canyon Formation may contain fusulinids of Permian age. If this is the case, the major period of deformation in the Secret Canyon area is considerably older and is possible related to the Sonoma orogeny. The problem requires additional study.

The Hoosac fault and probably the other northerly-trending faults of the Secret Canyon area as well are post-Carbon

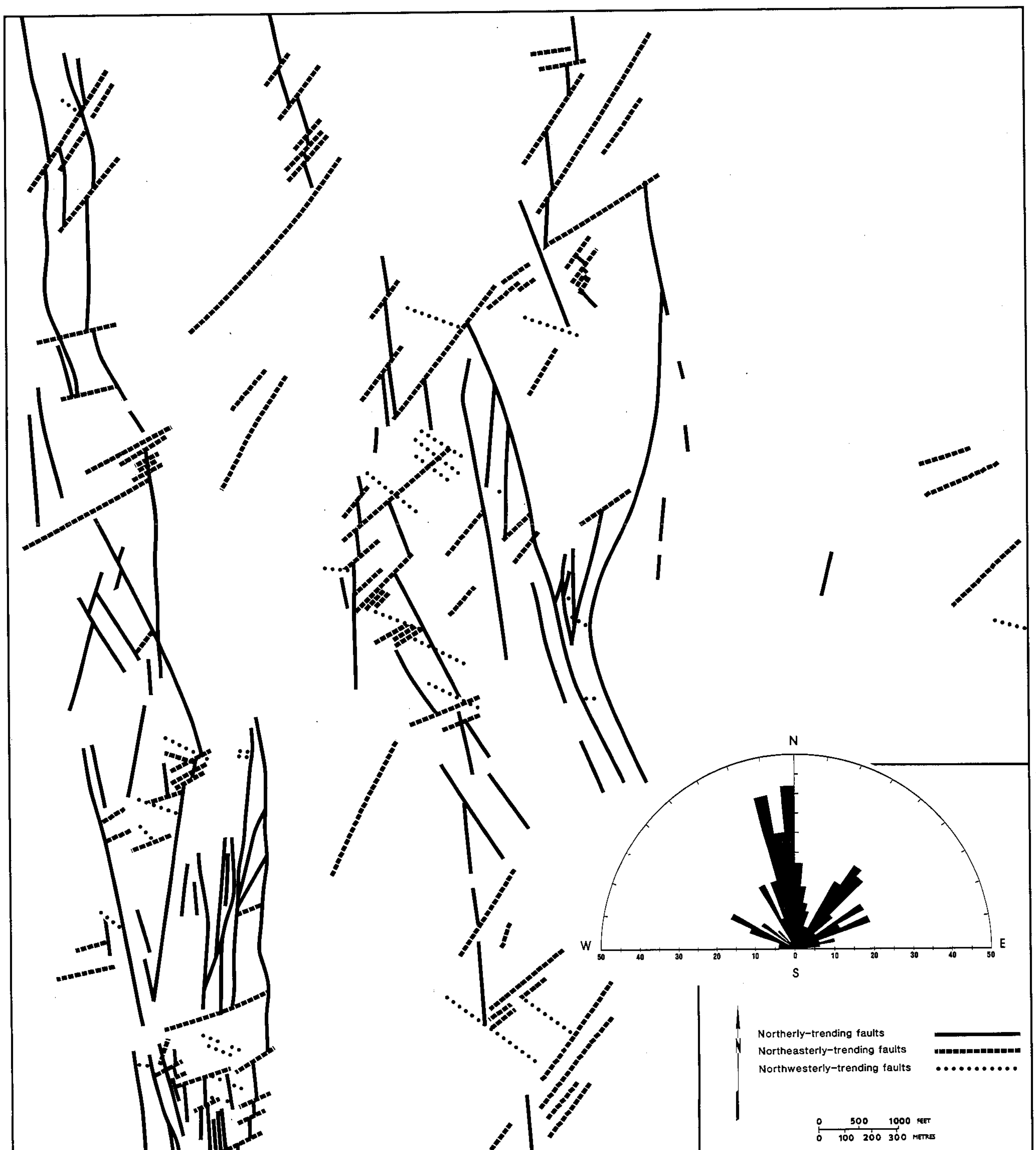

FIGURE 5.—Rose diagram and fault-pattern map showing fault trends and groupings of faults interpreted to be genetically related. Older northerly-trending faults are identified by solid lines; dotted and dashed lines identify components of a conjugate fault system. Rose diagram shows frequency of fault trends grouped in 5° increments; 230 measurements were made.

Ridge Formation and pre-Newark Canyon Formation. The Hoosac fault cuts the Carbon Ridge Formation, but is older than thrust and strike-slip faults. Strike-slip faults cut both the northerly-trending faults and the thrust fault and so are the youngest features in the Secret Canyon area. Nolan (1962) cites evidence found elsewhere in the Eureka district which shows that thrust and strike-slip faulting were closely related events. The conglomeratic and highly unconformable Cretaceous Newark Canyon Formation represents clastic material shed from this major Mesozoic orogenic pulse.

FIGURE 6.—Outcrop showing three silicified fault surfaces; two are roughly parallel, and the third intersects them at approximately 60°.

Cenozoic

The youngest rocks in the Secret Canyon area are Oligocene volcanic units which are part of an eruptive sequence centered southeast of the mapped area. These volcanic rocks are relatively undeformed. Deformation associated with the intrusive rhyolite dome in the southeast corner of the mapped area is slight, although volcanic breccia related to rhyolite emplacement does occur along the west side of Dale Canyon.

ECONOMIC GEOLOGY

Introduction

The earliest prospecting in the Secret Canyon area was precipitated by the discovery of ore in the Eureka district in 1864. The site of the original discovery is approximately 4 km north of the Secret Canyon area. The numerous adits, shafts, and pits found throughout the Secret Canyon area attest to the intense period of prospecting which followed the discovery.

Diggings within the Secret Canyon area are aligned in three roughly linear north-south-trending belts (fig. 2). The three minealized belts, here named for the topographic features with which they coincide, are (1) the Hoosac Mountain belt, which is bounded on the east by the Hoosac fault and occurs within the Eureka Quartzite; (2) the Hamburg Ridge belt, which occurs largely within the Hamburg Dolomite, but also includes mineralization within the Windfall Formation and the Pogonip Group; and (3) the Prospect Mountain belt, which includes mineralization within the Eldorado Dolomite.

Hoosac Mountain Belt

The Hoosac Mountain belt extends north-south over the summit of Hoosac Mountain and lies almost entirely within the Eureka Quartzite or along its faulted boundaries. The Hoosac fault is the eastern limit of the Hoosac Mountain belt and also of mineralization within the Secret Canyon area (fig. 2).

Mining

Two mines on Hoosac Mountain were designated by name in Nolan (1962): the Hoosac mine and the Hoosac Twin tunnel (fig. 2). Workings of both mines have long been inaccessible. Couch and Carpenter (1943) report that the Hoosac mine yielded 17,292 tons of ore valued at $158,616 between the years 1872 and 1882. The low dollar value, $9.00 per ton, was due in part to the difficulty in smelting the high silica ore, which is reported to have been high in silver and lead but deficient in gold.

Ore Deposits

Information about ore deposits on Hoosac Mountain is generally limited to outcrop and mine-dump data, except at the Hoosac mine, where Gold Creek Corporation conducted a drilling program from 1977 to 1979. Twenty-eight holes were drilled, and cuttings were fire-assayed for gold and silver at five-foot intervals. Five of the twenty-eight drill holes also had the lithology described by Dr. H. Star Curtis, a geologist with Gold Creek Corporation. From these the author made a structural cross section (fig. 7) showing a zone of anomalously high silver values and lithologic correlations between wells. Three general lithologies occurred in all drill holes. The shallowest of these, a near-surface horizon of kaolinite which is at times strongly silicified, is covered by a thin veneer of alluvium. Beneath the kaolinite is a silicically altered quartzite layer variously described as chert, chert with pods of quartzite, and cherty quartzite. The rock is dense and ranges in color from white to gray. The deepest rock type penetrated is a white to clear, granular quartz, which is typical of the unaltered Eureka Quartzite.

The zone of higher silver values, shown in figure 7, generally occurs in the lower portion of the cherty horizon although high silver values are also found to extend into the normal quartzite at drill hole HS-1. This silver-rich zone is encountered in most of the drill holes at depths between 10 m and 18 m and is from 3 m to 6 m thick. It appears to be sheetlike in form and occurs at a generally uniform depth below the surface. This geometry suggests that the ore body was produced by supergene enrichment. Silver values as high as 20 oz. per ton occur, but the total interval average in all wells is about 4 oz. per ton.

Other workings, less extensive than those of the Hoosac mine and the Hoosac Twin tunnel, occur on both the northern and southern slopes of Hoosac Mountain. These workings, also near the Hoosac fault, extend along mineralized veins and brecciated zones. Midway down the southern slope of Hoosac Mountain is an adit, now caved, which followed mineralization occurring along a contact between the Eureka Quartzite and an intensely silicified volcanic dike. Nearby jointing in the quartzite is also mineralized.

Mineralization

Minerals which crop out on Hoosac Mountain include hematite, limonite, silica, barite, and kaolinite. Hematite and limonite most commonly occur together with varying amounts of silica as in-fillings of veins and breccia zones. These two oxides of iron are also found disseminated in volcanic rocks. Barite and hematite commonly occur together in veins. Barite, at times very coarsely crystalline, occupies the central portion of veins lined with hematite. The occurrence of kaolinite is limited to volcanic rocks. Silica is abundant in all mineralized areas.

Minerals which have been identified in dump samples are black, very finely mammillary hematite; finely crystalline red brown sphalerite; jarosite, probably of the lead-rich (plumbojarosite) variety; green encrusting beaverite [$PbFe_6(SO_4)_4(OH)_{12}$]; drusy quartz; and light gray chert.

A third source of mineralogical data is the drilling program conducted at the Hoosac mine. In the five drillholes for which lithology was described the following minerals were reported: drusy quartz, chert, calcite, kaolinite, alunite, sericite, limonite, hematite, jarosite, cerrusite pseudomorphs after galena and beaverite. The majority of these are described as encrustations or films on quartzite or chert. Cerrusite, possibly silver bearing,

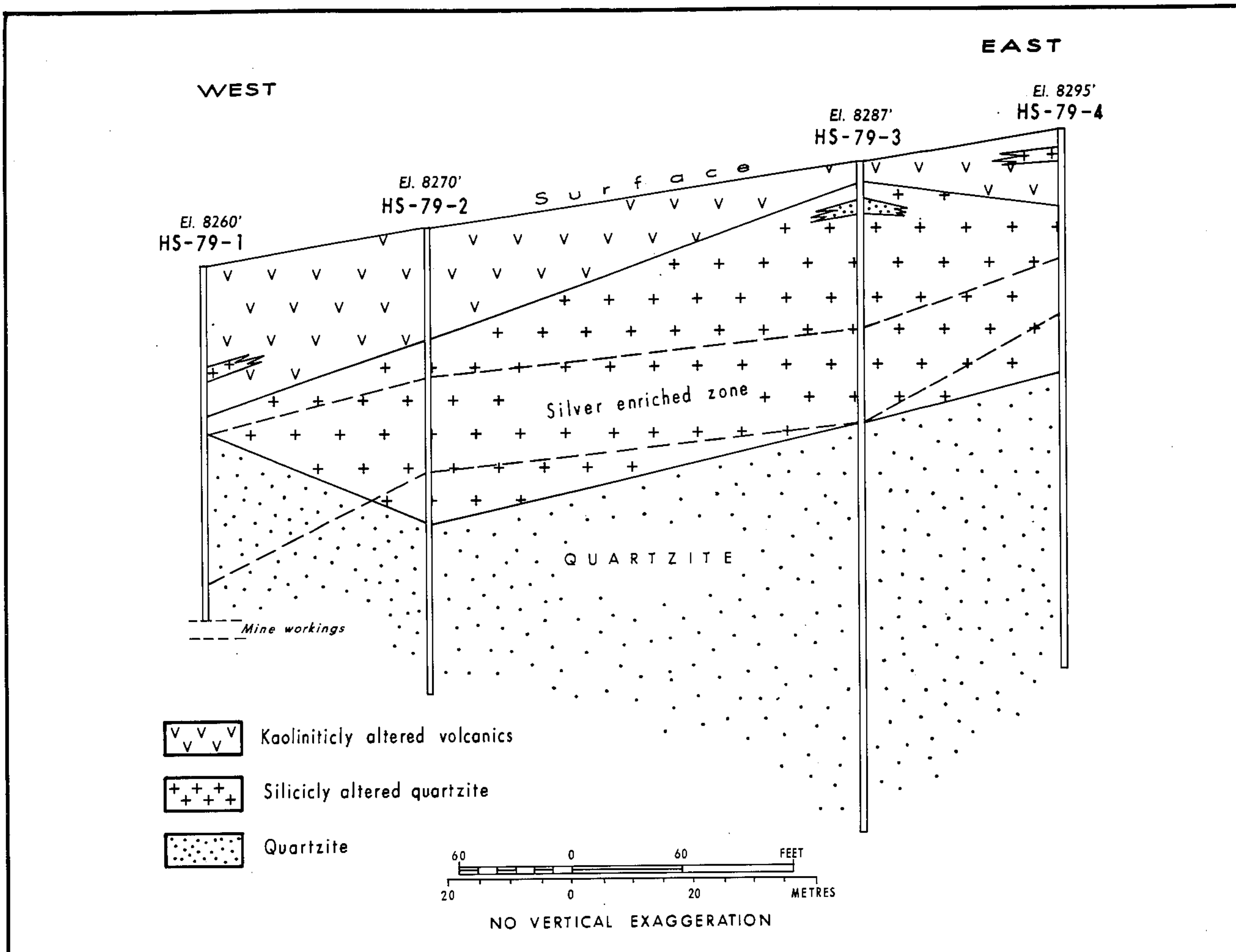

FIGURE 7.—East-west cross section at Hoosac mine, showing subsurface lithologic correlations between drill holes. Area between dashed lines has silver values of 4 oz. per ton or greater.

is likely the major ore mineral at the Hoosac mine. It is found with other secondary minerals in brecciated areas and along veins. The relative abundance of the several minerals described is not known. All are typical of the zone of oxidation.

Geochemical analysis by Chaffe and others (1978) of samples collected along the Hoosac fault show them to be enriched in arsenic, antimony, lead, copper, and zinc. Samples also have abundant iron and silicon. Arsenic, antimony, and copper minerals were not identified on Hoosac Mountain.

Alteration

Most of Hoosac Mountain is characterized by smooth alluvium-covered slopes. Existing outcrops generally occur along faults and tend to be elongated in the direction of fault trends and irregular in shape (fig. 2). A high percentage of these preserved outcrops have experienced some degree of alteration which has made them considerably more resistant to erosion. Hydrothermal alteration on Hoosac Mountain is closely associated with faults.

Silicic and pyritic alteration is widespread in the Hoosac Mountain belt. Kaolinite, the only argillic alteration product found on Hoosac Mountain, occurs only in volcanic rocks. In some locations only phenocrysts within the volcanic rock are altered to kaolinite, but often the entire rock is altered. Some areas of argillic alteration have also experienced pyritic and silicic alteration.

At the Hoosac mine there is a prominent altered outcrop of Eureka Quartzite present. This alteration is superficial and occurs as a veneer on the quartzite. Dump samples and cuttings from drill holes at the Hoosac mine show that alteration within the mine was also nonpenetrating and occurred in brecciated areas and along fractures. Massive replacement of the unbrecciated Eureka Quartzite wall rock has not been observed.

Ore Controls

The close association between structure and alteration present on Hoosac Mountain indicates that the Eureka Quartzite was made susceptible to mineralizing solutions by fracturing. Brecciated and altered areas within the Eureka Quartzite are largest and most common near the Hoosac fault. Other faults in the Hoosac Mountain belt have associated areas of brecciation, but they are of limited extent and appear to be of minor importance.

The relationship between the Oligocene rhyodacite dikes along the Hoosac fault and mineralization is unclear. The occurrence of several areas on Hoosac Mountain and throughout the Secret Canyon area where mineralization is found independent of volcanic bodies has led the author to conclude that the major epoch of mineralization predates the Oligocene volcanic event. The roughly horizontal near-surface body of highly altered volcanic rock at the Hoosac mine overlies and is approximately parallel to the ore body (fig. 7). The alteration in volcanic rocks at the Hoosac mine and elsewhere on Hoosac Mountain represents a second period of mineralization. The relative importance of this younger mineralizing event in the creation of the Hoosac mine ore body has not been determined.

In addition to the strong structural ore controls in evidence on Hoosac Mountain, a stratigraphic control may have been exerted by the impermeable shales within the hanging wall of the Hoosac fault. The structural position of these overhanging shales probably served to divert mineralizing solutions moving along the Hoosac fault into structurally induced porosity within the Eureka Quartzite.

The restriction of ore bodies to occurrence along faults constitutes a major aid to prospecting, but probably also limits opportunities for finding large laterally continuous ore bodies. The most favorable areas within the Eureka Quartzite, then, should have the highest fault density and some associated alteration. The present detailed mapping of structure and alteration has revealed two areas which appear to be promising.

One of them occurs 450 m south-southwest of the Hoosac mine. The area is located at the intersection of the Hoosac fault zone and a north-northwesterly-trending fault system. The area has a high density of photo lineations, and breccia is widespread. Alteration is quite strong, and barite-hematite veins are present. Like the Hoosac mine area, this area occurs near the Hoosac fault and contains rhyodacite (fig. 2).

The other somewhat less favorable area within the Hoosac Mountain belt is located on the north face of Hoosac Mountain also along the Hoosac fault. Here brecciated and mineralized outcrops of the Eureka Quartzite and Carbon Ridge Formation, occurring along the Hoosac fault, are cut by northwesterly-trending strike-slip faults.

The Hoosac fault appears to have been the major channel for ore-bearing solutions on Hoosac Mountain. Outcrops along the fault are sparse, and it is possible that important ore bodies exist which have no surface expression. However, the strong preference for preservation of altered rock suggests that the areas where outcrops do occur are likely to be the most highly mineralized and also the most favorable areas along the fault. The strong structural affinity of mineralization and the absence of massive replacement of the unbrecciated wall rock indicate that Hoosac Mountain belt ore bodies are veined and generally of limited size.

Hamburg Ridge Belt

The Hamburg Ridge belt includes mineralization which occurs largely within the massive Hamburg Dolomite and to a lesser extent within the Windfall Formation and the Pogonip Group. Mineralization within these formations occurs along the length of Hamburg Ridge and also on the lower west face of Hoosac Mountain (fig. 2).

Mining

A number of the small workings along the Hamburg Ridge belt date back to the 1870s, but the major period of mining activity here followed the discovery of gold ore at the Windfall mine in 1904. Production valued at $350,000 was reported for the Windfall mine during the period from 1908 to 1916. The ore was low grade and averaged $15.36 per ton. Values were entirely in gold which occurred within friable or sanded dolomite, a hydrothermal alteration product of the Hamburg Dolomite.

The most recent operator along the belt, Idaho Mining Corporation, dug a deep linear pit in the area of the older underground workings of the Windfall mine. Some of these old workings are now exposed in the walls of the open pit. Upon completion of the Windfall pit, in 1978, a second excavation, the Rustler pit, was commended. The Rustler pit is situated in the saddle between Hoosac Mountain and Hamburg Ridge (fig. 2). Idaho Mining Corporation is also exploring actively along Hamburg Ridge, south of the Rustler pit.

Ore Deposits

The largest known ore bodies along Hamburg Ridge, those of the Windfall and Rustler mines, appear to be very similar in nature. They occur in the highest strata of the Hamburg Dolomite, which has a dip of 40° to 60° to the east. Ore occurs as disseminated bodies within sanded dolomite. Common to both the Windfall and Rustler mines are near vertical dikes of rhyodacite which were emplaced along northerly-trending faults.

Areas of sanded dolomite also occur farther south on Hamburg Ridge (fig. 2). Within the Windfall Formation and the Pogonip Group mineralization is very limited, but several small prospects have been worked along veined replacements. No significant ore deposits occur in these formations within the Secret Canyon area.

Mineralization

In outcrop, a limited number of minerals occur along the Hamburg Ridge belt. Included are limonite, hematite, silica, kaolinite, chlorite, barite, beaverite, calcite, and dolomite. Limonite, hematite, and silica occur as gossans which cap most areas of sanded dolomite, as well as along faults in the Windfall Formation and the Pogonip Group. Kaolinite, chlorite, and barite are found in volcanic rocks along the belt. Beaverite was found in the klippen of Eureka Quartzite on southern Hamburg Ridge (fig. 2). Its mode of occurrence is similar to that described at the Hoosac mine. Coarsely crystalline calcite is a fill material along faults.

The last mineral on the list cited above, dolomite, requires additional explanation. The wallrock of Hamburg Ridge ore bodies is the dense, recrystallized Hamburg Dolomite. Sanded dolomite, an alteration product of the Hamburg Dolomite, is also composed almost entirely of dolomite. It occurs in two varieties: a dark gray to black, fine-grained dolomite, which exhibits original depositional texture; and a light gray to white, medium to coarsely crystalline dolomite, which occurs in irregular bands and nodules. Both types are extremely friable, and grains can be disaggregated with a fingernail. Nolan (1962) reported that many of the adits drifted into sanded dolomite in the Windfall mine were completed without drilling or blasting.

The chemical association of the gold within the sanded dolomite ore is unknown. Nolan (1962) believes that the gold occurs as a finely disseminated native metal. Alteration of the dolomite wallrock appears to have completely removed intergranular cement and added small amounts of gold and pyrite, while leaving dolomite grains unaltered. Subsequent uplift and erosion resulted in complete oxidation of the primary ore bodies. In the Windfall and Rustler mines, gold ore is not visually distinguishable from noneconomic sanded dolomite, and ore bodies must be identified by assay.

Alteration

The general pattern of alteration for the Hamburg Dolomite includes a zone of very strong silicic and moderate pyritic alteration in the highest portions of the formation which is underlain by a broad area of weak pyritic alteration and sanded dolomite or dolomitic alteration (fig. 2). Strata in the lower two-thirds of the Hamburg Dolomite are almost entirely unaltered.

A detailed view of alteration within the Hamburg Dolomite is afforded by a small adit drifted into the highest strata of the formation at a point a short distance south of the Rustler mine (fig. 8). The adit was abandoned when it encountered the intensely silicified zone at the top of Hamburg Dolomite, a zone composed of dark gray chert which is pervasively shattered. The largest portion of the adit is within sanded dolomite of the two types previously described. The dark variety with preserved depositional texture occupies a position beneath and in contact with the silicified zone. Irregularly shaped bodies of this same type also occur within the white, coarsely recrystallized sanded dolomite which occurs beneath it (fig. 8). The white sanded dolomite has veins of hematite and limonite which dip opposite to bedding planes. These small fissures appear to have influenced mineralization and may represent a fracture system present in the dolomite prior to mineralization.

Formations along the Hamburg Ridge belt which overlie the Hamburg Dolomite are not extensively altered. The Dunderberg Shale is pyritized only in close proximity to faults which cut the formation (fig. 2). The Windfall Formation and the Pogonip Group have experienced pyritic and silicic alteration closely associated with faults. Altered fault zones, topographically elevated by differential erosion, are common in both formations. Along faults cutting the Windfall Formation and the Pogonip Group alteration tends to be strongest in massive-bedded limestones. Thin-bedded units are infrequently altered. Volcanic rocks along the belt have experienced argillic, pyritic, and silicic alteration to varying degrees.

Ore Controls

The ore bodies of the Windfall and Rustler mines are of the massive replacement type. Their emplacement has been strongly controlled stratigraphically by the overlying impermeable Dunderberg Shale. Bodies of sanded dolomite occur sporadically along the outcrop trend of the Hamburg Dolomite, but they are always situated high in the formation near the dolomite-shale contact (fig. 2).

Structural control of ore emplacement is also apparent. The Windfall and Rustler mines are in areas of comparatively high fault density; however, the direct relationship between structure

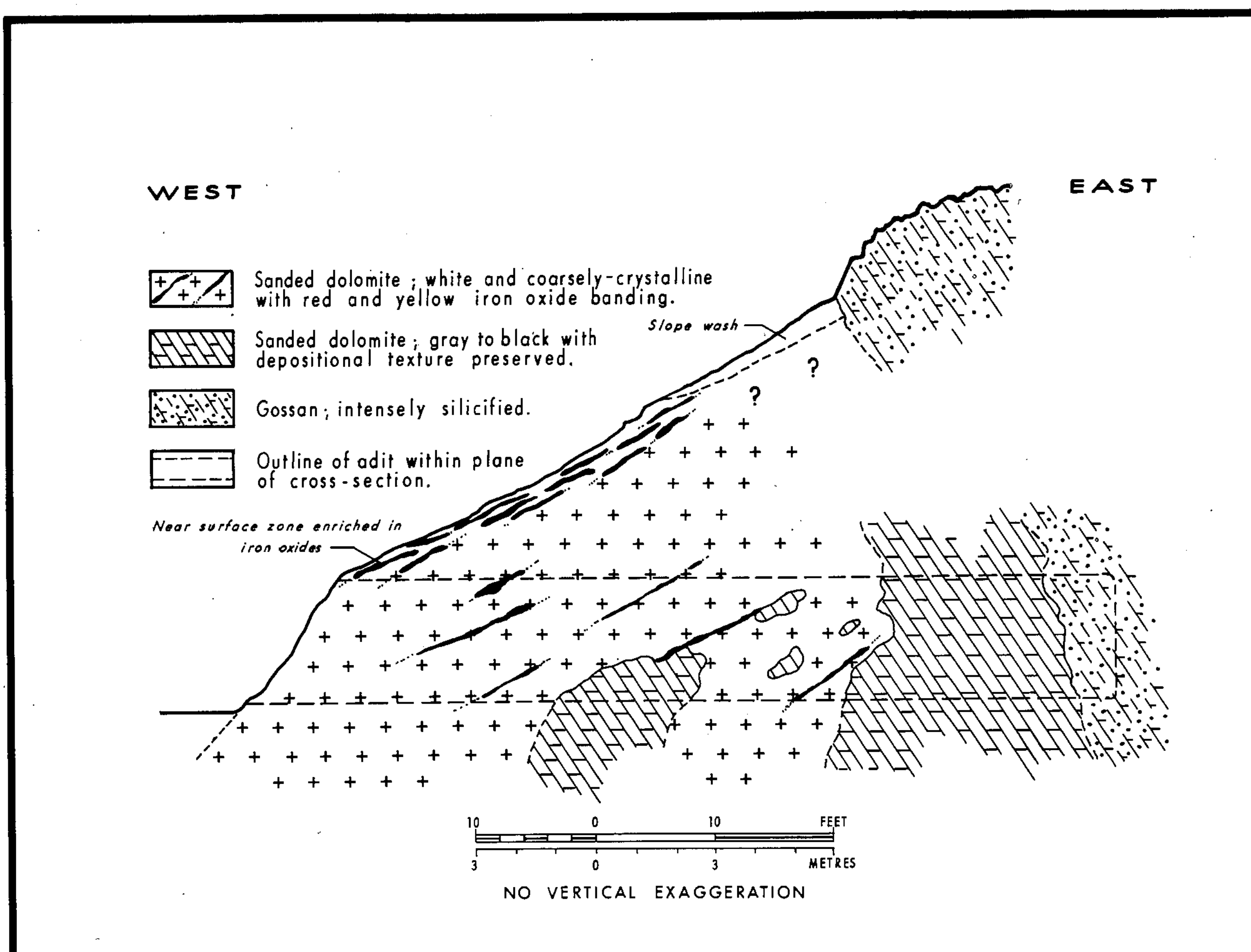

FIGURE 8.–East-west cross section through a small adit in Hamburg Dolomite located a short distance south of Rustler mine. Pattern shows approximate dip of bedding.

and mineralization observed in the Eureka Quartzite is not present in the Hamburg Dolomite. A near-vertical fault exposed in the west face of the windfall pit shows no apparent relationship to alteration. The intensity of alteration is fairly uniform along the length of the exposure despite the presence of the fault. One of the underground workings of the "old" Windfall mine is also exposed in the west wall of the Windfall mine, and it appears to have been drifted along the exposed fault. The positioning of the adit may indicate that, although dolomitic alteration was widespread and primarily stratigraphically controlled, later gold-bearing solutions were structurally controlled to a greater degree. Detailed assay data from the recent open-pit operations would be required to define the geometry of these ore bodies, but that information, if it exists, has not been made available.

It seems likely that the process of dolomitic alteration was preceded and aided by structural shattering of the dolomite. Although evidence of shattering is generally not discernible in areas of sanded dolomite, broad areas lower in the Hamburg Dolomite have been subjected to in situ shattering. Although the rock was pervasively shattered into small angular parts, individual fragments have not moved with respect to each other. A similar process probably preceded dolomitic alteration higher in the formation.

Besides occurring in the Windfall and Rustler mines,

Bodies of sanded dolomite are also found on southern Hamburg Ridge (fig. 2). One of them occurs as a narrow band along a small fault. Sanded dolomite is present only in the footwall, and the fault breccia zone and hanging wall are unaltered.

Additional ore bodies within the Hamburg Dolomite should be expected to occur near the dolomite-shale contact, probably where faults are present. Two areas which meet these criteria are present on Hamburg Ridge. One is centered about 800 m south of the Rustler mine where there is an elongated area of dolomitic alteration (fig. 2). The other is located on southern Hamburg Ridge southeast of a rhyolite body. Both areas have high fault densities.

Mineralization in the Windfall Formation and the Pogonip Group is largely controlled by structure, with some limited irregular replacement bodies in massive limestone units adjacent to faults. Dolomite is the preferred host for ore bodies of the Hamburg Ridge belt, in part, at least, because of the greater brittleness of the dolomite. The geochemical environment during ore deposition may also have favored dolomite over limestone.

The Prospect Mountain Belt

The Prospect Mountain belt is coincident with the outcrop band of the massive Eldorado Dolomite, which forms the west walls of Secret Canyon. Also included is mineralization in the Geddes Limestone, which has been mineralized slightly along faulted contacts with the Eldorado Dolomite. Both formations dip steeply to the east.

Mining

The first mining along the Prospect Mountain belt began in 1869 at the Geddes-Bertrand mine. In 1870, the town of Vanderbilt was established in Secret Canyon just below the mine. Remains of the mill used to process Geddes-Bertrand ore and several of the stone buildings can still be seen.

The Geddes-Bertrand mine was by far the largest along the Prospect Mountain belt. The first ore was mined from several large glory holes at the head of a small tributary of Secret Canyon. When the ore appeared to be continuous at depths, an adit was drifted westward from a point lower on the west wall of Secret Canyon (fig. 2). The adit intersected the ore body approximately 60 m below the surface. Ore was stoped from below as mining progressed upward along corkscrew inclines. Mine workings also extended about 15 m downward from the level of the main adit. No production figures appear to have been recorded, but Couch and Carpenter (1943) state that the principal values were in lead and silver.

Ore Deposits

With the exception of the Geddes-Bertrand mine area, mineralization in the Eldorado Dolomite is restricted to fault zone replacement bodies. The workings of the Geddes-Bertrand mine exploited a vertical pipe of ore mined to a depth of 75 m below the surface (fig. 9). The stoped area, in rock considered to be ore by the early miners, is in the shape of a crude pipe which maintains a fairly uniform diameter of 10–15 m. Around the ore pipe is a broad brecciated and mineralized area into which several other glory holes were dug.

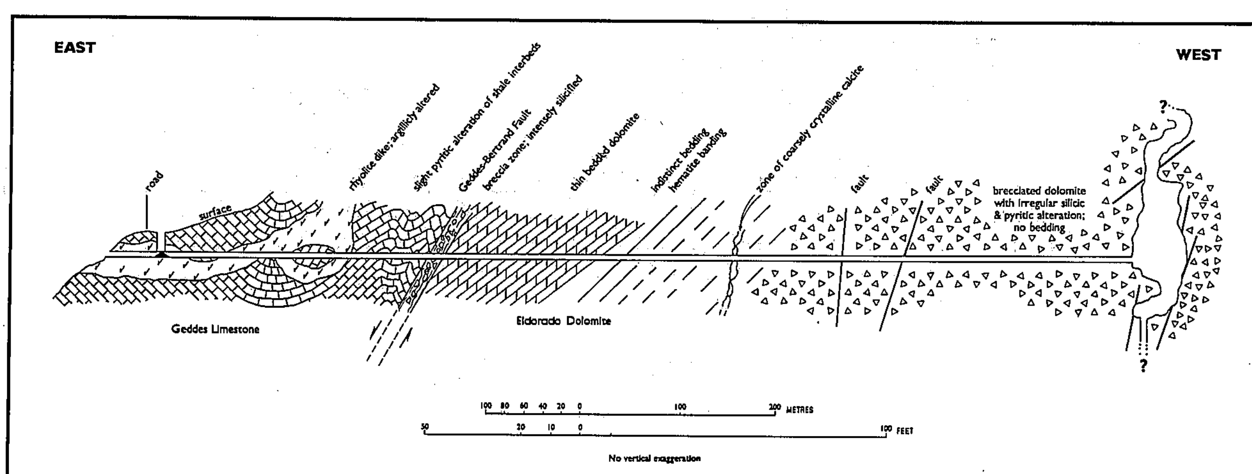

FIGURE 9.–East-west cross section through the Geddes-Bertrand mine. Cross section shows drag folds in Geddes Limestone, Geddes-Bertrand fault, and brecciated area in Eldorado Dolomite.

Mineralization

Of widespread occurrence in the Eldorado Dolomite are limonite, hematite, silica, calcite, and travertine. All of these are generally restricted to occurrence along faults. Massive kaolinite occurs as an alteration product within volcanic bodies.

In and around the Geddes-Bertrand mine, additional minerals have been identified. Bindhemite [$Pb_2S6_2O_6(O,OH)$] and possibly massicot and plumbojarosite occur as bright yellow ocherous masses encrusting dense green to gray masses of cerussite. All these minerals occur in somewhat friable masses with limonite and hematite boxworks and angular breccia clasts in varying stages of replacement by ore minerals. This mineral assemblage was called "pudding ore" by the early miners because of its bright color and smooth texture. At the Diamond mine 2 km north of the study area silver is associated with jarosite. The same relationship is probably present at the Geddes-Bertrand mine. Malachite and azurite have also been found in limited amounts.

Analysis of several geochemical samples collected by Chaffe and others (1978) around the Geddes-Bertrand mine reveals relatively high amounts of silver, copper, lead, zinc, and antimony. Zinc- and silver-bearing minerals have not been identified at the Geddes-Bertrand mine, but it seems certain that the ocherous oxidized ores of the mine have more complex mineralogy than is described here.

Alteration

Pyritic and silicic alteration are common along faults on Prospect Mountain. Limited dolomitic alteration has occurred within the Geddes Limestone along its faulted contacts with the Eldorado Dolomite.

In several areas, especially near the Geddes–Bertrand mine, the silicic alteration of fault zones has caused them to become more resistant to erosion. In these areas fault zones are often preserved as pronounced linear ridges or near vertical cliffs along canyon walls. Silicified slickensides are also abundant.

An area of dolomitic alteration has been mapped around the Geddes-Bertrand mine. It is generally not so intense as dolomitic alteration on Hamburg Ridge, but bodies of friable dolomite do occur. The altered rock is generally a brecciated dolomite which has been partly recrystallized and softened by partial removal of intergranular cement.

Ore Controls

Mineralization along the Prospect Mountain belt was controlled by, and localized along, fault zones. Faults have acted both to channel mineralizing solutions and to prepare a brecciated host rock with increased permeability. The Geddes-Bertrand mine is located between the southern end of the Jackson-Lawton-Bowman fault and the northern end of the Geddes-Bertrand fault (fig. 2), a region which has experienced widespread brecciation of the Eldorado Dolomite (fig. 9). The Geddes-Bertrand ore body occurs in the area of intersection of several high-angle faults. Within the Geddes-Bertrand mine numerous fault planes are preserved. Underground mapping completed during the present study shows that most of these have a northerly trend similar to that observed in outcrop, but several faults intersect the major northerly trend at high angles. This high density of fault intersections created the vertical ore pipe which the Geddes-Bertrand mine exploited (fig. 9).

A broad area of highly brecciated and intensely altered rock extends south from the Geddes-Bertrand mine (fig. 2), to form what appears to be an attractive area to explore for ore bodies within the Eldorado Dolomite. Other altered areas along the Prospect Mountain belt are more limited and probably less favorable.

Age of Mineralization

Within the Secret Canyon area, evidence pertaining to the age of mineralization is limited. No intrusive body comparable to the middle Cretaceous quartz diorite which crops out near the Ruby Hill mine at the northern end of the Eureka mining district has been found in the Secret Canyon area. The quartz diorite, believed to be the metaliferous source for the whole district, has been encountered in drill holes farther south, and its occurrence, possibly at considerable depth, beneath the Secret Canyon area has been postulated. If this assumption is correct, then the age of the major epoch of mineralization in the Secret Canyon area is also middle Cretaceous.

Small amounts of postmineralization movement along faults has been observed, but mineralization generally postdates the major post-Carbon Ridge Formation period of structural deformation. Oligocene volcanic activity appears to have modified the Hoosac mine ore body and may have had an influence on other previously mineralized zones in the Secret Canyon area.

RECOMMENDATIONS

Hoosac Mountain Belt

Prospects for discovery of important ore bodies in the Eureka Quartzite appear to be fair. Massive replacement of the quartzite host has not been observed, and mineralization is limited to occurrence in fissures and breccia zones where ore minerals encrust quartzite clasts.

The present detailed mapping of structure and alteration has indicated two favorable areas which have high fault density and associated alteration. One is centered 450 m south-southwest of the Hoosac mine in the area where the Hoosac fault and a system of north-northwesterly-trending faults merge. The other is on the north face of Hoosac Mountain where the Hoosac fault is cut by strike-slip faults. Both are altered and brecciated (fig. 2).

Hamburg Ridge Belt

The two important ore bodies on Hamburg Ridge, those of the Windfall and Rustler mines, occur in the highest portions of the Hamburg Dolomite immediately beneath the Dunderberg Shale, where they have been localized along northeasterly-trending strike-slip faults. Two areas which display similar features and are therefore attractive places for exploration occur on Hamburg Ridge. One is centered 800 m south of the Rustler mine where there is an elongated area of dolomitic alteration. The other is located on southern Hamburg Ridge just southeast of a rhyolite flow (fig. 2). Both have dolomitic alteration, are cut by faults, and are stratigraphically situated in the upper Hamburg Dolomite.

Prospect Mountain Belt

The Geddes-Bertrand mine ore body is of the massive replacement type and occurs in shattered Eldorado Dolomite. It lies within a broad area of highly brecciated and intensely altered rock which extends south from the mine. Another patch of dolomitic alteration occurs in an area of high fault density just south of the above mentioned area (fig. 2). Opportunities for discovery of new ore bodies in these areas appear to be very good.

Additional Study

The spotty geochemical data available for the Secret Canyon area indicates that there is an absence of gold in ores of the Eureka Quartzite and the Eldorado Dolomite but that the metal is relatively abundant in the Hamburg Dolomite. This apparent zonation is enigmatic, especially considering that the Hamburg and Eldorado Dolomites are very similar lithologically. A possible solution is to invoke a separate metaliferous source for the Hamburg Dolomite ore bodies. Geochemical sampling at a greater density than is presently available may reveal patterns of mineralization and offer increased understanding of the metaliferous source or sources responsible for mineralization in the Secret Canyon area.

Ores of the Hamburg and Eldorado Dolomites are ocherous and friable. While several minerals have been identified, the available geochemical data suggests that there are minerals present in these ores which are yet to be identified. There is also little known about how the gold and silver are carried in these ores. Additional work in these areas will be an aid to geochemical prospecting and shed light on the nature of the primary ore bodies.

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