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GEOLOGY, MINERAL RESOURCES and ROCK MATERIAL of CURRY COUNTY, OREGON

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GEOLOGY, MINERAL RESOURCES, AND ROCK MATERIAL OF CURRY COUNTY, OREGON

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GEOLOGY, MINERAL RESOURCES, AND ROCK MATERIAL OF CURRY COUNTY, OREGON

INTRODUCTION

Purpose

The purpose of this study is twofold: (1) to provide Curry County with mineral-resource information for planning purposes; and (2) to add to the data base of the Department of Geology and Mineral Industries. This study, which is to be used as a companion report to the Beaulieu and Hughes (1976) study, "Land Use Geology of Western Curry County, Oregon," contains a geologic map; an inventory of mineral resources; a brief review of mineral statistics, economics, and outlook; and an overview of mined land reclamation.

Methods of Study

The geologic map is largely a compilation of all available published and unpublished geologic information. The index to previous geologic mapping is shown on the Geologic Map of Curry County (Plate 1, in pocket).

Many areas of known geologic problems were field checked to improve the accuracy of the geologic map. Photogeologic interpretations were made using 1973 color infrared aerial photos belonging to the Siskiyou National Forest and 1969 U.S. Soil Conservation Service black-and-white photos of the coastal area outside the Forest boundary. Nearly all of the quarries, mineral deposits, and aggregate localities shown on the mineral deposits map have been examined in the field. Data available from previous reports on the area have been used; much of the data are new with this study and unavailable from any other source. The physical inventorying of rock-material sites included researching the files of the Department's Mined Land Reclamation Division as well as those of other State and County agencies for site locations. Additional sites were identified from aerial photos, from field surveying during trips, and by light airplane reconnaissance. The sites were surveyed by visually estimating the dimension and shape of each site relative to the volume of material removed and the amount remaining.

Acknowledgments

Employees of the Siskiyou National Forest made color infrared aerial photographs available for use in this study. County officials, particularly Curtis Brown and John Thorp, have been very helpful. Ewart M. Baldwin, University of Oregon, furnished unpublished field maps of the Agness, Marial, and Port Orford quadrangles and critically reviewed the completed map. Norm Peterson, Department of Geology and Mineral Industries, Grants Pass Field Office, helped with reconnaissance mapping in the Mount Emily area. Information on nickel-laterite deposits was obtained during 1975 under a U.S. Bureau of Mines research grant to gather data for their minerals availability system (MAS) computer program. Bruce C. McNeal, geology student from Southern Oregon State College, assisted in the field work. Robert G. Coleman and M. Clark Blake, U.S. Geological Survey, furnished copies of their field maps of parts of Curry County that were helpful in preparing the geologic map.

Previous Work

The first geologic mapping and investigation of mineral resources in Curry County was done between 1898 and 1900 by J. S. Diller (1903), U.S. Geological Survey, in the Port Orford 30-minute quadrangle. Diller (1914) also wrote "Mineral Resources of Southwestern Oregon," which lists a number of mines and prospects in Curry County. G. M. Butler and G. J. Mitchell (1916) prepared a preliminary survey of the geology and mineral resources of Curry County. "Oregon Metal Mines Handbook, covering Coos, Curry, and Douglas Counties," (Oregon Department of Geology and Mineral Industries, 1940) includes all available mine-file reports of the Department as of 1940. Francis G. Wells and others of the U.S. Geological Survey began geologic mapping in the Kerby 30-minute quadrangle in the summer of 1940. The field work was completed in 1946; the map published in 1949 as part of Bulletin 40, Oregon Department of Geology and Mineral Industries. Robert H. Dott, Jr., (1971) mapped and described the geology of the southwestern Oregon coast west of the 124th meridian. He combined reconnaissance mapping with detailed mapping by several students from the University of Wisconsin. Listed in the index to geologic mapping and also in the bibliography are more recent contributions to the literature of this area, including unpublished theses by students from the University of Wisconsin, University of Oregon, Oregon State University, and Portland State University.

GEOGRAPHY

Location, Extent, and Access

The study area includes all of Curry County (Figure 1), which is approximately 67 mi long and 14 to 34 mi wide. Total areal extent is approximately 1,629 sq mi. Access is provided by State Highway 101 along the coast and by County roads along the streams and within the coastal area. Roads belonging to the U.S. Forest Service and private timber firms provide access to the more remote upland area.

Socio-Economic and Political Factors

The following analysis is based in part on a U.S. Forest Service report on the Rogue Planning Unit (1974). The forest land of Curry County is stocked predominantly with Douglas fir. Other primary softwoods include sugar pine, Port Orford cedar, white and grand fir, lodgepole pine, western white pine, and others. Lumbering and wood-products manufacturing constitute the major industry in Curry County, with approximately 75 percent of the total manufacturing employment in the lumber and wood-products sectors. Sixty-five percent of the total land area is in Federal ownership, most of which is commercial forest.

Such a high degree of industrial specialization has historically resulted in seasonal and cyclical periods of unemployment in timber-dependent communities of southwestern Oregon. Any condition which adversely affects nationwide home construction quickly affects the woods-products industry. Therefore, it is one of the first to feel a cutback in times of a downturn in the general economy.

This labor market analysis from Oregon State Employment Division statistics summarizes County employment:

Table 1. 1972 labor market analysis of Curry County, Oregon

	Population	Percent
Total population of Curry County	13,500	—
Number of people in labor market	5,210	—
Number of unemployed	320	—
Percent unemployed	—	6.1
Total number employed labor	4,890	—
Total number employed in lumber and wood products	1,400	—
Percent employed in lumber and wood products	—	28.6

Although only 28.6 percent of the work force is directly employed in the lumber and wood-products industry, an equal number of people in service industries are indirectly supported by the lumber industry. Therefore, the actual timber-dependent employment of Curry County is closer to 57 percent.

Most of the land area in Curry County is mountainous terrain not suitable for tilling. Timber growing and harvesting, sheep raising, and bulb growing are the principal agricultural activities. In addition, two economic groups, tourists and retired persons, are becoming important factors in the Curry County economy. An increasing number of persons each year visit the Rogue River and surrounding area, and many later decide to return and spend their retirement years in Curry County. Income related to recreation also continues to increase each year. Timber, tourism, and retirement income will continue to constitute the area's most important economic factors in the foreseeable future.

The major political factor which can adversely affect mineral development is restriction placed upon the land base by competing usage. At present, Curry County has three major areas (Kalmiopsis Wilderness, Big Craggies Botanical Area, and the Rogue Wild and Scenic River Area) where mineral development faces an uncertain future. It is beyond the scope of this study to determine in detail the effect of these political restrictions. Review of the largest area, the Kalmiopsis Wilderness, however, is in order. This wilderness area occupies 128 sq mi, or about 12.7 percent of Curry County's land base. The U.S. Forest Service has proposed expansion of this wilderness by 29 sq mi, and a wilderness area with much larger square mileage has been the subject of recently proposed legislation. An asterisk beside the number of a metallic mine or prospect shown on the Mineral and Rock-Material Localities map (Plate 2, in pocket) or listed in Table 7 indicates that it lies within the Kalmiopsis Wilderness.

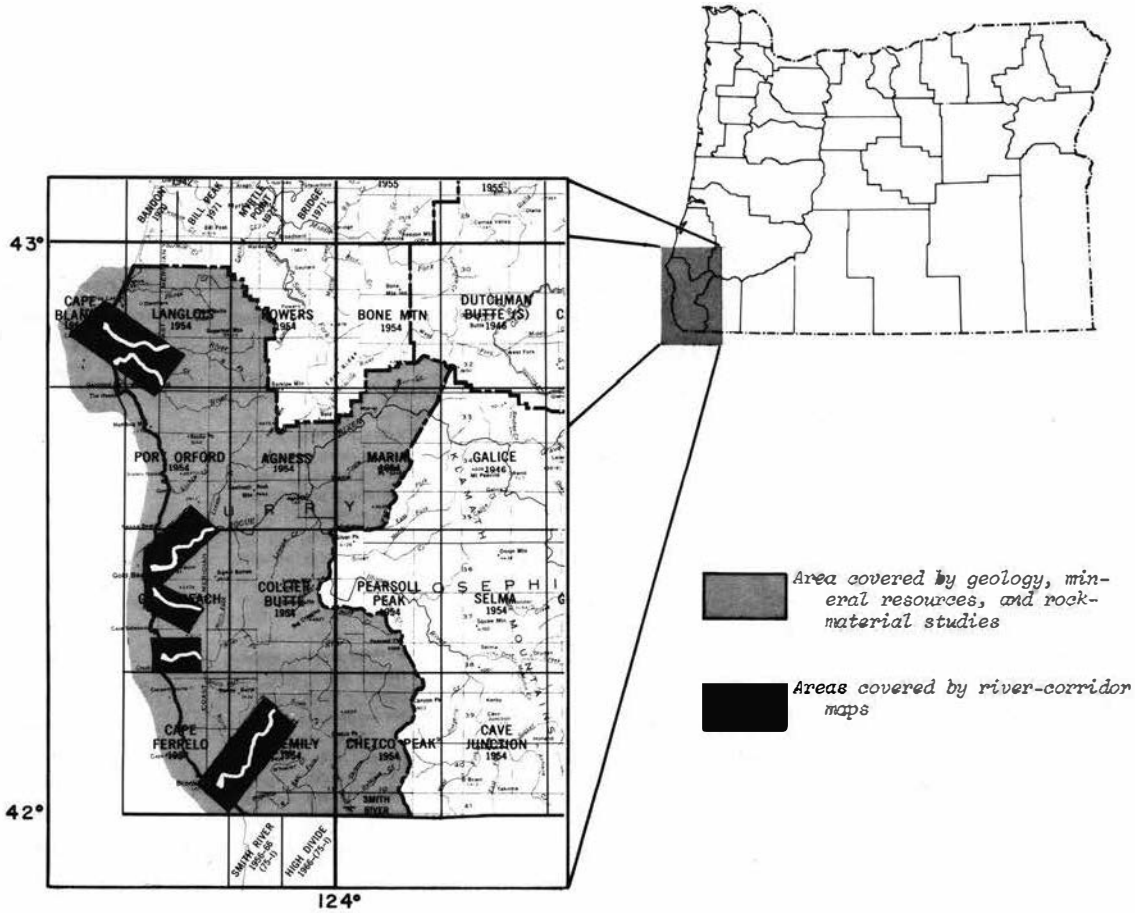


Figure 1. Index map of Curry County, showing USGS 15' quadrangle map coverage.

GEOLOGY

General

The geology of southwestern Oregon, and, in particular, Curry County, has for many years been the subject of much interest, controversy, and confusion. Widespread thrusting, tectonic metamorphism, and complex structural relationships make the area a challenge for the geologist to interpret. The geologic map of Curry County that accompanies this report is, like all other geologic maps, a progress report and subject to future revision. A brief description of each map unit and its mineral-resource potential is given in order from oldest to youngest. These descriptions are followed by a discussion of the complex structural features.

Geologic Units and Mineral-Resource Potential

Amphibolites (ag)

Geology: Amphibolites, including amphibole gneiss, schist, blueschist, and minor quartzite, are generally scattered and limited in exposure. The largest body of amphibolite is exposed west of Chetco Peak (T. 39 S., R. 11 W.). Small patches and lenses also occur along the thrust marking the northern edge of the Josephine ultramafic sheet. A large number of small, unmapped, isolated bodies of amphibolite and blueschist occur on top of rocks of the Otter Point Formation in the northern portion of the County. Other small bodies of amphibolite occur as isolated lenses within sheared serpentinite.

Coleman (1972) discusses the amphibolite and blueschist bodies in detail and reports isolated tectonic inclusions of amphibolite in serpentinite near Iron Mountain (T. 33 S., R. 12 W.) and Game Lake Peak (T. 36 S., R. 12 W.). Amphibolite mapped near Chetco Peak includes quartz-rich hornblende gneiss, lesser amounts of amphibole schist, impure metaquartzite, and gneissic metagabbro like that of the Big Craggies.

Coleman and others (1976) and Garcia (1976) map and discuss amphibolites in the Galice-Briggs Creek area of Josephine County, describing them as metamorphosed oceanic crust derived from basalt and chert. They state that the metamorphic grade (garnet-amphibolite facies) demonstrates that the amphibolites formed at a deeper level in the earth's crust and have been emplaced in juxtaposition with rock of lower grade (greenschist facies) by significant tectonic movement. Age of the amphibolites is uncertain; but Ramp (1975) suggests that at least some of the amphibolites may be equivalent in age to the Upper Triassic Applegate Group.

Mineral-resource potential: Amphibolite is suitable for crushed aggregate and has also been used for jettystone and riprap. The blueschist is usually sufficiently dense and tough enough to produce quality stone for both purposes. The small size and isolated nature of these rocks have been deterrents to extensive development for these uses.

Rogue Formation (Jr, Jrd)

Geology: Volcanic rock, well-exposed along the Rogue River in the Galice quadrangle, Josephine County, was called the Rogue Formation by Wells and Walker (1953). The unit consists of a thick series of fine- to coarse-grained tuffs, agglomerates, flow breccias, and minor lavas of andesitic to basaltic composition. Garcia (1976) divides the Rogue Formation into upper and lower units: the lower unit consists of coarse basaltic to andesitic agglomerates, tuff breccias, and lapilli tuffs; the upper unit is predominately fine-grained basaltic to rhyolitic tuff with minor basalt flows. Well-bedded tuffaceous sediments are mapped in the upper Chetco drainage area of Curry County (Ramp, 1975).

Rocks of the Rogue Formation have been metamorphosed to the greenschist facies, a low-grade regional metamorphism with characteristic secondary minerals including chlorite, calcite, albite, quartz, epidote, prehnite, pumpellyite, and hematite in basic volcanic rocks and chlorite, sericite, epidote, and clinozoisite in sedimentary rocks (Garcia, 1976).

In a few places such as Eagle Mountain, near the Josephine County line, Gray Butte, west of Horse Sign Creek, and the area west of Saddle Mountain on Lawson Creek drainage, the Rogue Formation has been intruded by numerous diabase and gabbro dikes and has the appearance of an intrusive body. The Rogue Formation, exposed in the northeastern arm of Curry County to the north and southwest of Marial, also has fairly abundant gabbroic dikes and irregularly shaped intrusive masses.

Mineral-resource potential: The Rogue Formation has in recent years become a target area in the search for volcanogenic sulfide deposits of copper, gold, silver, and zinc. A number of small gold and copper prospects occur in the formation, and a few areas of disseminated sulfides and gossan areas are of real interest to prospectors. Most of the rocks of the Rogue Formation are also suitable for use as aggregate in the construction of roads.

Galice Formation (Jg, Jgv)

Geology: Patches of Galice Formation occur in the area surrounding Pearce Peak diorite in the Elk River drainage, in the area around Iron Mountain, and in the headwaters of the South Fork of the Sixes River.

The rocks are characteristically fine-grained to medium-grained sediments (mudstone to graywacke and minor conglomerate) with some related volcanics. The entire formation has undergone low-grade metamorphism. Mudstone and siltstone have slaty characteristics; graywacke is indurated, fractured, and quartz veined; and the volcanic rocks (tuffs, agglomerates, and flows, including pillow lavas) are altered to greenstone and are not distinguishable from the Rogue Formation.

The Galice Formation overlies the Rogue Formation conformably in the type area. Based on fossil evidence, the age of the Galice Formation is middle Upper Jurassic.

Mineral-resource potential: Mineralization in the Galice Formation occurs in the South Fork of the Sixes River area. Gold occurs in association with sulfide minerals in quartz veins and mineralized shear zones, especially those between Galice rocks and serpentinite. The formation has been intruded by diorite dikes and stocks that probably furnished heat and volatiles to concentrate, transport, and deposit minerals. The Galice Formation is generally less mineralized than the Rogue Formation. The volcanic rocks (greenstones) are generally acceptable for use in road construction, both as base rock and as surfacing rock. In some areas, slaty sediments are used for road-base rock.

Colebrooke Schist (Jc, Jcv)

Geology: The Colebrooke Schist was named by Diller (1903) for exposures on Colebrooke Butte (T. 34 S., R. 14 W.). The formation includes tectonic metamorphic rocks derived mainly from fine-grained sedimentary rocks and subordinate amounts of submarine basalt. Lesser amounts of metasandstone, a few bodies of metachert that look like fine-grained quartzite, and occasional small areas of stretched-pebble conglomerate are also included in the unit.

The predominant rock type is a silver-gray, fine-grained schist or phyllite with abundant quartz veins. Coleman (1972) describes in detail the lithology, mineralogy, structure, and origin of the Colebrooke Schist. He has shown by chemical analyses that the most likely protolith of the Colebrooke Schist is the Galice Formation.

It appears probable that both the Galice Formation and the Rogue Formation have been altered in zones of thrusting to form the Colebrooke Schist. The small patches of phyllonite mapped along thrust faults in the vicinity of Vulcan Peak (T. 39 S., R. 11 W.) are probably equivalent to the Colebrooke Schist, and these rocks are apparently derived from the Rogue Formation.

Mineral-resource potential: Metavolcanic rock of the Colebrooke Schist is suitable for use as road metal, riprap, and jettystone. These rocks should also be prospected for possible volcanogenic sulfide deposits having gold-copper mineralization. The metasedimentary part of the formation probably has little or no mineral-resource potential.

Ultramafic rocks (Jur)

Geology: Serpentinite and various peridotites including harzburgite (saxonite), dunite, and pyroxenite occur in several areas of Curry County. The largest body is that of the Josephine ultramafic sheet, which is located in the southeastern corner of the County and which extends east into Josephine County and south into California. Other important localities are the Collier Creek-Game Lake area, the area surrounding Snow Camp Mountain, the Red Flat-Signal Buttes area, and the Iron Mountain area. In addition to these bodies, a number of smaller thrust-plate remnants and relatively thin, sheared serpentinites occur in zones of major faulting. As with the Colebrooke Schist, the presence of sheared serpentinite implies an area of profound tectonic movement. Serpentinite and peridotite form both the upper part of the thrust plate in a number of areas described above and also the sole, or lower part, of the upper plate in places such as the Big Craggies and the area of Colebrooke Schist of White Mountain, Summit Mountain, and Edson Butte in northern Curry County. Serpentinite, like Colebrooke Schist, is often involved in landsliding; and the presence of ubiquitous landsliding often obscures original bedrock distribution.

Degree of serpentinization ranges from fresh harzburgite and dunite bodies in a few areas in the eastern part of the County to complete alteration where remnant primary olivine and pyroxene minerals are completely lacking. Most of the "peridotites" of Curry County that retain their primary texture contain more than 50 percent by weight of serpentine minerals. Ultramafic rocks normally have a relatively high magnetic susceptibility and show up as positive anomalies on airborne magnetometer surveys.

Coleman (1972, p. 23) reports:

> ..... "Aeromagnetic anomalies related to the exposed serpentinites demonstrate that they are generally thin tabular sheets. However, anomalies most certainly resulting from concealed masses of serpentinite suggest that these tabular bodies may dip steeply into and beneath the Dothan graywackes and that the amount of serpentinite in the upper crust of this area is more extensive than implied by the surface map."

It is generally accepted that these ultramafic rocks, formed in the lower crust-upper mantle zone beneath the ocean, represent the base of an ophiolite sequence originally overlain by gabbro, submarine basalt, and deep ocean sediments. These rocks were then tectonically emplaced into the continental crust.

Age of the ultramafic rocks is uncertain. After their original formation, recrystallization probably occurred, following periods of partial melting that resulted from release of pressure during the rise of the rocks into the crust. Serpentinization probably began while the rocks were still cooling as they first came in contact with water-bearing formations. Serpentinization may have been gradual, occurring as the necessary water became available and as the rocks were further sheared during their long history of emplacement. Dick (1976) obtained an average K-Ar age of 150 m.y. for a large number of gabbroic and diorite dikes and stocks intruding the Josephine peridotite body. This age is similar to age-dating results of the Chetco River gabbro complex (Hotz, 1971b).

Additional scientific reports related to ultramafic rocks in Curry County include those by Himmelberg and Loney (1973) and Loney and Himmelberg (1976) on the Vulcan Peak area and by Medaris and Dott (1970) on the Vondergreen Hill body, about 6 mi north of Gold Beach.

Mineral-resource potential: Ultramafic rocks are a source of chromite, nickel, some copper, asbestos, and, possibly, other industrial minerals including serpentinite for admixture with superphosphate fertilizers and olivine for use in refractory brick and the production of foundry-casting sand. Although peridotite has been used as crushed aggregate, it is generally considered inferior for this purpose. A few magnetite-rich pyroxenites and hornblendic metapyroxenites have been prospected as a possible source of iron in the vicinity of Tincup Peak (T. 37 S., R. 10 W.).

Gabbro, metagabbro, and hornblendic metapyroxenite (gb, mg, hm)

Geology: The largest body of gabbroic rocks is mapped in the upper Chetco River drainage east of the Dothan Formation and west of the Pearsoll Peak peridotite body. A few medium-sized bodies of gabbroic composition associated with the Galice Formation and ultramafic rocks are mapped in the vicinity of Iron Mountain. Smaller bodies, including gabbro dikes, are associated with ultramafic rocks in the Collier Butte quadrangle within a 6-mi radius of Snow Camp Mountain. A number of other scattered gabbro and diabase dikes of similar age also penetrate ultramafic rocks and rocks of the Rogue Formation.

Most of the metagabbros appear to be tectonically deformed and in part look much like amphibolites. Gneissic metagabbros are mapped on the southern margins of the Illinois-Chetco gabbro-diorite complex, in the Big Craggies, at various points along the lower Illinois River from Collier Creek to Indigo Creek and along North Fork of Indigo Creek, where they are associated with Rogue Formation metavolcanic rocks. Areas of metagabbro are also mapped in the vicinity of Marial in the Mule Creek drainage and along the Rogue River downstream from Marial. In this area they are more or less intimately associated with Rogue Formation volcanic rocks, and details of their true distribution are incomplete. Metagabbro mapped along the California border in the extreme southeastern corner of Curry County by Wells and others (1949) and Vail (1977) is generally less gneissic than the rest.

Mineralogy of the gabbro varies with degree of alteration and with the initial whole-rock chemistry. Rocks in the large Chetco River complex, as it is referred to by Hotz (1971b), include hornblende gabbro, two-pyroxene gabbro, hornblende diorite (epidiorite), and some intermixed quartz diorite. Bands of pyroxenite also occur, and alteration of these rocks has produced the exotic and very coarse-grained hornblende-plagioclase rocks of the upper Chetco area. The metagabbros and epidiorites are often banded and generally have cataclastic textures, very little remaining pyroxene, abundant hornblende, and some secondary epidote, albite, chlorite, and quartz.

Coarse- to very coarse-grained hornblende-plagioclase rock or hornblendic metapyroxenite (hm) that is mapped in the upper Chetco drainage and Big Craggies area (Ramp, 1975) can also be classed as a gabbro. The rock is described by Wells and others (1949) as pegmatitic hornblende diorite and by Dick (1976) as pegmatitic hornblende gabbro. Dick implies that these rocks are truly igneous in nature and that they intrude and crosscut the other older gabbro and gneissic pyroxenite as a large sill-like mass.

Mineral-resource potential: A few scattered sulfides including minor disseminated pyrite and chalcopyrite have been seen in the gabbro, but no known commercial deposits have been found. The gabbro generally has fairly abundant magnetite, and a few magnetic anomalies which show up over the main Chetco complex may indicate significant concentrations of magnetite. The gabbro and metagabbro are suitable for most aggregate usage, and the larger blocks appear to be usable as riprap and jettystone.

Diorite and related rocks (di)

Geology: The largest body of diorite mapped in Curry County is the Pearse Peak pluton, located mainly on Elk River. Next in size is the body located on the upper Baldface Creek on the southeastern edge of the County. Among other smaller bodies are the hornblende diorite body in the headwaters of Diamond Creek on the California line and small bodies located on the head of Sixes River, at Collier Butte, and on the south flank of Iron Mountain. Lund and Baldwin (1969) describe the geology and mineralogy of most of the diorites in the northern portion of the County.

The diorite body at the head of Baldface Creek (T. 40 S., R. 10 W.) is described by Wells and others (1949) as granodiorite containing pendants of partly serpentinized saxonite cut by hornblendite. The North Fork Diamond Creek diorite to the south of the Baldface Creek body is described by Wells and others (1949) as granodiorite lying along the east side of an equally large mass of black hornblende-rich diorite.

A number of the "diorite" plutons, although relatively small, are actually mixtures of more than one igneous rock type with varying mineral content. "Quartz diorite" is found at a few places within and along the east margin of the large gabbro complex on the upper Chetco drainage. Some small dikes penetrating the Josephine ultramafic rocks are of variable composition from rhyolite and dacite to diabase, hornblende diorite, and gabbro. The dikes of dacitic and rhyolitic composition are similar to those

intruding the Dothan Formation, and are designated as "Ti". Dick (1976) obtained a K-Ar age date of 24 m.y. (early Miocene) for a dike on the Chetco River near Broken Cot Creek (T. 39 S., R. 10 W.). Most of the diorites have medium-grained granitic texture and were apparently emplaced slightly later than the gabbro but during the Late Jurassic Nevadan orogeny.

Mineral-resource potential: Gold mineralization in the pre-Nevadan rocks is believed to be related to the diorite (granitic) plutons that furnished heat and some of the volatile constituents necessary to gather, transport, and deposit minerals found in ore-bearing quartz veins. The size of granitic intrusive bodies apparently has no correlation to the amount of associated mineralization. Even small dacite or diabase dikes are believed to have influenced mineralization in some areas of the Klamath Mountains (Hotz, 1971a).

Locally, diorite rocks have been used satisfactorily in Curry County as crushed road-aggregate material. The degree of decomposition affects the quality. Other possible uses for the fresh (unweathered) diorite include building stone or riprap.

Dothan-Otter Point Formations (Jdo, Jv)

Geology: The Dothan and Otter Point Formations, which are of the same age and somewhat similar lithologies, cover a larger area than any of the other rock formations, approximately one-half the total area of Curry County. Fossils found along the Chetco River a short distance upstream from the mouth of Boulder Creek (sec. 7, T. 38 S., R. 11 W.) (Ramp, 1969) establish the age of the Dothan as latest Jurassic (Tithonian stage), equivalent to the Otter Point Formation. The formation, named for exposures at Otter Point (Koch, 1966), consists of a fractured to highly sheared sequence of graywacke and mudstone with subordinate chert, andesitic and keratophyric breccia, pillow basalt, minor conglomerate, and occasional limestone lenses in the graywacke-mudstone sequence.

Type locality for the Dothan Formation, named by Diller (1907), is along Cow Creek in southern Douglas County. Lithology of rocks of the Dothan Formation is quite similar to those of the Otter Point, but the Dothan Formation has a lower percentage of volcanic rock and has been notably less sheared. The mineralogical makeup of the sandstone also differs in that the source material for the eastern Dothan apparently includes a greater amount of plutonic rock such as quartz diorite while the source of the western Dothan and Otter Point includes a larger percentage of andesitic rock (M.C. Blake, Jr., personal communication, 1977).

Graywacke sandstone of both formations is normally quite fractured and penetrated by small quartz and occasional calcite veinlets. Index fossils *Buchia piochii* are found in both formations. Near the mouth of Euchre Creek, well-preserved *Buchia piochii* occur in small limestone lentils in the sheared Otter Point sandstone-siltstone sequence (R. G. Coleman, personal communication, 1975).

Structurally, the Dothan and Otter Point Formations form the lowest rocks in the section. They have been thrust under older formations including Colebrooke Schist, ultramafics, Rogue Formation, and Galice Formation. Cretaceous and Tertiary sediments unconformably overlie these formations. The Dothan Formation is equivalent to the Franciscan Formation to the south in California.

Mineral-resource potential: The Dothan and Otter Point Formations generally lack any metallic mineral-resource potential. The massive graywacke sandstone has been used for road metal in areas where rock of better quality is not available. The metavolcanic rock, including pillow basalt and greenstone (altered tuffs and breccias), is of fair quality for road-metal use. Some quarries in Dothan volcanic rock have supplied riprap and some jettystone (see Table 2). Colored banded cherts of the Dothan and Otter Point Formations are the sources of jasper pebbles found on the beach and collected by rock hounds for lapidary use. An excellent example of multicolored banded chert is Rainbow Rock, which crops out on the beach about 3.5 mi north of Brookings. Larger chert bodies, such as those on the Chetco River near the big bend south of High Prairie (T. 38 S., R. 12 W.), may have application as aggregate. Manganese-bearing cherts are also found in the Dothan and Otter Point Formations. If sufficient weathering and leaching out of the silica has occurred without much erosion, a residual concentration of manganese oxides may be found on the surface, for example, the Long Ridge prospect (sec. 13, T. 38 S., R. 12 W.).

Cretaceous sedimentary rocks (Km, Ku)

Geology of sedimentary rocks of lower Cretaceous age (Km): Lower Cretaceous rocks include the Humbug Mountain Conglomerate, Rocky Point Formation, and Myrtle Group. The Rocky Point Formation, which is the name given by Koch (1966) to a sequence of alternating sandstone and mudstone exposed in sea cliffs north of Humbug Mountain, contains some interbeds of chert-pebble conglomerate. The Rocky Point Formation overlies and grades into the Humbug Mountain Conglomerate. Rocks best exposed at Humbug Mountain along the coast and to the north in the vicinity of Port Orford form the Humbug Mountain Conglomerate and Rocky Point Formation (Koch, 1968). The Humbug Mountain Conglomerate includes several thousand feet of massive, thick-bedded, well-indurated conglomerate which grades upward into dark-gray sandstone. Clasts in the conglomerate, in order of decreasing abundance, include chert, schist, diorite, greenstone, sandstone, and quartz, as well as a few pebbles of argillite, phyllite, and dacite porphyry.

The Myrtle Group, originally mapped as a formation by Diller (1898) in the vicinity of Myrtle Creek in Douglas County and later mapped in the Port Orford quadrangle (Diller, 1903), included all area sedimentary rocks older than the Tertiary. Later mapping has led to the division of Diller's Myrtle Formation into the Galice, Dothan, and Otter Point Formations, as well as the Cretaceous rocks of Humbug Mountain Conglomerate and Rocky Point Formations.

Difficulties have been experienced in subdividing Myrtle Group rocks from the Otter Point Formation, for example, in the area along both sides of the Rogue River from 3 to 7 mi above the mouth. In mapping done for this report, Lower Cretaceous sediments have been subdivided from rocks previously mapped as Otter Point. A few, poorly preserved, broad-shelled Buchia fossils, believed to be Early Cretaceous in age, were found in mudstones on the north side of the river at about the section line between secs. 10 and 11, T. 36 S., R. 14 W. Distinctive chert-pebble conglomerates of the Myrtle Group are exposed at several places including Pebble Hill, Huntley Spring, and Horse Sign Butte (see Figure 2).

Geology of Late Cretaceous rocks in the Cape Sebastian area (Ku): Dott (1971) describes Late Cretaceous fossil-bearing sedimentary rocks in the vicinity of Cape Sebastian, extending south along the coast to a point near the mouth of Houstenader Creek (sec. 9, T. 39 S., R. 14 W.). He divides the rocks into two new formations: Cape Sebastian Sandstone, about 900 ft thick; and the overlying Hunters Cove Formation, about 1,000 ft thick. The Cape Sebastian Sandstone includes some conglomerate near the base containing clasts derived in part from rocks of the unconformably underlying Dothan-Otter Point Formations. The sandstone, which weathers to light tan, is very massive, arkosic, and often displays cross bedding. The overlying Hunters Cove Formation is a sequence of alternating thin sandstone and mudstone layers. Dott (1962) mapped 1,500 to 2,000 ft of Upper Cretaceous sediments in sea cliffs extending 0.5 mi northeast of Blacklock Point (sec. 19, T. 31 S., R. 15 W.). Dott (1971) correlated these rocks with the Hunters Cove Formation. A similar mudstone-siltstone sequence was mapped by Lent (1969) in a down-faulted graben on Edson Creek (secs. 3, 4, and 5, T. 32 S., R. 14 W.). These Upper Cretaceous sediments of the Cape Sebastian and Hunters Cove Formations have been deformed and commonly have dips of 40° or greater.

Mineral-resource potential: Sedimentary rocks of Cretaceous age have limited potential. Some use has been made of the more massive sandstone and conglomerate for fill and subgrade road metal. They are not normally considered hard enough for use as surface road metal or riprap. Late Cretaceous massive sandstone may also have limited application as building stone.

Tertiary sediments (Ts)

Geology: Rocks grouped under Tertiary sediments (Ts) on the geologic map (Plate 1, in pocket) include several formations belonging mainly to the Umpqua "Group" that Baldwin and others (1973) and Baldwin (1974) have subdivided into the lower Roseburg Formation, middle Lookingglass Formation, and upper Flournoy Formation. Only small areas of the Roseburg Formation are found in Curry County, occurring in patches along the northern border and a small area along the faulted western margin of undifferentiated Tertiary sediments in the Agness-Illahe area. Most of the remainder of the area between Illahe and Tate

Creek is designated as Flournoy by Baldwin (1974). The north flank of Moon Mountain (T. 32 S., R. 14 W.) is also designated as Flournoy. A nearby 2-mi-wide patch north of Illahe is mapped as Lookingglass Formation, as are most of the remaining areas of Tertiary sediments mapped in the County (Baldwin, 1974). The lithology of the Tertiary sediments includes rhythmically bedded sandstone and shale with pillow basalts in the Roseburg Formation; a thick, massive, conglomerate base and overlying rhythmically bedded sandstone and siltstone in the Lookingglass Formation; and a thick, massive, olive-green, micaceous sandstone with a few pebbles near the base and an overlying gray siltstone with minor interbedded sandstone in the Flournoy Formation. A profound angular unconformity occurs between the Roseburg and Lookingglass Formations, and a smaller angle unconformity exists between the Lookingglass and Flournoy Formations. Total thickness of the Tertiary sediments in Curry County is only a fraction of their aggregate thickness to the northeast in Coos and Douglas Counties, where a total of about 20,000 ft of sediments and underlying pillow basalts make up the Umpqua "Group."

The Roseburg Formation generally dips fairly steeply in comparison with other units except near areas of profound faulting as along the north-trending Coquille River fault, which marks the western boundary of the Tertiary sediments north of Agness. Tertiary sediments mapped in Curry County range in age from Paleocene to early middle Eocene (Baldwin, 1974). The small patch of old stream gravels in Gold Basin is dated as Miocene or Pliocene by Wells and others (1949).

Mineral-resource potential: Pillow basalts of the lower Tertiary Roseburg Formation are a major source of stone material in Coos County to the north but do not occur in large deposits in Curry County. The Tertiary sediments are of interest mainly for coal beds that occur in the Lookingglass Formation on the upper Sixes River and near the base of the Flournoy Formation near the mouth of Shasta Costa Creek in the Agness area. The black-sand deposit on Horse Sign Butte ridge (T. 36 S., R. 11 W.) is correlated with Tertiary sediments (Baldwin, 1968).

Tyee Formation (Tet)

Geology: The Tyee Formation is composed of cliff-forming, rhythmically bedded, buff to greenish-gray, medium- to coarse-grained, micaceous sandstone and dark mudstone with massive, cross-bedded, pebbly sandstone and conglomerate. The Tyee Formation caps older Tertiary sedimentary rocks along the Coos County line north of Illahe and west of Marial, as, for example, at Hanging Rock.

Mineral-resource potential: The Tyee Formation is coal bearing in the Eden Ridge area a short distance north of the County line, but its exposures in Curry County are very limited. No coal measures are reported for this portion of the formation.

Tertiary intrusive rocks (Ti)

Geology: A number of dacitic and rhyolitic dikes and sills intrude the Dothan Formation and the Josephine peridotite body. Dikes and sills are concentrated to the north of Brookings and in the areas of Winchuck River and Mount Emily. Dacite dikes intruding peridotite in the southeastern part of the County, although mapped with other intrusives as "dike rocks," are probably mostly Tertiary in age. Dick (1976, p. 92) determined by K-Ar geochronology of potassium feldspar from a dike on the Chetco River above Broken Cot Creek (T. 39 S., R. 10 W.) that the age of the dike is 25 m.y.; Dott (1971, p. 50) reports a K-Ar whole-rock determination from a dike at Harris Beach State Park yielded a date of 30 $\pm$ 1 m.y. The Tertiary intrusive rocks are therefore late Oligocene or early Miocene in age. Widmier (1962) proposed the name "Emily Rhyolite," describing the rocks as rhyolite porphyry, occurring as dikes and sills that are more or less concordant with the Dothan sediments they intrude. The dikes vary from a few inches to more than 0.5 mi in width (Figure 3).

Mineral composition of the rhyolites is reported by Widmier (1962) to include quartz, orthoclase, plagioclase, and amphibole phenocrysts in a fine siliceous matrix. The rhyolites also contain accessory iron minerals, zircon, and graphite in some dikes. Dott (1971, p. 50) describes a few, small, west-trending, dark-gray dioritic to gabbroic dikes which cut Otter Point strata along the coast between Thomas Creek and Horse Prairie Creek in secs. 21 and 28, T. 39 S., R. 14 W. A fresh sample of one of

these small (1- to 2-ft-thick) dikes taken from a U.S. Highway 101 roadcut was dated by whole-rock K-Ar dating as 28 ± 1 m.y., essentially the same age as the Emily Rhyolites. The weathered dacites and rhyolites are a light tan to darker brown with concentric brown bands. Fresh surfaces are mottled light gray.

Butler and Mitchell (1916, p. 35) describe the occurrence of a coarse-grained syenite porphyry dike on Mount Emily. Small dikes fitting this description were mapped on and near the top of Mount Emily during the present study.

Mineral-resource potential: The rhyolites and dacites have been used locally for decorative and building stone and appear to be well suited for this use. Rhyolites have also been quarried for use as road-base rock and surfacing. A few old prospects in the Mount Emily area all appear to be directly related to the rhyolites which intrude the Dothan Formation. Reported occurrences include gold, zinc, molybdenum, and a possible mercury-arsenic geochemical halo. No commercial metal deposits have been found to date, but further exploration of the area may be warranted. Although no testing is known to have been done, it is possible that in areas of sufficiently deep weathering, the rhyolites may develop a light-firing clay which may be suitable for fire brick or other ceramic use.

Tertiary stream gravels (Tg)

Geology: Cemented stream gravels covering an area of about 250 acres are deposited on a relatively flat erosional surface in Gold Basin at an elevation of about 4,000 ft (Ts. 37, 38 S., R. 10 W.). The gravel deposit is reported by Diller (1914, p. 96) to be as much as 110 ft thick where best exposed at its southern edge, but it thins rapidly to the east and west. Wells and others (1949, p. 16) suggest a Miocene or Pliocene age for the gravels. The gravels are deposited on gabbro bed rock.

Mineral-resource potential: These gravels have been tested for gold content, and a minor amount of placer mining has been conducted at the very head of Tincup Creek where the gravels are weathered. Values are reported to be very limited (Diller, 1914, p. 96).

Unconsolidated Quaternary deposits (Qus)

Geology: These deposits include beach sand on present beaches and elevated terraces; dune sand; stream-deposited alluvium, both in present streams and in elevated bench gravels; and glacial moraine material. The scale of the geologic map accompanying this report does not permit detailed presentation or subdivision of these materials. A better description of them and presentation on larger scale maps is available for the western part of the County (Beaulieu and Hughes, 1976).

Four levels of marine-terrace deposits are recognized along the coastal area. The upper terraces are older and more deeply dissected by erosion. Beach sands include fine, quartz-rich, gray sands with a few thin horizons of wave-concentrated, heavy-mineral bearing black sand and small areas of wind-deposited dune sand. Major streams draining Curry County have an abundant supply of sand and gravel (alluvium) of fair to good quality along their lower reaches. A number of small, isolated areas of high and lower bench gravels can be found on ridge tops and flanks of ridges and terraces.

A few small patches of glacial moraine occur at the head of the Box Canyon Creek drainage below Vulcan Lakes (T. 39 S., R. 11 W.), on Fresno Creek, at the head of the creek between Broken Cot and Madstone Creeks (T. 39 S., R. 10 W.), and at Game Lake (T. 36 S., R. 12 W.). The moraine deposits are unsorted, coarse to very fine, rock material that is generally poorly cemented.

Mineral-resource potential: The principal resource value of the unconsolidated Quaternary deposits is in the production of sand and gravel. Availability and quality of this resource are covered in a later chapter. Although the regular gray-colored beach sands and dune sands have had little commercial application, dune sands in other areas have been shown to be suitable for making glass (Carter and others, 1964); for example, there is a minor established use of Coos County sand for foundry-casting sand and sandblasting (Baldwin and others, 1973).

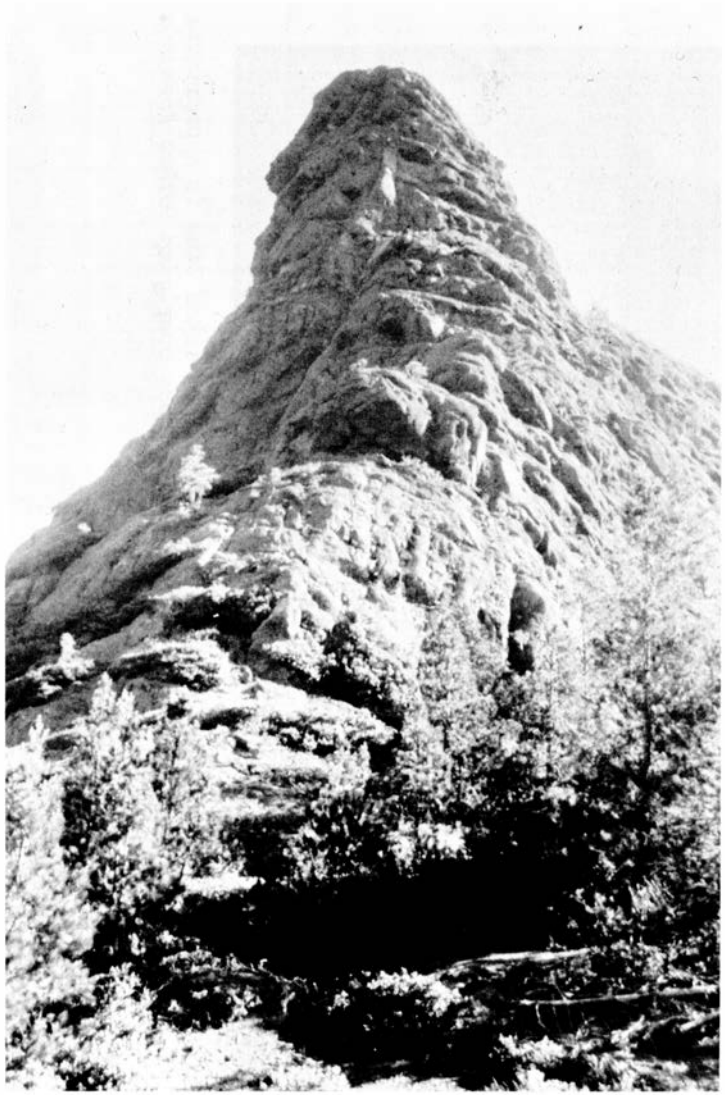


Figure 2. Horse Sign Butte, facing northeast. The butte is composed of Lower Cretaceous Myrtle Group chert pebble conglomerate beds which dip gently away from the viewer.

Figure 3. Small dacite or rhyolite dike in sheared Dothan Formation sediments exposed on south side of Mount Emily. Note geologist's pick for scale.

Block-sand lenses and layers found in terraces and back beaches contain varying amounts of chromite, gold, platinum, and various other heavy minerals that hove some value if concentrated in sufficient quantity. Stream-deposited gravels on benches and bars are known to contain gold values in a few areas of Curry County. The better known areas include the upper Chetco River and the Little Chetco, Carter, Bobyfoot, and Slide Creeks (T. 38 S., R. 10 W.); Bonanza Basin at the head of Boulder Creek, tributary to Lobster Creek; and the Sixes River, mainly the South Fork and the main stream below the forks. Platinum is also a minor constituent of some of these deposits and has been noted in the upper Chetco drainage (Ramp, 1975, p. 40). Mineral-resource potential of offshore unconsolidated sediments has been tested in only a reconnaissance manner (Clifton, 1968).

Structure

Attempting to describe in simple terms a complex structural area such as Curry County is a difficult, if not impossible, task. It has been attempted by Beaulieu and Hughes (1976, p. 35-38), and a brief summary of the tectonic history is given in this section.

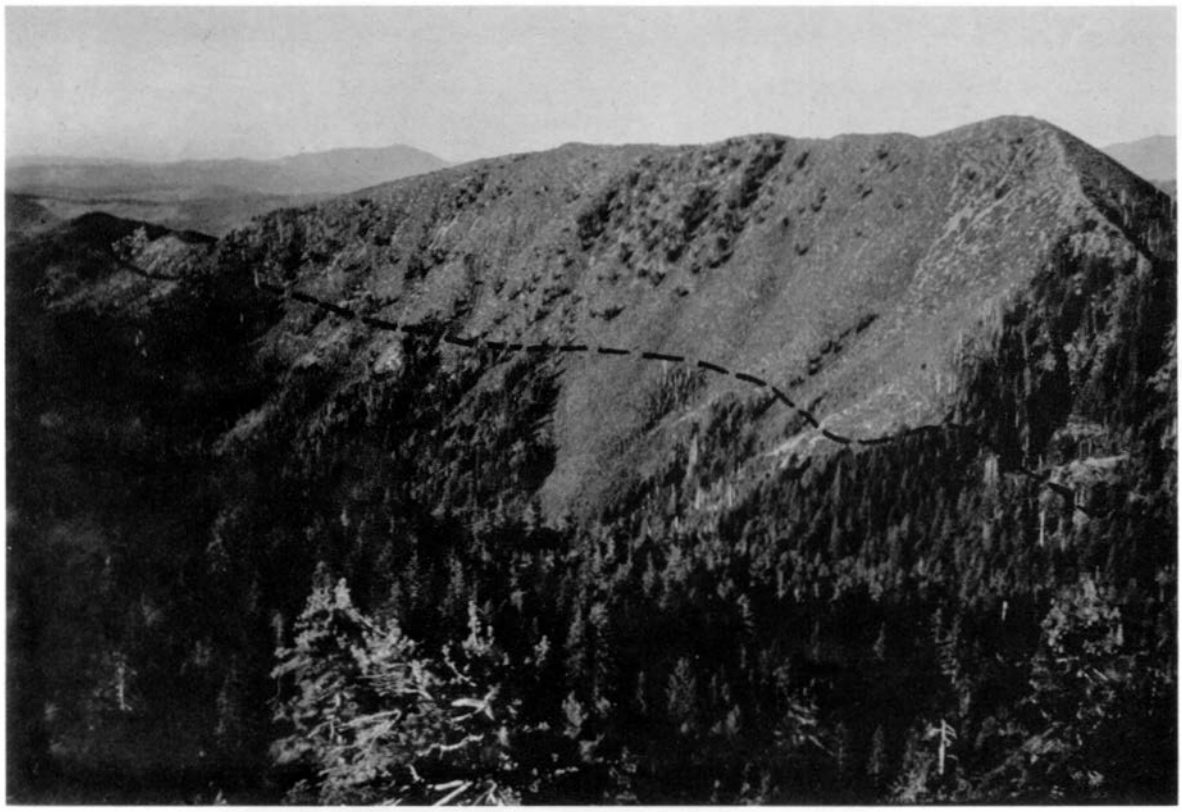


Figure 4. South end of Big Craggies, facing southwest. Dashed inked line is approximate thrust fault contact of metagabbro and serpentinite klippe overlying Dothan Formation sediments.

Thrust faulting

The principal structural feature in Curry County is a complex system of thrust faulting in which relative displacement of the overlying plates is in a west to northwesterly direction and of the underlying plates is in an east to southeasterly direction. Some basic observations regarding this system of thrusting are as follows:

1. More than one plane of thrusting is present. These planes appear to converge and intersect in the upper Chetco area.
2. Rock formations closer to the planes of thrusting display a greater degree of tectonic metamorphism and form gneiss, schist, phyllonite, and mélange. The Colebrooke Schist and amphibolites are good examples of tectonic metamorphism.
3. Older formations generally occur in the upper plate (see Figure 4).
4. The western portion of the thrust plane is an undulating blanketlike feature that becomes steeper and plunges at its line of emergence (the easternmost exposures).
5. Landsliding and numerous high-angle faults have complicated the overall structural picture.
6. Sheared serpentinite has been drawn into most of the major fault zones.

High-angle faulting

Several younger, high-angle, nearly vertical, north-trending faults and shear zones have offset the main plane of thrusting (see Plate 1, cross section A-A'). Major examples of this north-trending fault system include the fault which marks the contact between the Dothan and Rogue Formations in the vicinity of Marial, the Coquille River fault extending north from Agness, and the Mountain Well fault (Coleman, 1972), which splits the large patch of Colebrooke Schist and appears to have a hinge or rotational displacement. A number of other faults and shear zones belonging to this system are present in the area, and the principal ones are mapped. The presence of sheared serpentinite within Otter Point and Dothan terrane is probably best explained by its penetration along these high-angle faults and shear zones. The serpentinites overlying these younger rocks are erosional remnants of thrust plates and landslide blocks that, in some cases, have migrated a considerable distance downslope to their present positions and have become intermixed with the jumbled sedimentary rocks.

Lower Cretaceous sedimentary rocks of the Myrtle Group occur both above and below the thrust plate. Where they are found above, they are interpreted as having been deposited unconformably on top of the older rocks in the upper plate and carried along with them during movement of the thrust. These rocks were later downfaulted along the system of high-angle faults in areas such as Windy Valley and Agness so that they have been protected from erosion.

Age of faulting

Thrusting may have begun during latest Jurassic time, perhaps immediately following the Nevadan orogeny and during deposition of the Dothan and Otter Point Formations. The thrusting then continued, perhaps in surges, during the Cretaceous and apparently ended in the early Tertiary. Baldwin and Lent (1972, p. 125) suggest that thrusting of the Colebrooke plate at Edson Butte in the northern part of Curry County occurred during early Eocene time. Most of the high-angle faulting probably began after the period of thrusting. Movement along a few high-angle faults took place prior to deposition of Tertiary sediments and then occurred again following deposition of these sediments. This pattern of repeated movement is true of the Dothan-Rogue boundary fault extending southwesterly from Marial. Minor but distinct offsets can be seen in these early middle Eocene sediments (Flournoy Formation) (Baldwin, 1974) that overlap the fault, both on Burnt Ridge and on the ridge which extends west from Bobs Garden Mountain.

Most of the high-angle faults have profoundly displaced Tertiary sediments; and a few may well have sustained some movement as late as early Quaternary time, thereby offsetting Pliocene beds (Beaulieu and Hughes, 1976, p. 38). Beaulieu and Hughes (1976, p. 42) suggest that all faults in Curry County

are presently inactive, with the possible exception of the Port Orford shear zone, a zone of highly sheared rock about 1 to 2 mi wide extending in a northwesterly direction through Cape Blanco, Port Orford, and the Humbug Mountain area.

Folding

All rock formations except the unconsolidated Quaternary sediments have been folded to some extent. Most of the older formations, including the Colebrooke Schist and the Rogue and Galice Formations, have been tightly folded and, in many areas, overturned. Dips are generally steep, and the folding pattern is generally isoclinal. The Dothan and Otter Point Formations are also folded, and, except for a few small-scale drag folds near zones of intraformational shearing and thrusting, the folding is generally more gentle and open than that of the older formations.

Areas of very steeply dipping beds and some areas of overturned beds also occur in Cretaceous and Tertiary sedimentary rocks. Away from the fault zones, the folds are generally more open, and dips are relatively gentle. Axes of folding generally trend in a northerly direction, although local east-west axes of folding are found in Tertiary and Cretaceous rocks in the northern part of the County.

ROCK-MATERIAL RESOURCES

General

Rock material is any naturally formed mass of consolidated or unconsolidated mineral matter, and the term is also applied to those mined products that are obtained from such a mass. Deposits include clay and shale, sand and gravel, and stone. Mined products include material mined as pit or quarry run, and/or processed by crushing, and/or screening, and/or drying. Processing does not include calcining or other treatments by which physical characteristics of the rock material are changed.

The only rock materials that have been mined in Curry County are sand and gravel, stone (both crushed and dimension), and minor amounts of clay. The importance of field surveying of each site that has evidence of past mining cannot be overstressed. These sites have "grandfather" zoning rights, and much of the data needed for planning is obtainable only by on-site examination. Although much of the data on individual mining sites submitted to public agencies by owners are, by law, confidential, data obtained by the State Department of Geology and Mineral Industries on-site survey can be published. Lands that showed no evidence of past mining were not surveyed, even though they may contain future reserves. The U. S. Forest Service has a few sites that were not found by this survey, but they probably do not number more than 10 percent of the present total. A survey of all rock-material reserves of Curry County is beyond the scope of this report.

Clays

Use of natural clays from Curry County has been very limited. The Squaw Valley Brick Company, a small brick plant located in the NW$\frac{1}{4}$ sec. 4, T. 36 S., R. 14 W., operated for a short time in the 1920's (J.W. LeClair, personal communication, March 2, 1977). Clay was obtained from a small slide of weathered Myrtle (?) shale. Absence of a large pit indicates very limited production. A few areas of deeply weathered rock, including landslide areas in Dothan-Otter Point Formations and some Cretaceous and Tertiary sedimentary rocks, have produced common clay of untested quality.

Considerable field work, testing, and research would be needed to evaluate properly the clay-resource potential in Curry County. It seems possible that some of the more deeply weathered areas of rhyolite (Ti) in the vicinity of Mount Emily and Winchuck River may produce a fairly light-firing, possibly high-temperature ceramic clay. Some investigation of this possibility may be justified.

The distance from any market and the small population base of Curry County may preclude the exploration and development of clay or shale resources for the production of brick and tile and/or lightweight aggregate.

Dimension Stone

The most used and undoubtedly most attractive rock for building stone in Curry County is Tertiary rhyolite that occurs as small dikes in the area north of Brookings to near Carpenterville, in the Mount Emily area, and southward to the Winchuck River. This rock, which is buff color with darker reddish-brown bands of iron oxide stain, appears to be of adequate strength and sufficiently resistant to chemical weathering to be suitable for construction use. Some stone from the quarry (Table 2, rock-material site 504) near the quarter corner, sec. 32, T. 40 S., R. 12 W., and sec. 5, T. 41 S., R. 12 W., about 1 mi north of the Winchuck River, has been used for building stone. A few other rock formations are probably suitable for use as building stone but would require careful selection to obtain best results.

Blueschist, sandstone of the Tyee Formation, and basalt have been used to a limited extent in Coos County (Baldwin and others, 1973, p. 66-67). The small blueschist bodies scattered over the Otter Point

Formation in northern Curry County may afford a few sites for quarrying building stone. Some platy phyllites, metacherts, and "greenstones" of the Colebrooke Schist also appear to be suitable for use as building stone. Softer schistose material would have to be rejected. Fresh (unweathered) igneous rocks, mainly Pearce Peak diorite exposed along Elk River, should be quite suitable for building stone. Sandstone, including graywackes from the Dothan Formation, where not highly fractured, may have limited use. Some of the massive Upper Cretaceous sandstone near Cape Sebastian, such as that in the quarry near the mouth of Meyers Creek, has been used to a limited degree and appears suitable for certain types of construction. Blocky chert, often attractively colored, that occurs in the Dothan-Otter Point Formations may also have limited use. A stone mason, architect, or other qualified person should be consulted prior to using any given rock type in construction to be sure the material has the desired physical properties.

Sand and Gravel and Crushed Rock

Rock-material survey-data table and mineral and rock-material localities map

General: The Department located 211 rock-material sites within Curry County. The sites are plotted on the map showing mineral and rock-material localities (Plate 2, in pocket). Circles on the map indicate sand and gravel locations; triangles indicate stone quarries; squares indicate other mineral deposits. More detail on gravel resources by river corridor rather than by individual sites is presented in the section entitled "River corridor maps" and shown on larger scale maps (Plate 3, in pocket).

Data for sites are shown in Table 2, printed on the back of Plate 1. Information in the table for each site gives a reasonable picture of that individual mining site. Table data include site identification, location, status, size, source description, mining system, processing plant, and usage. Line and column items are left blank when the data are unknown. Because a maximum of data is compressed into Table 2, each of the major column headings will be discussed in the following paragraphs, in the order that they appear in the table.

Site identification: The site numbering system for rock material begins with number 301, starting in the northwest corner of the County. The numbers follow that township to the east, move back to the west end of next township to the south, and proceed again to the east. Only names of sites located in the field are listed in the column headed "Operator"; title searches were not made. Land ownership of sites is as follows: Federally-owned, 72 sites; State-owned, 10 sites; County-owned, 2 sites; city-owned, 1 site; and privately-owned, 126 sites.

Location: Site locations are described down to the quarter section; however, the plotting on the localities map is accurate to the quarter/quarter section (40 acres).

Status: The status of each site was determined. Between July 1975 and July 1976, 71 sites were active. In addition, 128 sites were inactive, 7 were abandoned, and 5 were unclassified because they were not field checked.

Size: Three categories are used to classify past production, and four categories are used for future potential of each site. If the volume of material that was removed is from 0 to 49,999 cu yds, the site is classified as small; 50,000 to 149,999 cu yds is medium; and 150,000 or more cu yds is large. If the site has been mined out, the future potential is classified as depleted. One hundred and forty-three measured sites have had small past production, 41 were medium, 24 were large, and four were not surveyed. For future potential, four sites are classified as depleted, 88 are small, 49 are medium, and 68 are large.

Source description: One hundred and seventy-one stone quarries have been developed in bed rock: basalt, metabasalt, sandstone, metavolcanic, metasediment, diorite, gabbro, greenstone, rhyolite, dacite, and conglomerate. The geological formation in which each quarry occurs is listed. In a few instances, the formation listed for a site on the survey-data table does not match that formation shown on the geologic map. If the mismatch occurs close to a formational contact, no notations are made in the

table. If the mismatch is not near a contact, then a question mark is placed next to the formation name in the survey-data table. Scale of the geological map is too small to portray areas the size of a stone quarry. In Curry County most stone quarries are developed in metamorphosed sedimentary and volcanic rocks, and a few are in coarse-grained intrusives. Table 3 shows the number of stone sources found in each geologic unit. The quality of quarry rock varies with each geologic formation and within individual formations; therefore, the quality of stone must be determined in each quarry on an individual basis. Such data for some sites are listed in Table 4.

Table 3. Number of sites by geological formation

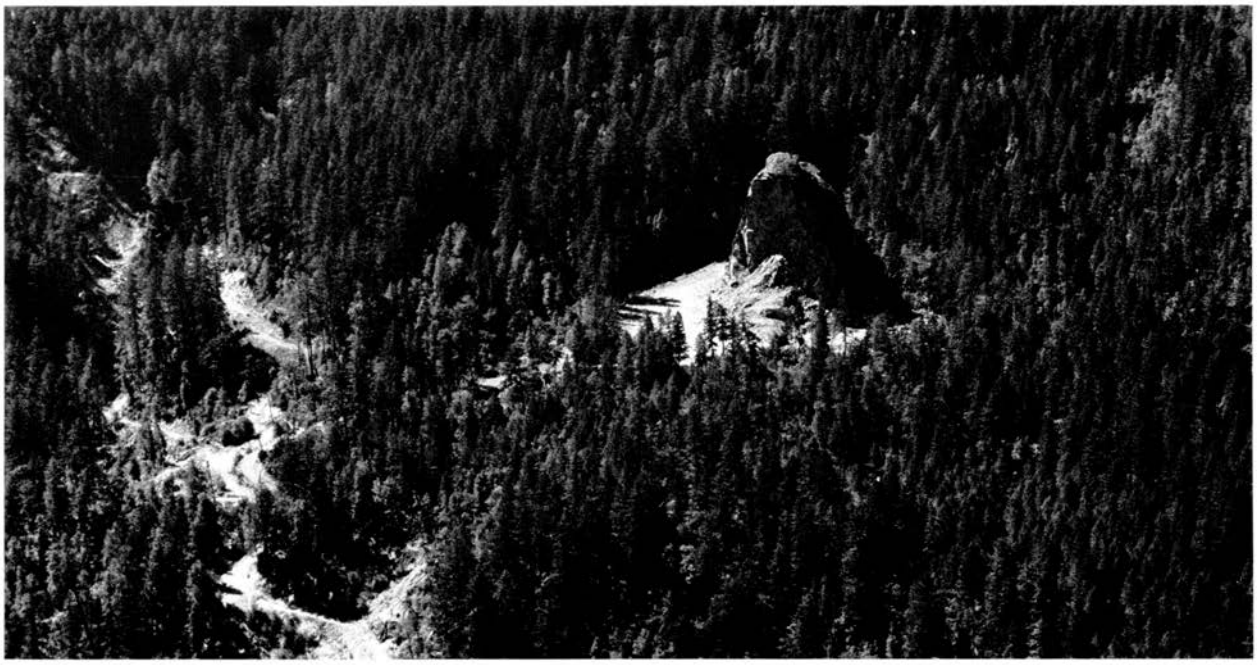
Formation	Number of sites
Alluvium	37
Umpqua "group" (Tertiary sediments)	1
Cape Sebastian (Late Cretaceous sediments)	1
Hunters Cove (Late Cretaceous sediments)	4
Dothan	63
Otter Point	61
Diorite	5
Gabbro	1
Colebrooke Schist	25
Galice	11
Total	211

When stone is needed in remote areas for construction of forest-access roads or other projects, a local rock of lower quality is often used in preference to a better stone that has to be transported over a greater distance, resulting in a higher cost. In construction of paved roads, the State or County generally utilizes a lower quality local stone for subbase material and a high-quality aggregate, often from a more distant source, for the top course and paving.

Normally, weathered bed rock which disintegrates into fragments, sand, or clay can be quarried without blasting. It may be suitable for embankments, or, if treated, it may be usable with cement for base rock in road construction.

Sand and gravel is being, or has been, mined from 37 sites, both within beds and banks of streams and also from terrace deposits. Alluvium is indicated as the source of sand and gravel. Only the gravels mined from terraces need much washing to remove excessive amounts of fines. More details are given on sand and gravel sources under the section entitled "River corridor maps." The quality of sand and gravel within a stream corridor will be determined by the kind of bed rock found in the drainage area of the stream. Source areas containing abundant metamorphic, igneous, and other hard rock introduce large amounts of gravel into streams; if the country rock is primarily sedimentary or schistose rock, gravel is minimal and generally of poor quality. Quality data for these individual sites are also included in Table 4.

Mining system: In Oregon, rock material is mined mainly by surface methods. Information in columns titled "Benching," "Highwalls," "Jointing," and "Ground-breakage system" refers mainly to stone quarries and is best illustrated by photographs. The table does not have columns that indicate public safety or ease of reclamation, but these can be illustrated by examining photographs. Figure 5 (rock-material site 405) shows a single-bench stone quarry with a 175-ft highwall. The greenstone is hard and strong, and its jointing is massive. The material has been used for riprap along the Rogue River. The system used to develop the quarry was to undercut the bottom and let the top cave down. Horizontal-blast drill holes at the quarry floor level were used for undercutting. After these holes were loaded and shot, the top portion of the quarry caved down. Unfortunately, this system creates a safety hazard because the overhanging highwall that is left is almost impossible to make safe because of the danger of loose stone. In this case, the threat to public safety is minimal because the quarry is away from any public highway and relatively inaccessible. If this pinnacle had been mined from the top down, however, the highwall would not be present, and the quarry would have been left in a state that would allow another round of mining without prohibitive costs.



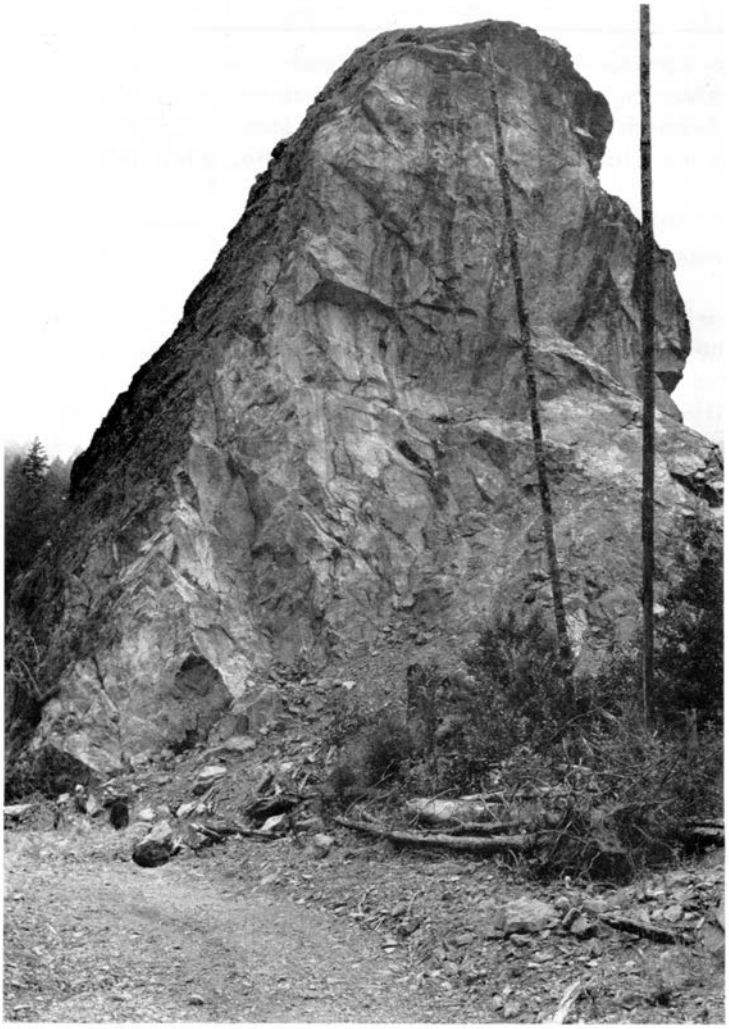


Figure 5. Rock-material site 405. Upper photo: Aerial view of site 405. Lower photo: Single bench stone quarry with 175-ft highwall. Some of this massively jointed greenstone has been used for riprap along the Rogue River. Rock was broken by undercutting bottom and letting top cave down. Remaining overhung highwall is dangerous because of loose stone. If pinnacle had been mined from top down, highwall would not be a problem and quarry could be mined again without prohibitive cost. Note figures at lower left for scale.

Rock-material site 472 (Figure 6) has a shorter highwall, and the jointing ranges from blocky (12 to 18 in) to massive (18 + in). Because this site, which is next to State Highway 101, has many loose stones that could fall, it is a public safety hazard. The small stone circled on the photograph appears to be a keystone that is wedging in the much larger jettystone-size stone above it. Without the keystone, the larger stone would probably have fallen to the quarry floor. The other large stones lying on the quarry floor have already made that trip. To make this site safe, all of the loose stone should be scaled down.

Sand and gravel operators do not have to be concerned about jointing and ground breakage. Those with pits adjacent to a stream channel should consider the effects the excavation may have on erosion during flooding. Streams running through thick gravel can easily develop new channels as a result of improperly constructed berms or unprotected gravel-pit excavations. Dikes, roadways, and other structures associated with rock production, when constructed in the flood path, can either act as dams, causing flood waters to rise higher than normal or divert the force of the current, leading to the erosion of valuable agricultural land.

Uses: In this section, rock-material uses are described, starting with the use that requires the least size and strength specifications. The term "embankment" is used interchangeably with the term "fill." Materials used for embankment or fill can range in size from sand to jettystone and are used to bring roads and construction sites to grade. All that is required of the material is that it remain stable after it is placed in a low area.

The size of rock material used for subbase and base is normally less than 6 in. This material supports the road. The base course is a layer of specified or selected material of planned thickness constructed on the subgrade or subbase of a roadbed. Material placed in the base course ranges in size from less than $3\frac{1}{2}$ in down to dust. Fines are needed to hold coarser material in place but should constitute up to only 25 percent of the total material. The subbase is below the base course and above the embankment. Material placed in the subgrade or subbase can range up to 6 in but must also contain a certain percentage of fines to act as binder.

The rock-material use called "top course," "topping," "surfacing," or "road metal" is the small-sized material minus 1 in and is the last layer placed on a roadbed. This rock material should be durable because the road surface is subject to wear from vehicle tires. The rock material can be either sand and gravel or stone. It must be graded to less than 1 in with very little material smaller than $\frac{1}{4}$ in. Stone to be used for surfacing roads needs normally to be crushed. However, some gravel deposits can be screened to give the correct sizes for the road-surfacing uses.

The term "aggregate" refers to uncrushed or crushed gravel, crushed stone, sand, and artificially produced inorganic material (such as smelter slag) which form the major part of Portland cement or asphaltic concrete. Cement concrete is used for highways, streets, sidewalks, curbs, foundations, buildings, and bridges. Asphaltic concrete is used mainly for surfacing highways and parking lots. It does not have the structural strength of cement concrete and must rely on the road base to provide stability. Hot weather can cause an asphaltic road surface to soften.

Riprap and jettystone are rock materials that are used to build jetties and to line stream banks, beach fronts, and highway embankments. The rock materials used for riprap and jettystone should be hard, durable, angular in shape, resistant to weathering, and heavier than 160 lbs/cu ft. The difference between riprap and jettystone is size. The size range of riprap is from 50 lbs to 2,000 lbs for each stone (see Figures 5 and 6). The size range of jettystone is from 0.25 tons to 28 tons for each stone (see Figure 6). Material of jettystone size is needed only where the extreme force of ocean storms must be counteracted.

State Highway Division laboratory data

General: All of the data from laboratory tests that were performed by the Oregon State Highway Division on materials from Curry County were made available to this study. In Table 2, sites from which materials were tested are marked with an asterisk. The data are summarized in Table 4. Sometimes several types of tests were performed on material from one site; other times only one test was done. Samples that were tested were selected by different people over a long period of time, and the testing was also done by different people. Therefore, data given in Table 4 should be regarded only as a guide and not as final authority.

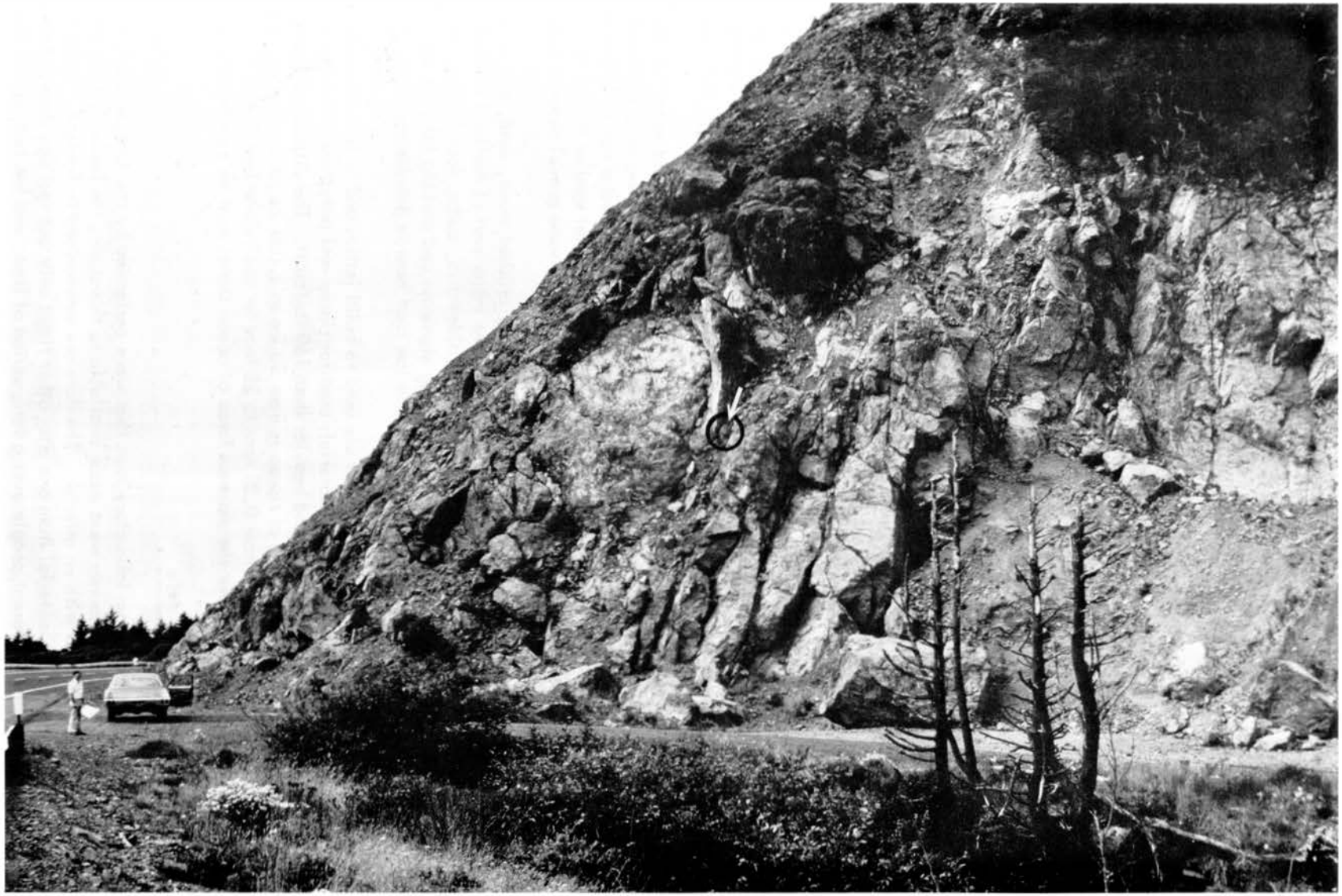


Figure 6. Rock-material site 472, showing unscaled highwall face. Jointing ranges from blocky to massive. Small stone in circle (see arrow) is keystone supporting large stone above.

Different size fractions from the same site will give different test results. Therefore, to present the best statistics for the entire deposit instead of just for a particular size fraction, the data ranges (the highest and lowest values) were used in Table 4. No attempt was made to determine a weighted data average for a site. If no range is indicated for material from a particular site, either all test results were the same or only one test was conducted. Table 5 gives test standards for each type of use.

The test-data table will probably be used by contractors and others who know and understand the testing. For those not familiar with the tests, a brief description of each is in order.

Table 5. Test standards by usage

Usage	Test standards						
	Specific gravity (minimum)	Los Angeles rattler (maximum percent)	Sodium sulfate (maximum percent)	Plasticity index (nonplastic or maximum percent)	Liquid limits (nonplastic or maximum percent)	Oregon degradation	
						Maximum percent	Maximum height in in
Asphalt concrete aggregate							
fine - $\frac{1}{4}$ in		35	18	6	33	30	4
coarse - 1 in + $\frac{1}{4}$ in		30	18			30	3
Cement concrete aggregate							
fine - 3/8 in + 100 mesh		30	10			30	3
coarse - $2\frac{1}{2}$ in + $\frac{1}{4}$ in		30	12			30	3
Surface - topping		35					
Base		35		6	33	30	3
Subbase		45					
Riprap	2.5		16			35	8

Specific gravity: Specific gravity is an index number that is the ratio between the weight of a unit volume of a substance and the weight of an equal volume of water, at the same temperature and pressure. The higher the number, the denser and, in most cases, the stronger the rock material.

Los Angeles rattler: This test tells how material will withstand the grinding action of heavy traffic. The material to be tested is weighed, subjected to tumbling for a set time, screened, and then reweighed. The statistic listed is the percentage lost during the testing.

Sodium sulfate test: The sodium sulfate test is used to see how weather will affect rock material. Again the material is weighed, tested, then reweighed. The percent of loss is the statistic reported. Testing consists of soaking the sample in a strong brine solution at an elevated temperature for 16 to 18 hours and then drying it at an elevated temperature for 2 hours. The sample is soaked and dried for several cycles.

Plasticity index and liquid limits: To test the clay content of a rock material sample, the plastic limit and liquid limit must be determined. Plastic limit is the lowest water content, by weight, at which the rock material becomes plastic. Liquid limit is the moisture content, by weight, at which the rock

material passes from a plastic to a liquid state. The plasticity index is the range over which the rock material is plastic.

Oregon degradation test: The Oregon degradation test is designed to measure the quantity and quality of the material produced by attrition similar to that caused in a roadway by repeated traffic loading and unloading. The quantity is indicated by a percentage, by weight, of fine material produced; the quality is measured by a modified sand equivalent test. The fine material is made by using air jets to rub one particle against another in water.

River-corridor maps

To fulfill the County's needs for more detailed mapping of sand and gravel resources than can be obtained from the small-scale mineral locality map (scale: 0.5 in = 1 mi), an aerial photographic survey was conducted along the six major streams. The streams were surveyed from the Pacific Ocean to either the U.S. Forest Service boundary or the point where sand and gravel resources along the stream become unimportant. Gravel-resource units were taken from 1965 aerial photographs and transferred to a 1955 U.S. Forest Service base map (scale: 2 in = 1 mi). These river-corridor maps (Plate 3) are to be found in the back pocket of this bulletin.

On the river-corridor maps, sand and gravel deposits are classified as either channel, river wash, or terrace. The channel deposits occur at the lowest elevations, river wash at intermediate, and terraces at the highest elevations. The boundary of the river corridor is plotted at that ground point where the slope changes sharply from flatland to hillside. The positions of the three types of gravel are shown in Figure 7. This photograph, a view of the Rogue River near its mouth, also shows the position of rock-material sites 391 and 392.

The area mapped as channel sand and gravel is the area covered by water at summer levels. Because of the 10-year interval between the production of the base map and the taking of aerial photographs, and the 11-year period between the time the photographs were taken and the summer of 1976, positions of open water and river-wash gravels are not consistent. Although the river shifts back and forth within the river corridor, the ratio of open water to river-wash gravel remains fairly constant as long as gravel removal does not exceed natural gravel replacement.

River-wash sand and gravels form point bars and other bars that are flooded annually. Streams in mountainous areas have small valley widths, high gradients, and high stream velocities, with large volumes of gravel transported downstream during periods of high water. When these streams enter a wider valley, the gradient and velocity are diminished, the load of gravel that was carried along the upper reaches is deposited, and the channel becomes clogged. When this occurs, part of the stream may flow in new channels and form a braided stream. Many of the areas mapped as river wash are braided-stream channels. The quality of channel and river-wash material is generally good. Because these two units are probably replenished annually at a faster rate than they are mined, continual removal of fairly large quantities from them should have little adverse effect on the stream.

Terrace sand and gravel deposits generally lie above the level of annual flooding and may or may not be flooded by 10-year floods. Streams continually erode their banks where the current is swiftest and deposit sand and gravel where the current slackens. As the stream migrates back and forth across a valley, the gravel deposited during successive cycles forms sand and gravel beds which may extend across an entire valley. Positions of terrace sand and gravels are generally more stable over long periods of time, but the material is not as clean as sand and gravel from other units. Terrace sand and gravel may contain silt, clay, and other types of soil. Almost all of these terrace areas are being used for agricultural purposes. Because of the availability of channel and river-wash gravels, the sand and gravel values of the terrace areas are probably less than those values obtainable from continuing long-term agriculture uses.

After corridor boundaries and corridor units were transferred to base maps, a planimeter was used to determine the acreage of each unit. To obtain cubic yard volumes, assumptions were made about the thickness of each unit. Table 6 (back of Plate 1, in pocket) summarizes acres and cubic yards of sand and gravel for each stream and for each unit. Volume of the three units totals 75 million cu yds, which would equal about 400 years of supply at the present rate of demand. The streams are listed in order from north to south. The 26 gravel sites that lie along the mapped rivers are listed in the survey-data table, plotted on the mineral-localities map, and also shown on the river-corridor maps.

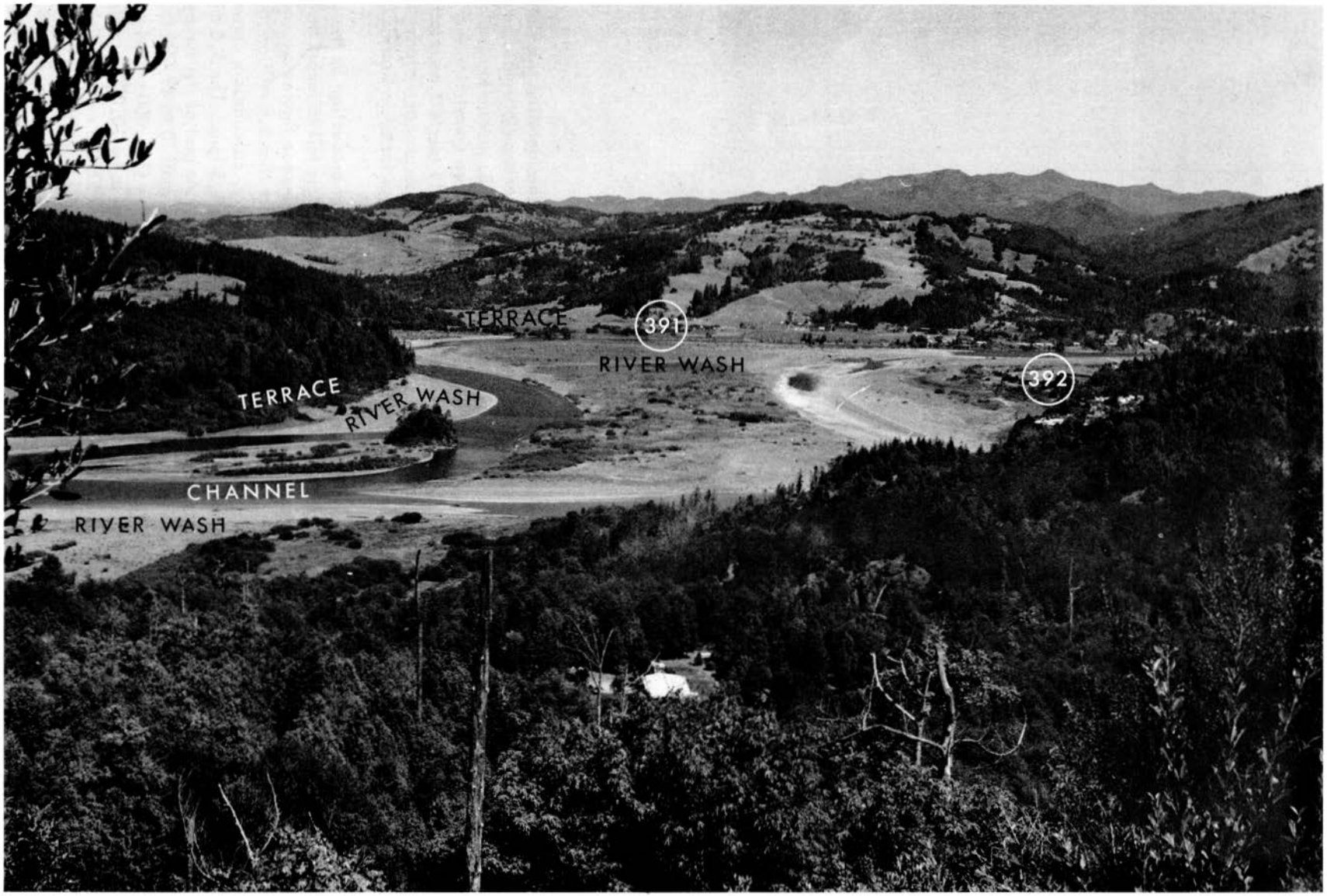


Figure 7. View along Rogue River, showing rock-material sites 391 and 392 and the three types of gravels found within a river corridor.

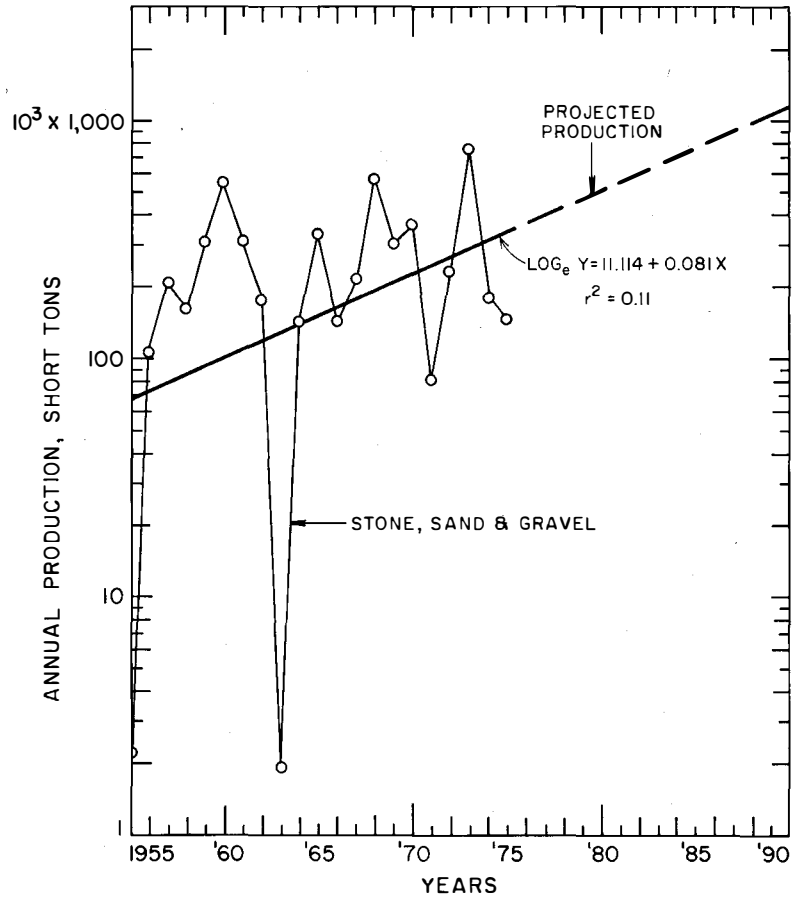


Figure 8. Log of annual production of sand and gravel and stone v. time.

Forecasts

Estimates of future production of sand and gravel and stone must take into consideration the factors in the past that have controlled historic production. Most Oregon rock-material economic studies have used time and population as the only factors accounting for production. In Figure 8, production is plotted against time, forming a graph with a series of very sharp oscillations. A least-square correlation was computed with production against time. The coefficient of determination (r^2) was 0.11 (perfect correlation between time and production is 1.0). The very low figure of 0.11 means that 89 percent of variation of the production data cannot be accounted for by time; therefore, time is not a major factor in Curry County sand and gravel and stone production.

One of the major factors that might cause data variation is undercounting of production by the U.S. Bureau of Mines. Bureau production statistics are incomplete because some operators fail to report their annual production. A volume measurement of pits and quarries suggests that the Bureau figures are only about 40 percent of the total actual production. The U.S. Bureau of Mines report that 5.6 million tons of sand and gravel and stone were produced between 1940 and 1975. In this study, calculations converting tons to cubic yards are based on the assumption that 1 cu yd in place weighs 1.5 tons. The 5.6 million tons produced between 1940 and 1975 are therefore equal to 3.8 million cu yds. As part of the surveying of each site, an estimate was made of past production. There are 143 sites with small (0 to 49,999 tons) past production, 40 sites with medium (50,000 to 149,000 tons), and 24 with large (150,000+ tons) past production. The average production for a site with small production was assumed to be 10,000 cu yds; for medium production, 75,000 cu yds; and for sites with large past production, 200,000 cu yds. Using these assumed averages, a total of 9.2 million cu yds of rock material has been produced in Curry County. The cubic-yard figure obtained by site measuring is 2.5 times greater than the figure the U.S. Bureau of Mines obtained from its voluntary mail canvass of rock-material producers. When broken down into

components, the measured production is 1.8 times that of the U.S. Bureau of Mines canvass figure for sand and gravel and 2.9 times that for stone.

Rock materials in Curry County are used for the construction of new homes, streets, sewers, churches, businesses, municipal buildings, and other facilities; many rock-material uses can be therefore directly related to population needs. Every new housing unit generates a need for 176 cu yds of cement concrete, including material used for the house itself as well as material needed to provide public services for that household (Art Heizenrader, Oregon Concrete Aggregate Producers Association, personal communication, March 22, 1977). New housing starts also lead to an increase in rock-material production for use in asphalt concrete. A highway constructed of asphalt concrete is 25 to 40 percent cheaper to build than one of cement concrete, constructed with the same load-carrying capacity (Mike Huddleston, Asphalt Association of Oregon, personal communication, March 23, 1977). Huddleston estimates that 4 million tons of asphaltic concrete are used annually. The 1975 U.S. Bureau of Mines' cement statistics indicate that production of cement concrete is about 2 million tons, about half as much as that of asphalt concrete.

Because size of population has an effect on the production of sand and gravel and stone, the unchanging population of Curry County should stabilize production at some level. Production statistics, however, show a range of 80,000 to 750,000 tons. The range in production, in fact, occurs because the largest portion of rock used in Curry County during the past 20 to 30 years is related to timber-harvest road construction and maintenance projects and bears little relation to local population or to time. Curry County economy is mainly based on timber production. Although it is beyond the scope of this report to generate a forecasting model which would accurately account for all factors of production, this type of model is needed to understand past production and future demands. For this study, the assumptions are made that actual (reported and unreported) sand and gravel annual production for the next year should be between 100,000 to 200,000 tons and that stone production should be between 100,000 to 600,000 tons. During the next 10 to 20 years, possibly by 1988, combined production should peak at over the million-ton mark. Data from the river-corridor section of this report indicates that sand and gravel reserves should last for about 400 years at the present rate of consumption. Calculations made by combining future-potential data given in Table 2 with the estimated average production for the three site sizes (10,000 cu yds for small, 75,000 cu yds for medium, and 200,000 cu yds for large) suggest that present sand and gravel operations will last for only 20 years at the current rate of consumption. Stone reserves of currently operating quarries, calculated in the same way, appear large enough to supply the needs of Curry County for about 30 years at the present rate of consumption. The stated prediction of 20 years for sand and gravel and 30 years for stone does not mean that Curry County will run out of these materials at the end of these time periods. It means, instead, that new sites will be needed in both the immediate and distant future. These new sites should be planned in terms of market needs and secondary land uses. Data from Table 2 indicate that some sites will be used up faster than others; the 20- and 30-year figures quoted here are only averages. Planners should take into account the life-expectancy of individual sites.

METALLIC-MINERAL RESOURCES

General

Any mineral occurrence lying within the Kalmiopsis Wilderness (marked with an asterisk in Table 7) is subject to special restrictions and therefore has much less chance of being developed and mined. In most cases, wilderness restrictions preclude any commercial development. In addition, proposed additions to existing wilderness should also be of interest to any mineral developer.

Numbers following mine, placer, or prospect names refer to numbers used in Mineral and Rock-Material Localities map (Plate 2, in pocket) and in Tables 7, 8, and 9.

Chromite

Chromite, the only commercial source of chromium metal, is a complex oxide of chromium, iron, aluminum, and magnesium. The content of these oxides can vary widely in chromite, and their relative abundance determines the value and ultimate use of the ore.

Under peaceful world political situations, the United States imports all of its chromite. Domestic production has occurred during World Wars I and II and the Korean War, when a special ore-buying depot was established in Grants Pass, and incentive prices for chromite ore were offered.

The current trend of increasing metal prices, the strategic importance of chromium, and the unsettled political situation in Africa have stimulated renewed interest in domestic chromite deposits. It appears reasonable to expect some exploration and possible mining activity at a few of the County's more promising occurrences.

Chromite occurs in ultramafic rocks (peridotite and serpentinite); in Curry County, it is also found in placer deposits of marine black sand.

History of mining

Chromite production has been restricted to periods of wartime emergency. The largest of the 23 producing occurrences in Curry County is the Sourdough (Baldface) mine (83). It was first worked in 1918 (Diller and others, 1921, p. 34); the second period of operation was from 1941 through 1944; the third period was from 1951 to 1958. Total production of the mine was about 1,567 long tons. McCaleb mine on Sourdough Flat (11) ranks second in total production with about 1,200 tons (mostly mill concentrates) during the 1952-58 period when the government was purchasing chromite for the emergency stockpile.

In the Signal Buttes area, the Laurel mine (193), which began shipping ore in 1941 and produced about 400 tons of lump ore, ranks third in size. Total production for the County has been about 4,320 tons.

Black-sand deposits

In addition to chromite, the black-sand deposits contain a few other minerals of some potential value, including gold, platinum, magnetite, garnet, zircon, and ilmenite. Other common associated minerals include feldspar, quartz, olivine, pyroxene, and epidote.

Griggs (1945) delineates a few black-sand deposits in the Denmark-Cape Blanco area along the beaches at the mouth of the Rogue River.

Explored black-sand deposits

Butler (Baker) mine (north extension of Sixes beach placer) (103): The Butler mine was explored by Krome Corporation in 1941, and the U.S. Geological Survey conducted a magnetometer survey in 1942. The existing pit is from earlier gold-mining activity. The magnetometer survey and the 37 drill holes and pits define the orebody as lenticular in shape, 1,600 ft long, 90 to 300 ft wide (average width of 220 ft), with an average thickness of 5.9 ft. The maximum thickness of 14.8 ft is located near the center of the orebody. The sand and clay overburden has an average thickness of 15 ft. The orebody and bed rock slope about 5° to the west. Average grade is about 8.5 percent Cr_2O_3. Coarse gravel at the base of the deposit indicates that it was deposited near the mouth of the former channel of the Sixes River. About 30 percent of the body has been mined for its gold and platinum content. Dates and recovery are not reported (Griggs, 1945, p. 144).

Sixes beach placer (103): The placer was worked for a few seasons around 1902. A one-acre pit about 12 ft deep was mined with a hydraulic elevator. Fine gold and platinum were recovered, but the total value is unreported. When seven holes were drilled by Oregon Department of Geology and Mineral Industries in 1942 on a magnetic anomaly, 2 to 3 ft of black sand covered by 30 to 50 ft of overburden were encountered in two of the holes. The black sand contains 5 percent Cr_2O_3. Bed rock is Cretaceous sandstone and shale (Diller, 1902, p. 5; Griggs, 1945, p. 144).

Madden (Blanco) placer (104): This deposit is composed of 12 to 20 ft of material ranging in size from coarse sand to gravel, with scattered, thin (fraction of an inch) layers of chromite-bearing black sand overlain by 8 ft of wind-blown sand. The placer, worked for several years by Cyrus Madden around the turn of the century, had an annual yield of about $1,100. Gold to platinum ratio is about 20:1. There has been no chromite production (Diller, 1903, p. 5; Griggs, 1945, p. 145).

Cape Blanco beach placer (101 and 102): The Blanco beach area was reportedly worked off and on from about 1853 to 1938, when the plant was wrecked by waves. A strip of the beach midway between Cape Blanco and The Heads, 4,000 ft long, 30 to 60 ft wide, lying just west of the sea cliff, is covered with a veneer of alternating layers of black and gray sand averaging 0.5 ft in thickness. A 2.5-ft channel sample taken at an indentation where the black-sand concentration was thicker assayed 12.18 percent Cr_2O_3. Mint receipts were reportedly lost in the Bandon fire, but records from January 4 to July 8, 1937 were for $1,650.32 (gold) and $1,133.93 (platinum and osmium). Recovery was reported to be about $2.00/yd, but percentage of recovery was poor (about 50 percent). There is no record of chromite production (Oregon Department of Geology and Mineral Industries unpublished mine-file report, 1939; Griggs, 1945, p. 147).

Parker (Ophir) beach placer (186): The back beach about a mile long and as much as 1,200 ft wide contains a concentration of black sand in a triangular area about 500 ft on a side in the northeastern part of the beach. Channel samples across 12 ft and 8.5 ft assayed 9.3 and 8.1 percent Cr_2O_3, respectively. Attempts to set up an extraction plant to process the sands and produce chromite concentrates in the early 1940's were apparently unsuccessful (Oregon Department of Geology and Mineral Industries, 1940, p. 69-70; Oregon Department of Geology and Mineral Industries unpublished mine-file reports, 1941, 1942; Griggs, 1945, p. 147).

Rogue River (including Smedberg) beach placers (190): Sands about 20 ft thick, 400 to 500 ft wide, and about 4 mi long contain 10 to 25 percent of black opaque grains that are largely magnetite. Eleven channel samples of 4 to 9 ft thickness averaged only 1.12 percent Cr_2O_3. In 1938, Carl Smedberg operated a small plant on the beach (sec. 1) about 1 mi south of Gold Beach to recover gold. The operation reportedly had only limited success, and there was little production (Oregon Department of Geology and Mineral Industries, 1940, p. 65-66; Griggs, 1945, p. 147-148).

There are no data on the other chromite-bearing black-sand occurrences marked on the Mineral and Rock-Material Localities map (Plate 2, in pocket).

Lode chromite occurrences

A few lode chromite occurrences are described here in alphabetical order with only the more pertinent data listed. Other occurrences are listed in Table 7.

Babyfoot mine (29): Small, massive, high-grade (52 percent Cr_2O_3, 3.1:1 Cr:Fe ratio) chromite lenses occur in sheared serpentinite along a footwall of argillite which strikes N. 15° W. and dips 68° NE. A second, less important, chromite-bearing zone lies 50 to 80 ft east of the footwall contact. The argillite is a thin (5-ft) layer underlain by porphyritic andesite of the Rogue Formation. About 100 long tons of chromite averaging 48 percent Cr_2O_3 were shipped by the Chetco Mining Company during the period from 1951 through 1954 (Ramp, 1961, p. 65-66).

Burned Cabin mine (40): Massive chromite boulders as much as 2 ft in diameter were recovered from landslide debris. About 40 long tons of 45 percent Cr_2O_3 with a Cr:Fe ratio of 2.9:1 were shipped in 1953 by the Chetco Mining Company (Ramp, 1961, p. 67).

Chetco Lake chromite mine (64): A 3-ft-thick ore zone contains fine disseminated chromite and lenses of massive chromite as much as 10 in thick. The zone of bleached serpentinized dunite that strikes N. 50° W. and dips 35° NE. can be traced for about 100 ft. The thrust fault marking the base of the ultramafic rocks lies about 100 yds southwest down the slope, where the underlying Dothan Formation sandstones strike from N. 40° to 60° W. and dip from 35° to 60° NE. During 1954, a small shipment of ore was taken for mill testing. A sample of the more massive ore assayed 42.04 percent Cr_2O_3, 10.51 percent Fe, and 8.42 percent SiO_2 (Ramp, 1961, p. 96 and 98).

Foster Creek mine (144): Lenses of massive chromite occur in a relatively narrow sheared serpentinite zone bounded on the east by the Coquille River fault contact with Tertiary sediments and on the west by Jurassic greenstones of the Galice Formation and a gabbro dike. There appears to have been landsliding of the area. Foster Creek Mining Company shipped 13.7 long tons of ore assaying 44.01 percent Cr_2O_3, 10.57 percent Fe, and 3.44 percent SiO_2 in 1956 (Ramp, 1961, p. 114).

Gardner mine (50): Massive chromite occurs in stringers and lenses as much as 4 ft thick, lying in a zone 30 to 50 ft wide which strikes N. 45° to 65° W. and dips 30° to 45° SW. The host rock is a highly sheared, green serpentinite that has been intruded by a number of rodingite dikes in the vicinity of the ore zone. The mine, which was worked by Fred Gardner and sons from 1952 to 1958, produced 200 long tons of ore assaying about 50 percent Cr_2O_3 with a Cr:Fe ratio of 2.9:1 from an open cut about 200 ft long, 300 ft wide, and 50 ft deep (Ramp, 1961, p. 97-99).

Hawks Rest View mine (55): A narrow, tapering, discontinuous zone of disseminated to massive chromite strikes N. 10° W. and dips about 50° W. The zone occurs in a partly serpentinized dunite surrounded by a clinopyroxene-bearing peridotite (wehrlite). The mine is about 100 yds east of the contact with phyllitic metavolcanics of the Rogue Formation, which strike about north and dip 35° to 40° E. The Chetco Mining Company shipped about 40 tons of ore containing 45 to 48 percent Cr_2O_3 and a 3:1 Cr:Fe ratio from a shallow bulldozer trench about 200 ft long and 50 ft wide (Ramp, 1961, p. 69).

Irene mine (92): Chromite occurs as several small lenses in serpentinite striking northwest and dipping southwest about 45°. The largest lens is 20 ft long and as much as 5 ft thick. The occurrence lies near the center of a 2-mi-wide overthrust arm of peridotite overlying Dothan Formation sediments. About 50 tons were shipped in 1955. The ore reportedly assayed about 38 percent Cr_2O_3 (Ramp, 1961, p. 95).

Laurel mine (Signal Buttes) (192 and 193): Chromite occurs in one or more lenses in the serpentinite thrust plate intimately associated with Colebrooke metavolcanic rock, phyllite, and schist. The Signal Buttes occurrence was described as a lens of massive ore 8 ft thick, 20 ft long, and 15 ft downdip, occurring near the center of a 60-ft-wide sheared serpentinite zone with chromite grains scattered throughout. The zone strikes N. 20° W. and dips 30° S. The production reported for the Laurel mine (193) probably included

ore from Signal Buttes (192), as well (Allen, 1941, p. 37-40). Ore shipped mainly in 1941 to Baltimore totaled between 200 and 400 tons. The grade was about 50 percent Cr_2O_3 (Allen, 1941, p. 37-40; Oregon Department of Geology and Mineral Industries unpublished mine-file report, July 1941).

Little Siberia mine (6): Chromite occurs in irregular patches of disseminated ore and stringers of fairly massive ore in coarse-grained dunite. Maximum width of the ore zone is about 5 ft; but the zone appears to lack a definite trend. Selected massive ore assays about 55 percent Cr_2O_3 and 13 percent Fe. Approximately 195 tons of low-grade mill ore were shipped during 1951 to 1955 (Ramp, 1961, p. 103-104).

Lost Lee mine (89): Lenses of massive chromite occur along a shear zone striking N. 40° E. and dipping 65° W. in blocky, serpentinized, olivine-rich peridotite. The ore assays about 41 percent Cr_2O_3 and 11 percent Fe. About 15 tons were shipped in 1952 and 1957 (Ramp, 1961, p. 115).

McCaleb mine (Sourdough no. 2) (11): Banded, disseminated chromite occurs in a 5- to 12-ft thick, northeast-striking zone that dips 45° to 65° NW. The zone is located in a pale-green, serpentinized dunite in darker green, serpentinized harzburgite and contains a few small lenses of fairly massive ore. Variable trends indicate faulting and, perhaps, slide movement. Low-grade ore, mostly from this deposit milled at McCaleb's mill on Sourdough Flat between January 1953 and January 1956, produced about 1,200 long tons of concentrates containing about 50 percent Cr_2O_3 with 2.5:1 Cr:Fe ratio (Ramp, 1961, p. 106-107).

Pearsoll mine (3): Small patches of disseminated chromite in serpentinized dunite and scattered lenses of massive ore are exposed in the upper, shorter adit and surface near the portal. No obvious pattern or trend of occurrence is apparent. In the early 1950's, about 250 tons of mill ore averaging about 23 percent Cr_2O_3 were concentrated by E. A. Foster to 95 tons assaying about 52 percent Cr_2O_3 and 13 percent Fe (Ramp, 1961, p. 101-102).

Pines (Chetco) (Tolman) (217): Massive chromite occurs as float boulders (one as heavy as 1,000 lbs) in small, residual slump blocks of overthrust serpentinite on Dothan Formation sediments. At the Upper Pines deposit, two north-trending stringers of lower grade ore 2 and 3 ft thick are separated by 3 ft of serpentinite. They dip about 45° W. Float ore from the Lower Pines assayed 47 percent Cr_2O_3 with 2.5:1 Cr:Fe ratio. Upper Pines ore assayed about 30 percent Cr_2O_3 and 25 percent Fe. Three tons of the high-grade ore were shipped in 1953. Earlier small shipments may have been made (Allen, 1941, p. 35,36; Ramp, 1961, p. 116).

Rosie mine (51): Lenses of massive chromite occur in highly-sheared serpentinite in a major thrust zone. The shearing trends about N. 35° E. and dips 25° SE. (variable). Blocks of gneissic amphibolite and pale-green phyllonite derived from the Rogue Formation crop out in the immediate vicinity. The largest chromite lens was reported to be 3 ft thick and 20 ft long. About 30 tons of hand-sorted ore containing 45 percent Cr_2O_3 and 2.5:1 Cr:Fe ratio were shipped during 1953 and 1954 (Ramp, 1961, p. 99).

Sourdough (Baldface) mine (83): Disseminated and banded chromite occur in a narrow dunite zone in harzburgite (both are largely serpentinized). The ore zone has been traced over a horizontal length of about 3,000 ft and to a vertical depth of about 1,000 ft. Thickness varies from less than a foot to more than 20 ft, and the zone is probably discontinuous. Average thickness may be about 3 ft. The chromite-bearing dunite zone strikes from N. 45° W. to N. 55° W. and dips from 30° to 45° NE. Average grade of the ore zone may be about 35 percent chromite. More massive layers and streaks of chromite, sometimes as thick as 1 ft, when hand-sorted, assay about 48 percent Cr_2O_3 with a Cr:Fe ratio of 3:1. The ore zone lies on the east limb of a northwest-plunging anticline about 600 to 800 ft from the thrust contact with the underlying (younger) Dothan Formation. Chromite in the west flank of the folded zone may be represented by the Irene (92) and Winton Mountain (90) occurrences. A total of about 1,567 long tons were produced from intermittent operations during the period from 1918 to 1958. The average grade of all shipments was about 44 percent Cr_2O_3 with a Cr:Fe ratio of about 2.8:1. Estimated reserves in 1940 were 50,000 to 100,000 tons of milling-grade ore (Diller and others, 1921; Wells and others, 1940; Allen, 1941; Ramp, 1961).

Trails End prospect (106): The area is one of scattered, small, residual, thrust patches of sheared serpentinite and Colebrooke Schist overlying Late Jurassic Otter Point sediments and volcanics. Some infaulted lenses of sheared serpentinite occur in the Otter Point. A small amount of disseminated chromite sampled by Morrison in 1939 assayed 14.5 percent Cr_2O_3. Stories vary on the source of high-grade ore (48 percent Cr_2O_3) which was on the dumps prior to 1951. One source says the ore was derived from discrete pods in the sheared serpentinite, and another reports that it was hauled to this site by a promoter from another deposit during World War I. Ten tons of ore on the dumps were shipped in 1951 (Oregon Department of Geology and Mineral Industries, 1940, p. 88-89; Oregon Department of Geology and Mineral Industries unpublished mine-file reports, 1950, 1951; Ramp, 1961, p. 118).

Uncle Sam mine (8): Medium-grained, disseminated chromite occurs with a few small clots of massive ore in altered talcose serpentinized dunite. The ore is reported to occur as lenses plunging to the southwest. Sourdough Flat is believed to be a large, massive, slide block. Probably less than 100 tons of mill ore assaying about 30 to 35 percent Cr_2O_3 were mined up to 1955. The ore was processed at McCaleb's mill, located nearby (Ramp, 1961, p. 106).

Wonder mine (7): Small lenses of thickly disseminated chromite with talcose serpentine (altered from dunite) gangue are exposed in the cut on the no. 2 claim about 200 yds north of the $\frac{1}{4}$ corner secs. 11 and 14. The area is in a large broken slump block. Maximum thickness of lenses seen is 5 ft. Minor showings were found in other cuts. Although an 80-ton mill was constructed in 1953, total production is believed to have been less than 250 tons, but records were not obtained (Ramp, 1961, p. 104).

Other chromite occurrences: The remaining chromite occurrences shown on the Mineral and Rock-Material Localities map (Plate 2, in pocket) are listed in numerical order in Table 8. With proper exploration and development, some may have potential for future production under conditions of incentive price for chromite ore and the availability of a market.

Chromite also occurs in the nickel-bearing lateritic soils developed on peridotite (see Nickel).

Cobalt

Cobalt in Curry County occurs with nickel in laterites and with a few copper deposits such as those in the Collier Creek area (205), the Cobalt group occurrence (202) on the Illinois River, and the unnamed Cobalt copper prospect (72) near Doe Gap in the southeastern part of the County. The metal occurs in only small amounts and cannot be considered economically significant until its by-product value enables a deposit to be profitably mined.

Copper

Three, or possibly four, groups of copper prospects in Curry County may be described as areas, and the other occurrences appear to be scattered without pattern or association with these main areas. Copper mineralization appears to be somewhat concentrated in the western strip of Rogue Formation in the upper Chetco drainage area in the southeastern part of the County. Copper mineralization in this first area is associated with tuffaceous sediments, siliceous volcanic rocks, and sheared serpentinites, especially along their contacts with layered volcanic rocks. This area includes a number of small occurrences such as the Eagle Creek group (18) and the Copper Creek group (56). The area extends to the north into Josephine County and includes similar copper occurrences on Rancherie Creek and Fall Creek (Diller, 1914, p. 84). The deposits are probably volcanogenic in origin.

A second area of copper occurrences is the Collier Creek area, where a few high-grade boulder-type occurrences in serpentinite can be found. The third area, which is somewhat less important, is the area near Rusty Butte in the South Fork of the Sixes River drainage, where mineralization occurs in sediments and volcanic rocks of the Galice Formation. These occurrences have been prospected for gold, not copper.

The copper prospects of Upper Shasta-Costa Creek (168-169) may have some merit and may constitute a fourth area, although only two prospects are mapped. These deposits occur in altered volcanic rocks of the Rogue Formation and are probably volcanogenic.

History of mining

Butler and Mitchell (1916, p. 53-54) state that, in 1908, a small amount of high-grade copper ore was reportedly shipped from the Collier Creek area, brought to Agness on pack horses, carried to Gold Beach in small boats, and then shipped by water to San Francisco. Information on the total amount and value of the ore shipped was not obtained.

Description of occurrences

Available information on the various copper occurrences is summarized below. A few of the occurrences were developed as gold prospects and happened to contain some associated copper. They are described with the other gold deposits.

Bunker Hill prospect (210): The boulder-type deposits in sheared serpentinite are similar to Collier Creek deposits. Associated minerals are magnetite (cubic), erythrite, and pyrrhotite in a dacite dike. Original work was probably done about 1900 or at least prior to 1916. There has been no recent development. No production is reported. Recent investigations have been unsuccessful in locating the prospects (Parks and Swartley, 1916, p. 47).

Cobalt group prospects (202): Mineralization in the form of disseminated pyrite, chalcopyrite, and pyrrhotite occurs within and along the contact of pyroxene-rich, partly-serpentinized peridotite and metagabbro. Samples indicate low values. Further field investigation is indicated (Oregon Department of Geology and Mineral Industries unpublished mine-file reports, 1952, 1970; Parks and Swartley, 1916; Ramp, 1963).

Cobalt prospect (72): A 3-ft-thick, 125-ft-long, northwest-striking, nearly vertical zone of magnetite-bearing pyroxenite, with pyrrhotite, minor chalcopyrite, malachite, and erythrite, occurs in partly serpentinized peridotite. A grab sample assayed no Au and Ag, trace Co, 0.2 percent Cu, 0.1 percent Ni, and no Pt (Ramp, 1975, p. 24).

Copper City (Collier Creek) prospects (205): Mineralization occurs as pods and lenses of magnetite with malachite, chalcocite, azurite, erythrite, pyrite, and chalcopyrite in sheared serpentinite. Copper showings are scattered over an area 1.5 mi long and 0.75 mi wide. Butler and Mitchell (1916, p. 53-54) report 45 tons copper ore were shipped to San Francisco in 1908 after having been packed to Agness on horses and to Gold Beach in small boats. There appears to be little promise of significant tonnage in these deposits (Oregon Department of Geology and Mineral Industries unpublished mine-file report, 1952).

Copper Creek group (Chetco Copper Company) (54 and 56) (includes Melanterite tunnel (54)): There are three short adits and small cuts: the northern, upper "Melanterite tunnel" is 25 ft long; the southeastern adit is 50 ft long; and the southwestern (Sunset tunnel) is 90 ft long with a 15-ft crosscut to the right. The country rock is a siliceous, phyllitic metavolcanic of the Rogue Formation. Mineralization consists of thickly disseminated to massive granular pyrite with lesser zones of chalcopyrite and minor sphalerite. The deposits appear to be volcanogenic. A small shipment was reportedly made from this locality by the Chetco Copper Company (Diller, 1914, p. 84; Ramp, 1975, p. 27-29).

Diamond prospect(95): A 10-ft-thick zone of disseminated pyrite that strikes about N. 65° E. and dips 35° S. occurs in weathered fine-grained mafic to intermediate intrusives and volcanic (?) rocks near their thrust (?) contact with peridotite to the north. Preliminary samples showed only a trace of gold, silver, and copper (Oregon Department of Geology and Mineral Industries mine-file report, 1963).

Eagle Creek group (18): Gossans, quartz veins with sulfides, and mineralized shear zones are found within and along the contact of a body of serpentinite with metavolcanic rocks which are intruded by small diabase, diorite, and gabbro dikes. Disseminated pyrite and chalcopyrite occur in quartz and cherty tuffaceous metasediments interbedded with volcanic rocks underlying the serpentinite. Preliminary sampling shows Cu values from 0.60 to 13.30 percent. Gold and silver values are low. There has been no production (Ramp, 1975, p. 27).

Kessler and Fry prospects (200): Serpentinite is intruded by a 100-ft-thick dacite porphyry dike adjacent to greenstone and Colebrook Schist. Copper-stained serpentinite is exposed in a wash near the tunnel, and high-grade copper-bearing float is found on the flat below the tunnel (Butler and Mitchell, 1916, p. 98-99; Oregon Department of Geology and Mineral Industries, 1940, p. 52).

Miller Creek gossan (17): This gossan is characterized by disseminated to compact, granular, stratified (?) pyrite with minor chalcopyrite. Patches of gossan occur over a 100- by 300-ft area in altered volcanic rocks of the Rogue Formation. Preliminary samples show low gold, silver, and copper content. The deposit is probably of volcanogenic origin and worthy of further exploration (Ramp, 1975, p. 27,28,33).

Miss Dolly prospect (138): Minor copper mineralization, malachite, and, possibly, sulfides in sheared serpentinite are exposed in the cut. There has been no production. Department samples XG-189 and XG-190 (P-28630, P-28631) were taken by Ramp (1963).

Morrison Gulch prospects (22): Malachite, chalcopyrite, pyrite, and pyrrhotite occur in a 4-ft-wide, north-striking, vertical, sheared serpentinite zone which crops out on the east side of the mouth of Morrison Gulch. A sample across the zone assayed 0.3 oz/ton Au and 0.9 percent Cu. A shallow cut beside the trail on the west side of the creek less than 0.5 mi to the south also exposes copper-stained, sheared serpentinite (Ramp, 1975, p. 28-29).

Pine Flat prospect (179): Thin seams and stains of malachite and azurite in sheared serpentinite occur alongside a dacite porphyry dike. Samples indicate from 3.5 to 9.8 percent Cu and traces of Au and Ag. The serpentinite occurs along the contact of pebble conglomerate of the Myrtle Group on the east and Colebrooke Schist to the west. There has been no reported production (Oregon Department of Geology and Mineral Industries unpublished mine-file report, 1957; Parks and Swartley, 1916, p. 180).

Red Cub prospect (169): Mineralization in the form of pyrite, with abundant secondary silica, minor chalcopyrite, and less abundant (?) sphalerite, is found in metavolcanic rocks of the Rogue Formation. Most of the samples representing fairly large areas of mineralization have less than 1 percent Cu, about 0.2 oz/ton Ag, and a trace of Au. Two 100-ft diamond drill holes that were completed in 1966 reportedly bottomed in serpentinite. Assay results were very low (L.E. Frizzell, personal communication, April 28, 1977). The deposit, including the Shasta Costa prospect (168), is probably volcanogenic in origin and warrants further investigation (U.S. Bureau of Mines unpublished confidential-file report, 1944).

Shasta Costa prospect (168): A mineralized zone about 100 ft wide contains pyrite, minor chalcopyrite, and some malachite in altered volcanic rock of the Rogue Formation. The zone reportedly assays 0.67 percent Cu. This mineralization is similar to and probably associated with the Red Cub prospect (169) about 1 mi to the south. The area probably warrants further investigation (U.S. Bureau of Mines, unpublished confidential-file report, 1944).

Starr (McKinley) mine (194): Sheared serpentinite contains fairly abundant copper carbonate, iron stain, and minor chalcopyrite in a zone about 12 ft wide. Occasional isolated pods of massive pyrrhotite and chalcopyrite also occur. Mineralization could not be traced to depth. The serpentinite is part of the thrust sheet associated with greenstone bodies and Colebrooke Schist overlying the Dothan-Otter Point Formations (Parks and Swartley, 1916, p. 211).

Stone prospect (12): A 5-ft-thick gossan with residual chalcopyrite and pyrrhotite striking N. 45° E. and dipping steeply SE. occurs on the serpentinite-metavolcanic contact. The gossan assayed 2.5 percent Cu (Ramp, 1975, p. 28).

Sulfides occurrence (184): The area is in the vicinity of the overthrust contact of Colebrooke Schist on the Dothan-Otter Point Formations. The deposit occurs as small blebs and veinlets of fine-grained sulfides (pyrite and minor chalcopyrite) in vuggy quartz and assayed 0.04 oz/ton Au, 0.90 percent Pb, 4.20 percent Cu, trace Ag, and trace Zn (Oregon Department of Geology and Mineral Industries assay P-15629, 1953).

War Baby prospect (113): Rocks in the area are mapped as Galice Formation sediments, volcanics, and small intrusives. Of two samples submitted in 1950, the first (P-10106) assayed a trace Au, 0.90 oz/ton Ag, 2.20 percent Cu, and trace Zn. The second (P-10107) assayed no Au, trace Ag, 0.60 percent Cu, and 1.60 percent Zn (Oregon Department of Geology and Mineral Industries assay files, 1950).

Gold and Silver

A large number of small gold mines and prospects are to be found in Curry County. Since information is limited on many of the prospects, they are listed in Table 9 (Other gold and silver occurrences) and are not summarized separately. Placer mines are not reported individually, but main placer-mining areas are discussed briefly in general terms.

History of mining and production

During the early 1850's, the first mining activity in Curry County, gold prospecting along the beaches in the vicinity of Port Orford and Gold Beach, led to a brief (1854-1855) period of prosperity for Port Orford (Spreen, 1939, p. 11).

The more important gold-producing beaches in Curry County were at Ophir, Pistol River, Gold Beach, Port Orford, and Cape Blanco (Horner, 1918). The mining in these beach areas began about 1853; but mining was brief in duration because of inadequate equipment for saving the extremely fine gold.

Placer gold mining sprang up along the Sixes River about 1857. The elevated beach placers along the eastern edge of the broad coastal plane north of Port Orford started up in 1871 (Diller, 1903). Essentially all of the gold production from the Sixes River area (reportedly valued at about $1 million (Diller, 1903)) was from placer mines, and the best producers were the bench-gravel deposits along the South Fork of the Sixes River and the Sixes River downstream from the South Fork.

Other County gold-producing areas which became active during the 1870's were the upper Chetco area (China Diggings district), which included Carter, Babyfoot, Slide, and Miller Creeks, the Little Chetco River, and benches such as Taggert's and Chetco bars that were worked in a small way along the main Chetco River; placers in Bonanza Basin on the headwaters of Boulder Creek; and the area along the Rogue River and Mule Creek in the vicinity of Marial.

Records of the total value of gold production in Curry County are incomplete; therefore, production figures are only estimates. Curry County, however, is one of the smaller gold-producing counties in the State, ranking behind neighboring counties of Jackson, Josephine, Douglas, and Coos. An idea of their production can be obtained from Diller (1914, p. 30) who reports that in the year 1912, Curry County produced $12,786 worth of placer gold (based on a price of $20.67/fine oz) and 39.91 fine oz of gold from lode mines.

Pardee (1934, p. 26) reports production of gold and platinum from beach placers during the period from 1903 to 1929 as follows: from the Port Orford-Cape Blanco area, 869 oz of gold valued at $17,901 and $188 worth of platinum; from the Ophir-Gold Beach area, 761 oz of gold valued at $15,676 and no platinum recovery reported.

Access to the upper Chetco area (China Diggings district) was through Josephine County, and early production from that area may have been credited to Josephine County. Total placer-gold production in the upper Chetco area has been estimated at 2,500 oz; total lode mine production, largely from the Peck mine (21), may have been about 8,000 oz (Ramp, 1975, p. 23).

Mining in the Mule Creek district was first done in 1891 by John Billings and his son, G.W. Billings (Butler and Mitchell, 1916). Principal production was from the placers on lower Mule Creek and the Rogue River bars just downstream from Mule Creek. By the early 1900's, four lode mines with a small amount of reported production had been developed. The mines were the Paradise prospect (151), Marigold (also known as the Lucky Boy and the Tina H.) (156), Red River Gold Mining Company (Mule Creek) placer (162), and the Mule Mountain mine (164).

Total production from the Mule Mountain mine, which was mined from three separate veins, is estimated to have been about $60,000. The Tina H. (Marigold) produced about $50,000 in gold. Although other lode mines in the district are reported to have some high-grade specimen ore, all have had very little production.

The Red River Gold Mining Company placer, which operated during the late 1800's and early 1900's, was undoubtedly the largest producer in the area (Diller, 1914; Butler and Mitchell, 1916, p. 121-123). Several acres were mined on the bench along the northwest side of the Rogue River and west of Mule Creek. Diller (1914) described the deposit as 30 ft of fairly coarse gravel which was capped by about 35 ft of fine sandy material lying on a bench 20 ft above the river. No record of total production of the Red River Gold Mining Company was obtained. Floods of later years have obliterated all evidence of this placer-mining activity.

Future potential

Future potential for gold production in Curry County probably lies in volcanogenic sulfide deposits of the Rogue Formation in the Mule Creek and upper Chetco areas and in the remote possibility of developing offshore black-sand deposits.

Placer areas

Beach placers, including beach-terrace deposits: The best values in beach placers are found in the wave-concentrated black-sand deposits, most of which also contain an interesting amount of chromite. A number of these gold- and platinum-bearing deposits that were worked in the early days are described in another section (see Chromite). Beach placers are characterized by multiple, thin, wispy layers of black sand in gray sand. The better concentrates occur near sea cliffs on back beaches where wave action during high tides and storms washes away the lighter minerals and leaves a residual rough concentrate of heavy minerals, pebbles, and drift wood.

Obtaining accurate samplings and assays for gold and platinum-group metals is quite difficult, and techniques and results obtained must be carefully evaluated (Pardee, 1934, p. 34-35). Reported assays vary widely from a few cents to a few dollars per ton of sand.

Problems encountered in mining beach-terrace deposits include the presence of deep overburden and difficulty in separating very fine particles of precious metals from coarser grains of abundant, relatively heavy minerals occurring in the black-sand horizons. Pardee (1934, p. 26) reports that gold particles in the beach deposits range in size from microscopic specks to thin flakes about 1 mm in diameter.

Sixes area placers: Much of the gold-bearing bench gravel deposited along the Sixes River (from 50 to 130 ft above the present stream) was worked during the peak periods of early placer-mining activity. A few isolated areas of high bench gravel along the South Fork and main Sixes River probably remain unworked, but no surveys are available to delineate virgin gravel deposits. Baldwin and Boggs (1969) have determined the concentration of detrital gold in the alluvium in the Sixes River drainage (see Figure 9) and report that the richest concentrations of gold are in parts of the South Fork drainage. They believe the area around Rusty Butte is the major gold source in the Sixes River drainage area.

Upper Chetco area placers: Information on gold-placer deposits in the upper Chetco drainage is summarized by Ramp (1975, p. 29-30). The principal placer-gold values are found along the headwaters of the Little Chetco River and in bench gravels along the Chetco River downstream from the Little Chetco in the vicinity of the mouths of Babyfoot and Slide Creeks. These areas are in the Kalmiopsis Wilderness.

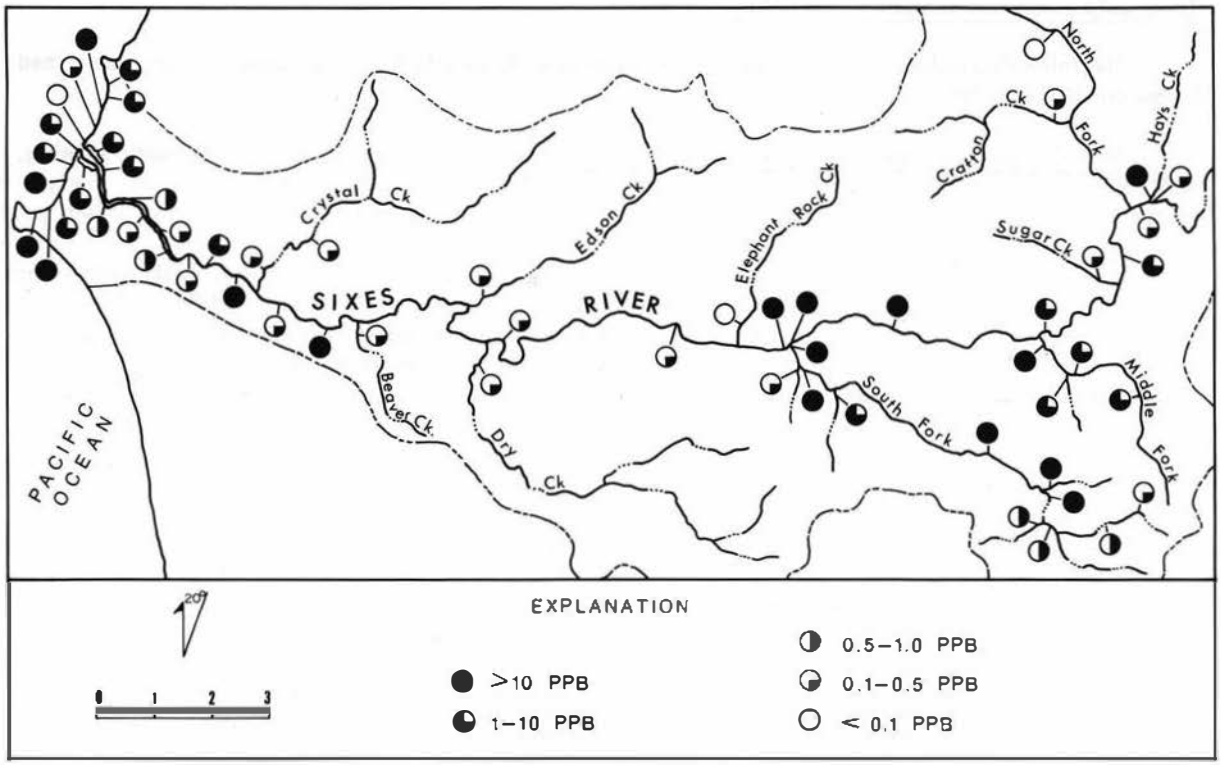


Figure 9. Average concentrations of gold in Sixes River drainage (Baldwin and Boggs, 1969). PPB - parts per billion.

Bonanza Basin - Boulder Creek placers: A small amount of placer mining took place along Boulder Creek, especially at the head of the drainage area in Bonanza Basin, south of Iron Mountain in secs. 4, 5, and 8, T. 34 S., R. 12 W. The principal mines were the Bonanza Basin placer (139), Bonanza (White Elephant group) placer (140), Wildcat group (Grizzly Bear) prospect (142), and the Boulder Creek Mining Company placer (172). Except for the area of bench gravels near the mouth of Boulder Creek (N½ sec. 25, T. 34 S., R. 13 W.), the available yardage is quite limited. The Wildcat group (Grizzly Bear) prospect on Bluebell Creek, a tributary of Boulder Creek in S½ sec. 4 and NE¼ sec. 9, produced between $2,000 and $3,000 (@ $20 to $35/oz) between 1930 and 1940 from about 2 acres of placer ground. The Bonanza (White Elephant group), worked intermittently from 1874 to 1941, produced about $70,000 from 2 acres. Bonanza Basin gold is reported to be in the form of coarse water-worn nuggets from 50¢ to $25 size (@ $35/oz), with very little in the way of fines recovered. The largest reported nugget weighed 7 oz. It is speculated that the gold was derived from pocket deposits along a serpentinite-"porphyry" contact (Oregon Department of Geology and Mineral Industries unpublished reports, 1941, 1946).

Attempts at mining the extensive bar at the mouth of Boulder Creek in 1915-16 by the Boulder Creek Mining Company (172) were apparently not very successful. Although not reported, it is probable that gold values are considerably diluted by South Fork Lobster Creek gravels.

Rogue River placers: Small amounts of gold are continually carried by the Rogue River and deposited in gravel bars along its banks. Several attempts to mine these deposits profitably have met with limited success and a number of failures. Slightly richer Rogue River deposits that formed immediately downstream from junctions with tributaries carrying greater gold values have been worked more successfully. An example is the bar below Mule Creek at Morial, where the Red River Gold Mining Company operated around the turn of the century.

Lode gold mines and prospects (excluding placers)

The following gold mines and prospects are arranged alphabetically. Occurrences not summarized below are listed in Table 9.

Bear Cat group prospect (114), Sixes River area: Pyrite and gold occur in a 12-in, north-striking, 45° east-dipping quartz vein on the contact of the slate hanging wall and "porphyry" footwall. Sample of vein assayed 0.13 oz/ton Au and trace Ag (Oregon Department of Geology and Mineral Industries, 1940, p. 80).

Big Ben (Rusty Butte) (Harrison) mine (109), Sixes River area: Northeast-striking, 12-ft wide, shear zone in argillite has small quartz and calcite veins and ore minerals including gold, silver, galena, pyrite, chalcopyrite, and arsenopyrite. Production was unrecorded but was probably a few thousand dollars in gold (Diller, 1903: Oregon Department of Geology and Mineral Industries unpublished mine-file report, 1950; Brooks and Ramp, 1968, p. 184).

Cliffside Lode mine (131), Elk River area: Vertical quartz vein strikes N. 60° W. and occurs in diorite containing pyrite and chalcopyrite. Assay values are spotty. The vein was discovered in 1938, but there has been no production (Oregon Department of Geology and Mineral Industries unpublished mine-file report, 1938; Oregon Department of Geology and Mineral Industries, 1940, p. 82; Brooks and Ramp, 1968, p. 184).

Combination prospect (111), Sixes River area: Quartz veinlets occurring in N. 20° W., nearly vertical, 10- to 20-ft-wide shear zones in argillite contain spotty pyrite, galena, and sphalerite and have low gold and silver values. A small amount of hand-sorted, high-grade sulfide ore was probably mined, but there has been no other production (Oregon Department of Geology and Mineral Industries unpublished mine-file report, 1950; Oregon Department of Geology and Mineral Industries assay records; Brooks and Ramp, 1968, p. 185).

Dinawadja (Margarette) prospect (157), Mule Creek area: This prospect is reported to be either a southwesterly extension of the Marigold or Tina H. vein or a parallel vein lying about 50 ft east. A small quartz vein in metavolcanic rocks that strikes northeast and dips steeply northwest contains pyrite, chalcopyrite, and minor gold (Oregon Department of Geology and Mineral Industries unpublished mine-file reports, 1935, 1946; Oregon Department of Geology and Mineral Industries, 1940, p. 72).

Emily mine (58), upper Chetco area: Workings are in a greenstone inclusion surrounded by serpentinite. The adit follows a northwest-trending, vertical shear zone along the serpentinite contact. A limonite gossan occurs at the surface. Minerals recognized in the serpentinite shear zone include magnetite, chalcopyrite, some malachite with limonite, and minor chalcocite. A 2-ft chip sample across this zone at the portal assayed 0.11 oz/ton Au, 0.10 oz/ton Ag, and 0.3 percent Cu. During the 1880's the mine reportedly produced about $1,000 worth of gold by hand methods from high-grade oxidized ore (Perry Davis, personal communication, 1965; Ramp, 1975, p. 30).

Frazier mine (23), upper Chetco area: A 1- to 6-ft-thick vein of fractured, iron-stained quartz lies along the north-trending sheared contact of a narrow serpentinite zone in metavolcanic rocks. The main ore mineral is arsenopyrite with some pyrite and free gold. A sample from the ore pile taken in 1969 assayed 0.36 oz/ton Au and 0.20 oz/ton Ag. A $12,000 to $14,000 pocket was reportedly mined in 1935, and an additional $650 production is reported up to 1938 (Oregon Department of Geology and Mineral Industries unpublished mine-file report, 1938; Ramp, 1975, p. 31).

Golden Bullet (Old Red) mine (150), Mule Creek area: Free gold and sulfides (pyrite, sphalerite, galena, argentite (?), chalcopyrite) occur in a 4- to 12-in-thick shear zone striking N. 55° W. and dipping 45° NE. in metavolcanic rock of the Rogue Formation. The mine has been worked intermittently since 1930, but production, if any, has been small (Oregon Department of Geology and Mineral Industries, 1940, p. 23; Oregon Department of Geology and Mineral Industries unpublished mine-file report, 1946).

Golden Dream (Higgins) (Empire) mine (9), upper Chetco area: Sheared metasedimentary and metavolcanic rocks along serpentinite contacts contain numerous small quartz veinlets, some sulfide mineralization, and free gold in sheared talcose rock. Some diorite and gabbro dikes are nearby. Higgins set up a three-stamp mill on Slide Creek about 2,100 ft in elevation. Rich eluvial material was sluiced at several sites in the early 1900's, but production figures are not reported (Diller, 1914, p. 65; Parks and Swartley, 1916, p. 120; Oregon Department of Geology and Mineral Industries, 1940, p. 59; Brooks and Ramp, 1968, p. 197; Ramp, 1975, p. 31).

Golden Eagle mine (24), upper Chetco area: Gold occurs in a blanket mixture of crushed iron-stained vein quartz with clay and other rock fragments, 6 in to 2.5 ft thick, lying parallel to the hill slope, 6 to 30 ft deep in landslide debris. Slide material is composed of mixed sediments and volcanic rocks of the Rogue Formation. Underlying bed rock is serpentinite and argillite. The mine was located in 1935 and mined in a small way intermittently, both as a hydraulic placer operation, concentrating gold in a sluice box, and as an open-pit hand operation which recovered gold on an amalgam plate below a small scrubber. Total production to 1963 is probably about $1,000 (Oregon Department of Geology and Mineral Industries, 1940, p. 59-60; Oregon Department of Geology and Mineral Industries unpublished mine-file report, 1963; Brooks and Ramp, 1968, p. 197; Ramp, 1975, p. 31).

Golden Fraction and Golden Rattler prospects (153), Mule Creek area: A northwest-trending, steeply dipping to the northeast, narrow shear zone in metavolcanic rock and metagabbro contains pyrite, calcite, and quartz. Assay values range from a trace to 0.12 oz/ton Au. There has been no production. See Table 9 for information about another nearby prospect, Golden Rattler (Oregon Department of Geology and Mineral Industries, 1940, p. 73; Oregon Department of Geology and Mineral Industries unpublished mine-file report, 1946).

Hilltop group (Hamaker) prospects (35 and 38), upper Chetco area: The workings in sec. 36 lie along the contact of serpentinite and metavolcanic rock, separated by a thin zone of metasedimentary rock. A small cut above the inclined adit at the contact exposes small quartz veinlets in metasedimentary rock. Veins strike about N. 55° E. and dip 60° SE. A selected sample of this vein material (P-32132, taken in 1967) assayed 0.44 oz/ton Au and trace Ag. Other openings in SW$\frac{1}{4}$ sec. 31 expose mostly highly fractured greenstone (metabasalt) with small discontinuous quartz veinlets. Values are quite erratic. Gold can be panned from the soil at a number of spots in the area. Some rhodonite and manganese oxides occur in cuts above the 60-ft adit. There is no record or evidence of production (Oregon Department of Geology and Mineral Industries unpublished mine-file report, 1938; Appling, 1958, p. 25-27; Ramp, 1975, p. 36).

Hustis mine (16), upper Chetco area: Mineralization occurs in a north-striking, nearly vertical shear zone injected by highly sheared talcose serpentinite exposed between fractured volcanic wacke to the west and a partly decomposed diorite dike intruding metavolcanic rocks to the east. A few, narrow, malachite-stained gossan lenses indicate the presence of sulfides. Values were recovered as free gold in sluice boxes. A sample (P-31195), cut across a 1-ft by 8-ft lens of gossan in the main pit on the north side of the saddle, assayed 0.42 oz/ton Au, 0.20 oz/ton Ag, and 0.50 percent Cu. Diller (1914) reports an old arrastre in ruins as evidence of mining activity several years earlier, probably in the late 1800's. Production statistics are not available (Diller, 1914, p. 65; Brooks and Ramp, 1968, p. 198; Ramp, 1975, p. 32).

Keystone prospect (165) (see Mule Mountain group), Mule Creek area

Lancaster (Venner) prospect (149), Mule Creek area: Quartz veinlets in metavolcanic rock of the Rogue Formation contain pyrite and free gold (Oregon Department of Geology and Mineral Industries, 1940, p. 75).

Lucky Strike prospect (154), Mule Creek area: North-trending mineralized shear zone in metavolcanic rock dips about 50° E. and contains a 14-in-thick iron-stained gouge zone with pyrite stringers and a 20-in-thick zone with 1-in quartz veinlets. Samples indicate low gold values (Oregon Department of Geology and Mineral Industries unpublished mine-file report, 1946).

Lucky Warren, Mt. Emily prospects (Florence, etc.) (220), Mount Emily area: Mineralization is associated with rhyolite breccias intruded along fault zones in Dothan Formation sandstone. A number of rhyolite, dacite, and coarse-grained nepheline syenite dikes and sill-like intrusive bodies are in the Mount Emily area. Gold and silver values appear to be uniformly low. Zinc and molybdenum are also reported; but sampling failed to show significant mineralization (see Platinum - Mount Emily area) (Butler and Mitchell, 1916, p. 109-113; Parks and Swartley, 1916, p. 145; Oregon Department of Geology and Mineral Industries unpublished mine-file report, 1946).

Mammoth prospect (159), Mule Creek area: A northeast-striking, southeast-dipping quartz vein 3 in to 2 ft thick occurs in altered hornblende diorite or metagabbro country rock. Owner reported that 43 samples had an average assay value of $55.30/ton. Four tons were milled in the Tina H. stamp mill and 8 tons in an arrastre near Mule Creek below the mine. Recovery was poor (Oregon Department of Geology and Mineral Industries, 1940, p. 75-76; Oregon Department of Geology and Mineral Industries unpublished mine-file report, 1946; Brooks and Ramp, 1968, p. 190).

Marigold (Tina H.) mine (156), Mule Creek area: Free gold and minor chalcopyrite occur in 1- or 2-in to 1-ft multiple quartz veins which strike northeast and dip steeply northwest in chloritic country rock. The mine, which was formerly called Lucky Boy, was originally located in 1902 or 1903. It produced $48,000 prior to 1910 using water-powered two-stamp mill. Production from later work is not reported (Butler and Mitchell, 1916, p. 79-82; Oregon Department of Geology and Mineral Industries, 1940, p. 76-77; Brooks and Ramp, 1968, p. 190).

MC mine (37), upper Chetco area: A few narrow quartz veins and numerous small discontinuous veinlets occur in a belt of fractured and deformed metavolcanic and metasedimentary rocks including tuffs, tuffaceous sandstone, chert, and argillite underlain by a sill-like body of serpentinite to the west. Some gold was recovered from near-surface debris and soil by panning. A 20-in chip sample across the sheared serpentinite contact exposed in the short adit (XG-216) assayed 0.40 oz/ton Au. Claims were located in 1958. Bulk sampling and mill testing have been done by two different companies in search of low-grade orebodies. Values appear to be spotty, and sampling results were discouraging. Total production has probably been about 20 oz to date (Oregon Department of Geology and Mineral Industries unpublished mine-file report, 1973; Lloyd Frizzell, personal communication, February 5, 1974; Ramp, 1975, p. 33).

Melanterite tunnel (54) (see Copper for description of Copper Creek area)

Miller Creek gossan (17) (see Copper)

Moss Rose (Axtel) prospect (133), Elk River area: A series of quartz veins in greenstone strike N. 60° E. and dip 54° NW. Veins from a mineralized zone are over 12 ft wide. Chalcopyrite occurs in quartz veins, pyrite in greenstone. Some molybdenite and marcasite are also found (Parks and Swartley, 1916, p. 18; Oregon Department of Geology and Mineral Industries, 1940, p. 86).

Mule Mountain mine (164), Mule Creek area: Country rocks are recrystallized greenstone and metagabbro. The Mule Mountain vein has its apex on the ridge in sec. 17 at an elevation of 1,680 ft. The main vein (eastern of the two parallel veins) is 8 in to 2 ft thick. Fine particles of free gold, probably derived from breakdown of pyrite, occur in a limonite-bearing gouge. The Big Devils Stairs Creek workings are about 200 yds northwest and 340 ft below the Mule Mountain shaft. Some pyrite and chalcopyrite occur in the keystone vein which consists of parallel shear zones striking about N. 25° W. and dipping 76° E. One or more quartz veins with sheared rock, gouge, and chlorite occur in zones from a few inches to more than 20 ft wide.

Mule Mountain vein was discovered about 1896. Early mining on the ridge resulted in about $3,000 production. In 1931-1932, a 400-ft adit, financed with promotion funds, was driven to the Mule Mountain vein from 300 ft lower on the east side of the ridge, but no production resulted. The two parallel veins on the ridge have been worked in a small way during recent years by R. L. Venner. Total production from the mill

that was situated near Blossom Bar is reported to have been about $60,000, probably all prior to 1920 (Butler and Mitchell, 1916, p. 83-90; Oregon Department of Geology and Mineral Industries, 1940, p. 77; Oregon Department of Geology and Mineral Industries unpublished mine-file field notes and map, 1956; R.L. Venner, personal communication, 1965; Brooks and Ramp, 1968, p. 190-191).

Paradise prospect (151), Mule Creek area: Country rocks are Rogue Formation metavolcanics and metagabbro. The vein is faulted with discontinuous tapering segments that widen to as much as 4 ft in places but are generally narrower, striking about east and dipping steeply south. Only ore mineral noted is free gold. Values are occasionally rich but spotty. History is mostly lacking. One thousand pounds of selected ore were reportedly shipped from the property, possibly around 1900 (Butler and Mitchell, 1916, p. 78-79; Oregon Department of Geology and Mineral Industries, 1940, p. 77-78; Oregon Department of Geology and Mineral Industries unpublished mine-file report, 1961; Brooks and Ramp, 1968, p. 191).

Peck mine (Bacon) (21), upper Chetco area: Ore occurs in an east-northeast-striking, steep south-dipping, quartz fissure vein in greenstone. Average width of the vein structure where mined is about 30 in. Veins in the greenstone are cut off at the sheared serpentinite contact. Ore minerals include arsenopyrite, pyrite, chalcopyrite, pyrrhotite, and gold. Veins are also offset by a north-striking high-angle fault exposed in the workings. Some of the ore mined was exceptionally rich. The mine was located by I. F. Peck in 1919. A total of $79,140.10 was produced from a small, rich ore shoot in 1928 and 1929. Some early production by ground sluicing was undoubtedly accomplished after completion of the ditch from Miller Creek by Bacon prior to Peck's development of the vein (Diller, 1914, p. 65-66). The mine was worked intermittently to 1952 by W. D. Bowser who produced about $40,000. Total production to 1952 is estimated to be in excess of $120,000 worth of gold. Very little mining has been done since that time (Diller, 1914, p. 65-66; Shenon, 1933, p. 51-55; Oregon Department of Geology and Mineral Industries unpublished mine-file reports; Ramp, 1975, p. 34).

Robert E. (Miller) mine (19), upper Chetco area: The workings are on the faulted contact of serpentinite with altered chloritic metavolcanic rocks. At this point the contact strikes about N. 60° W. and is nearly vertical. Values occur in the sheared contact zone and in small quartz veins containing some calcite with disseminated sulfides including arsenopyrite, pyrrhotite, and chalcopyrite. Assays in excess of 1 oz/ton Au are not uncommon. Some of the ore from this mine may have been milled at and credited to the Peck mine. Records of placer production and production from the adit are not available, and very little information has been obtained on the history of this mine (Diller, 1914, p. 65; Ramp, 1975, p. 34).

Stevens and Stear (Indigo group) prospects (176), Agness area: Workings are on an irregular, quartz-filled, greenstone breccia near the serpentinite contact. The zone is reported to be 20 ft wide in places. Grab samples indicate a small amount of gold and silver (0.10 oz/ton Au; 0.12 oz/ton Ag). Free gold can reportedly be panned in places. The ruins of a small Chilean-type mill remain on the property (Oregon Department of Geology and Mineral Industries, 1940, p. 53; Oregon Department of Geology and Mineral Industries assay AKG-77, 1976).

Stumble mine (36), upper Chetco area: Thin, coarse-crystalline to vuggy, tapering, multiple quartz veinlets in a zone 2.5 to 4.5 ft thick strike N. 43° W. and dip 60° SW. Veinlets penetrate thin-bedded, indurated tuffaceous sediments. Ore minerals include gold, chalcopyrite, pyrite, and arsenopyrite. Gold assays range from about 0.5 oz to nearly 8 oz/ton. A small amount of high-grade ore has been mined, but no production records or history are available (Wells and others, 1949, mine no. 109; Oregon Department of Geology and Mineral Industries unpublished mine-file report, 1962; U.S. Forest Service unpublished mineral-examination report, 1964; Brooks and Ramp, 1968, p. 199; Ramp, 1975, p. 34).

Wildcat group (Grizzly Bear) prospect (142), Bonanza Basin area: A narrow (about 1 ft) NE-striking gray quartz vein with disseminated pyrite, chalcopyrite, and minor malachite occurs along a serpentinite Galice Formation contact or shear. Gold values are low to spotty. There has been no production (Oregon Department of Geology and Mineral Industries unpublished mine-file report, 1954).

Table 9. Other gold and silver occurrences

Map number	Name	Location ¼	Sec.	T(S)	R(W)	Development	Production	Reference	Remarks
13	Eagle Mountain (Gossans)		13	38	10	Small pits	None	Ramp (1975)	Prospect guide
47	Unnamed prospect	SW	3	39	10	Shallow shaft	Small (?)	None	In phyllitic metavolcanics
116	Unnamed prospect	NW	27	32	13	Unknown	Unknown	Topographic map	Powers quadrangle
117	Butcher Hill quartz		21	32	13	Unreported	Unknown	*	Not visited
152	Golden Oak and Golden Cargo (?) prospects		31	32	10	Shallow cuts and 4 short adits	Unknown	**	Important information lacking
153	Golden Rattler prospect		32	32	10	6 small cuts	None	**	Important information lacking
155	Good Luck, Home Lode, and other prospects		32	32	10	Small adit and several cuts	Minor placer production	**	Important information lacking
158	Donaghue (Yellow Moon) prospect	SE	32	32	10	150 ft adit	None	**	Low values
166	Pinnacle Point occurrence	NE	19	33	10	Undeveloped	None	None	From distance appears mineralized

* Oregon Department of Geology and Mineral Industries unpublished mine-file report
**Oregon Department of Geology and Mineral Industries, 1940, and unpublished mine-file reports

Young mine (33), upper Chetco area: Country rocks are layered, silicified, tuffaceous sandstone and shale which strike north and dip 50° E. Several quartz veinlets occur in the metasediments. A 6-in breccia- and crystalline quartz-filled fissure that strikes west and dips 65° S. is exposed in the face of the cut. A $1,000 pocket was reportedly recovered by R. D. Young in 1937 (Oregon Department of Geology and Mineral Industries, 1940, p. 62; Brooks and Ramp, 1968, p. 199; Ramp, 1975, p. 35).

Iron

Future potential

A few iron prospects and occurrences are known in Curry County, and those in the upper Chetco area may have some potential as relatively large low-grade sources of iron in the future. These are described by Ramp (1975, p. 35) as follows:

> "Magnetite is a common mineral in the gabbros, pyroxenites, and the coarse-grained hornblendic metapyroxenites. In a few areas, magnetite is sufficiently abundant to attract the interest of prospectors.
>
> "A group of claims called the Tincup group (1) was located in the area between Tincup Peak and Gold Basin about 1957. Coarse-grained and granular aggregates of magnetite up to 0.75 in in diameter are disseminated in pyroxenite and in part of the gabbro. Preliminary sampling and mapping indicate a large low-grade deposit in this area containing from about 15 to 25 percent magnetite by weight, which when concentrated magnetically assays about 60 percent Fe, 1.4 percent TiO_2, trace Ni, and 0.18 percent Cr_2O_3.
>
> "Outcroppings of similar magnetite-rich rock occur on the ridge (45) in sec. 31, T. 38 S., R. 10 W.; on the east slope of Mount Billingslea; as float in the west tributary of Box Canyon Creek in sec. 35, T. 38 S., R. 11 W.; and in bench gravels along the Chetco for a short distance upstream from the mouth of the Little Chetco. Some of the gabbros of Granite Butte in the northern part of the area also appear to have interesting amounts of disseminated magnetite. Further investigation of the iron potential in the area may be justified."

Other iron occurrences in the County are probably of academic interest only and are listed below in brief summary reports.

Description of deposits

Berry prospect (203): The description sounds much like the Horse Sign Butte deposit and may possibly be the same and not a separate occurrence. Magnetite in sandstone 50 to 100 ft wide occurs between two greenstone "dikes" surrounded by serpentinite. Beds appear to strike N. 20° E. and dip 51° NW. The iron reportedly extends for some distance down both sides of the ridge. A sample assayed 51.45 percent Fe. Further investigation seems warranted (Butler and Mitchell, 1916, p. 64-66; Parks and Swartley, 1916, p. 32).

Horse Sign prospect (199): Baldwin (1968, p. 51-52) describes the black-sand deposit as belonging to the middle member of the Umpqua Group (Lookingglass Formation) which is included in this report under Tertiary sediments (Ts). The stratified sands, which dip gently southward, contain a few scattered pebbles near the base and grade upward into sandstone with increasing content of black sand. The deposit is reported by Baldwin to be about 125 ft wide, 250 ft long, with a maximum depth of probably less than 50 ft (average depth of the black-sand portion is less than 10 ft). Baldwin reports between 30,000 and 50,000 tons of black sand; Allen and Lowry (1942) suggest 227,500 tons. Composition of the black sand includes as much as 95 percent magnetite, with ilmenite, chromite, hornblende, zircon, quartz, garnet, tremolite, and pyrite. The material assayed 54.94 percent Fe, 0.114 percent S, 0.37 percent V, 2.70 percent Ti, and 0.004 percent P. Spectrographic analysis shows 2 to 5 percent Cr and 0.01 and 0.05 ppm Au. This deposit is interpreted as having formed in a manner similar to present-day black-sand beach deposits

(Butler and Mitchell, 1916, p. 64-66; Allen and Lowry, Oregon Department of Geology and Mineral Industries unpublished mine-file report, 1942; Baldwin, 1968, p. 45-54).

Iron Hill (Black Rock) prospect (182): Country rocks are Colebrooke Formation metachert, phyllite, and schist containing small lenses of manganiferous magnetite. The best exposure is reported to occur in a cut 5 ft wide and deep and 8 ft long entirely in "ore" that is cut by numerous quartz seams. The "ore" assayed 22.87 percent Fe, 7.30 percent Mn, 0.56 percent P, and no Ti, As, Cu, or S. The occurrences are too small to be of commercial interest (Parks and Swartley, 1916, p. 132).

Unnamed prospect (69): A small (1-ft-thick) lens of magnetite with some combined manganese oxide was dug out of tuffaceous phyllitic siliceous metasediments or metarhyolite (?) striking about N. 80° W. and dipping steeply north. No other lenses were discovered.

Manganese

Mining history

Small shipments of manganese ore have reportedly been made from three occurrences in Curry County. They were the McAdams, Long Ridge, and Black Bear. The McAdams manganese deposit (96), located on the Coos-Curry County lines, but mostly in Coos County, is reported to have produced some surface-weathered enriched manganese (Appling, 1958; Brown, 1942).

Future potential

Although a few of the manganese deposits in Curry County have had some production, the resource potential of manganese in the area is very limited. The principal interest related to manganese deposits is in the associated occasional occurrence of small amounts of rhodonite. Nearly all of the reported occurrences are the result of surface weathering enrichment of manganese oxide occurring in chert. Without exception, these residual surface deposits give way rapidly to high-silica, low-manganese rock at shallow depth. Most of the deposits occur in the Dothan and equivalent Otter Point Formations. Summary reports of most of the various occurrences follow. Some additional information may be obtained from Oregon Department of Geology and Mineral Industries Bulletin 17, "Manganese in Oregon," by Libbey and others (1942).

Description of deposits

Black Bear prospect (93): Manganese oxides occur in fracture fillings and veinlets in gray chert of the Dothan Formation. White and pink to reddish-purple chert is also reported. Occasional 10-in float boulders of high-grade ore were found. Selected high-grade ore assayed 49.2 percent Mn, 1.05 percent Fe and 12.9 percent SiO_2. A 6-ft channel sample across oxide-stained, spongy chert assayed 17.6 percent Mn, 1.76 percent Fe, and 60.2 percent SiO_2. A small shipment made in the early 1940's was rejected because it did not meet grade requirements (Oregon Department of Geology and Mineral Industries, 1940, p. 56; Libbey and others, 1942; Appling, 1958, p. 5-6).

Chetco Lake rhodonite (65): A small, 30-in lens of rhodonite with some rhodochrosite and associated manganese oxides occurs in quartzite (probably metachert) in gneissic amphibolite. Foliation strikes about N. 35° E. and dips 35° W. A small quantity of specimen lapidary rock has been produced from this site (Ramp, 1975, p. 36-37).

Clapshaw prospect (105): This occurrence, although not reported as such, is probably associated with chert of the Otter Point Formation. It was worked in a small way in 1918; and there may have been minor production of surface-enriched oxides (Oregon Department of Geology and Mineral Industries, 1940, p. 82; Libbey and others, 1942, p. 35).

Colegrove prospect (218): Dothan-Otter Point Formation banded chert adjacent to pillow basalt and submarine volcanic breccia contains some surface manganese oxide enrichment. Landsliding has affected most of the prospect area. A grab sample from a 7-ft exposed width of brown manganese-bearing chert assayed 14.9 percent Mn. The majority of samples were much lower grade. No rhodonite is reported (Brown, 1942, p. 5-6; Libbey and others, 1942, p. 38-39; Oregon Department of Geology and Mineral Industries unpublished mine-file report, 1950; Appling, 1958, p. 6-7).

Copper Canyon prospect (173): Rocks exposed in Copper Canyon are largely submarine volcanics. The manganese reportedly occurs in a narrow ledge striking N. 50° E. which can be traced up the mountain to the northeast for about 0.25 mi. A 2-ft sample assayed 9.4 percent Mn. Although not reported, the ledge, which is no more than 5 ft wide, is probably of chert (Oregon Department of Geology and Mineral Industries, 1940, p. 52; Libbey and others, 1942, p. 36).

Hilltop (Hamaker) prospect (38) (see Gold): Small lenses of chert and rhodonite occur in fine-grained siliceous sediments interbedded with volcanic rocks of the Rogue Formation. Appling (1958, p. 25-26) states:

> "Rhodonite and intermixed quartz, with disseminated pyrite, occur in the metasediments as five small, irregular pods, the largest of which was estimated to weigh approximately three-fourths of a ton. Most of the pods are fractured, and oxides of manganese coat the fracture surfaces. A grab sample from one of the pits assayed 23 percent Mn."

The area is also described by Ramp (1975, p. 36).

Iron Hill (Black Rock prospect) (182) (see Iron)

Long Ridge mine (49): Manganese oxides occur on fracture surfaces and as pods in chert lenses in graywacke sandstone of the Dothan Formation. Manganese oxide pods weighing from a few pounds to 6 tons are erratically distributed through the chert lenses. A sample taken from a 30-ton stockpile assayed 52.5 percent Mn and 1.3 percent Fe. The property was developed in 1941, and about 50 tons of ore were reportedly shipped during World War II (Oregon Department of Geology and Mineral Industries unpublished mine-file report, 1941; Appling, 1958, p. 11-12; Ramp, 1975, p. 36).

McAdams property (96): The country rocks consist of Otter Point Formation sandstone and siltstone with chert lenses and overlapping patches of amphibole schist. A few small patches of basalt also crop out in the area. Manganese oxide boulders and pebbles are found over a fair-sized area in the surface soil creep. During World War II, 280 tons with an average grade of 38 percent Mn were shipped (Brown, 1942; Oregon Department of Geology and Mineral Industries unpublished mine-file report, 1950; Appling, 1958, p. 11-12).

Mislatnah chert (48): Large float boulders of dark brown to black, manganese oxide-stained, ferruginous chert show up in the creek bed. The country rocks are from the Dothan Formation with some serpentinite and gneissic metagabbro float from the overthrust plate. The chert is similar to that at the Long Ridge managnese deposit. No analyses were made (Ramp, 1975, p. 37).

Newhouse prospect (99): Prospect occurs in chert and sandstone of the Otter Point Formation with some discontinuous surface concentration of manganese oxides. Amphibolite ("blueschist") crops out nearby. A carload of manganese was hauled to Bandon dock in 1918, but it was not shipped because it was not up to grade (Libbey and others, 1942, p. 34).

Unnamed prospect (69) (see Iron)

Roberts prospect (100): Psilomelane and associated manganese oxides occur at the top of a thin layer of red chert directly beneath a 30-ft thick white chert lens in Otter Point Formation. The material is generally low grade, assaying about 30 percent Mn (Brown, 1942, p. 5).

Smith prospect (191): The prospect is located in Dothan Formation sandstone that contains highly fractured, manganese oxide-coated red chert and pillow basalt with nearby serpentinite. The first recorded occurrence in Oregon of neotocite (hydrated manganese silicate) was found in this locality. The grade is reportedly low, and there has been no production (Brown, 1942, p. 6; Oregon Department of Geology and Mineral Industries unpublished mine-file report, 1942).

Mercury

General

There are four known mercury prospects widely scattered in the County without any apparent geologic relationship. In addition there are two areas of anomalous mercury discovered through geochemical sampling. The Babyfoot mercury anomaly (77) was discovered from stream sediment sampling done by the Oregon Department of Geology and Mineral Industries (Bowen, 1969), and anomalous mercury was noted in rhyolites in the Mount Emily area. This latter occurrence is discussed later under an evaluation of the mineralization in the Mount Emily area.

Description of deposits

Babyfoot mercury anomaly (77): Country rocks are Rogue Formation metavolcanics, largely tuffs and lavas (pillow basalts and andesites). Some faulting, small gabbro dikes, and serpentinite bodies are present in the area. Small amounts of cinnabar can be panned from the stream, and a sediment sample contained greater than 20 ppm Hg. Attempts to trace the cinnabar to its source have thus far been unsuccessful (Ramp, 1975).

Clarno prospect (187): Significant amounts of cinnabar and free quicksilver were reported to occur in a gold placer on Euchre Creek about 1 mi east of Ophir (Brooks, 1963, p. 100).

Harmony prospect (110): Mineralization occurs for about 1,000 ft along a northwest-dipping, N. 35° E. striking fault contact between Galice shales to the northwest and Myrtle conglomerate and sandstone to the southeast. Cinnabar and calcite impregnate the conglomerate alongside the shale hanging wall. A few small lenses of high-grade cinnabar were found. Channel samples: 8 ft assayed 0.2 lbs, and 5 ft assayed 3.05 lbs Hg/ton (Brooks, 1963, p.98-99).

Pistol River (Red Flat) prospect (196): Small amounts of mercury and cinnabar have been reported in the lateritic soil of Red Flat and in the highly sheared serpentinite and underlying Colebrooke Schist across the creek on the east edge of Red Flat. There is no record of production, and assays indicate very low values (Oregon Department of Geology and Mineral Industries, 1940, p. 64; Brooks, 1963, p. 99).

Red Devil group (Diamond Creek placers) (94): Mineralization in the form of scattered streaks and dissemination of cinnabar occurs in a diorite body surrounded by peridotite. The "diorite" ranges in composition from granodiorite to gabbro and hornblendite. Areas of shearing and alteration along the margins of the diorite contain increased concentrations of cinnabar. Preliminary sampling indicates about 3 million tons of 0.5 lb/ton Hg. Some placer mining of cinnabar took place on the North Fork of Diamond Creek in the early 1930's (Cater and Wells, 1953, p.126-127; Brooks, 1963, p.99; Frizzell, 1965, unpublished report on file with the Grants Pass Field Office, Oregon Department of Geology and Mineral Industries).

Nickel

General and forecasts

Lateritic soils and saprolite (a weathered rock retaining the original rock texture) derived from

chemical weathering and leaching of peridotite typically contain some nickel. Unweathered peridotite and serpentinite usually contain about 0.2 percent nickel. The weathering process leaches out more soluble elements such as magnesium and silica and leaves behind residual concentrations of iron oxides, chromite, nickel, and cobalt oxides in a reddish yellow-brown soil and saprolite zone that is usually referred to as laterite. Areas of ultramafic rocks, especially peridotite (rather than serpentinite), that have been exposed to weathering for long periods of time and have escaped the normal rapid erosion processes that wash away the soil as soon as it develops form deposits of nickel-bearing soil and saprolite such as those at Red Flat.

Topographic conditions and geologic factors that protect soil and saprolite areas from erosion include (1) the presence of hard, erosion-resistant formations such as dikes on the downslope side of a deposit; (2) large slump or landslide areas through which water percolates, speeding up chemical weathering and retarding development of surface drainage; and (3) high mountaintop areas of gently sloping topography where fairly recent uplift has taken place and where drainage systems are not well developed.

Nickel is the only metallic resource that appears to have a significant positive affect on the future economic climate of Curry County. Development may, however, be as much as 10 years off (Kingston and others, 1970) and will depend a great deal on reclamation costs and the world market picture.

The Oregon Department of Geology and Mineral Industries has recently conducted a study of nickel laterites in southwestern Oregon under a contract with the U.S. Bureau of Mines. A study of Oregon nickel resources will be published, following additional reconnaissance work in northeastern Oregon.

Description of deposits

Summary reports on each of 17 separate areas of nickel-bearing laterite in Curry County are given here.

Baldface Ridge laterite (81): Ten or more small patches of residual lateritic soil and saprolite on the south part of the ridge between Baldface and Chrome Creeks have been delineated in the area by field reconnaissance and use of aerial photos. The area is underlain by partly serpentinized harzburgite that has been intruded by a few small dikes of diabase and dacite composition. These ultramafic rocks are thrust over the younger Dothan Formation in the vicinity of Chrome Creek, about a mile west of the ridge. The north- to northeast-trending ridge has a fairly flat top and a few slump-formed bench areas on the steeper slopes toward Baldface and Chrome Creeks. Data for this area are very limited, and further examination is needed. The total soil area, about 250 acres, is probably too small and shallow to be of commercial interest at present. Preliminary sampling indicates that the soil and saprolite (excluding rock) contain about 0.75 percent Ni, 0.14 percent Co, and 1.78 percent Cr. The estimated average rock content is about 65 percent (Oregon Department of Geology and Mineral Industries unpublished preliminary report, January 15, 1976).

Cedar Spring laterite (82): The bed rock is fresh to partly serpentinized harzburgite and dunite. Patches of lateritic soil occur near the southern contact of a large body of diorite. The main area of soil development, located about 0.25 mi east of Cedar Spring, largely in Josephine County, is about 0.25 mi wide and 0.75 mi long. Average soil depth is estimated to be about 8 ft. Preliminary estimates indicate that the rock and soil have an average grade of 0.40 percent Ni. Exclusion of the 55 percent of rock greater than 4 in in size would leave soil and saprolite assaying about 0.6 percent Ni, 0.12 percent Co, and 2 percent Cr. Three, small, aerial photo-indicated soil areas that have not been examined or sampled lie along the diorite contact that strikes N. 30 ° W. within 1.5 mi northwest of the main area (Oregon Department of Geology and Mineral Industries unpublished report, October 21, 1975).

Chrome Creek laterite (78): This area is near the west edge of the Josephine peridotite sheet where it is in thrust-fault contact with the underlying Dothan Formation. Four or five small areas of rocky lateritic soil, some of which display definate slump features, are exposed on both sides of the headwaters of Chrome Creek. The areas total about 200 acres. An average of seven shallow hand-auger samples gives 0.69 percent Ni and 0.88 percent Cr. The average depth of soil and saprolite development may be about 10 ft, but further exploration is needed (Oregon Department of Geology and Mineral Industries unpublished report, August 15, 1977).

Cleopatra Ridge-Taylor Creek area (85): Four areas of rocky nickel-bearing soil lie on the north end of Cleopatra Ridge beginning a little more than 0.5 mi north of the old Lookout site and extending northward to within 0.25 mi of the mouth of Taylor Creek where it flows into Baldface Creek. The southern soil areas are thin and represent erosional remnants of what may have once been fairly extensive deposits. The soil on slopes facing north and east toward Taylor Creek areas is composed of very rocky slump material and is undoubtedly deeper. Calculated grade of the mixed soil and rock is 0.40 percent Ni and for the soil and saprolite, excluding rock, is about 1.00 percent Ni, 0.10 percent Co, 1.80 percent Cr, and 32 percent Fe. Four mapped soil patches cover an area of about 200 acres to an estimated average depth of about 10 ft. The rock content may be as high as 80 percent (Oregon Department of Geology and Mineral Industries unpublished report, November 30, 1975).

Collier Creek laterite areas (204): A few residual patches of soil occur on a partly serpentinized harzburgite which overlies the Dothan Formation to the west because of thrusting and underlies a klippe of gneissic metagabbro of the Big Craggies to the east. The two main areas of soil lie on both sides of the ridge between North Fork and Main Collier Creek, mostly in sec. 1 but extending down into sec. 36. These areas, which were sampled by hand-augering nine shallow holes, contain about 100 acres with an estimated average depth of about 6.5 ft. The calculated grade of mixed rock and soil is about 0.40 percent Ni, 0.03 percent Co, and 0.44 percent Cr. Soil and saprolite, excluding rock, average about 0.70 percent Ni, 0.08 percent Co, 1.4 percent Cr, 29 percent Fe, and 0.02 percent Cu. The areas have an estimated 65 percent rock in the soil. Further investigation may be warranted (Appling, 1955; Oregon Department of Geology and Mineral Industries unpublished report, December 3, 1975).

Cottonwood Camp laterite (76): The area is mostly steep and rocky. The thrust-fault contact of peridotite over Dothan Formation is in the immediate vicinity, but several areas of peridotite debris and soil have slid down over the contact. Soil areas appear to be small, rocky, and shallow. An 8.8-ft deep auger sample (AKG-75) taken in the W$\frac{1}{2}$ SE$\frac{1}{4}$ sec. 22 at an elevation of about 2,900 ft assayed 0.86 percent Ni and 1.63 percent Cr. Some further reconnaissance of the area may be justified.

Diamond laterite (88): Small erosional remnants and slump deposits of soil occur on partly serpentinized harzburgite and dunite. The peridotite has been intruded by small stocks and dikes of basic to intermediate igneous rock. Maximum depth of soil is estimated to be about 50 ft and the average depth about 7 ft. The soil is very rocky, averaging about 60 percent rock, and the largest area in NW$\frac{1}{4}$ sec. 10 contains abundant secondary silica. The soil covers a total area of about 100 acres. The estimated average grade, based on six samples, for the soil and rock is about 0.47 percent Ni; average grade of soil and saprolite is 0.75 percent Ni, 0.12 percent Co, and 1.16 percent Cr (Oregon Department of Geology and Mineral Industries unpublished preliminary report, October 16, 1975).

Gray Butte laterite (198): The areas appear to be small slump benches containing lateritic soil. The northern patch covers about 20 acres. The estimated maximum depth of the northern patch is about 30 ft; average depth is about 10 ft. The weathered rock is in part pyroxenite with some intermixed gabbro so that the average grade is low (0.41 percent Ni). The southern patches were not sampled but were viewed from Horse Sign Butte ridge. They appear to be better quality soil but are very small, covering a cumulative area of probably not more than 22 acres (Oregon Department of Geology and Mineral Industries unpublished preliminary report, January 1976).

Iron Mountain laterite (137): Iron Mountain is made up of a body of partly serpentinized harzburgite about 1.5 mi wide and 4.5 mi long. The peridotite body is in fault contact with the Galice Formation and has been intruded by gabbro and quartz diorite bodies. A small downfaulted segment of coal-bearing Tertiary sediments is situated on the southeast edge of the peridotite in NW$\frac{1}{4}$ sec. 4 and SW$\frac{1}{4}$ sec. 33. The main area of lateritic soil (two patches) is also adjacent to this contact and is about 5,000 ft long and about 700 ft wide. The soil is generally rocky and thin. Average depth is about 7 ft, but the maximum may be more than 25 ft. Average grade of the soil and saprolite is about 0.76 Ni, 0.07 percent Co, and 1.74 percent Cr. The calculated average grade of the soil and rock mixture, assuming a 70-percent rock content, is about 0.40 percent Ni (Appling, 1955; Oregon Department of Geology and Mineral Industries unpublished preliminary report, November 6, 1975).

Lower Lawson laterite (197): Eight small patches of lateritic soil occur in a 1-mi-wide area of partly serpentinized harzburgite, bounded on the west by Colebrooke Schist and on the east by diabase and gabbro of Gray Butte. The slopes appear to have sustained some landsliding. The soil is apparently quite shallow, averaging a depth of 6 or 8 ft, and is underlain by o highly sheared serpentinite. Maximum soil depth is believed to be no more than 20 ft. The largest soil area is about 2,500 ft long and an average of about 600 ft wide. Preliminary areal estimations are about 75 acres of soil. The calculated grade of soil and rock is about 0.42 percent Ni; and the grade of soil and saprolite averages about 0.56 percent Ni, 0.07 percent Co, and 1.89 percent Cr. Visual estimation of rock in soil is about 50 percent (Oregon Department of Geology and Mineral Industries unpublished preliminary report, October 17, 1975).

Red Flat laterite (195): Lateritic soil has developed on the upper surface of a relatively thin thrust sheet of partly serpentinized harzburgite overlying Colebrooke Schist and younger Dothan-Otter Point marine sediments and volcanic rocks. Slumping has occurred on the ridge flanks: to the north toward Hunter Creek, to the west toward Big South Fork of Hunter Creek, and to the east toward Pistol River. The total area of lateritic soil cover is about 750 acres. The maximum depth of soil is about 50 ft and the estimated average depth is about 8 ft. Some areas are much more rocky than others, but the estimated average amount of rock is about 60 percent. The calculated average grade of soil and rock is about 0.41 percent Ni, 0.09 percent Co, and 0.53 percent Cr_2O_3. The average grade of the soil and saprolite, excluding rock, is about 0.80 percent Ni, 0.15 percent Co, 1.14 percent Cr_2O_3, and 18 percent Fe. Additional exploration appears to be justified (Libbey, Lowry, and Mason, 1947; Dole, Libbey, and Mason, 1948; Hundhausen, McWilliams, and Banning, 1954; Appling, 1955; Hotz, 1964; Hotz and Ramp, 1969; Oregon Department of Geology and Mineral Industries unpublished preliminary reports, 1973, November 18, 1975).

Smith River laterite (91): The area is a synclinal arm of the peridotite overthrust sheet underlain by Dothan Formation sediments. The peridotite has been intruded by small diabasic to rhyolitic dikes. Four small residual patches of lateritic soil totaling about 120 acres lie north of Cedar Creek. Both in-place weathering and slide deposits are present. Estimated maximum depth of soil is about 20 ft with an average depth of about 7 ft. The northern soil areas appear to contain about 70 percent rock. It is estimated that there may be as much as 50 acres of lateritic soil extending into Oregon from the Pine Flat deposits to the south. Estimated grade of the mixed soil and rock in the combined areas is about 0.45 percent Ni; the soil and saprolite grade is about 0.73 percent Ni, 0.07 percent Co, and 1.76 percent Cr_2O_3 (Benson, 1963; Hotz, 1964; Oregon Department of Geology and Mineral Industries unpublished preliminary report, October 17, 1975).

Snow Camp laterite (208): Partly serpentinized harzburgite thrust sheet overlies Colebrooke Formation phyllonite and metavolcanic rocks. The Snow Camp Meadow deposit is a large landslide area which was occupied by a slide pond that is now filled with sediment (Figure 10). Lower Cretaceous Myrtle Group sediments are in fault contact with the ultramafic rocks and are exposed in Windy Valley and to the northeast above Huntley Spring. Areas of lateritic soil on the north and east slope of Snow Camp Mountain ridge cover about 78 acres. The average depth of soil is estimated to be about 8 ft; the average amount of rock is estimated visually to be about 70 percent. The Snow Camp Meadow slide area contains about 60 acres. The lake sediments contain no nickel enrichment. The average depth is difficult to estimate. Calculated grade, based on very limited sampling, is about 0.42 percent Ni for the overall area of soil and rock; the approximate grade of soil and saprolite, excluding rock, is 0.86 percent Ni, 0.09 percent Co, 1.13 percent Cr, and 20 percent Fe (Oregon Department of Geology and Mineral Industries unpublished preliminary report, October 31, 1975).

Figure 10. Snow Camp Meadow from Snow Camp Mountain. Old landslide area of largely ultramafic rocks with nickel-bearing lateritic soil. Meadow was once occupied by pond that became filled with sediment.

Sourdough Flat laterite (75): The area of the deposit appears to be a large slide mass. Rock involved in the slide includes very coarse-grained dunite, harzburgite, and serpentinite. The ultramafic rocks nearby have been intruded by diorite dikes. The area of principal soil accumulation is nearly 0.5 mi long, 0.25 mi wide, and oval in shape, containing about 40 acres. The average depth is estimated to be about 14 ft. The soil area contains an estimated 70 percent rock. Calculated grade of the soil and rock is about 0.44 percent Ni; the soil and saprolite, excluding rock, average about 1.00 percent Ni, 0.07 percent Co, 1.25 percent Cr, and 24 percent Fe (Oregon Department of Geology and Mineral Industries unpublished preliminary report, November 7, 1975; Ramp, 1975, p. 37-38).

Spokane Creek laterite (79): The area is underlain by partly serpentinized harzburgite which has been intruded by few small dacite to diabase dikes and a fairly large body of diorite to the east. The soil areas appear to be erosional remnants of what was once more extensive lateritic soil cover. Three of the five outlined areas have been examined to date. The best appearing area is approximately on the north edge of sec. 16 on a bench at about 3,300 ft elevation, about 0.33 mi north of a small pond. This soil area is estimated to be about 20 acres; and the average depth is about 10 ft (two samples were augered to a depth of 9 ft). Estimated rock content to this depth is 60 percent. Limited sampling indicates a lower-than-normal average grade for the soil and saprolite of about 0.50 percent Ni. Further reconnaissance and sampling of the surrounding area may be justified (Oregon Department of Geology and Mineral Industries unpublished preliminary report, October 20, 1975).

Upper Chetco laterite (67): Partly serpentinized harzburgite has several small patches of lateritic soil cover. The total areal extent of 10 patches is about 112 acres. Shallow (2- to 4-ft-deep) auger samples from the area northeast of the river assayed from 0.30 to 0.73 percent Ni. Areas to the south of the river near the corner of secs. 20, 21, 28, and 29, and small areas by Doe Gap near the center of sec. 34 and about 0.5 mi to the north in the S½ sec. 27 may be worthy of further exploration and sampling. Samples taken in sec. 34 assayed 0.50 and 0.99 percent Ni. The areas all lie within the existing Kalmiopsis Wilderness (Ramp, 1975, p. 37-38).

Upper Lawson laterite (207): Areas of rocky lateritic soil occur on partly serpentinized harzburgite that is overthrust on Colebrooke Schist. Both the ultramafic rocks and Colebrooke Schist are thrust over the Dothan Formation. The main area of lateritic soil, which is on the north slope of a small ridge between the forks of Lawson Creek, is about 4,500 ft long and 800 ft wide and contains about 90 acres. The maximum depth of soil is probably about 35 ft; the average depth is estimated to be about 8 ft. Calculated average grade of the soil and rock is 0.34 percent Ni; average grade of the soil and saprolite is about 0.67 percent Ni, 0.05 percent Co, 2.29 percent Cr, and 23 percent Fe. Three small photo-mapped soil areas lie along a vertical fault about 0.5 mi to the west and northwest of Huntley Spring. Their total area is estimated at about 37 acres; but these areas have not been sampled (Oregon Department of Geology and Mineral Industries unpublished preliminary report, October 30, 1975).

Windy Creek laterite (211): Four small patches of lateritic soil with a total area of 40 acres occur on a thrust plate of partly serpentinized harzburgite overlying Colebrooke Schist. One auger sample from the NE$\frac{1}{4}$ sec. 30 to a depth of 4.2 ft assayed 0.54 percent Ni and 0.14 percent Co and is probably not representative. Further sampling and mapping is needed (Oregon Department of Geology and Mineral Industries unpublished preliminary report, October 31, 1975).

Platinum

Production history

Some of the platinum-group metals have been recovered from many of the placer mines in Curry County, expecially by miners working the black-sand deposits on terraces and present beaches. Periods of greatest platinum production have corresponded with periods of increased gold placer mining activity. Diller (1914, p. 128) reports platinum production in Oregon during the period of 1907 through 1910, when a total of 431 oz was marketed. The year 1906 was reported to have been a peak production year; but records for that year were not obtained. Annual production reportedly dropped off in 1912 when only 39 oz of platinum metals were produced in southwestern Oregon.

The amount of platinum-group metals appears to increase in black-sand deposits when the chromite content increases. Page and others (1975) give further evidence of this association. Diller reports that platinum and iridosmine are the most abundant metals of the platinum group recovered from the black sands. Wells and others (1949, p. 21) report that analytical data are scanty, but samples from the Kerby quadrangle contain about 30 percent Pt, 32 percent Ir, 25 percent Os, 13 percent Ru, and little or no Rh or Pd. The relative abundance of platinum metals to gold recovered from various areas is quite variable. Diller (1903, p. 6) reports that at both the Madden (Blanco) placer (104) and at the Sixes beach placer (103), the ratio was about 1 to 20. Diller also reports that very little platinum was recovered from the Sixes River placers.

Small amounts of platinum have been recovered with placer gold in the upper Chetco area; in 1968 prospecting at the Stevens placer (46) with a small power dredge resulted in production of a few pounds of concentrates containing platinum metals (Ramp, 1975, p. 40). Some platinum is occasionally found in the placers on the Little Chetco River; some has also undoubtedly been recovered from the Madstone placer (66), but records of such production are nonexistent.

Future potential

The potential for future platinum-metal production is probably very limited. Some may be produced as a by-product of processing beach-deposited black sands for chromite, gold, and other associated minerals such as ilmenite, zircon, and garnet. The offshore concentrations of heavy minerals on the continental shelf may be considered a potential source area; but much more exploration and research are necessary to determine this potential.

Mount Emily Area

For many years the Mount Emily area has been considered a potential area to prospect for gold, silver, quicksilver, molybdenum, tungsten, and zinc. The Mount Emily district, in particular the Florence and the Lucky Warren prospects (220), is described by Butler and Mitchell (1916, p. 109-113). They report the Florence prospect, situated just below the crest on the north slope of Mount Emily, as consisting of an 8-ft-wide northeast-striking mineralized zone along the contact of rhyolite in the alteration zone with Dothan shale. Sphalerite and pyrrhotite impregnate the fractured hornfels. A sample across the mineralized zone assayed 3.57 percent Zn and trace Au. No new work has been done in the old pit that they describe.

The Lucky Warren prospect, a short distance south of the crest of Mount Emily, is reportedly similar in nature to the Florence prospect but with a narrower mineralized zone. Molybdenite occurs between brecciated fragments of the hornfels. A sample across the mineralized zone reportedly assayed 3.10 percent Mo (see Gold). A number of later attempts to discover commercially interesting deposits of molybdenum and zinc have met with failure. Reports of tungsten and cobalt have apparently been unfounded.

Work done in connection with this study has produced a more accurate geologic map of the area. In addition, chip samples were taken across several hundred feet of iron-stained and apparently altered rhyolite or rhyodacite (?) rock without finding any interesting amounts of gold, silver, zinc, or molybdenum. In 1975, analyses of samples obtained by R. C. Parker (consulting geologist employed by Canadian Superior Mining (U.S.) Ltd.) showed relatively low background results for gold, silver, copper, and molybdenum. A few areas of fairly high (greater than 1,000 ppm) As and up to 12,000 ppb Hg, with a generally high background in both these elements, were noted. These findings may point to a mercury and arsenic halo surrounding higher temperature mineralization at depth, or they may merely be the result of low-temperature, volatile mineralization associated with these Tertiary intrusives.

More detailed geologic mapping coupled with grid-type geochemical soil and rock sampling are needed to properly assess this area. One should be prepared to cope with extremely thick brush near the top of the mountain. Fortunately, logging roads provide access to many points on and around Mount Emily.

NONMETALLIC-MINERAL RESOURCES

The nonmetallic minerals of Curry County include asbestos, borax (priceite), gemstones, limestone, and olivine. Because the Oregon Department of Geology and Mineral Industries estimates that no one in Curry County is currently employed in the development and utilization of any of these minerals, the nonmetallic minerals have no major economic significance at the present time. During the next 10 to 20 years, only gemstones appear to have the potential for some development that would add to the County's employment base.

Asbestos

General information

The term "asbestos" designates a group of fibrous noncombustible minerals used in fireproof textiles, clothing, theatre curtains, brake linings, clutch facings, electrical insulation; asbestos-cement pipe, sheets, and moulded products; and pipe wrappings, gaskets, floor tile, joint cement, and roofing. Because of its high strength-to-weight ratio and its ability to withstand high temperatures, asbestos is adaptable to more than 2,000 uses.

The principal variety of asbestos is chrysotile, a hydrous magnesium silicate (serpentine-group mineral) that is strong and flexible. Chrysotile usually occurs as cross-fiber veins in blocky serpentinite. The longer, more flexible, and greater strength fibers command a higher price. Even very short fibers, down to about 2 mm, are used in industry.

Varieties of amphibole asbestos include amosite, an iron-magnesium silicate; crocidolite, a hydrous sodium-iron silicate; tremolite, a hydrous calcium-magnesium silicate; and anthophyllite, a hydrous magnesium-iron silicate. Only chrysotile and tremolite are known to occur in Curry County.

Areas of serpentinite are the best places to prospect for asbestos. Prospecting techniques are described by Bright and Ramp (1965). Fault zones containing highly sheared serpentinite may contain slip-fiber chrysotile and often some tremolite, especially where other sheared formations are intermixed with serpentinite.

Tremolite, which has limited use and relatively low market value, is the variety of asbestos most readily recognized by unskilled prospectors. Cross-fiber chrysotile asbestos may be unnoticed unless the sun is shining at the right angle on serpentinite so as to reflect from the fiber veinlets.

Description of deposits

Very little is known of asbestos in Curry County. Only the Shyrite (Lake of the Woods) deposit (171), a tremolite locality, is listed on the mineral deposits map.

In addition, specimens of fairly good-appearing chrysotile asbestos reported to be from the serpentinite zone near Carpenterville have been submitted to the Oregon Department of Geology and Mineral Industries. The source of this material has not been examined in the field. Further investigation may be warranted.

Another occurrence is situated in a small body of serpentinite alongside the road a short distance northeast of Pyramid Rock, probably in sec. 17, T. 37 S., R. 13 W. Shallow bulldozer cuts exposed the area of sheared serpentinite. A very brief examination of this prospect by the writer in 1970 gave the impression of insufficient tonnage and grade to be of commercial interest.

The amphibole prospect is summarized below.

Shyrite (Lake of the Woods) prospect (171): The country rock is composed of small bodies of sheared serpentinite in Colebrooke Schist, and the area appears to be landsliding. The asbestos is described as being white, iron-free, amphibole (tremolite), slip fiber that has good tensile strength. It tends to break into 1-in lengths. Fairly abundant talc is associated with the asbestos (Oregon Department of Geology and Mineral Industries unpublished mine-file report, 1942).

Borax (Priceite)

From 1890 to 1892, about 580 tons of priceite (a hydrous calcium borate) were mined about 5 mi north of Brookings by the mouth of Lone Ranch Creek; and the sorted borate was shipped to San Francisco by the Pacific Coast Borax Company. The company reportedly paid the miners $23/ton for it. It is also reported that some 3,600 to 5,400 tons of borate were blocked out at the time of closure in 1892. The main tunnel at the mine was about 480 ft long. The priceite occurs in serpentinite and, according to Staples (1948), is possibly associated with the intrusion of a rhyolite dike; but its origin remains uncertain. Following discovery and development of large evaporite borax deposits in southeastern California during the late 1800's (Ver Planck, 1957, p. 89), this deposit became noneconomic. The land was donated to the State of Oregon for a State park in 1950, but minerol rights to the underground deposit were retained by the mining company.

Gemstones

Beach agates, petrified wood, jasper, jade, and other colorful beach pebbles have attracted the attention of hobbyists, rockhounds, and tourists since the time of early settlers. The principal source of jasper is the banded, colored chert of the Dothan-Otter Point Formations. Various colors of jasper are abundant in the headwaters of the North Fork of the Sixes River.

A specimen of pale-green jadeitic pyroxene from glaucophane-bearing amphibolites was reported by Lent (1969, p. 65) from the Sixes River drainage area. The close association of serpentinites with amphibolites in this area may give rise to the formation of jade minerals.

According to Lawrence Brown, U.S. Bureau of Mines (personal communication, 1976), jade boulders are occasionally found among the blueschist boulders along the coast from a point a short distance north of Cape Blanco to Humbug Mountain to the south. The blueschist boulders, which change color from gray when dry to a deep blue when wet, make an interesting addition to a rockery.

Although no cutting-grade serpentine has been reported from Curry County, with the large amount of common serpentine present in the area, "gem-quality" material may eventually be found.

During the surveying of rock-material sites, notations were made of a few sources of cutting-grade materials. Quarry sites 319,320, and 471 all contain some cutting-grade chert. The chert that is exposed at the State Highway quarry-site 471, Rainbow Rock quarry, also crops out at the beach level. Green chert is reported to crop out in the SE$\frac{1}{4}$ NE$\frac{1}{4}$ sec. 3, T. 40 S., R. 14 W. and in the center of NW$\frac{1}{4}$ sec. 11, T. 40 S., R. 14 W. Grossularite (a greenish calcium garnet) derived from rodingite dikes in serpentinite, such as those at the Gardner mine (50), takes a beautiful polish and is called "mutton-tallow jade" by some rockhounds.

Some of the silica boxwork or "nickel float" chalcedony associated with supergene nickel enrichment is attractive when polished. This material is particularly plentiful at the Diamond laterite occurrence (88) and can be found by searching several other laterite areas. Some chrysoprase, an apple-green, nickel-bearing chalcedony, is found at Nickel Mountain in Douglas County and may also be associated with the Curry County nickel deposits.

Rhodonite occurs at a few of the manganese deposits and has been specifically reported at the Chetco Lake (65), the Hilltop (38), and McAdams (96) occurrences. The material can be associated with relatively unmetamorphosed cherts but is usually found in the higher grade metamorphic rocks, such as the Triassic Applegate Formation in Josephine and Jackson Counties (Appling, 1958).

During the next 10 to 20 years, development of gemstone deposits may add to the County's employment base. Curry County economy, with its established tourist business, could be further diversified into providing more gemstone material, both at free and fee collecting areas and at retail and wholesale levels. If the gemstone deposits were to be fully utilized, the Oregon Department of Geology and Mineral Industries estimates that up to 10 additional jobs could be created over the next 10 years. At present, more visitor days are spent looking for the small bright-colored jasper and agates which are found in the beach gravels than for any other Curry County gemstone.

Limestone

Curry County apparently has no limestone deposits approaching commercial size. A few, very small, limestone lentils occur in the Otter Point Formation; none observed or described are more than a very few feet thick, and they pinch out rapidly along strike.

Brown (1942, p. 1), in discussion of the geology of the McAdams property (96) on the Coos-Curry County line, reports a limestone outcrop about 2 mi southeast of his map area. Brownfield (1972), however, who mapped the area in detail for his master's thesis at the University of Oregon, did not mention the limestone. The limestone, if present, is probably quite restricted in size and is an isolated lens in the Otter Point Formation.

Olivine

Potentially large reserves of fresh olivine suitable for the manufacture of refractory brick, foundry sand, and other possible uses (Wagner and Ramp, 1969, p. 192) are present in the vicinity of Pearsoll Peak and Sourdough Flat. The olivine occurs in very coarse-grained, fresh dunite. Although not mapped in detail, the dunite exposures are on the southwest flanks of Pearsoll Peak in secs. 2 and 3, near Prospectors Dream chromite occurrence at the west edge of sec. 11, and on Sourdough Flat in the SW$\frac{1}{4}$ sec. 11 and NW$\frac{1}{4}$ sec. 14, T. 38 S., R. 10 W.

Optics and X-ray diffraction analyses of the dunite indicate a forsterite content greater than 80 percent (R. A. Loney, U.S. Geological Survey, written communication, 1971).

The remote location and wilderness status of most of the olivine area makes its development extremely unlikely. It is also highly doubtful that Curry County olivine could compete for a portion of the already developed market because of the lack of railroad facilities, the reluctance of consumers of nonmetallic minerals to change to new suppliers after their production system has been established, and the large preproduction capital investment that would be needed to even test the market. Although olivine has also been used for refractory, sand blasting, roofing granules, and nonslip applications, for all of these uses other less expensive resources are already entrenched in the market.

MINERAL FUELS

Coal

No commercial or presently economically feasible coal deposits are known in the County. The Eckley prospects (107), Middle Fork Sixes coal prospect (108), Iron Mountain (Carol Ann) coal occurrence (141), and the Agness (Shasta Costa) prospects (170) have been known for many decades, but the limited extent, thinness of seams, and remoteness from markets preclude any mining in the foreseeable future (Diller, 1903; Oregon Department of Geology and Mineral Industries unpublished report, 1941).

Oil and Gas

In general, the geologic formations in the County are not favorable for the production of oil and gas. Possible exceptions are younger marine rocks offshore, Tertiary sediments northeast of Agness, and Late Cretaceous sediments in the Cape Sebastian-Pistol River-Crook Point area.

RECLAMATION

General

When the Curry County planners or the land use decision makers try to accommodate surface mining into a comprehensive land use plan, they will find built-in conflicts with other objectives of the plan. On one hand, residential areas must be protected from noise, dust, vibration, traffic, and unsightliness of pits and quarries; on the other hand, they must insure the availability of mineral resources to be used by industry for the good of Curry County and the State of Oregon. They must insure a low-cost supply of rock materials for construction purposes. Because of transportation costs, a mine providing material for urban construction should be in or near town. For timber-harvest roads, quarries should be only a few miles apart.

The 1971 Oregon Legislative Assembly passed the Mined Land Reclamation Law, which addresses these concerns:

(1) To provide that the usefulness, productivity, and scenic values of all lands and water resources affected by surface mining operations within this State shall receive the greatest practical degree of protection and reclamation necessary for their intended subsequent use, and

(2) To provide for cooperation between private and governmental entities in carrying out the purposes of the Mined Land Reclamation Law.

The State Department of Geology and Mineral Industries has been charged by law to carry out the purposes of the Mined Land Reclamation Law. To discharge its duty under that law, a Division of Mined Land Reclamation was established in Albany, Oregon. Curry County, through its zoning laws, also is involved with carrying out the purposes of the Mined Land Reclamation Law; and its role is no less important than that of the State Department of Geology and Mineral Industries. Within their respective roles, both agencies have the right to modify or veto a reclamation plan submitted by a mining operator. The two roles are complementary: the Oregon Department of Geology and Mineral Industries has expertise in mining geology, mining techniques, and reclamation processes; the County has the best knowledge of local needs. It should not be the function of the County Planning Department to prepare a reclamation plan for a particular mining site; but the County could set guidelines that have secondary and tertiary uses in mind. For example: a gravel resource might be kept in an open-space use, such as farming, even if it were circled with urban development. Then, after the area is mined, the secondary use might be for a demolition fill; the tertiary use could be as a residential development or a community park.

The operator-landowner's role should not be that of an adversary of the two agencies. The operator has as much stake in carrying out the purposes of the Mined Land Reclamation Law as any agency. Reclamation is a planning process that allows the operator-landowner to maximize his total profits by continued utilization of mined-out land. A good example of what can be accomplished when the three parties cooperate toward the goal of mined land reclamation is shown by the gravel site (334) located on the Knapp property north of Port Orford. The actual results of the cooperation can be illustrated with photographs taken during and after mining.

Figure 11, taken during August 1976, shows the maximum amount of land that was affected by mining. Figure 12, taken during April 1977, shows over half of the site reclaimed. Only the stockpile area is unreclaimed. The bond for this area will not be released until the crushed material has been removed, the soil replaced, and the area seeded.

The above example illustrates how judicious planning can result in wise land use and conservation of mineral resources. The diverse use of land for agriculture, recreation, residential and commercial-industrial development, and mining can all be integrated with foresight and determination to serve everyone's purposes. The trend for the future should be the preplanning of sequential land use by either governmental agency or a private party.

Figure 11. Rock-material site 334 during mining.

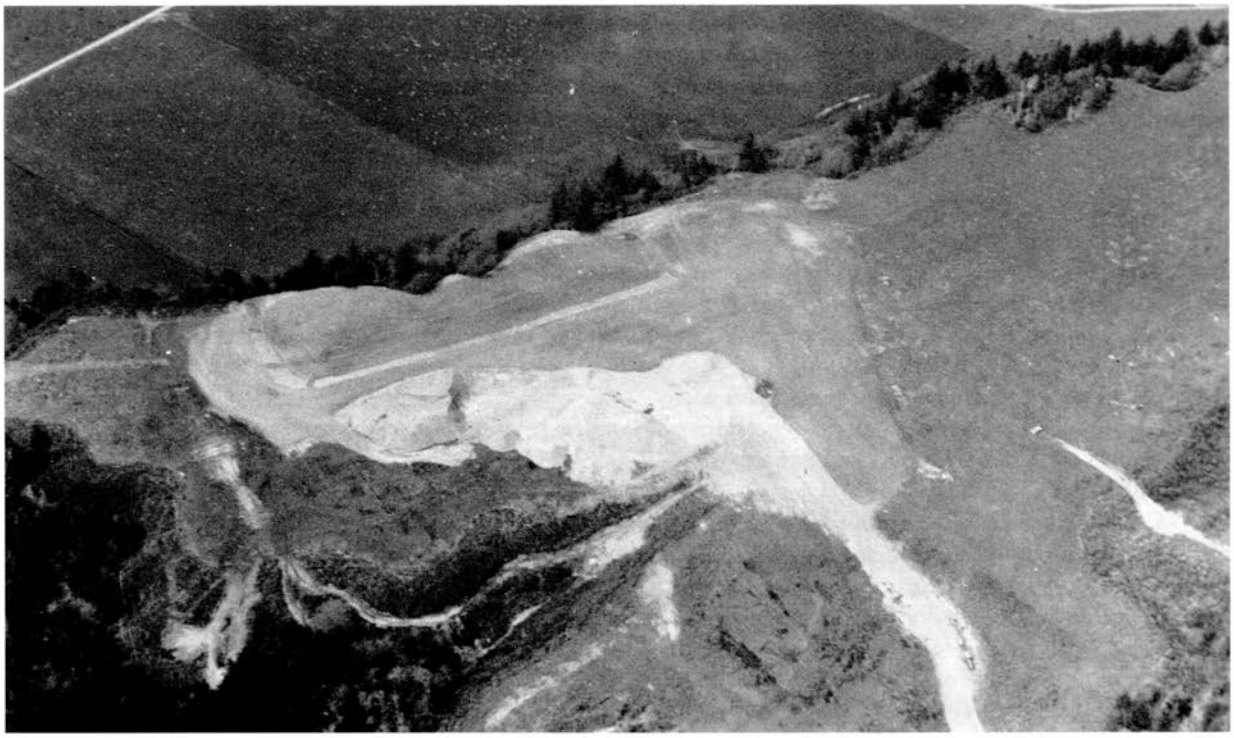


Figure 12. Rock-material site 334 after it has been shaped and seeded. Only stockpile area is unreclaimed.

Division of Mined Land Reclamation Procedures

The Division of Mined Land Reclamation procedures were designed to allow as much input into the reclamation plan as possible, to minimize conflict with other land uses, and to insure performance of the planned reclamation. The steps for residents of Curry County are as follows:

(1) A potential mining operator files with the Division an application (a copy of which is reproduced as Appendix 1), a reclamation plan, and the appropriate permit fee.
(2) The application and plan are copied and submitted for review to 11 State agencies and to Curry County; and if the operation is to be on Federal land, copies will also be sent to the particular Federal land manager. The County planners have the opportunity and duty to provide input into an operator's reclamation plan during the review cycle.
(3) Review comments are collected and evaluated by the Division specialists.
(4) An on-site inspection is arranged with the operator and a Division specialist; and if the review of the reclamation plan has produced some conflict or concerns, representatives of the reviewing agencies may be requested to meet on-site to resolve differences.
(5) On-site inspection determines if the reclamation plan is feasible, resolves conflicts, and determines the amount of bond that needs to be posted by the operator.
(6) The operator accepts the modified reclamation plan, posts the bond, and pays the appropriate inspection fee.
(7) The Oregon Department of Geology and Mineral Industries issues an operating permit that may or may not have conditions attached to it.

Available Assistance for Mined Land Reclamation

The Oregon Department of Geology and Mineral Industries not only serves as a surface-mining regulator but also works to assure that the State of Oregon has and maintains a viable mineral base. A copy of the Department's Mined Land Reclamation Division's reclamation plan guideline is included as Appendix 2. This guideline, which was prepared as a checklist for the Division specialists, can be used by a mine operator as a standard method of preparing a reclamation plan.

Actual monetary assistance has been provided for reclaiming surface mines for recreation under the U.S. Department of the Interior, Bureau of Outdoor Recreation, Program of Reclamation for Recreation. The Bureau's report, "Sources of Assistance in Reclaiming Surface Mined Lands for Outdoor Recreation," lists sources of assistance for all types of reclamation (U.S. Department of Interior, 1974).

An outstanding series of reports (Bauer, 1965, 1970; Baxter, 1969; Jensen, 1967; Johnson, 1966; National Sand and Gravel Association, 1960; and Schellie and Rogier, 1964) on all phases of the reclaiming of sand and gravel and rock quarries have been published by the National Sand and Gravel Association. These reports are available only to members of the Association. A set of these reports might be obtained on loan from any Curry County aggregate producer belonging to the Oregon Concrete Aggregate Producers Association, Inc. The Mined Land Reclamation Division also has a set on loan which can be used at the Division's office.

Curry County might be able to help the planning and decision-making process involving surface mining by establishing a reclamation library. A major value of the library's availability at the County level would be that the operator, planner, and the public could see what has been and what could be done for secondary or tertiary uses of mined-out areas. A partial list of uses for mined-out areas includes residences, both single-family and high-rise; open space, such as regional parks, golf courses, or country clubs; water impoundments, such as municipal water reservoirs, waterbased parks, or sewage lagoons; commercial-industrial sites; sanitary or demolition fills; or agriculture, such as truck farms, tree farms, or fish ponds.

CONCLUSIONS AND RECOMMENDATIONS

This study provides a strong mineral-resource data base and a much improved geologic map for use of the County Planning Department. The report should also be of value to others, including County and State road and highway departments, private contractors, prospectors, company exploration geologists, and private citizens who are interested in the area where they live or plan to explore.

Forecasts of mineral-resource availability and future demands for these resources help to place the County's needs into focus. The report points out the necessity of planning for secondary usage and reclamation of surface-mining sites so as to eliminate much of the adverse environmental effects and the usual accompanying public outcry.

Ownership of various metallic and nonmetallic mines, prospects, and mineral occurrences has not been reported. A few areas of mineral deposits, such as the black-sand layers in old marine-terrace deposits, are now highly developed private residential or agricultural lands that will probably never be mined.

The effect of withdrawing land from mineral-resource development by various governmental agencies (e.g. wilderness areas, botanical areas, and recreation sites) can have a profound impact on future production. County zoning of land which excludes mineral-resource development also has the effect of preventing any future production. As this report does not itemize restrictions on each occurrence, the land status, which is subject to change, will have to be determined on an individual basis at the time any deposit or area is being investigated.

We recommend that the land status of all active and potential mining sites, particularly those near urban areas, be determined. All future changes in land status should take into consideration the mineral-resource potential of each parcel.

The County may wish to have a supplemental study prepared which relates land status to mineral-resource potential. A County-wide, rock-materials demand-curve model should be developed to present a better picture of future needs.

The County is in a good position to promote and encourage (even require) mined land reclamation on all surface-mining sites within its boundaries. By working closely with State agencies, the County may have significant input into the State program by reviewing all reclamation plans. A mined land reclamation library should be built up and maintained by the County.

Should future mineral-resource related problems develop, the State Department of Geology and Mineral Industries offers its advice and assistance.

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APPENDIX

APPENDIX 1. MINED LAND RECLAMATION APPLICATION FORM

STATE DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES
1129 S. E. Santiam Road
Albany, Oregon 97321
Telephone (503) 967-2039

Identification No._____

Office Use Only _____

APPLICATION FOR OPERATING PERMIT OR GRANT OF EXEMPTION UNDER ORS 517.750 - 990

1. Responsible Parties

A. Operator

Name_____

Street or Box No._____

City_____State_____

Zip_____Telephone_____

B. Landowner (if other than operator)

Name_____

Street or Box No._____

City_____State_____

Zip_____Telephone_____

3. MINERAL DEPOSIT CHARACTERISTICS

A. Description

Type of overburden_____

Approximate depth of overburden_____

Approximate depth of mine_____

Primary mineral to be removed_____

Estimated quantity of mineral (yards)_____

B. Size

Size in acres of any areas presently affected by surface mining_____

How much of the above was affected
before 7/1/72_____
before 7/1/75_____

Has any of the above area been reclaimed?_____

If yes, how much and when?_____

Approximate acreage to be affected by surface mining during the ensuing 12 months_____

C. Volume

Total cubic yards excavated 7/1/72 to date_____

During ensuing permit year, what is the scheduled total cubic yards to be excavated_____

D. Status

☐ Active Date mining began _____

☐ Inactive Date mining will begin _____

☐ New

2. Identification of Site

A. ¼Sec. Section Township Range County

Distance in miles | Direction from | Nearest Community

Type of site: (Check all that apply)

☐ 1. Pit ☐ 5. Prospect
☐ 2. Stockpile ☐ 6. Refuse Disposal
☐ 3. Plant ☐ 7. Other
☐ 4. Quarry

4. Application is hereby made for: (complete only one - see instructions)

A. Operating permit - operator claims no exemptions_____

I apply for a surface mining operating permit under ORS 517.800_____date_____
(signature) Title_____

B. Grant of limited exemption based on: (check one or both)

☐ Prior mined

☐ Valid contract

I apply for a grant of limited exemption from the requirement for a reclamation plan and bond, but not the fees Signature _____
Date_____ Title _____

C. Grant of total exemption.

I apply for a grant of total exemption from the requirements of a reclamation plan, bond, and the fees under ORS 517.750 (11) and 517.770 (2) because:

☐ 1. All mining activity takes place between the banks of a stream. (The vegetation line defines the bank).

☐ 2. Access road's borrow pit or quarry.

☐ 3. On-site construction.

☐ 4. The site is less than one acre, and

☐ 5. a total of less than 2,500 cubic yards of material have been, or will be, removed.

☐ 6. The site is inactive.

☐ 7. Other

_____date_____
(signature) Title_____

D. Even though entitled to exemptions as shown above, a reclamation plan is submitted voluntarily.

Yes. No.

NOTICE

If more than 50 cubic yards of material are to be removed or placed in fill within the bed and banks of a natural waterway, a permit from the Division of State Lands, 1445 State Street, Salem, Oregon 97310, telephone: 378-3805, is required.

INSTRUCTIONS FOR COMPLETING THIS FORM ARE ON THE REVERSE SIDE

SMLR-1 071476

APPENDIX 1. (continued)

GENERAL INSTRUCTIONS

I. Each application for a surface mining permit must be accompanied by:

1. Completed application form, SMLR-1. (See instructions on reverse side of SMLR-1)

2. Application fee as indicated ($265.00).

3. Reclamation and development plan including site plans, cross sections, aerial photographs, or other drawings needed to show the present condition, planned development, and final configuration. Scale of such drawings or plans not to exceed 1" = 600'. The Reclamation Plan Guidelines, form SMLR-16, may be used for this purpose.

4. Performance bond or other security as required by ORS 517.810. The amount of this bond or security shall be determined by the Department not to exceed $500 per acre of land presently mined and unreclaimed.

II. Each application for a grant of limited exemption must be accompanied by:

1. Application form, SMLR-1.

2. Application fee as indicated ($265.00).

3. Site drawing, survey map, or aerial photograph establishing the surface mining perimeter as of July 1, 1972, and/or a copy of the mining contract if the exemption claimed is based on that provision.

4. No bond required.

III. Application for total exemption:

1. Check only the items in 4C that apply.

2. No fees required.

3. No reclamation plan required.

4. No bond required.

NOTE: Part 4A - Application for a surface mining permit:

Check and sign ONLY if your mining operation exceeds 1 acre and/or 2,500 cubic yards of disturbance in any 12 month period AND involves surfaces which were unmined as of July 1, 1972. If part of your operation is on land mined before July 1, 1972, and part after July 1, 1972, you must sign in 4A.

SMLR-2 Revised

APPENDIX 2. RECLAMATION PLAN GUIDELINE

DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES
MINED LAND RECLAMATION DIVISION

RECLAMATION PLAN GUIDELINE

A. NAME, ADDRESS AND TELEPHONE NUMBER OF THE OPERATOR OR HIS AGENT:

B. NAME AND ADDRESS OF LANDOWNER:

C. LIST OF KNOWN MATERIALS FOR WHICH THE OPERATION IS TO BE CONDUCTED:

1. PROPOSED STARTING DATE:
2. PROPOSED ENDING DATE (IF KNOWN):

D. OPERATIONAL PLAN:

1. METHOD TO BE EMPLOYED:

   a. SINGLE BENCH c. DREDGE
   b. MULTIPLE BENCH d. OTHER_____

2. TYPES OF EQUIPMENT TO BE USED:

3. DISPOSITION OF OVERBURDEN:

E. WHAT WILL BE THE PLANNED SUBSEQUENT "BENEFICIAL USE" OF THE PERMIT AREA? THIS CAN INCLUDE, BUT IS NOT LIMITED TO, CONSTRUCTION SITE, SANITARY LAND FILL, PARK, WATER IMPOUNDMENT, AGRICULTURAL USE (BE SPECIFIC, EXAMPLE: GRAZING LAND, CROP TO BE PLANTED, ETC.), FOREST LAND.

APPENDIX 2. (continued)

F. 1 (a) Reclamation will begin _____ days following completion of mining.
(b) Reclamation will be concurrent with mining. _____ yes _____ no

F.2 PROVISION FOR RECLAIMING MINED LANDS ON A CONTINUING BASIS WHERE FEASIBLE.

G. RECLAMATION PROCEDURES

1. WHAT WILL YOU DO TO INSURE GROUND STABILITY?

2. PROVISION FOR REVEGETATION. (Minimal survival rate is 75% uniformly distributed.)

(a) HOW WILL YOU SAVE AND STORE TOPSOIL?

(b) WHAT MEASURES WILL YOU TAKE TO PREVENT EITHER WIND OR WATER EROSION OF TOPSOIL DURING STORAGE?

(c) WHAT WILL BE THE AVERAGE DEPTH OF TOPSOIL REPLACED ON THE AREA TO BE RECLAIMED.

(d) HOW WILL YOU PREPARE SEED BED PRIOR TO PLANTING?

(e) WHAT TYPES AND AMOUNTS OF GRASS SEED WILL YOU USE PER ACRE AND HOW WILL THIS BE PLANTED?

(f) WHAT TYPES AND AMOUNTS OF FERTILIZER, MULCH, AND LIME WILL YOU USE?

(g) WHAT TYPES AND AMOUNTS OF SEEDLINGS AND SHRUBS WILL YOU PLANT?

(h) WHEN WILL SEEDING AND PLANTING TAKE PLACE? (SEASON OF YEAR)

APPENDIX 2. (continued)

H. WATER AND DRAINAGE

(a) WHAT PROVISION WILL YOU TAKE TO INSURE PROPER DRAINAGE?

(b) WHAT PROVISION HAS BEEN TAKEN FOR SILT CONTROL?

(c) IF WATER IMPOUNDMENT IS TO BE LEFT, SEE PAGE 6.

I. VISUAL SCREENING

(a) WILL YOU EMPLOY VISUAL SCREENING? (IF NO, EXPLAIN)

(b) WHAT TYPES AND AMOUNTS OF PLANTS WILL YOU USE?

(c) WHAT WILL BE THE SPACING BETWEEN PLANTS?

J. PROVISION FOR REMOVING STRUCTURES, EQUIPMENT, AND REFUSE FROM THE PERMIT AREA IN ACCORDANCE WITH THE RECLAMATION PLAN.

K. MAP OF AERIAL PHOTO REQUIREMENTS

(a) WILL AREA PHOTO BE SUBMITTED? YES _____ NO _____

SCALE_____

(b) MAP(S) REQUIREMENTS. THE MAP SHOULD SHOW, BUT IS NOT LIMITED TO:

(1) SCALE: (1" = 400' to 600')

(2) NORTH SHALL BE INDICATED

(3) QUARTER SECTION, SECTION, TOWNSHIP AND RANGE

(4) DISTANCE AND DIRECTION TO NEAREST MUNICIPALITY

(5) LOCATIONS AND NAMES OF ALL STREAMS, ROADS, RAILROADS, UTILITIES

APPENDIX 2. (continued)

(6) LOCATION AND NAMES OF ADJACENT LANDOWNERS

(7) ALL OCCUPIED HOUSES WITHIN 500 FEET

(8) LOCATION OF ALL PROPOSED ACCESS ROADS

(9) LOCATION OF PLANT, OFFICE AND MAINTENANCE FACILITIES

(10) SHOW BOUNDARIES OF AREA TO BE PERMITTED

(11) TYPICAL CROSS-SECTION OF PRESENT GROUND LINE AND PROJECTED GROUND LINE AFTER RECLAMATION

(12) CONTOUR INTERVAL, DATE OF MAP PREPARATION, NAME OF PERSON PREPARING MAP.

(13) AREA FOR TOPSOIL STORAGE, WASTE DISPOSAL

(14) A SEPARATE MAP SHOWING GENERAL LOCATION OF THE OPERATING AREA (NOT LARGER THAN 8½" x 11")

(c) A REVISED MAP MAY BE REQUIRED ANNUALLY

L. IF APPLICABLE, WHAT PROVISIONS HAVE BEEN MADE FOR STREAM CHANNEL, BANK STABILIZATION AND REHABILITATION?

M. EVIDENCE, IN WRITTEN FORM, STATING THAT ALL OWNERS OF A LEGAL, EQUITABLE, FIDUCIARY OR POSSESSORY INTEREST IN THE LAND CONCUR WITH THE PROPOSED SUBSEQUENT USE FOR ANY MINING OPERATION COMMENCING SUBSEQUENT TO JULY 1, 1972.

N. OTHER PERMITS IF APPLICABLE:

DIVISION OF STATE LANDS	NO._____	DATE _____
DEPARTMENT OF ENVIRONMENTAL QUALITY	NO._____	DATE _____
COUNTY USE PERMIT	NO._____	DATE _____
OTHER (IDENTIFY)	_____	

O. OTHER COMMENTS:

_____

(SIGNATURE OF APPLICANT)

TITLE _____ DATE _____

APPENDIX 2. (continued)

WATER IMPOUNDMENTS

(1) HOW LARGE WILL THE SURFACE AREA BE, IN ACRES? _____

(2) WHAT PROVISIONS HAVE BEEN MADE FOR PUBLIC SAFETY?

(3) WHAT PROVISIONS HAVE YOU MADE TO PREVENT WATER STAGNATION?

(4) WHAT IS THE WATER SOURCE FOR THE IMPOUNDMENT?

(5) WILL THERE BE PUBLIC ACCESS FOR FISHING?

APPENDIX 2. (continued)

INSTRUCTIONS FOR CROSS-SECTION

1. THE TWO EXAMPLES SHOWN ARE "TYPICAL" CROSS-SECTIONS OF A WATER IMPOUNDMENT LEFT AFTER EXCAVATION IS COMPLETE.

2. IF ONE OF THE PLANS SHOWN IS TO BE USED, PLEASE INDICATE WHICH ONE AND PROVIDE THE FOLLOWING INFORMATION ON THE PLAN SELECTED. YOU DO NOT HAVE TO RE-DRAW THE CROSS-SECTION.

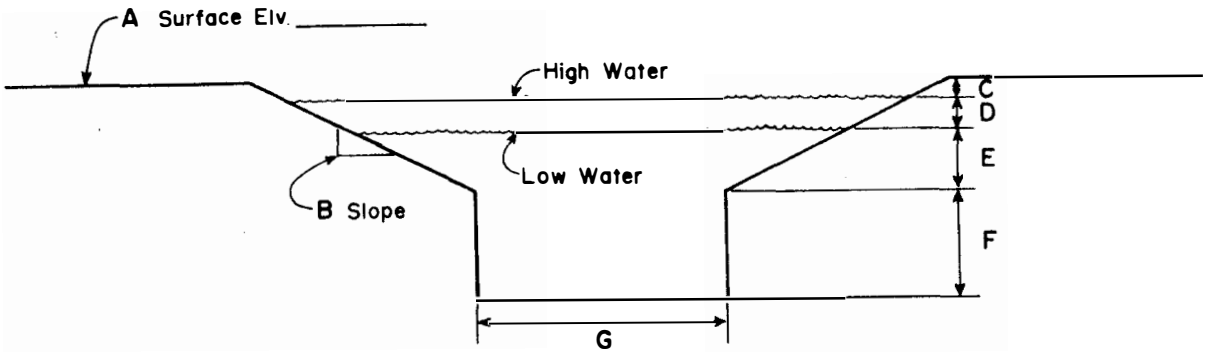
   A. SURFACE ELEVATION TO THE NEAREST 5 FEET.

   B. SLOPE OF THE BANK (MAXIMUM IS 2:1 OR 27°).

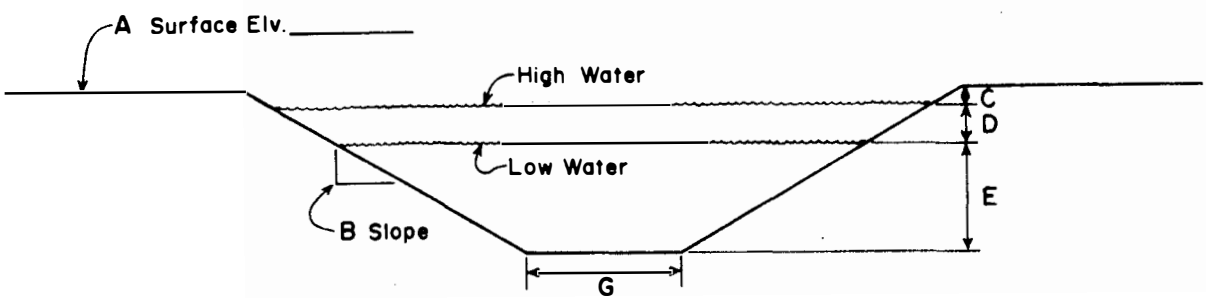
   C - G. THE DIMENSIONS IN FEET.

Typical Cross - Section(s) of Water Impound

TYPE I



TYPE II



APPENDIX 3. GLOSSARY

agglomerate - coarse contemporaneous pyroclastic rock containing rounded or subangular fragments greater than 32 mm in diameter in an ash or tuff matrix.

aggregate - uncrushed or crushed gravel, crushed stone, sand, or artificially produced inorganic material used to form the major part of Portland cement concrete or asphaltic concrete.

alluvium - earth, sand, gravel, or other rock materials transported and laid down by flowing water.

amphibole - group of common rock-forming silicate minerals including hornblende, tremolite, actinolite, glaucophane, anthophyllite, riebeckite, etc., having characteristic elongate prismatic habit.

amphibolite - medium- to coarse-grained metamorphic rock consisting mainly of amphibole and plagioclase with little or no quartz. As the content of quartz increases, the rock grades into a gneiss.

andesite - fine-grained to porphyritic dark-colored lava or dike rock of intermediate composition, i. e., between that of basalt and rhyolite.

basalt - dark-colored, fine-grained extrusive (lava) or dike rock of basic (mafic) composition. See pillow basalt.

base rock or base course - layer of specified or selected material of planned thickness, constructed on the subgrade or subbase of a road. Size is usually 3.5 in minus for base course; can be larger for subgrade or subbase.

basic - describing an igneous rock such as gabbro or basalt which is relatively low in silica.

bed rock - any more or less solid, undisturbed rock in place at the surface of the earth. May be exposed or may be hidden beneath unconsolidated surficial material.

blueschist - a dynamothermal metamorphic rock which contains fairly abundant blue amphibole (glaucophane). The rock is believed to form in a tectonic environment of thrust faulting where locally high pressures (5,000 bars) and relatively low temperatures (300° to 400°C) occur.

cataclastic - structure produced in a rock by severe mechanical stress during dynamic metamorphism; includes bending, breaking, and granulation of minerals.

commercial materials - rock materials produced for sale to the public.

complex - a large-scale association or assemblage of rocks, such as an igneous complex of intimately mixed diorite and gabbro, that are difficult to differentiate in mapping.

crushed rock - quarry rock (bed rock) which has been crushed and screened to a certain dimension.

dacite - a fine-grained, light-colored, often porphyritic, igneous rock that may occur as a lava flow, dike, or sill; the approximate fine-grained equivalent of quartz diorite.

diabase - medium-grained, dark-gray, basic intrusive rock having characteristic texture of abundant plagioclase with pyroxene filling the interstices.

diced rock - closely jointed and/or naturally fractured outcrop of rock. Usually can be excavated from a quarry with little or no blasting.

dike - a tabular igneous intrusion that cuts across the planar structures of the surrounding rock.

diorite - plutonic rock of intermediate composition between acidic (granitic) and basic (gabbroic); always contains plagioclase feldspar and may contain pyroxene, amphibole (hornblende), small amounts of quartz, and various other accessory minerals.

evaporite - nonclastic sedimentary rock composed primarily of minerals produced from a saline solution that was concentrated by evaporation.

gabbro - a group of dark-colored basic intrusive igneous rocks composed of calcic plagioclase and pyroxene in which various other minerals such as olivine, magnetite, and minor quartz may be present.

geochemical - an exploration technique by which soils or other surface deposits are sampled and analyzed for abnormal element concentrations that may be clues to economic mineral deposits.

gneiss - medium- to coarse-grained foliated metamorphic rock in which bands or lenticles of granular minerals alternate with bands or lenticles of flaky or elongate prismatic minerals.

grandfather rights - rights held by an operation which was established prior to passage of new regulations. These rights exempt the operator from compliance with the new regulations.

gravel - rounded to subrounded rock generated by a combination of weathering processes and running water. Water has been the agent of transportation and deposition. The size range is minus 3 in and plus 3/8 in. Deposits contain variable amounts of sand.

gravel bed - a deposit of stream-transported rounded rock and sand.

gravel pit - an excavation in an alluvial deposit from which sand and gravel have been or are being mined.

graywacke - gray "dirty" indurated sandstone consisting of poorly sorted angular grains of feldspar, quartz, rock fragments, mafic minerals, clay and silt, and mica. The mineral grains often have been altered. Bedding is generally massive due to rapid deposition and may be graded. The rock is formed in an environment of rapid erosion, transportation, and deposition of sediments where usually easily destroyed minerals survived.

harzburgite (saxonite) - peridotite composed chiefly of olivine and orthopyroxene.

isoclinal - type of a fold, the limbs of which have been so compressed that they are parallel.

K-Ar (potassium-argon) - an unstable radioactive isotope of potassium decays at a constant rate to form argon. Precise analytical techniques enable determination of the approximate age of a fresh igneous rock containing these elements.

keratophyre - a general term applied to all silica- and alumina-rich, highly sodic, feldspar-bearing extrusive and near-surface intrusive rocks characterized by the presence of secondary albite, chlorite, epidote, and calcite. Keratophyres are often associated with saussuritized basic marine lavas and interbedded marine sediments.

klippe - an outlier or erosional remnant of the upper thrust plate separated from the main mass of similar rocks.

lapilli - angular clasts found in pyroclastic rocks (tuff) ranging from the size of a pea to that of a walnut.

laterite - highly weathered and leached red soil, usually formed in a very wet tropical to temperate climate, generally rich in secondary oxides of iron and aluminum and void of bases and primary silicate minerals. Nickel-bearing "laterites" contain very little alumina, and only a small part of these soils developed on peridotite can be classed as truly lateritic.

lentil - a minor rock-stratigraphic unit of a formation having lenticular shape and limited geographic extent.

mafic - magnesium- and iron-rich.

materials source - gravel pit or rock quarry.

mēlange - a chaotic mixture of sheared rock and exotic tectonic fragments, blocks, or slabs, all of diverse origin and ages, that may be as much as several kilometers in length.

metagabbro - (see gabbro) an altered gabbro that has usually sustained both chemical and physical alteration. Pyroxenes have usually been altered to amphiboles, plagioclase has been saussuritized, and structure may have been deformed to become gneissic or cataclastic.

m.y. - million years.

noncommercial materials - rock material produced under contract for construction projects such as Federal dams, State and Federal highways, and U.S. Forest Service roads.

olivine - common rock-forming silicate mineral which is rich in magnesium and iron; a principal constituent of ultramafic rocks.

orogeny - geologic period of major mountain building accompanied by folding, uplift, and intrusion of plutonic rocks.

outcrop - that part of a rock formation or stratigraphic unit that is exposed at the earth's surface or would be exposed if surficial materials were removed.

peridotite - a general term for a coarse-grained plutonic rock composed chiefly of olivine (peridot), with or without other mafic minerals such as pyroxene and amphibole, and with little or no feldspar.

pit or quarry run - raw rock material taken from a pit or quarry; not crushed, screened, or dried.

protolith - unmetamorphosed rock from which a given metamorphic rock was formed; parent rock.

pyroclastic - fragmental rock material formed by volcanic explosion or aerial expulsion from a volcanic vent; also pertaining to rock texture of explosive origin.

pyroxene - a group of dark, rock-forming silicate minerals containing varying amounts of calcium, sodium, magnesium, iron, and aluminum; characterized by short, stout, prismatic crystals.

pyroxenite - an ultramafic rock composed chiefly of pyroxene with accessory olivine, amphibole, or mica; magnetite; and secondary serpentine.

quarry - a bedrock outcrop or talus area from which rock material is being dug or mined.

road metal - gravel or other rock suitable for surfacing roads.

rock material - any natural occurrence of consolidated or unconsolidated mineral matter and products dug or mined from it. Includes clay, shale, pumicite (volcanic ash), volcanic cinders, scoria, sand and gravel, and stone; also includes the above material mined as pit or quarry run that has been crushed, screened, or dried. Does not include material calcined or otherwise processed to alter physical characteristics.

rhyolite - light-colored, siliceous, extrusive or near-surface intrusive igneous rock, often having a porphyritic texture with phenocrysts of quartz and alkali feldspar (orthoclase) in a glassy to cryptocrystalline groundmass; the fine-grained equivalent of granite.

sand - any hard, granular rock material resulting from the natural disintegration of bed rock; finer in size than gravel and coarser than dust; the size of material that passes a 3/8-in sieve but is retained on a 200-mesh sieve.

sand and gravel deposit - an alluvial deposit composed of a mixture of sand, gravel, cobbles, and boulders.

saprolite - a soft, earthy, clay-rich, thoroughly decomposed rock formed in place by chemical weathering; found underlying laterites.

saussuritization - the replacement, especially of calcic plagioclase, in basic igneous rocks, by a fine-grained aggregate of secondary minerals including zoisite, epidote, albite, calcite, sericite, and zeolites; a metamorphic process frequently accompanied by chloritization of ferromagnesian minerals.

schist - a strongly foliated crystalline rock, formed by dynamic metamorphism, which can be readily split into flakes or slabs due to parallel orientation of tabular and elongate minerals.

serpentinite - a rock consisting almost wholly of serpentine-group minerals (hydrous magnesium silicates) with some residual pyroxene, chromite, and both primary and secondary magnetite. The rock is usually altered from peridotite.

serpentinization - process of hydrothermal alteration by which serpentine minerals are formed from magnesium-rich primary silicate minerals.

siliceous - containing abundant silica.

stone - individual blocks, masses, fragments, or crushed sizes of rock taken from a quarry or natural outcrop.

subduction - the process of one large crustal block descending beneath another as a result of plate collision.

syncline - a fold, the core of which contains younger layered rocks; it is concave upward.

talus - loose, unsorted, and incoherent rock fragments, soil, and cliff debris transported downslope chiefly by gravity.

tectonic - pertaining to the forces and processes of rock deformation including folding, faulting, and uplift that have taken place in the earth's crust.

troy weight - weight used for precious metals. One oz troy = 31.103 gram.

tuff - compacted pyroclastic deposit of volcanic ash and rock fragments derived from an explosive volcanic eruption; may contain up to 50 percent mixed sediments from other sources.

tuffaceous - sediments containing up to 50 percent tuff.

ultramafic - igneous rock composed chiefly of mafic minerals such as olivine, pyroxene, and serpentine (examples - peridotite and serpentinite).

volcanogenic - of volcanic origin; mineral deposits formed as a direct result of submarine volcanism.

STATE OF OREGON
DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES
RALPH S. MASON, STATE GEOLOGIST

-TABLES-

Table 2. Rock-materials survey data

Identification: Map number	Identification: Operator	Identification: Ownership (F-Federal, S-State, C-County, L-Local, P-Private)	Location: ¼ Section	Location: Section	Location: Township (S)	Location: Range (W)	Status (a-active, i-inactive, undeveloped, p-prospect)	Size D-Depleted S-Small M-Medium L-Large: Past production	Size: Future potential	Source Description: Deposit type (B-Bedrock, C-Gravel)	Source Description: Rock type	Source Description: Geological formation	Mining system: Bench number (S-Single, M-Multiple)	Mining system: High wall (feet)	Mining system: Jointing (f-fine 1"-6", c-coarse 6"-12", b-blocky 12"-18", m-massive 18"+)	Mining system: Breaking ground (r-ripped, e-explosives)	Mining system: Crushing plant	Mining system: Use (e-embankment, s-sub-base, b-base, r-road, c-concrete aggregate, r-riprap, j-jetty stone)	Remarks
301*		P	SW	36	30	15	i	S	S	B	Metamorphic	Otter Point	S		b	e		e-b	
302		P	NE	30	30	14	i	S	L	B	Metamorphic	Otter Point	S		f-b	r		e-b	
303	County	P	NW	31	30	14	i	S	S	B	Metamorphic	Otter Point	S		f	r		e-b	
304		P	NW	32	30	14	ab	S	S	B	Metamorphic	Otter Point	S		b	e		e-b	
305*		P	SW	3	31	15	a	S	S	G	Various	Alluvium	S		f	r		e-t	
306		P	SE	3	31	15	a	S	S	G	Various	Alluvium	S		f	r		e-t	
307	County	P	SW	1	31	15	a	S	S	G	Various	Alluvium	S		f	r		e,s	
308*	Bullard Sand and Gravel	P	NE	12	31	15	a	S	L	B	Metasediment	Otter Point	M		f	r		e-t	Chert, no cutting material.
309*	Bullard Sand and Gravel	P	SE	12	31	15	a	M	L	B	Metasediment	Otter Point	M	200'	f-m	e,r	yes	e,s,r	
310*	State Highway Division	P	SE	22	31	15	i	S	M	B	Metabasalt	Otter Point	S	30'	m	e		e,r	
311*	State Highway Division	P	SW	31	31	15	i	M	M	G	Various	Alluvium	S	5'	f	r		e-t	
312	Susie White	P	SW	35	31	15	a	S	S	B	Blueschist	Otter Point	S	15'	f-b	r		e-t	
313	County	C	SE	6	31	14	a	M	L	B	Metabasalt	Otter Point	S	125'	b	e		e,s	
314		P	SE	35	31	14	i	M	M	B		Otter Point	S	60'	f-b	r		e,s	
315	Georgia Pacific, Inc.	P	SE	14	31	13	i	S	S	G	Various	Alluvium	S	3'	f	r		e-t	
316	Georgia Pacific, Inc.	P	SW	29	31	13	i	S	S	B	Blueschist	Otter Point	S	15'	f-m	r		e-t	
317	Georgia Pacific, Inc.	P	SE	27	31	13	i	S	L	B	Sandstone	Otter Point	S	25'	f-b	r		e-b	
318	Georgia Pacific, Inc.	P	NE	35	31	13	i	S	M	B	Sandstone	Otter Point	S	60'	b-m	e		e-b	
319	Georgia Pacific, Inc.	P	SW	25	31	13	i	S	S	B	Metasediment	Otter Point	S	30'	b-m	e		e-b	Green and brown chert, good cutting material.
320	Georgia Pacific, Inc.	P	NW	32	31	13	i	S	S	B	Metasediment	Otter Point	S	15'	f	r		e-t	Green and maroon thin-bedded chert, same cutting grade.
321	Georgia Pacific, Inc.	P	NE	34	31	13	a	S	L	B	Metasediment	Otter Point	S	60'	f	r		e-t	Chert, no cutting material.
322*	State Highway Division	S	SE	6	32	15	i	S	L	G	Various	Alluvium	S	15'	f	r		e-t,o	
323*		P	NW	7	32	15	i	S	M	G	Various	Alluvium	S	10'	f	r		e-t,o	
324*	County	P	NW	9	32	15	i	S	S	G	Various	Alluvium	S		f	r		e-t	
325	County	P	SE	9	32	15	i	S	S	B	Sandstone	Otter Point	S	30'	f	r		e,s	
326		P	SW	10	32	15	i	S	S	G	Various	Alluvium	S		f	r		e,s	
327		P	SW	10	32	15	i	S	S	B	Greenstone	Otter Point	S	15'	m	e		e,r	
328	County	P	SW	11	32	15	a	S	M	G	Various	Alluvium	S		f			e-t	
329*	Herbert Marrill	P	SW	11	32	15	a	L	L	B	Metamorphic	Otter Point	S		b-m	e		e,r	
330*	Western Builders Supply	P	SE	11	32	15	a	S	S	G	Various	Alluvium	S		f	r		e-t,o	
331*	County	P	SW	12	32	15	a	S	S	G	Various	Alluvium	S		f	r		e-t	
332	Ryce Wilson	P	SE	12	32	15	i	S	L	B	Metamorphic	Otter Point?	M		b-m	e		r,j	
333*		P	SW	16	32	15	i	S	M	B	Sandstone	Otter Point?	S	50'	f	r		e,s	
334*	State Highway Division	P	SW	20	32	15	a	L	L	G	Various	Alluvium	S		f	r		e-a	
335*	State Highway Division	S	SE	21	32	15	i	S	S	G	Various	Alluvium	S		f	r		e-a	
336*	Griffin Enterprises	P	SE	29	32	15	a	M	M	B	Metamorphic	Otter Point?	S		c-m	e,r		e,s,r	
337	County	P	SW	26	32	15	a	S	S	G	Various	Alluvium	S		f	r		e-t,o	
338		P	SW	36	32	15	a	S	L	B	Metabasalt and metasediment	Rocky Point	S		b-m	e		e,r	
339	County	P	SE	36	32	15	a	S	S	G	Various	Alluvium	S		f	r		e-t	
340	Ryce Wilson	P	SW	6	32	14	i	S	S	G	Various	Alluvium	S		f	r		e-t	
341	County	P	SW	7	32	14	a	S	S	G	Various	Alluvium	S		f	r		e-t	
342	Void number																		
343	Georgia Pacific, Inc.	P	NW	12	32	14	i	S	S	B	Sandstone	Otter Point	S	10'	f-b	r		e-b	
344		P	NE	12	32	14	ab	S	D	B	Metabasalt	Otter Point	S		f-b	r		e	
345	Georgia Pacific, Inc.	P	NW	6	32	13	i	S	S	B	Quartzdiorite	Otter Point	M	15'	f-b	r		e-t	
346	USFS	F	SE	5	32	13	i	S	S	B	Sandstone	Otter Point	S	20'	f	r		e-b	
347	Georgia Pacific, Inc.	P	NW	2	32	13	i	S	S	B	Metasediment Unpaque and chert	"group"	S	15'	f	r		e-t	Chert, no cutting material.
348	USFS	F	NW	15	33	14	a	S	L	B	Diorite	Pearce Peak	S		f	r		e,s	
349	USFS	F	NE	24	33	14	ab	S	D	B	Sandstone	Galice	S		f	r		e,s	
350	USFS	F	SW	25	33	14	a	S	L	B	Metasediment	Galice?	S		f	r		e,s	
351	USFS	F	NW	36	33	14	i	S	S	B	Metasediment	Galice	S		f	r		e,s	
352	USFS	F	NW	36	33	14	i	S	S	B	Metasediment	Galice?	S		f-b	r		e,s	
353	USFS	F	NW	36	33	14	i	S	M	B	Metasediment	Galice?	S		f	r		e,s	
354	USFS	F	SW	28	33	13	i	S	S	B	Metagabbro	Galice	S		b	e		e,s	
355	USFS	F	SE	34	33	13	a	L	L	B	Sandstone	Galice	S		f	r	yes	e-t	
356	USFS	F	NW	36	33	12	a	M	L	B	Sandstone	Galice	M	30'	f	r	yes	e-t	
357	BLM	F	NE	26	32	10	i	S	M	B	Sediment	Dothan	S					e-b	No on-site survey (BLM data).
358	BLM	F	SE	28	32	9	i	S	S	B	Sediment	Dothan	S					e-b	No on-site survey (BLM data).
359	BLM	F	NE	30	33	9	i	S	M	B	Sediment	Dothan	S					e-t	No on-site survey (BLM data).
360	Georgia Pacific, Inc.	P	SW	5	34	14	a	M	L	B	Metagabbro Metabasalt	Rocky Point	S		f-b	e		e,s	
361	State Highway Division	S	SE	7	34	14	i	L	L	B	Metasediment	Rocky Point	S		b-m	e	yes	e-t,r	
362*	State Highway Division	P	NE	31	34	14	a	L	L	B	Basalt	Otter Point	M		f-m	e	yes	e-t,r	
363*	State Highway Division	S	SW	29	34	14	i	S	S	B	Metasediment	Colebrooke Schist	S			e		e,s,r	
364	USFS	F	NE	5	34	13	i	S	S	B	Sandstone	Galice?	S		f	r		e,s	
365	USFS	F	NW	4	34	13	i	S	S	B	Sandstone	Galice?	S		f	r		e,s	
366	USFS	F	NE	4	34	13	i	S	S	B	Sandstone	Galice	S		f	r		e,s	
367	USFS	F	SW	5	34	13	a	M	M	B	Metasandstone	Rocky Point	S		f	r	yes	e-t	
368		P	NW	29	34	13	i	S	S	B	Metasandstone	Colebrooke Schist	S		f	r		e,s	
369		P	NW	32	34	13	ab	S	S	B	Metamorphic	Colebrooke Schist	S		f-b	r		e,s	
370		P	NE	33	34	13	i	M	M	B	Metavolcanic	Colebrooke Schist	S		f	r		e-t	
371	USFS	F	SW	17	34	12	i	S	M	B	Diorite	Pearce Peak	S		m	e		e,s,r	Landslide area.
372	USFS	F	NE	19	34	12	a	M	L	B	Greenstone	Colebrooke Schist	M	60'	f-b	e,r	yes	e-t	
373	USFS	F	NW	27	34	12	a	L	L	B	Metabasalt and metasediment	Colebrooke Schist	M	20'	f	r	yes	e-t	
374	USFS	F	SE	26	34	12	i	S	L	B	Basalt	Colebrooke Schist	S	40'	f	e		e,s	
375	USFS	F	SE	4	34	10	i	M	L	B	Sandstone	Dothan	S	15'	f-b	r	yes	e-t	
376	USFS	F	NE	28	34	10	i	S	S	B	Sandstone	Dothan	S		f	r		e-b	
377	USFS	F	SW	31	34	10	i	S	S	B	Sandstone	Dothan	S		f-b	r		e-b	
378	USFS	F	NE	31	34	10	i	S	M	B	Sandstone	Dothan	S		f	r		e-b	
379*		P	SE	3	35	14	a	S	S	B	Metasediment	Colebrooke Schist	S		f-b	r		e,s	
380		P	NE	9	35	14		S	M	B	Metasediment	Otter Point	S					e-b,r	No on-site survey (OSHD data).
381		P	SE	36	35	14	i	M	L	B	Metasediment	Otter Point	S		b-m	e		e,r	If mining continued, the highway could be straightened.
382	Georgia Pacific, Inc.	P	SE	6	35	13	a	S	M	B	Metasediment	Colebrooke Schist	S	10'	f-b	r		e-t	
383		P	NW	4	35	13	i	S	S	B	Metasediment	Colebrooke Schist	M	250'	f	r		e,s	
384		P	NE	8	35	13	a	S	M	B	Metasediment	Colebrooke Schist	M	20'	f-b	r		e,s	
385	USFS	F	SE	27	35	12	i	S	S	B	Metamorphic	Colebrooke Schist	S	40'	f	r		e-t	
386	USFS	F	SE	32	35	12	a	L	L	B	Metamorphic	Colebrooke Schist	M	30'	f	e,r	yes	e-t	
387	USFS	F	NE	13	35	11	a	M	L	B	Sandstone	Dothan	M	25'	f-b	r	yes	e-t	
388		P	NE	1	36	14	a	L	L	G	Various	Alluvium	S	10'	f	r	yes	e-t,o	
389		P	NE	1	36	14	i	S	M	B	Sandstone	Otter Point	S	75'	b	e		e,s	
390		P	NE	11	36	14	i	S	L	B	Basalt	Otter Point			f-m	e,r		e-t	
391	State Land Board	S	NW	16	36	14	i	M	L	G	Various	Alluvium	S		f	r		e-t	
392*	U. S. Plywood	P	NE	16	36	14	i	L	L	G	Various	Alluvium	S		f	r		e-t	
393*		P	NW	15	36	14	i	M	L	G	Various	Alluvium	S		f	r		e-t	
394		P	SW	22	36	14	i	M	M	B	Metasediment	Otter Point	S	100'	f-b	r		e,s	
395		P	SW	22	36	14	a	S	M	B	Metasediment	Otter Point	S	50'	f-b	r		e,s	
396		P	SW	29	36	14	i	L	M	B	Metasediment	Otter Point	M	30'	b-m	e		e,r	
397		P	NE	32	36	14	i	M	M	B	Metabasalt	Otter Point	S	60'	m	e		e,r	
398		P	SW	32	36	14	i	S	S	B	Sandstone and conglomerate	Otter Point	S	10'	f	r		e-t	
399		P	SE	32	36	14	i	M	M	B	Basalt	Otter Point	S	30'	f	r		e-t	
400		P	NE	32	36	14	i	M	S	B	Basalt	Otter Point	S	45'	f	r		e-t	
401		P	NE	33	36	14	i	S	S	B	Metasediment	Otter Point	S	15'	f	r		e,s	
402		P	SE	32	36	14	i	S	S	B	Basalt	Otter Point	S	20'	f-b	e,r		e-t	
403		P	NE	4	36	13	a	S	S	B	Metamorphic	Colebrooke Schist	S	20'	f	r		e-t	
404	USFS	F	SW	1	36	13	i	S	S	B	Greenstone	Otter Point ?	S	75'	b-m	e		e,s,r	
405	USFS	F	SW	12	36	13	i	L	L	B	Greenstone	Otter Point	S	175'	m	e		e,r	
406	USFS	F	NW	15	36	13	i	S	S	B	Metabasalt	Colebrooke Schist	S	10'	f	r		e,s	
407	USFS	F	NE	21	36	13	i	S	S	B	Metabasalt	Colebrooke Schist	S	10'	f	r		e,s	
408	USFS	F	SE	27	36	13	ab	S	D	B	Metabasalt	Colebrooke Schist	S	10'	f	r		e,s	
409	USFS	F	NW	33	36	13	i	M	S	B	Greenstone	Colebrooke Schist	S	50'	b-m	e		e,s,r	
410	USFS	F	SW	33	36	13	a	S	S	B	Metasediment	Colebrooke Schist	S	30'	f-b	r		e,s	
411	USFS	F	SW	6	36	12	a	M	L	B	Metamorphic	Colebrooke Schist	S	50'	f-m	r		e,s	
412	USFS	F	SW	5	36	12	i	S	S	B	Metamorphic	Colebrooke Schist	S	15'	f-b	r		e-t	
413	USFS	F	SW	36	36	12½	i	S	S	B	Metamorphic	Colebrooke Schist	S	50'	b-m	e	yes	e-t	
414		P	NW	6	37	14	a	S	S	B	Metavolcanic	Otter Point	S	30'	f	r		e,s	
415		P	NE	6	37	14	i	L	L	B	Metavolcanic	Otter Point	M	200'	f-b	e,r		e,s	
416		P	SE	5	37	14	i	M	M	B	Basalt	Otter Point	S	30'	f	r		e-t	
417		P	SE	15	37	14	i	S	M	B	Metavolcanic	Otter Point	S	75'	f	r		e,s	
418*		P	NE	19	37	14	i	S	S	G	Various	Alluvium	S	5'	f	r		e,s	
419*		P	NW	20	37	14	i	S	M	B	Metavolcanic	Otter Point	S	75'	b-m	e		e,s	
420	Curry County	P	SW	21	37	14	a	S	S	G	Various	Alluvium	S	3'	f	r	yes	e-t,o	
421	Agnew Timber Products	P	SE	22	37	14	a	L	L	B	Basalt	Otter Point	M	30'	f-m	e	yes	e-t	
		P	SW	27	37	14	a	L	L	B	Greenstone	Otter Point	M	30'	f-m	e	yes	e-t	
422		P	NW	24	37	14	i	S	M	B	Metamorphic	Colebrooke Schist	S	30'	f-m	r		e,s	
423	State Highway Division	S	SW	30	37	14	a	S	S	B	Sandstone	Cape Sebastian	S	30'	b	r		e	
424	Agnew Timber Products	P	NW	36	37	14	i	S	S	B	Greenstone	Otter Point	S	20'	f-m	r		e,s	
425	USFS	F	NE	1	37	13	a	S	D	B	Sandstone	Dothan	S	20'	f	r		e-t	
426	USFS	F	NW	1	37	13	i	M	L	B	Igneous	Upper Jurassic gabbro	S	150'	b-m	e		e,r	
427	USFS	F	NW	1	37	13	i	S	S	B		Dothan	S	30'	b	e		e,s	
428	USFS	F	NW	1	37	13	i	S	S	B	Sandstone	Dothan	S	15'	f	r		e-t	
429	USFS	F	SW	1	37	13	a	L	L	B	Sandstone	Dothan	S	15'	f		yes	e-t	
430	USFS	F	NW	9	37	13	i	S	S	B	Greenstone	Dothan	M	15'	f-b	r		e,s	
431	USFS	F	NE	12	37	13	i	S	S	B	Sandstone	Dothan	M	15'	f-b	e,r		e,s	
432	USFS	F	NW	18	37	13	i	M	L	B	Greenstone	Otter Point ?	M	30'	f-b	r		e,s	
433	USFS	F	NW	25	37	12½	a	M	M	B	Metavolcanic	Colebrooke Schist	S		f-b	r	yes	e-t	
434	USFS	F	NW	9	37	12	i	S	L	B	Basalt	Colebrooke Schist	S	15'	f-b	r		e-t	
435	Agnew Timber Products	P	NW	3	38	14	i	S	M	B	Sandstone	Otter Point	S	10'	f	r		e-t	
436*		P	NE	7	38	14	i	S	M	B	Sandstone	Hunter Cave	S	40'	b-m	e		e,r	
437	State Highway Division	S	SW	7	38	14	i	M	L	B	Metabasalt	Otter Point	S	100'	f-m	e		e,s	
438	Agnew Timber Products	P	NW	14	38	14	i	S	M	B	Sandstone	Otter Point	S	40'	f	r		e-t	
439	Agnew Timber Products	P	SE	14	38	14	a	M	L	B	Sandstone	Otter Point	S	70'	f-b	r		e,s	
440*	Curry County	P	SW	20	38	14	a	S	S	G	Various	Alluvium	S	3'	f	r		e-t	
441	Curry County	P	SW	21	38	14	a	S	S	B	Sandstone	Otter Point ?	S	50'	b-m	r		e,r	
442*	State Highway Division	S	SW	20	38	14	i	M	S	G	Various	Alluvium	S	10'	f	r		e,s	
443*	Curry County	P	SW	21	38	14	a	S	S	G	Various	Alluvium	S	3'	f	r		e-t	
444	USFS	F	SW	33	37½	12	i	S	L	B	Greenstone	Dothan	S		f	r		e-b	
445	USFS	F	NW	33	38	12	i	S	L	B	Greenstone and chert	Dothan	M	15'	f	r	yes	e-t	
446		P	Center	4	39	14	i	S	S	B	Sandstone	Hunter Cave	S	10'	f	r		e,s	
447		P	SW	3	39	14	i	S	M	B	Metasediment	Otter Point	S	35'	f	r		e,s	
448		P	SE	2	39	14	a	S	S	B	Sandstone	Otter Point	S	15'	f	r		e-t	
449	Agnew Timber Products	P	SE	10	39	14	a	S	L	B	Sandstone	Otter Point	S	100*	f	r		e-t	
450	State Highway Division	S	S	14	39	14	i	S	S	B	Greenstone	Otter Point	S	20'	b-m	e		e,s,r	
451*		P	Center NW	13	39	14	a	M	L	B	Dacite	Mount Emily	S	100'	f-b	e		e-t	
452		P	SE	22	39	14	i	M	S	B		Otter Point	S		f	r		e,s	
453		P	SW	23	39	14	i	S	L	B	Metabasalt	Otter Point	S	30'	f-b	e		e,s	
454		P	SE	5	39	13	i	S	L	B	Sandstone	Dothan	S	30'	f	r		e-t	
455		P	SE	5	39	13	i	S	M	B	Sandstone	Dothan	S	60'	f-b	r		e,s	
456	BLM	F	SW	3	39	13	i	M	L	B	Sandstone	Dothan	S	40'	f	e,r		e-t	
457		P	SW	8	39	13	i	S	M	B	Greenstone	Dothan	S	35'	f-m	r		e,s	
458		P	NE	18	39	13	ab	S	S	B	Sandstone	Dothan	M	15'	f-b	r		e-t	
459		P	SW	25	39	13	i	S	S	B	Sandstone	Dothan	S	25'	f-b	r		e,s	
460	Agnew Timber Products	P	N Center	32	39	13	i	M	M	B	Greenstone	Dothan	S		b	e		e,s	A pinnacle is being mined from top down.
461	USFS	F	NE	3	39	12	i	S	M	B	Sandstone	Dothan	S	30'	f	r		e,s	
462	Curry County	P	SW	8	39	12	a	S	L	B	Sandstone	Dothan	S		f	r		e-t	Newly opened; talus slope appears to extend to top of ridge 300-400 ft above.
463	Curry County	P	NE	8	39	12	a	L	L	G	Various	Alluvium	S	5'	f	r		e,s	
464	USFS	F	NW	19	39	12	a	M	L	B	Metasediment	Dothan	M	25'	m	e		e,s	
465	USFS	F	NW	19	39	12	i	S	S	B	Sandstone	Dothan	S	20'	f	r		e-t	
466	USFS	F	NE	19	39	12	i	S	S	B	Metasediment	Dothan	S	20'	f-b	r		e,s	
467	USFS	F	SW	31	39	12	i	S	M	B	Rhyolite	Mount Emily	S	100'	f	r		e-t	A 200-ft-wide dike is being mined.
468		F	SW	35	39	12	i	S	L	B	Sandstone	Dothan	S	40'	f	r		e-t	
469		P	NW	3	40	14	i	S	S	B	Metamorphic	Dothan	S		f	r		e-t	Material is cherty.
470		P	NE	12	40	14	i	S	S	B	Metasediment	Dothan	S	65'	f	e		e,s	
471*	State Highway Division	S	NE	26	40	14	i	M	M	B	Metamorphic	Dothan	S		f	r		e,s	Some of the chert should be of cutable grade for art works.
472	State Highway Division	S	NE	26	40	14	i	S	M	B	Greenstone	Dothan	S		b-m	e		e,r	High wall is not scaled down and is a safety hazard.
473*		P	NW	25	40	14	i	S	S	B		Dothan	S	60'	b-r	e		e,r	
474		P	NW	1	40	13	i	S	S	B	Sandstone	Dothan	S	30'	f-b	e		e-t	Top of ridge 40ft above the road level.
475		P	NE	12	40	13	ab	S	S	B	Sandstone	Dothan	S		f-b	r		e,s	
476		P	SE	12	40	13	a	S	S	B	Sandstone	Dothan	S	25'	f-b	r		e,s	
477		P	SE	12	40	13	a	L	L	G	Various	Alluvium	S	6'	f	r		e-t	
478		C	SW	19	40	13	i	S	S	B	Sandstone	Dothan	S	100*	b-m	e		e,s	County sanitary landfill is above quarry.
479		P	SE	19	40	13	a	S	L	B	Basalt	Dothan	S	75'	f-b	r		e,s	
480*	South Coast Lumber Co.	P	NW	24	40	13	i	M	L	B	Greenstone	Dothan	S	50'	b-r	e		e,s,r,j	
481		P	NE	30	40	13	a	L	L	B	Sandstone	Dothan	M	20'	f-b	e,r		e-t	
482		P?L?	Center	32	40	13	a	S	M	B	Sandstone	Dothan	M	30'	f	r		e-b	Some question about whether land is privately or city owned.
483	Ferry Creek Rock and Concrete, Inc.	P	SE	32	40	13	a	M	L	B	Sandstone	Dothan	M	20'	f-b	r		e,s	
484*	Ferry Creek Rock and Concrete, Inc.	P	SE	32	40	13	a	L	L	G	Various	Alluvium	S	10'	f	r	yes	e-t	
485*	Pacific Rock and Paving	P	NW	33	40	13	a	L	L	G	Various	Alluvium	S	15'	f	r	yes	e-t	
486	Acco Contractors	P	NE	33	40	13	a	L	L	G	Various	Alluvium	S	15'	f	r	yes	e-t	
487		P	NW	33	40	13	i	S	S	B		Dothan	S	30'	f-b	r		e,s	
488		P	SW	34	40	13	a	M	L	G	Various	Alluvium	S	10'	f	r		e-t	
489		P	SE	34	40	13	a	L	L	G	Various	Alluvium	S	10'	f	r		e-t	
490*		P	SE	34	40	13	a	L	L	G	Various	Alluvium	S	10'	f	r		e-t	
491*		P	SW	35	40	13	a	L	L	G	Various	Alluvium	S	15'	f	r		e-t	
492		P	NW	35	40	13	i	M	M	B	Sediment	Dothan	S	70'	f-b	e		e	
493	USFS	F	NW	9	40	12	i	S	M	B	Sandstone	Dothan	M	30'	f	r		e,s	Good road material.
494	USFS	F	SW	17	40	12						Dothan							No on-site survey (location from USFS data).
495	USFS	F	SE	15	40	12	i	S	S	B	Rhyolite and sandstone	Dothan	S		f-b	r		e-b	
496	USFS	F	SW	19	40	12	i	S	L	B	Sandstone	Dothan	M	30'	b	e		e,s	
497	USFS	F	SE	19	40	12	i	S	S	B	Metasediment	Dothan	S	75'	f	r		e-t	
498	USFS	F	NE	29	40	12	i	M	M	B	Sandstone	Dothan	M	30'	f-b	r		e-t	
499	USFS	F	NE	28	40	12	i	S	M	B	Sandstone	Dothan	S		f	r		e-b	
500	USFS	F	SW	27	40	12	i	S	L	B	Sandstone	Dothan	M	10'	f	r		e,s	
501	USFS	F	NW	32	40	12	i	S	M	B	Metasandstone	Dothan	S	60'	f	r		e-t	
502	USFS	F	NW	32	40	12	p	–	L	B	Metasandstone	Dothan	S		f	r		e-t	Top of ridge is 100 ft above road level; site could be mined from top down.
503	USFS	F	NE	32	40	12						Mount Emily							No on-site survey (location from USFS data).
504	USFS	F	SW	32	40	12	i	S	M	B	Rhyolite	Dothan	S	20'	f-b	r		e-t	
505		P	NE	3	41	13	i	M	L	B	Metasediment	Dothan	S	200'	b-m	e		e,r	Dangerous pit; not scaled down along a major public highway.
506		P	SW	10	41	13	a	M	M	B	Conglomerate	Dothan	S	30'	f-b	r		e,s	
507 *		P	SW	15	41	13	i	S	S	B	Greenstone	Dothan ?	S		b-m	e		e,r	
508		P	Center	14	41	13	i	S	S	B	Sediment	Dothan	S	20'	f-b	r		e,s	
509		P	Center	6	41	12	a	S	S	G	Various	Alluvium	S	3'	f	r		e,s	
510	USFS	F	NW	3	41	12	a	S	M	B	Sediment	Dothan	M	30*	f	r		e,s	
511	USFS	F	SW	3	41	12						Dothan							No on-site survey (location from USFS data).
512	USFS	F	SW	5	41	11	a	L	L	B	Sandstone	Dothan	M	15'	f-b	r		e-t	

* Additional test data in Table 4.

Table 4. State Highway Division laboratory data

Map number	Specific gravity	Los Angeles rattler test (% loss)	Sodium sulfate test (% loss)	Natural fines: Plasticity index (%)	Natural fines: Liquid limit (%)	Manufactured fines: Plasticity index (%)	Manufactured fines: Liquid limit (%)	Degraded material: Plasticity index (%)	Degraded material: Liquid limit (%)	Oregon degradation: Pass No. 20 (%)	Oregon degradation: Height (inches)
301	2.79	21.8	0.9	–	–	0	19	–	–	–	–
305	2.67-2.69	26.0-30.0	12.0-24.6	0	19	–	–	–	–	–	–
308	2.56-2.73	23.6-26.3	10.1	0-3	20-21	–	–	0-6	20-29	–	–
309	2.83-2.93	12.7-17.4	0.2-6.3	0-2	17-22	–	–	0	23	19.2-27.4	2.0-2.6
310	2.69-3.16	9.1-31.8	0.3	0	21	–	–	0-2	23-25	–	–
311	2.58-2.64	13.5-30.0	–	0	24	–	–	–	–	–	–
322	2.39	24.28	–	NP*	28	–	–	–	–	18.0-19.5	4.3-4.6
323	2.48	22.76	3.78-8.7	–	–	–	–	–	–	–	–
324	2.68-2.71	24.2-30.9	6.4-16.1	0	17-22	–	–	–	–	25.63	6.5
329	2.61-2.67	16.0-20.6	0.6-29.5	–	–	–	–	0	21	14.3-18.7	2.1-7.7
330	2.74-2.75	20.7-24.3	15.3-24.5	0	18-19	–	–	–	–	21.6-28.2	2.9-5.2
331	2.71	26.9	32.6-33.7	0	19	–	–	–	–	26.1-28.0	5.0-7.1
333	2.67-2.68	14.5	0.8	7	27	–	–	0	19	–	–
334	2.45-2.55	20.9-30.2	4.6-20.0	–	–	–	–	–	–	16.0-19.3	0.8-5.4
335	2.74-2.76	22.3-23.2	2.5-11.6	0	18-23	–	–	–	–	19.8-25.6	2.0-3.2
336	2.89	11.8	1.3-25.5	–	–	–	–	0	23	14.5-18.7	2.1-7.7
362	2.63-2.66	20.9-26.4	18.5-33.2	–	–	–	–	–	–	26.9-27.9	7.6-8.5
363	2.80	17.2	–	–	–	–	–	–	–	–	–
379	2.61	29.0	–	–	–	–	–	–	–	–	–
392	2.75-2.78	18.8-20.0	0.1-5.7	0-2	19	–	–	–	–	17.0-17.5	1.4-2.0
393	2.69	23.6	4.5	0	19	–	–	–	–	–	–
418	2.60-2.71	24.5-29.1	10.2-12.9	0-2	19-22	–	–	–	–	–	–
419	2.54-2.63	18.1-25.4	16.7	–	–	–	–	–

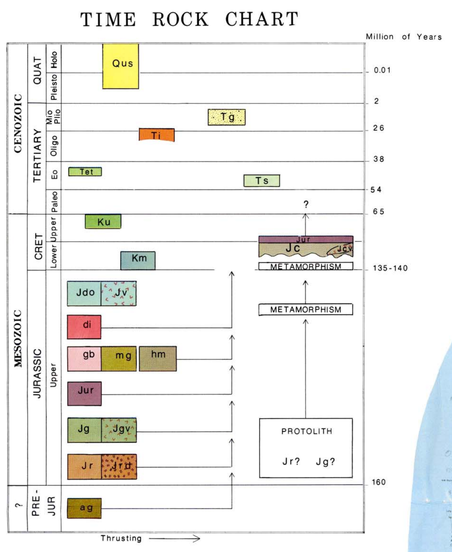
PLATE 1
GEOLOGIC MAP OF CURRY COUNTY, OREGON

Compiled by Len Ramp, 1977.

New mapping includes field work and photogeology by Ramp (1975-76) in the Agness, Marial, Collier Butte, Gold Beach, and Chetco Park quadrangles and by Ramp and N. V. Peterson (1976) in the Mt. Emily area.

STATE OF OREGON
DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES
RALPH S. MASON, STATE GEOLOGIST

TIME ROCK CHART



EXPLANATION

See **TIME ROCK CHART** above for ages of units.
(Boundaries are approximate; statements are general; site evaluations require on-site investigation.)

- **Qus** — **Quaternary unconsolidated sediments.** *Alluvium, marine and fluvial terrace deposits, beach sand, dune sand, stream bench gravels, and glacial moraine.*
- **Tg** — **Tertiary gravels of Gold Basin.** *Partly decomposed cemented stream gravel and sand.*
- **Ti** — **Fine-grained intrusive igneous rocks.** *Mount Emily rhyolite, dacite, and nepheline syenite. Includes a few small dark-colored intermediate to basic dikes and dikes of uncertain age.*
- **Tet** — **Tyee Formation.** *Marine and continental sedimentary rocks; cliff-forming, massive; micaceous sandstone (pebbly, in part), siltstone, and conglomerate.*
- **Ts** — **Tertiary marine and nonmarine sedimentary rocks and marine volcanic rocks.** *Umpqua "Group" sandstone, conglomerate, pillow basalt, siltstone, mudstone, and some coal. Includes the Roseburg, Flournoy, and Lookingglass Formations.*
- **Ku, Km** — **Cretaceous marine sedimentary rocks.** *Late Cretaceous Cape Sebastian sandstone and Hunter Cove Formation sandstone, shale, and conglomerate* (Ku). *Early Cretaceous Myrtle Group including Humbug Mountain conglomerate and Rocky Point Formation of graded sandstone, mudstone, and conglomerate* (Km). *Part of the Myrtle Group may include Late Jurassic rocks.*
- **Jdo, Jv** — **Latest Jurassic sedimentary and volcanic rock.** *Graywacke, sandstone, mudstone, minor conglomerate, and chert of the Dothan and Otter Point Formation* (Jdo); *pillow basalt and breccia of the Otter Point and Dothan Formations* (Jv). *Mapped as Dothan in eastern and southern parts of the County and as Otter Point in the northern and western parts of the County. Some areas of the Otter Point Formation are highly sheared to a melange and have some intermixed serpentinite and blueschist.*
- **di** — **Diorite and related rocks.** *Quartz diorite of Pearse Peak, upper Baldface Creek, and various smaller bodies* (di); *hornblende diorite of Diamond Creek and other areas includes undifferentiated small dikes locally.*
- **hm** — **Very coarse-grained hornblende-plagioclase rock (pegmatitic hornblende gabbro).** *Formed in part from alteration of ultramafics. Mapped in the Upper Chetco drainage area.*
- **gb, mg** — **Gabbro and metagabbro.** *Two-pyroxene gabbro, hornblende gabbro, and gabbro-diorite* (gb). *Gneissic metagabbro of Big Craggies and Bailey Mountain* (mg).
- **Jur** — **Ultramafic rocks.** *Serpentinite; peridotite and serpentinite mixed. Peridotite (mainly harzburgite) and pyroxenite widespread in thrust plates and in high-angle fault zones.*
- **Jc, Jcv** — **Colebrooke Schist.** *Quartz-mica phyllite, metachert, stretch-pebble conglomerate* (Jc); *metavolcanic rocks, largely pillow basalts* (Jcv), *derived mainly from the Galice Formation.*
- **Jg, Jgv** — **Galice Formation.** *Slaty mudstone and siltstone, graywacke, argillite, minor chert, and conglomerate* (Jg). *Metavolcanics (greenstone), including pillow lavas* (Jgv).
- **Jr** — **Rogue Formation.** *Regionally altered andesitic to siliceous tuffs and flows, including pillow lavas, tuffaceous sediments, and chert* (Jr). *Areas intruded by abundant diabasic and gabbroic dikes* (Jrd).
- **ag** — **Gneissic amphibolite.** (age uncertain) *Includes hornblende-quartz-plagioclase gneiss, amphibole schist, minor quartzite, and gneissic metagabbro.*

GEOLOGIC SYMBOLS

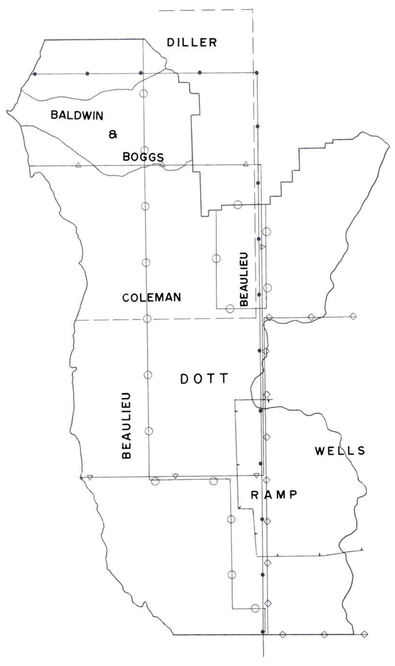
Contacts
- Definite contact
- Approximate contact

Faults
- Definite fault
- Approximate fault
- Inferred fault
- Concealed fault
- Normal fault *(ball and bar on downthrown side)*
- Thrust fault *(teeth on upper plate)*

Folds
- Definite anticline
- Definite syncline
- Approximate anticline
- Approximate syncline
- Inferred anticline
- Inferred syncline
- Concealed anticline
- Concealed syncline

Bedding
- Strike and dip of bed
- Strike of vertical bed
- Strike and dip of overturned bed

INDEX TO GEOLOGIC MAPPING



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Diller — 962
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Dott — 1971
Beaulieu — 1976

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Dick — 1976
Howard — 1961
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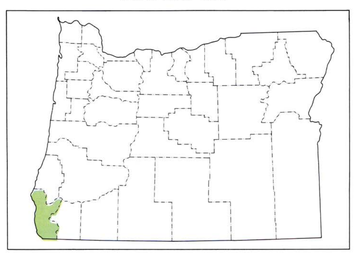
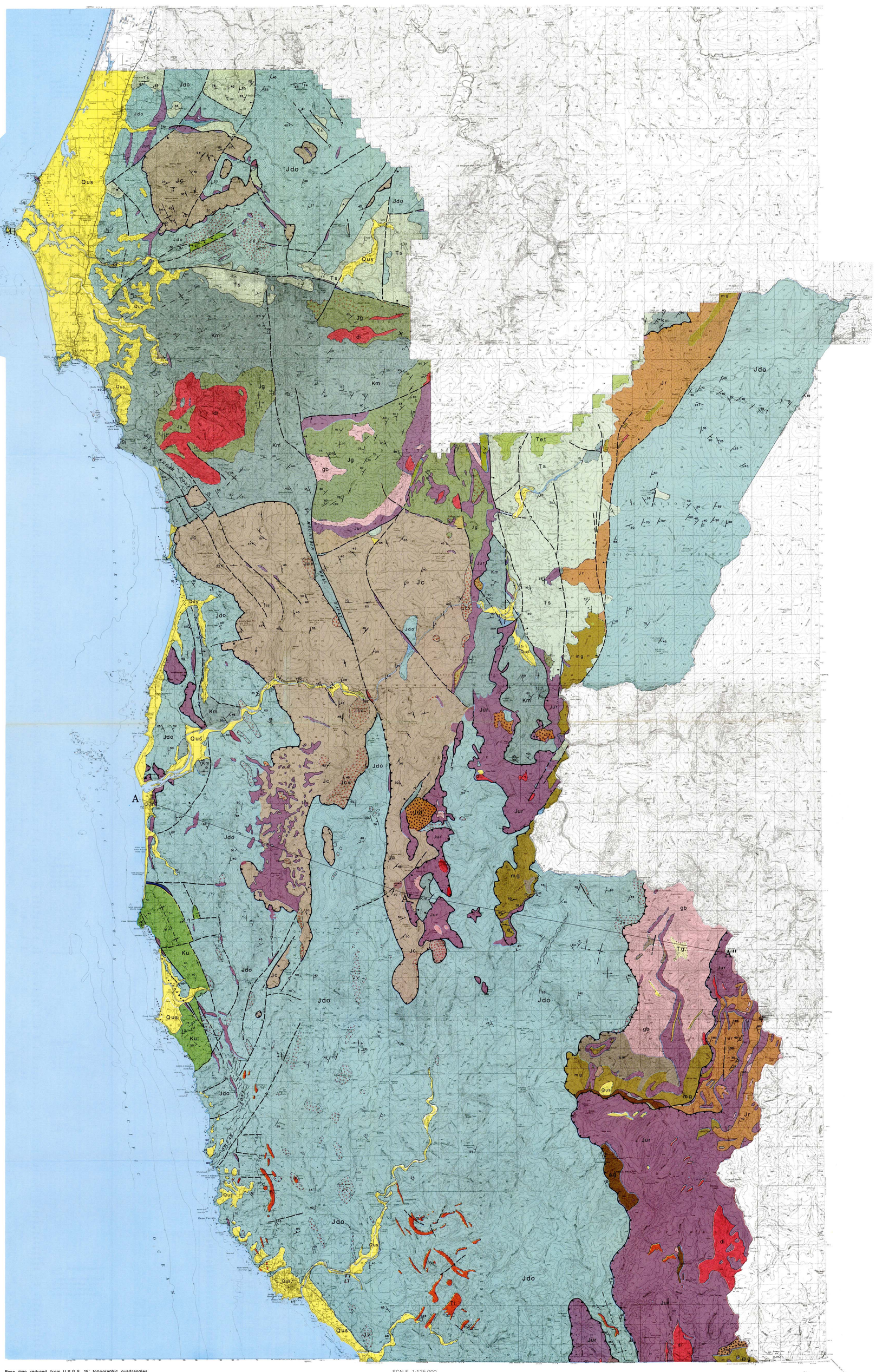
Howard & Dott — 1961
Koch, Kaiser, & Dott — 1961
Dott — 1966
Baldwin — 966
Baldwin & Rud — 1972

Additional source material includes preliminary unpublished field maps of Agness and Marial quadrangles by Baldwin and a partial unpublished field map of Collier Butte quadrangle by M. C. Blake, Jr., U.S.G.S. (1975-76).

LOCATION MAP



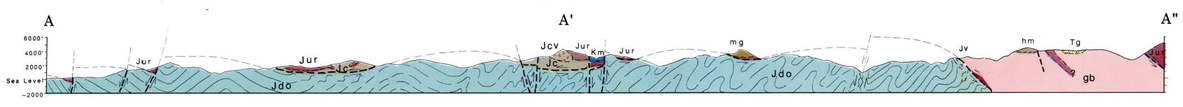


Base map reduced from U.S.G.S. 15' topographic quadrangles.
Control by USGS and USC&GS
Topography from aerial photographs by multiplex methods
Aerial photographs taken 1952. Field check 1954
Hydrography compiled from USC&GS Chart 5896 (1951)
Polyconic projection. 1927 North American datum
10,000-foot grid based on Oregon coordinate system, south zone

SCALE 1:125 000

TRUE NORTH
MAGNETIC NORTH
APPROXIMATE MEAN DECLINATION, 1954

Geologic Cross Section



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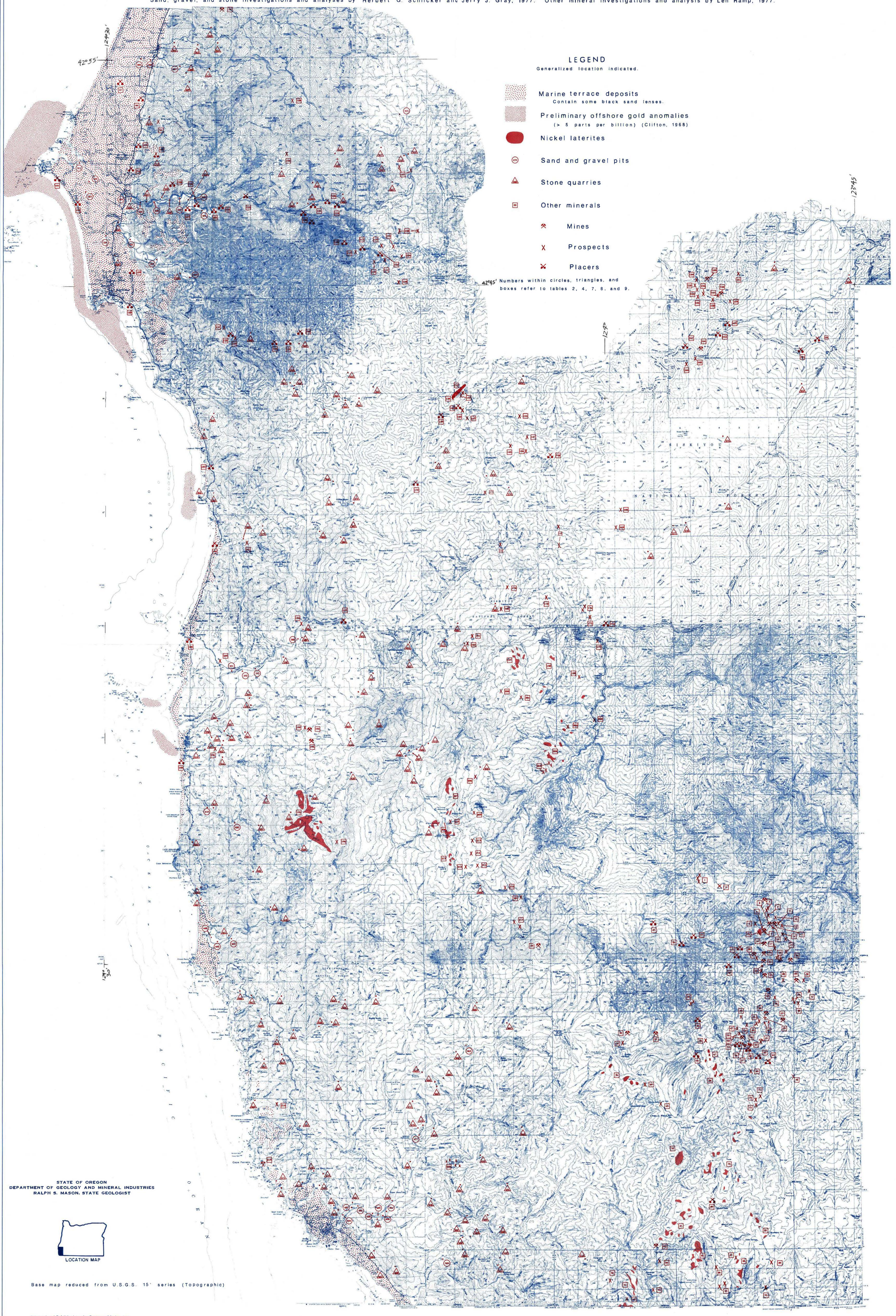
Ralph S. Mason, State Geologist; C. A. Schumacher, Chief Cartographer

Cartography and Editing by C. A. Schumacher and Paul E. Staub.

PLATE 2

MINERAL AND ROCK-MATERIAL LOCALITIES OF CURRY COUNTY, OREGON

Sand, gravel, and stone investigations and analyses by Herbert G. Schlicker and Jerry J. Gray, 1977. Other mineral investigations and analysis by Len Ramp, 1977.



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LOCATION MAP

Base map reduced from U.S.G.S. 15' series (Topographic)

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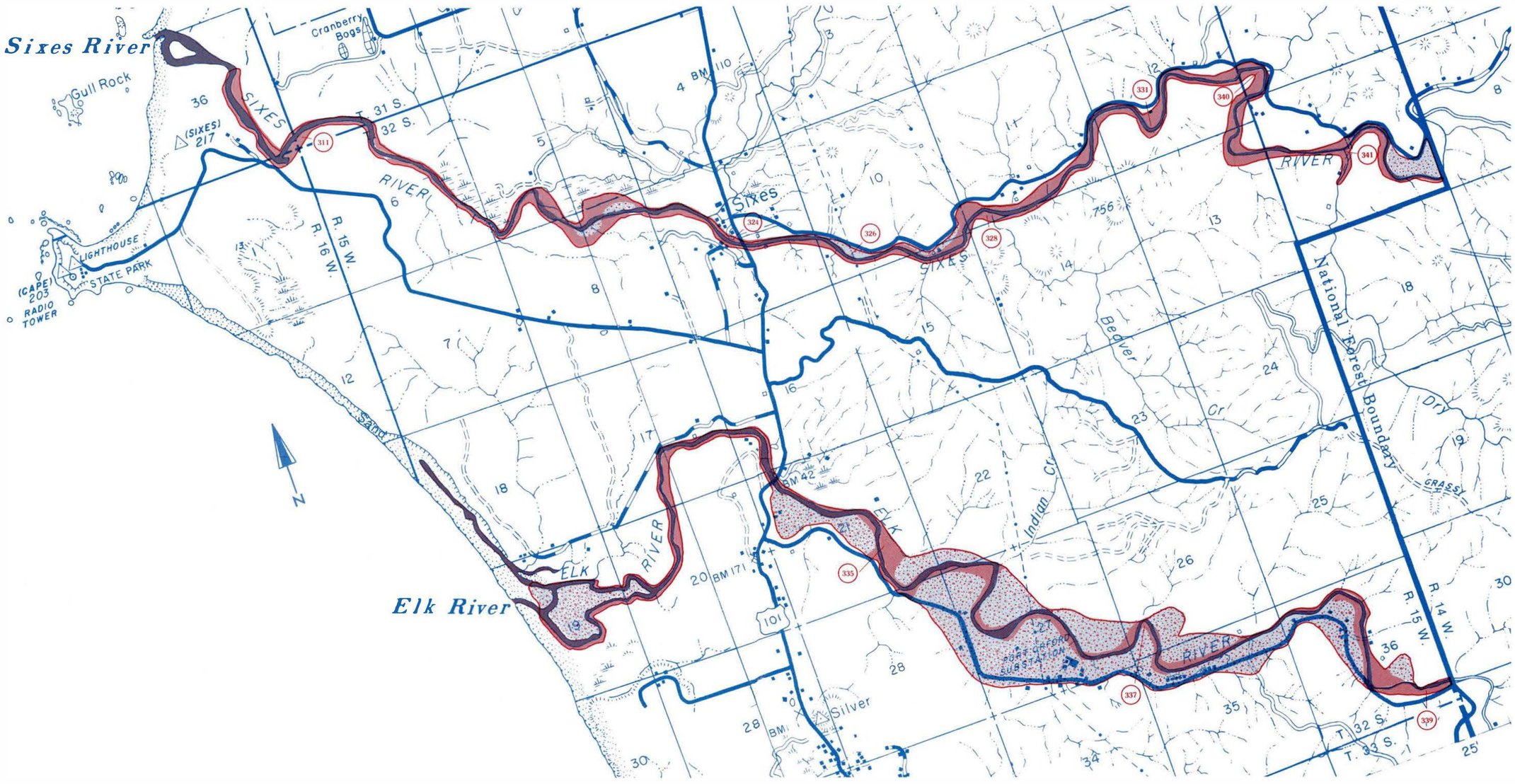
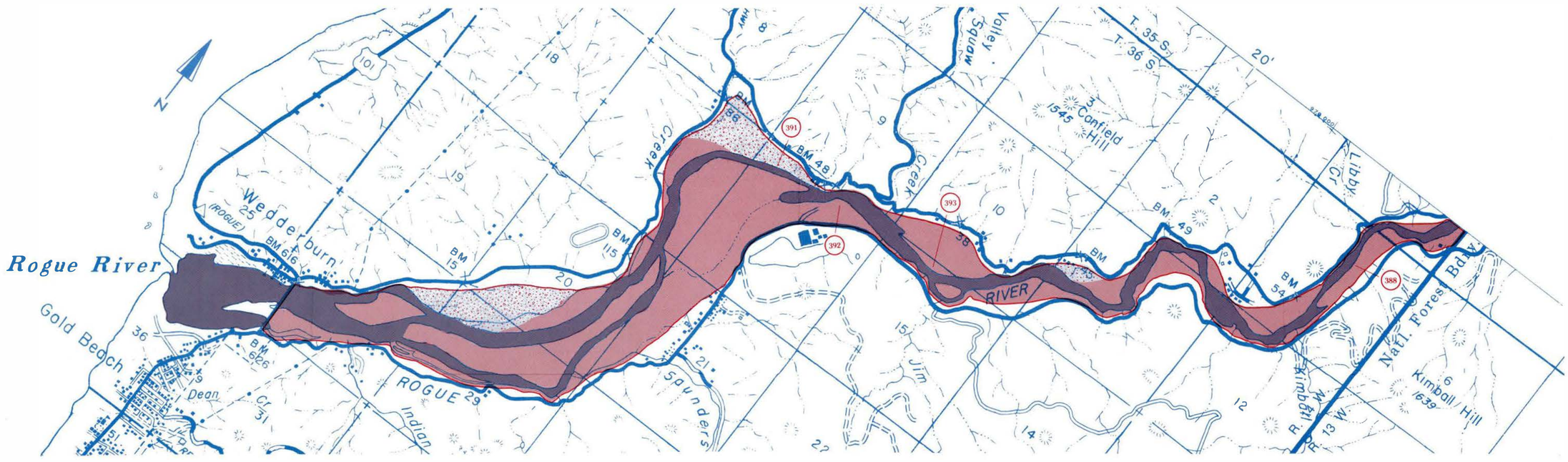
Cartography by Paul E. Staub and Richard K. Askew.

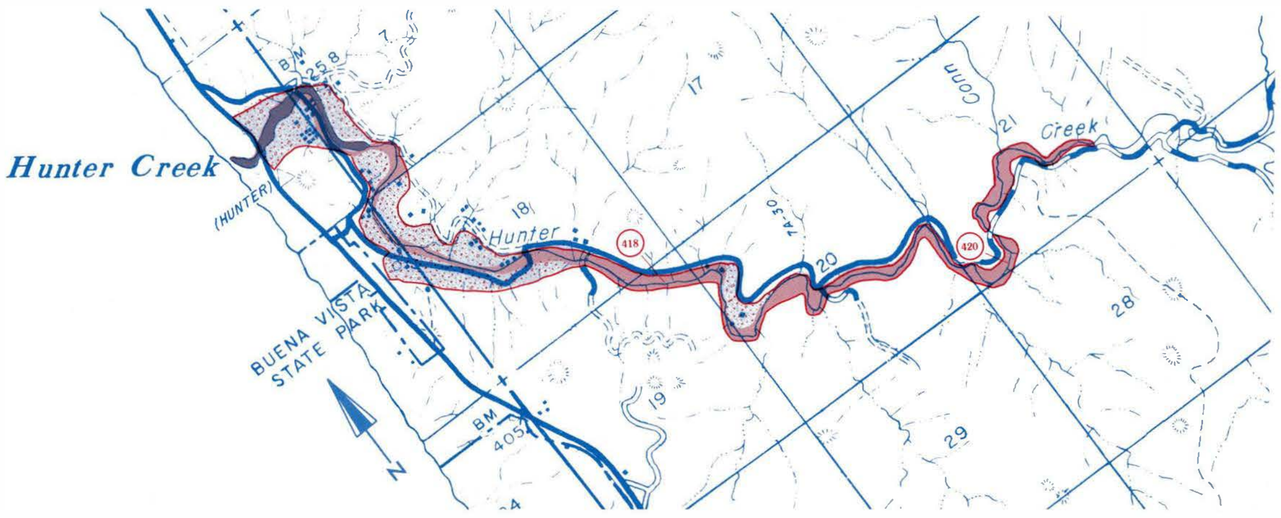
PLATE 3

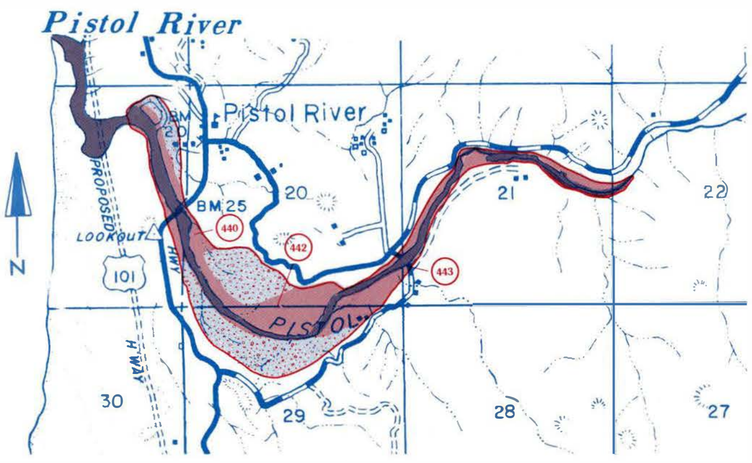
RIVER CORRIDORS OF CURRY COUNTY, OREGON

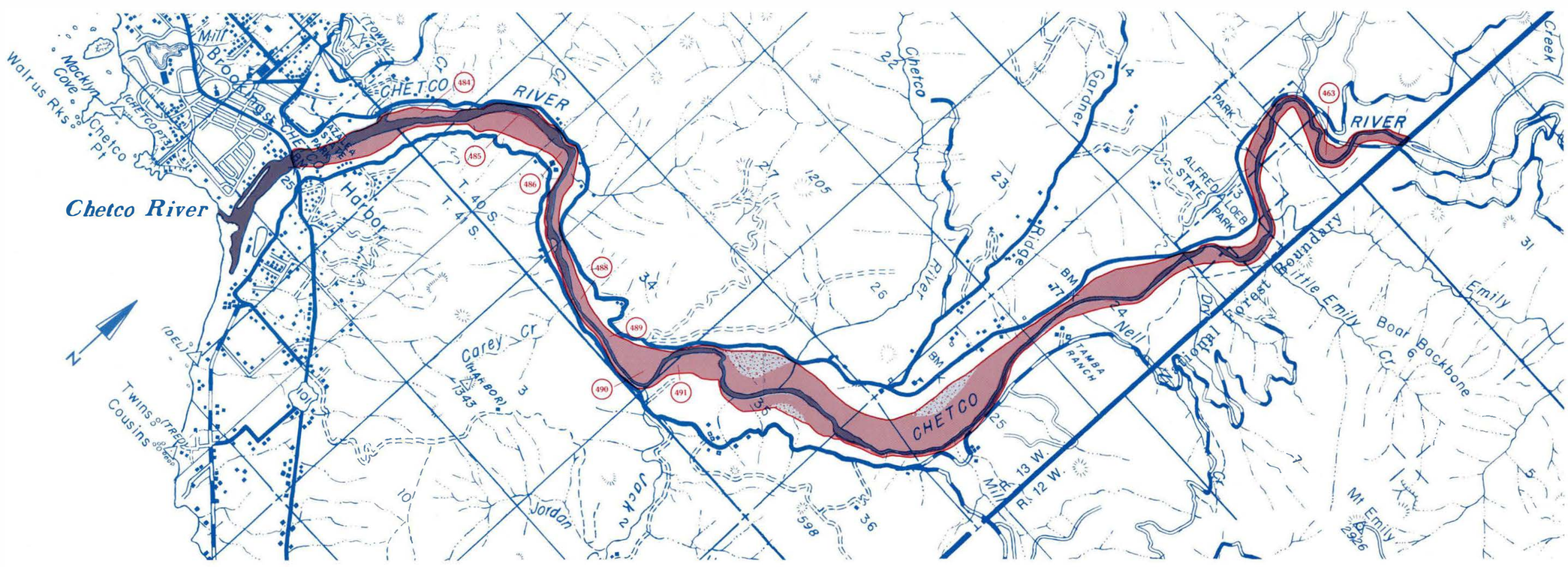
Interpretations and field investigation by Jerry Gray, 1977











SCALE 1 :31,680

MILES

Base map from U.S. Forest Service, 1972 (Planimetric)

Cartography by C. A. Schumacher and Paul E. Staub

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LEGEND

RIVER CORRIDOR BOUNDARY — RIVER WASH — CHANNEL GRAVEL — TERRACE GRAVEL — (485) GRAVEL SITES (refer to Table 2, Rock-materials survey data)