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GEOLOGY OF THE POWERS QUADRANGLE, OREGON

by

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Introduction

The Powers quadrangle is situated along the northern edge of the Klamath Mountains in Coos and Curry Counties, Oregon. The quadrangle is bisected by the drainage divide separating the west-flowing Sixes River and the east- and north-flowing South Fork of the Coquille River. The region is one of moderate relief, approximately 3,500 feet, in which steep, brushy, almost impenetrable areas are common. The eastern side of the quadrangle is accessible by the Myrtle Point to Agness road that passes through Powers, the largest community in the area. An access to the west side is provided by a road along the Sixes River; however, lumber companies maintain and control the present network of roads throughout most of the western half of the quadrangle.

The first geologist in the area was John Evans, who in 1856 journeyed along the north side of the Sixes Valley and turned southward near the Powers ranch, crossing between Salmon and Johnson Mountains into the gold camps along Johnson Creek. It was on this trip that the Port Orford meteorite was reportedly found. J. S. Diller (1903) mapped the Port Orford 30-minute quadrangle, which included the Powers 15-minute quadrangle as its northeastern quarter. Access at that time was more by trail than road but despite the handicaps Diller was able to describe the general geology of the area.

Diller (1907 and 1914) mentions the placers along Johnson Creek and the Sixes River and the Eckley coal prospects. Butler and Mitchell (1916) were largely concerned with the mining and refer to the South Fork of the Sixes mining area. Allen and Baldwin (1944) mapped the 30-minute Coos Bay quadrangle to the north. Wells (1955) included the Powers area in his generalized geologic map of southwest Oregon. Dott (1966) and Koch (1966) studied the Mesozoic stratigraphy in nearby areas. Koch named and described Late Jurassic and Early Cretaceous formations referred to in this report. Coleman (1969) mapped the Colebrooke Schist in the area along the Rogue River and Lent (1969) mapped the southern half of the Langlois quadrangle immediately to the west of the Powers quadrangle. Phillips (1968) mapped the northern third of the Langlois quadrangle which joins on the northwest. Baldwin (1969) mapped the Myrtle Point area to the north. Krans (1970) mapped the northwest quarter of the Bone Mountain quadrangle which abuts the Powers quadrangle to the east.

Born (1963) mapped the southeast quarter of the Powers quadrangle and Hess (1967) mapped the northeast quarter. The writers have worked jointly in the broader study of the entire quadrangle and have collaborated with R. L. Lent in an effort to solve the regional problems of the Powers and Langlois quadrangles. For a more complete petrographic description of stratigraphic units of the two areas see Hess (1967) and Lent (1969).

That part of the Powers quadrangle lying in the Sixes River drainage was included by Baldwin and Boggs (1969) in the U.S. Geological Survey Technical Report No. 2. The writers are indebted to H. E. Clifton of the U.S. Geological Survey, under whose supervision much of the work was undertaken, and E. H. Lund of the University of Oregon for critically examining the manuscript, and to staff members of the State of Oregon Department of Geology and Mineral Industries for editing the manuscript and preparing the map and text for publication. Appreciation is extended to Leroy Maynard, Richard Robertson, and Michael Brownfield, graduate students at the University of Oregon, who assisted in the field.

Stratigraphy

Colebrooke Schist

The Colebrooke Schist, named after Colebrooke Butte situated on the coast about 6 miles south of Humbug Mountain, was first described by Diller (1903). The age of the Colebrooke Schist is as yet undetermined, but it may be either older than the Galice Formation or a metamorphic equivalent.

The main outcrop areas of Colebrooke Schist in southwestern Oregon occur in two separated parts of a thrust sheet. The southern part spans the lower Rogue River and was studied by Coleman (1969). The northern remnant occurs in the Langlois quadrangle, and was studied by Lent (1969). Within the Powers quadrangle, a small outcrop area occurs next to a fault about 2 miles north of the Dement ranch. There the schist is situated beneath the Otter Point sandstone along the upthrown side of a fault, and its position may be the result of thrusting. Another remnant of a thrust plate of Colebrooke Schist lies immediately to the west of the Powers quadrangle on Calf Ranch Mountain in secs. 8 and 9, T. 31 S., R. 13 W.

The Colebrooke is composed primarily of dark gray micaceous schist and phyllite, small fragments of which weather to thin silvery chips. Some pods of greenstone, perhaps of both extrusive and hypabyssal origin, are present. The age of the initial deposition of Colebrooke Schist is uncertain, but Coleman (1969) gives a metamorphic age of approximately 130 million years.

Galice Formation

The Galice Formation was named and described by Diller (1907) in the type area along the Rogue River near the village of Galice. In the Powers quadrangle, the formation crops out south of the Sixes River fault, mainly in the South and Middle Forks of the Sixes River. It is composed of dark gray to black, partly fissile mudstone and siltstone interbedded with fine-grained, dark-gray sandstone. Fragments of volcanic breccia, pillow lavas, and tuffs with perhaps some intrusive basalts are present in the upper part of the formation, both within the area mapped and in contiguous areas to the south and east. The formation is intruded by numerous small diorite stocks and dikes.

The thickness of the Galice Formation is difficult to determine because of complex deformation and incomplete exposure within the Powers quadrangle. Wells and Walker (1953) estimate a thickness of approximately 15,000 feet in the type area.

In most places, the sedimentary beds are composed of steeply folded, dark gray argillites which dip toward an east-trending synclinal axis, the center of which is occupied by the volcanic rocks of Rusty Butte. Much of the volcanic rock is fragmental, such as that seen in the bed of the South Fork of the Sixes where it crosses the border between the Powers and Langlois quadrangles. Despite erosion, nearly 2,000 feet of volcanic rock is still present in the center of the syncline. The volcanic rock is presumably the youngest part of the local section.

The Galice beds are extensively fractured and in places are offset by small faults. The fractures are filled with quartz and calcite. Many small dikes and sills only a few feet in thickness border the larger mapped dioritic intrusions, and mineralization of the wallrock evidently accompanied intrusion.

The age of the Galice Formation has been determined as late Oxfordian to middle Kimmeridgian (Late Jurassic) on the basis of meager fossil evidence (Wells and Walker, 1953; Koch, 1966; and Dott, 1966).

Intrusive rocks

During the Nevadan orogeny, which followed deposition of the Galice Formation, large masses of ultramafic rocks now altered almost entirely to serpentinite were intruded in the northern Klamath Mountains. This episode was followed by intrusion of smaller stocks and sills of dioritic or quartz dioritic composition.

Serpentinites in the Powers quadrangle occur in relatively small bodies, many of which are linear along the steeper faults. Coleman (1969) suggests that the serpentinite was a "tectonic carpet" on which the Colebrooke Schist was emplaced. The size of the various outcrops varies considerably, but commonly they are less than 200 feet across; some of the narrowest bodies are too small to be mapped. In nearly all exposures the serpentinite has been sheared so that it is difficult to determine the parent rock type. Hess ((1967) and Lent (1969) give petrographic descriptions of the serpentinite in and immediately to the west of the Powers quarangle.

Intermediate intrusive rocks, mainly diorite and quartz diorite, intrude the Galice Formation south of the Sixes River fault. One stock, covering nearly 2 square miles, is bisected by Benson Creek, and numerous small dikes are present nearby. One of the largest dikes extends from Rusty Creek eastward through the Middle Fork of the Sixes River into Salmon Mountain. These intrusive rocks are described by Lund and Baldwin (1969) and are correlated with the Pearse Peak diorite of Koch (1966). The Pearse Peak body, which intrudes the Galice Formation along Elk River to the south, is described by Koch (1966, p. 51-52).

Lode gold deposits reported by Brooks and Ramp (1968) in the South Fork of the Sixes drainage and on Rusty Butte are apparently associated with the dioritic intrusive bodies. Boggs and Baldwin (1970) concluded that most of the placer gold of Sixes River drainage came from gold introduced into the sedimentary rocks of the Galice Formation during intrusion.

The diorite intrusions cut pre-Nevadan formations but have not been found in Late Jurassic (Portlandian) or younger units. They evidently were emplaced during the Nevadan orogeny. Koch (1966) reports K-Ar dates ranging between 140 and 150 million years within the time span of the Nevadan orogeny.

Otter Point Formation

The Otter Point Formation occurs north of the Sixes River fault. It is widely distributed in the Powers quadrangle and is continuous into the Langlois quadrangle to the west. The formation is composed of a thick section of sandstone, siltstone, conglomerate, chert, volcanic rocks, and scattered blocks of blueschist. It was named and described by Koch (1966), and the type area is at Otter Point on the coast 3 miles north of Gold Beach. Rock now considered part of the Otter Point Formation was originally included in the Myrtle Formation by Diller (1903), later redefined as Myrtle Group by Imlay and others (1959).

Two general divisions of the Otter Point Formation have been recognized in the Sixes River area by the writers and Lent (1969). The lower part consists of a heterogeneous assemblage of rock types that have been tectonically mixed. The structure is interpreted by the writers to be a melange, as defined by Hsu (1968). The upper part of the Otter Point Formation is composed largely of massive, light-gray sandstone which weathers to a buff color. It may rest unconformably upon the melange of the lower Otter Point, or it may be a part of the overriding plate that helped to produce the melange.

The thickness of the Otter Point Formation is unknown, but Koch estimates it to be in the order of 10,000 feet or more. Koch's section may have been less complete than that of the Sixes River, and thus his estimate would appear to be a minimum. Where the Otter Point is a melange, the structural thickness would be of little stratigraphic value.

The sandstone of the lower Otter Point Formation is characteristically lithic in composition, light gray to black, highly fractured, and generally well-bedded (Lent, 1969). Mudstone interbeds are abundant. Coarser grained sandstones within the lower Otter Point consist primarily of clasts of chert and volcanic rock.

According to Lent (1969), the sandstone of the upper Otter Point Formation is feldspathic in composition and commonly forms massive cliffs, as in Sugarloaf Mountain, or monoliths in the sheared areas. The rock exhibits irregular fracture, commonly along pyrolusite-stained microfractures. Dark gray mudstone clasts are usually present and impart to the rock a "salt-and-pepper" appearance.

Conglomerates are not common, but they apparently occur in both the upper and lower Otter Point Formation. Conglomerate lies just above the thin outcrop of Colebrooke Schist in sec. 24, T. 31 S., R. 13 W. A bed on the northwest side of the fault contains pebbles of blueschist as does conglomerate high on the south side of Sugarloaf Mountain in the SW$\frac{1}{4}$ sec. 34, T. 31 S., R. 13 W. In both layers the pebbles are rounded. Whether these were brought in from an unknown schist terrain or represent erosion of the numerous angular blocks of blueschist that occur in the lower melange, is not known.

Bedded chert occurs in scattered outcrops throughout the lower, more heterogeneous part of the Otter Point Formation. The chert is red, pink, green, or white, and is usually associated with volcanic rocks. The chert stands out in relief above the sheared terrain and has been utilized locally for roadrock. Layers of chert are interbedded with thinner mudstone layers. These, as well as the chert, are commonly stained by manganese dioxide. The chert is commonly veined and in many places is intricately folded. Lent (1969) found that the cherts contain numerous radiolaria set in a matrix of cryptocrystalline or microcrystalline quartz. Silica-filled radiolarian tests constitute from less than 15 to more than 70 percent of the fresh or slightly recrystallized bedded cherts. Lent observed that the red cherts are rich in disseminated hematite and are the least recrystallized of the cherts. Radiolaria in the red cherts are therefore generally well preserved.

Volcanic rocks make up approximately 10 to 15 percent of the Otter Point Formation in the Sixes River area. Pillow lavas are exposed along the Sixes River road at the west edge of the Powers quadrangle. Flows, breccias, and tuffs are scattered as irregularly shaped masses throughout the Otter Point terrain. Locally, the volcanic rocks may represent dikes or sills.

Abundant rootless blocks of blueschist are scattered throughout the lower or melange part of the Otter Point Formation. The larger blocks are jagged and, in places, clusters of several similar blocks suggest fragmentation of a once larger block. Although possibly introduced later than Otter Point deposition, they are herein mapped with the Otter Point. Both Hess (1967) and Lent (1969) describe rock of this type found in and near the Powers quadrangle.

The Otter Point Formation is correlative with part of the Franciscan assemblage of California. No fossils were found in the Otter Point in the Powers quadrangle, but Buchia assigned by Imlay to a very Late Jurassic age were found to the west by Koch (1966). Whether the Otter Point is the eugeosynclinal facies equivalent to thinner and better sorted shelf sediments, later telescoped by thrusting, or whether the eugeosynclinal beds were folded, eroded, and then transgressed by the slightly younger Humbug Mountain Conglomerate is not known. The apparent greater thickness and heterogeneous nature of the Otter Point suggest that it was deposited under different conditions than the nearby Humbug and Rocky Point Formations. Whether the upper feldspathic sandstone of the Otter Point deserves separation as a formal unit is not yet apparent. It does occur high in the section, is less deformed than the lower part, and appears to have been deposited under a different sedimentary environment.

The well-rounded pebbles and boulders of blueschist in sandstone of the upper Otter Point on Sugarloaf Mountain suggest possible derivation from the melange facies. If such an interpretation is correct, an unconformity must separate much of the lower Otter Point from the upper Otter Point.

Humbug Mountain Conglomerate

The Humbug Mountain Conglomerate, named by Koch (1966), includes the conglomerate in Humbug Mountain 5$\frac{1}{2}$ miles south of Port Orford and some sandstone and siltstone beds near the top of the formation. It apparently grades upward into the Rocky Point Formation, although a continuous section is seldom found. Because the Rocky Point Formation contains conglomerate beds where it laps against older formations, it is difficult to distinguish from the Humbug Mountain Conglomerate. The Rocky Point Formation has not been recognized in the Powers quadrangle.

The Humbug Mountain Conglomerate occurs south of the Sixes River fault along the southern margin of the drainage basin. It is particularly well exposed in Mount Butler just west of the quadrangle, in Mount Avery, and around the south rim of the basin to Barklow Mountain. In this region the Humbug Mountain Conglomerate rests unconformably on the Galice Formation. Dott (1966) was the first to call attention to the unconformity between the conglomerate and the Galice beds at Barklow Mountain. Rocks mapped as Humbug Mountain Conglomerate occur also in the Salmon Creek drainage and at the north end of Johnson Mountain. Along Salmon Creek the conglomerate appears to rest unconformably upon the Otter Point Formation. On Johnson Mountain, it is in fault contact with Otter Point. One small outcrop interpreted to be Humbug Mountain Conglomerate lies on the north side of the Sixes River fault about 1 mile north of Rusty Butte.

The basal part of the section on the north side of Mount Avery, near the contact with the Galice volcanic rocks, is a massive, coarse conglomerate composed almost entirely of greenstone pebbles, commonly 6 inches in diameter, set in a tuffaceous matrix. The mass is sheared in places, and calcite and zeolites have been deposited in the joints. The pebbles were clearly derived from a nearby mass of greenstone, probably that of the Galice Formation, in Rusty Butte.

Above the basal part, the Humbug Mountain Conglomerate is composed of pebbles of widely varying composition commonly 2 to 3 inches in diameter, showing they were derived from other parts of the ancestral Klamath Mountains. Pebble counts made by Lent (1969) at five localities in the Sixes River drainage area show that chert ranges from 25 to 34 percent, quartz 4 to 8 percent, sandstone 4 to 13 percent, schist and phyllite 13 to 26 percent, diorite 10 to 24 percent, and extrusive volcanic fragments 9 to 21 percent. The presence of diorite pebbles indicates uncovering of the Nevadan diorite intrusive bodies. A greater variation might be obtained if other localities were to be examined in detail.

Sandstone and siltstone beds are rare in the Mount Avery section. To the west in the Langlois quadrangle, at the head of Dry Creek drainage, Lent (1969) observed that massive basal conglomerate appears to progress upward into rapidly thinning beds of graded conglomerate, sandstone, and siltstone. This section contains a much greater proportion of arenaceous and argillaceous beds.

The thickness of the Humbug Mountain Conglomerate is difficult to determine. Excluding the local greenstone conglomerate, the formation is about 2,000 feet thick at Mount Butler and Mount Avery.

The relationship of the Humbug Mountain Conglomerate to the Otter Point Formation is open to question. At no place in southwestern Oregon are conglomerate beds known to rest on the Otter Point, except in the Salmon Creek area of the Powers quadrangle where an apparent unconformity exists. This gives rise to two concepts concerning the relationship: either the Humbug was deposited as a basal conglomerate by an encroaching sea on the Otter Point and older formations, or it represents shelf deposits brought into juxtaposition with the Otter Point by thrust faulting. Several factors favor the interpretation of an encroaching sea. The Humbug Mountain Conglomerate at Barklow Mountain appears to be in depositional contact with the Galice Formation, and the coarse greenstone conglomerate at the base of the section on Mount Avery is clearly derived from a local source.

Poorly preserved Buchia were found in beds mapped as Humbug Mountain Conglomerate on Salmon Creek about 100 yards above the bridge near the east edge of sec. 4, T. 32 S., R. 12 W. According to Imlay (written communication, March 28, 1968), the Buchia are the robust, moderately to coarsely ribbed forms similar to what has been called B. crassicollis. On the basis of their association with ammonites elsewhere they are dated as middle and probably also lower Valanginian (Early Cretaceous).

Beds mapped as Humbug Mountain Conglomerate in sec. 36, T. 31 S., R. 12 W. at the north end of Johnson Mountain contain abundant Buchia resembling the Early Cretaceous B. crassicollis.

Koch (1966) collected Buchia crassicollis at Humbug Mountain, indicating an Early Cretaceous age for the formation at its type locality. Dott (1966) reported Late Jurassic Buchia piochii from Barklow Mountain, but recent work by Jones, Bailey, and Imlay (1969) reveals that many of the Buchia species identified as piochii are, instead, Buchia uncitoides, an Early Cretaceous species. Thus the entire Humbug Mountain Conglomerate is probably Early Cretaceous.

Lower Umpqua Member

The Umpqua Formation of Diller (1898) has been divided by Baldwin (1965) into mappable units which will be named as formations in a later publication. The lower Umpqua member contains thick masses of submarine basalt near the base in the Roseburg area and along the Middle Fork of the Coquille River near the base in the Roseburg area and along the Middle Fork of the Coquille River near the northeast corner of the quadrangle. The basalts are overlain by thick sections of graywacke and siltstone, and minor amounts of conglomerate.

The lower Umpqua beds described by Baldwin (1969) in the Myrtle Point area continue southward into the northwestern part of the Powers quadrangle. The main mass of lower Umpqua is down-faulted into the Mesozoic terrain, and several narrow faulted blocks are present to the south. No volcanic flows were found in the northwestern part of the quadrangle.

Another down-faulted block of lower Umpqua containing volcanic rock extends southward from the Middle Fork of the Coquille River to Gaylord, where it is overlain unconformably by middle Umpqua strata.

Strata assigned to the lower Umpqua are steeply folded and in places thrust so that it is difficult to assign age or stratigraphic position. Baldwin (1965) suggests that the lower part of the lower Umpqua was deposited during Late Cretaceous, Paleocene, and early Eocene time.

Middle Umpqua Member

The middle Umpqua member, as designated by Baldwin (1965), is unconformable upon both pre-Tertiary and lower Umpqua strata. Characteristically, the base is made up of massive conglomerate of varying thickness which grades upward into sandstone and mudstone. The middle Umpqua strata are well represented in the upper part of the Sixes River area from the Sixes River fault northward to the vicinity of the Dement ranch. Small detached blocks are present on Sugarloaf Mountain and near the junction of Crafton Creek with the North Fork of the Sixes River. An eliptical basin filled with middle Umpqua is well exposed along the South Fork of the Coquille around Gaylord.

The basal beds around the northern periphery of the outcrop in the upper Sixes contain relatively thin beds of coarse conglomerate, in many places 10 to 25 feet thick, grading into massive sandstone. Most of the unit is thin, rhythmically bedded sandstone and mudstone. Beds are not steeply folded except along the Sixes River at its westward extension. Sections are difficult to measure, but the writers estimate a thickness of about 1,500 feet. The southern outcrop terminates against the Sixes River fault, indicating that the last movement involved down-faulting along the north side.

Megafossils are present in some of the bedded basal sandstone. Foraminifera examined by W. W. Rau (Baldwin, 1965) collected a short distance west of the mouth of Big Creek along the Sixes River were assigned a middle Eocene age. A middle Eocene microfauna in beds of similar age near Powers was examined by Thoms (Born, 1963), and another outcrop along Fourmile Creek to the north contained a middle Eocene molluscan fauna (Allen and Baldwin, 1944). Phillips (1968) also collected a middle Eocene fauna in middle Umpqua strata along Fourmile Creek, a short distance north of the mapped area.

Tyee Formation

The Tyee Formation, named and described by Diller (1898), makes up the central part of the Coast Range. South of the Middle Fork of the Coquille River it lies in a broad, open syncline whose axis is just east of the Powers quadrangle. The western limb crests in Woodby and Sand Rock Mountains. The formation may reach a thickness of more than 3,000 feet in the southeastern corner of the quadrangle.

The Tyee is made up of massively bedded sandstone with some pebbly layers near the base. Although rhythmical bedding predominates in the central Coast Range, near the southern end of the basin the beds show less vertical grading and more evidence of lateral sorting with crossbedding, channeling, and other signs of a shallow-water, near-shore environment of deposition. The Tyee in this area contains less mica and more clasts of locally derived material. At Hanging Rock a few miles south and east of the Powers quadrangle, the Tyee transgresses older Tertiary formations to rest on the Mesozoic volcanics of the Mule Creek area. Coaly beds are present.

Potentially minable coal beds were drilled in the Eden Ridge coal field near Cedar Swamp in the southeastern corner of the Powers quadrangle and in adjacent parts of the Agness and Bone Mountain quadrangles by the Pacific Power & Light Co. during the late 1950's and early 1960's. The Eden Ridge field was first discussed by Lesher (1914) and Williams (1914). Little additional work was done until the drilling program by the power company. An open-file report by Wayland (1964) discusses the history of the field and some of the recent finds. Bituminous coal, slightly higher in rank than that of the Coos Bay field, is present.

Carbonized and partially silicified stumps and logs are common in the Tyee Formation, and reworked pieces are present in streams draining the formation. Few fossils were found in the Tyee within the area mapped, but the age of the formation is middle Eocene, as determined by fossils found to the north.

Stream terraces

The sediments described as stream terraces lie mostly along the South Fork of the Coquille River and within the stream valley. They rest on relatively flat, eroded rock benches. Some remnants of older sediment are present up to elevations of approximately 250 to 300 feet. Only the larger deposits have been mapped.

The stream terraces are potential sites of placer deposits. This fact has been appreciated by miners, and many of the deposits have already been worked at least once.

Alluvial deposits too small to map are present along the stream below the broader terraces.

Regional Tectonic History

The Galice Formation and perhaps the Colebrooke Schist are the only pre-Nevadan formations in the Sixes River drainage of southwest Oregon. During the Nevadan orogeny, deformation was accompanied by intrusion of diorite, quartz diorite, and serpentinite bodies in the Galice Formation. It may have been at this time that the Colebrooke Schist formed.

Post-Nevadan sedimentation produced the Otter Point Formation, which was laid down under variable conditions, probably in latest Jurassic at a time of tectonic instability. The history was further complicated by tectonic movements that mixed the lower Otter Point into a melange. The fact that the upper part of the Otter Point Formation is not a melange may be a function of its more arenaceous nature. The Humbug Mountain Conglomerate and Rocky Point Formation are somewhat younger (Early Cretaceous) and are less disturbed. They appear to have been deposited in a sea which overlapped deformed Otter Point beds, although they have not been definitely proved to lie in stratigraphic contact on the Otter Point. Alternatively they may be shelf deposits which were thrust over the Otter Point when the melange was forming. The Sixes River fault now separates the Humbug Mountain Conglomerate on the south from the Otter Point Formation on the north. Exceptions are the one small outcrop interpreted to be Humbug Mountain Conglomerate, which lies north of the fault about a mile north of Rusty Butte, and the outcrops in the Salmon Creek area.

After deposition of the Early Cretaceous rocks, no seaways covered this part of Oregon until near the end of the Cretaceous, when some Campanian and Maestrichtian beds were laid down at Cape Sebastian and presumably also at Blacklock Point and along Edson Creek, a tributary of the Sixes River. In the basin to the north, lower Umpqua strata accumulated. Severe folding and faulting followed, and in middle Eocene time the middle Umpqua seaway overstepped the existing formations. It may have been in the interval between deposition of the Late Cretaceous and deposition of the middle Umpqua strata that the Colebrooke Schist was tectonically emplaced by thrusting.

The Tyee Formation was deposited upon the middle Umpqua with an angular disparity, which is more than 45°, along the Kelly Creek road half a mile south of the quadrangle border in sec. 36, T. 32 S., R. 12 W.

Post middle-Umpqua faults, such as the Sixes River and the Powers-Agness faults, appear to be normal and to have a throw of at least a thousand feet. Their relationship to the Tyee Formation is difficult to determine because it is not bounded by one of the faults. Continued movement along the fault probably affected the Tyee Formation.

The latter part of the Cenozoic Era has been a time of intermittent uplift and erosion. Broader valleys with alluvial terraces have formed in those parts of the quadrangle underlain by less resistant rock.

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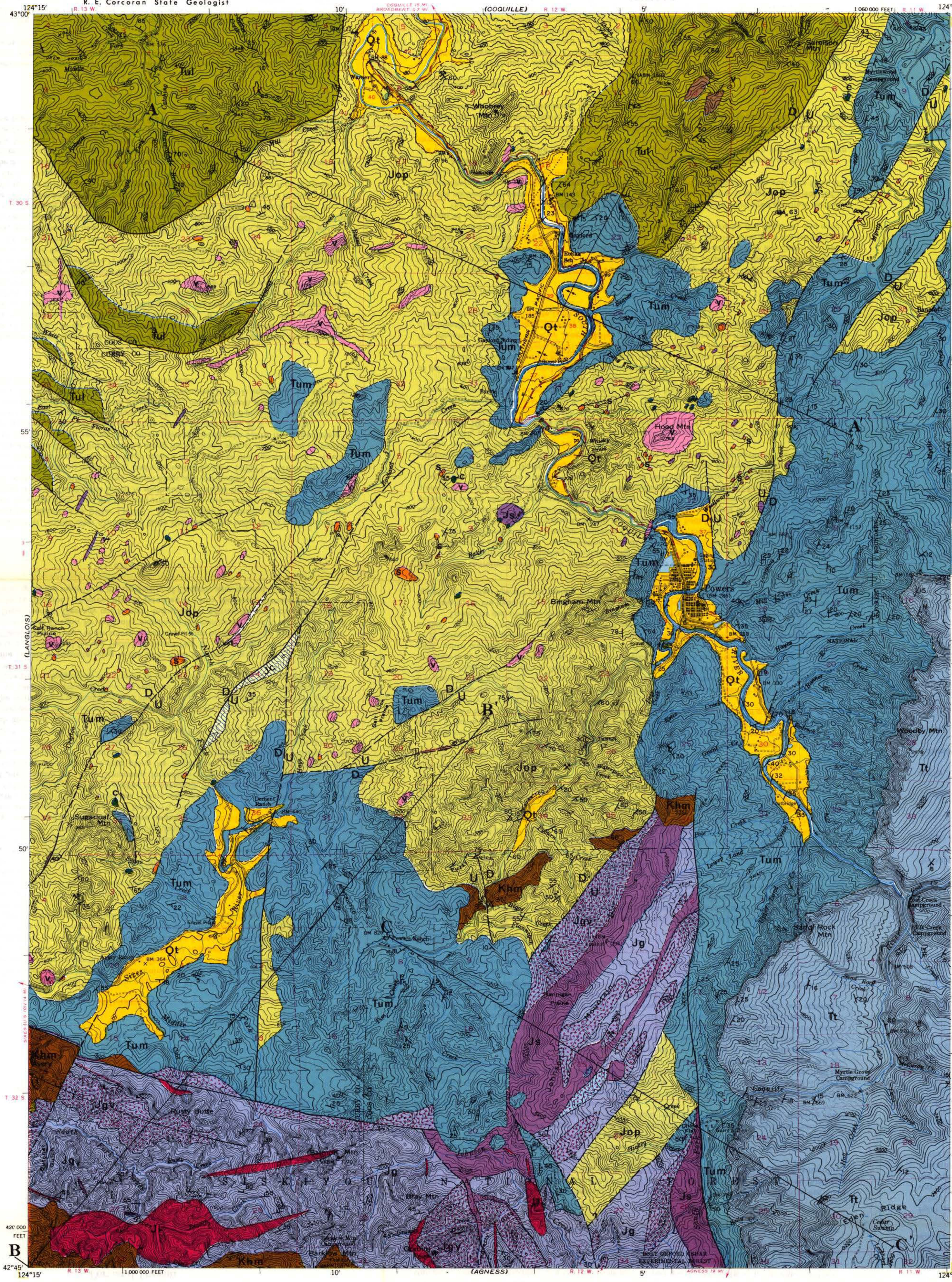
GMS-5

STATE OF OREGON
DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES
R. E. Corcoran State Geologist

GEOLOGIC MAP of the POWERS QUADRANGLE OREGON



Base Map by U.S.G.S. 1954
Topographic Quadrangle of
POWERS, OREGON
N 4245—W 12400/15

SCALE 1:62500

CONTOUR INTERVAL 80 FEET
DATUM IS MEAN SEA LEVEL

APPROXIMATE MEAN DECLINATION, 1954

QUADRANGLE LOCATION

ROAD CLASSIFICATION
Heavy-duty
Medium-duty
Light-duty
Unimproved dirt
U.S. Route
State Route

Cartography by S.R. Renoud (1970)

Geology

By Ewart M. Baldwin
& Paul D. Hess

EXPLANATION

QUATERNARY — *Pleistocene*

Qt — Terrace Deposits
Alluvium on terraces bordering the principal streams.

UNCONFORMITY

TERTIARY — *Middle Eocene*

Tt — Tyee Formation
Massively bedded sandstone with siltstone interlayers; coal bearing in places.

UNCONFORMITY

Tum — Middle Member Umpqua Formation
Sandstone and siltstone with basal conglomerate or pebbly sandstone.

UNCONFORMITY

Paleocene - lower Eocene

Tul / v — Lower Member Umpqua Formation
Sandstone and siltstone; some extrusive basalt (v).

UNCONFORMITY

CRETACEOUS — *Lower Cretaceous*

Khm — Humbug Mountain Conglomerate
Coarse, basaltic conglomerate at base grading upward to finer texture and more variable composition.

UNCONFORMITY

JURASSIC — *Upper Jurassic*

Jop (s, v) — Otter Point Formation
Lower part a melange of sheared siltstone and sandstone with lenses of chert (c), extrusive basalt (v), and detached blocks of blueschist (s); overlain by massive, poorly bedded sandstone containing small, angular mudstone clasts.

UNCONFORMITY

Js / Ji
Serpentinite (Js), diorite stocks and dikes (Ji) intruded during the Nevadan orogeny.

UNCONFORMITY

Jgv / Jg — Galice Formation
Dark gray to black argillite and fine to medium grained sandstone with minor amounts of conglomerate containing sedimentary clasts; includes extrusive volcanic flows and breccia (Jgv) in upper part.

FAULT CONTACT

Jurassic (?)

Jc — Colebrooke Schist
Predominantly a dark gray mica schist which weathers silvery.

GEOLOGICAL SYMBOLS

D U — Faults
Dashed were approximately located or indefinite, dotted where concealed. U, upthrown side; D, downthrown side.

Contacts
Approximately located

Anticlinal axis

Synclinal axis
Showing trace of axial plane and bearing of axis.

Approximate strike and dip of beds or flow.

Geologic Cross Sections