The geology of the Floras Creek area, Curry County, Oregon

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AN ABSTRACT OF THE THESIS OF Jon Dudley Bounds for the Master of Science in Geology presented December 14, 1982.

Title: The Geology of the Floras Creek area, Curry County, Oregon.

APPROVED BY MEMBERS OF THE THESIS COMMITTEE:

Gilbert T. Benson, Chairman

Ansel G. Johnson

Robert O. Van Atta

The Floras Creek area, east of the town of Langlois, near the southwest Oregon coast, includes Colebrooke Schist (a klippe of metamorphosed pelitic sediments of Jurassic age), Jurassic Otter Point Formation (a melange complex), and lower the middle Eocene Roseburg and Lookingglass Formations, part of a sandstone-shale sequence occurring more extensively in other areas. The Colebrooke Schist occurs in the south-central part of the area, bounded on the Otter Point and Roseburg. The Lookingglass is exposed as a small (1.5 sq. km) block in the north-north-west part
of the area. Two major structural trends are found in the Floras Creek area; an older Mesozoic east-west normal fault trend which is truncated by younger serpentinite-filled, north-south shear zones. The younger fault trend was active into the Tertiary as the faults cut the Eocene. Detrital modal analyses of sandstones suggest that the Otter Point is related to the coeval Dothan Formation of the interior Klamath Mountains, in the same way that the Franciscan is related to the Great Valley sequence in California. The detrital modal analysis indicates that the Otter Point is trench-slope deposited sediments as is the Franciscan and the Dothan is forearc basin deposits similar to the Great Valley.
THE GEOLOGY OF THE
FLORAS CREEK AREA, CURRY COUNTY, OREGON

by

JON DUDLEY BOUNDS

A thesis submitted in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE
in
GEOLOGY

Portland State University

1983
TO THE OFFICE OF GRADUATE STUDIES AND RESEARCH:

The members of the Committee approve the thesis of
Jon Dudley Bounds presented on December 14, 1982.

Gilbert T. Benson, Chairman

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# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACKNOWLEDGMENTS</td>
<td>iii</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>vi</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>vii</td>
</tr>
<tr>
<td>LIST OF PLATES</td>
<td>ix</td>
</tr>
<tr>
<td>INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>Location and Accessibility</td>
<td>1</td>
</tr>
<tr>
<td>Purpose</td>
<td>1</td>
</tr>
<tr>
<td>Previous Work</td>
<td>1</td>
</tr>
<tr>
<td>ROCK UNITS</td>
<td>7</td>
</tr>
<tr>
<td>Mesozoic Rock Units</td>
<td>7</td>
</tr>
<tr>
<td>Colebrooke Schist</td>
<td>7</td>
</tr>
<tr>
<td>Otter Point Formation</td>
<td>9</td>
</tr>
<tr>
<td>Matrix</td>
<td>11</td>
</tr>
<tr>
<td>Native Blocks</td>
<td>12</td>
</tr>
<tr>
<td>Thin Section Petrograph</td>
<td>15</td>
</tr>
<tr>
<td>Exotic Blocks</td>
<td>15</td>
</tr>
<tr>
<td>Metabasalt</td>
<td>15</td>
</tr>
<tr>
<td>Glaucophane Schist</td>
<td>19</td>
</tr>
<tr>
<td>Radiolarian Chert</td>
<td>24</td>
</tr>
<tr>
<td>Tertiary Rock Units</td>
<td>27</td>
</tr>
<tr>
<td>Roseburg Formation</td>
<td>27</td>
</tr>
<tr>
<td>Lookingglass Formation</td>
<td>28</td>
</tr>
</tbody>
</table>
# LIST OF TABLES

<table>
<thead>
<tr>
<th>TABLE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Definition of Grain Populations for Triangular Diagrams</td>
<td>33</td>
</tr>
<tr>
<td>II. Sandstone Point Count Data</td>
<td>34</td>
</tr>
<tr>
<td>III. Grain Parameters and Populations Plotted on Triangular Diagrams</td>
<td>35</td>
</tr>
</tbody>
</table>
LIST OF FIGURES

<table>
<thead>
<tr>
<th>FIGURE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Index Map Showing Location of the Floras Creek area</td>
</tr>
<tr>
<td>2</td>
<td>Correlation Chart</td>
</tr>
<tr>
<td>3</td>
<td>Geologic Sketch Map of the Floras Creek Study area</td>
</tr>
<tr>
<td>4</td>
<td>Photomicrograph of Native Block Sandstone</td>
</tr>
<tr>
<td>5</td>
<td>Photomicrograph of Native Block Conglomerate</td>
</tr>
<tr>
<td>6</td>
<td>Photomicrograph of Type I Basalt</td>
</tr>
<tr>
<td>7</td>
<td>Photomicrograph of Type II Basalt</td>
</tr>
<tr>
<td>8</td>
<td>Photomicrograph of Glaucophane Schist (X-nic)</td>
</tr>
<tr>
<td>9</td>
<td>Photomicrograph of Garnet Porphyroblast (ppl)</td>
</tr>
<tr>
<td>10</td>
<td>Photomicrograph of Garnet Porphyroblast (X-nic)</td>
</tr>
<tr>
<td>11</td>
<td>Photomicrograph of Radiolarian Chert</td>
</tr>
<tr>
<td>12</td>
<td>Photomicrograph of Radiolaria within Chert</td>
</tr>
<tr>
<td>13</td>
<td>Photomicrograph of Typical Roseburg Formation Sandstone</td>
</tr>
<tr>
<td>14</td>
<td>Photomicrograph of Typical Lookingglass Formation Sandstone</td>
</tr>
<tr>
<td>15</td>
<td>Q F L Triangular Diagram</td>
</tr>
<tr>
<td>16</td>
<td>Qm F Lt Triangular Diagram</td>
</tr>
<tr>
<td>17</td>
<td>Qp Lv Ls Triangular Diagram</td>
</tr>
<tr>
<td>18</td>
<td>Qm P K Triangular Diagram</td>
</tr>
</tbody>
</table>
FIGURE

19  Schematic Cross-section of Typical Arc-Trench System .................. 45

20  Cartoon Map View of Subduction Zone .................. 47

21  Schematic Cross-section of Typical Flow Melange .................. 54

22  Index Map of the Floras Creek Area Showing Areas Mapped on the Basis of Aerial Photo Interpretation .................. 75
# List of Plates

<table>
<thead>
<tr>
<th>Plate</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Geologic Map of the Floras Creek Area</td>
<td>in pocket</td>
</tr>
<tr>
<td>II</td>
<td>Geologic Cross-sections A-A' and B-B'</td>
<td>in pocket</td>
</tr>
</tbody>
</table>
INTRODUCTION

LOCATION AND ACCESSIBILITY

This study covers an area of approximately 73 square kilometers (28 square miles) in the northern half of the Langlois quadrangle, Curry County, Oregon (Figure 1). The town of Langlois is located at the western edge of the area, and Port Orford is about 32 km (20 mi) to the south. This area straddles the boundary between the Klamath Mountains province, which consists of Mesozoic metamorphosed sedimentary and volcanic rocks to the south, and the Coast Range province, Tertiary sedimentary and volcanic rocks to the north.

A paved county road from Langlois, along Floras Creek to the eastern boundary of the study area, provides the primary access. Another paved county road from Langlois crosses the northwest corner of the area, and an unpaved road runs from the Floras Creek Road south to Edson Butte (Plate I). In general, access is poor, and so are exposures.

PURPOSE

This study is an attempt to define the stratigraphic and structural relationships between the Otter Point Formation, the Colebrooke Schist, and the Roseburg and
Figure 1. Index map showing the location of the Floras Creek area.
Lookingglass Formations (Figure 2). In addition it begins to explore, on the basis of sandstone petrology, the regional significance of the Otter Point in relation to coeval units in the Klamath Mountains and compared to the Franciscan and Great Valley sequences in California.

PREVIOUS WORK

In the United States Geological Survey Port Orford Folio, Diller (1903) assigned unmetamorphosed pre-Tertiary rocks in the Floras Creek area to the Myrtle Formation. Diller's Myrtle Formation was named for lower Cretaceous rocks exposed south of Roseburg in Douglas County, Oregon. The "Myrtle Formation" along the southwestern Oregon coast is separated from the type Myrtle by Tertiary rocks of the Oregon Coast Range. Imlay and others (1959) raised the type Myrtle to group status and subdivided it into the Riddle and Days Creek Formations. The rocks mapped as belonging to the Myrtle Formation near the coast by Diller (1903), contain the same upper Jurassic and lower Cretaceous fossils, but are lithologically different from the type Myrtle (Lent, 1969). Thus similarity in ages resulted in rocks in the Port Orford and Gold Beach area being mapped as members of the Myrtle Group in spite of lithologic differences (Lent, 1969). Koch (1966) divided the coastal Myrtle Group into uppermost Jurassic Otter Point Formation and lower Cretaceous Humbug Mountain Conglomerase and Rocky Point Formation based on faunal and lithologic variations.
Figure 2. Stratigraphic correlation diagram of formations in and near the thesis study area. (after Baldwin, 1974)
in a seemingly homogeneous eugeosynclinal suite, Koch correlated the coastal uppermost Jurassic and lower Cretaceous formations with the inland Riddle and Days Creek Formations. However, the earliest Cretaceous age of the Riddle Formation as suggested by Jones (1969), and an apparent major unconformity between the coastal uppermost Jurassic and lower Cretaceous require that only the lower Cretaceous (i.e. Humbug Mountain Conglomerate and Rocky Point Formation) be correlated with the Myrtle Group.

The Dothan Formation was named by Diller (1907) for a locality on Cow Creek, in Douglas County, 64 km (40 mi) east of the study area. Diller believed that the formation extended southwest to the coast near the California border, an interpretation supported by Wells and Walker (1953) and Ramp (1964). For many years it appeared that Dothan rocks extend directly into the Franciscan assemblage, a pattern which has produced a long-standing state-line stratigraphic boundary problem.

Wells and Walker (1953) mapped four distinct zones within the Dothan Formation. The westernmost, which is in fault contact with an ophiolite mass, is predominantly thinly stratified mudstone and siltstone with rare sandstone units, and volcanic rocks and chert at the top; zone 2 is sheared black mudstone with local calcareous nodules and thin conglomerate; zone 3 is massive cliff-forming graywacke; and the most easterly zone 4 is characterized by interstratified mudstone and sandstone with sandstone
increasing in abundance to the east. Along the coast, just north of the California border, the Dothan Formation was separated into two members by Widmier (1962). The eastern Winchuck Member, consists of black mudstone. The coastal Macklyn Member has a higher percentage of graywacke, volcanics, and chert. In addition, the Macklyn Member is much more highly sheared than the Winchuck Member. The Winchuck Member possibly corresponds to the zones 1 and 2 of Wells and Walker (1953). The Macklyn Member probably does not correspond to any of these zones on the basis of its predominantly sandstone composition.
ROCK UNITS

MESOZOIC ROCK UNITS

COLEBROOKE SCHIST

In the south-central quarter of the study area, metamorphic rocks occur in what has been mapped by previous workers (Brownfield, 1969) as a small klippe (19.4 sq. km) of the Colebrooke Schist, the major body of which is present 40 km to the south of the study area (Plate I).

In the type section to the south as described by Coleman (1972), the Colebrooke Schist consists of primarily metamorphosed pelitic sediments with minor metabasalt. Metamorphosed graded beds of sandstone and shale, 2-8 cm in thickness, are predominant. The mineral assemblages of pelitic and basaltic rocks reflect metamorphism intermediate between blueschist and greenschist facies.

The Colebrooke klippe in the study area appears to be somewhat different from the type Colebrooke Schist. The most noticeable difference between the type Colebrooke Schist and the northern klippe is the occurrence of thick beds of metagraywacke in the northern klippe while in the type Colebrooke, to the south, thick beds of metagraywacke are notably absent. In fact some northern Colebrooke metagraywacke outcrops have the same color and appearance as graywacke outcrops of the Otter Point Formation. Also, within this metagraywacke occur conglomerate lenses of very
well-sorted chert and basalt pebbles of 3-5 mm in diameter, which look identical to conglomerate lenses in Otter Point graywacke outcrops.

The northern Colebrooke klippe does resemble the type Colebrooke in degree of metamorphism. Mica schist is probably the most common higher grade metamorphic rock in the klippe. In outcrop examination, the mica schist looks identical to mica schist in the type Colebrooke outcrops.

Another similarity between the northern klippe and the Otter Point Formation, and therefore a difference between this klippe and the type Colebrooke Schist, is the general appearance of the units in aerial photographs. The Colebrooke Schist to the south appears as a rugged, high relief terrain, whereas the northern Colebrooke and the Otter Point both have more rounded and hummocky topography with relatively moderate relief.

Along the north boundary of the northern klippe, the contact of the Colebrooke Schist with the Roseburg Formation looks like, and has been mapped (Brownfield, 1969) as, a thrust with the Colebrooke Schist forming the upper plate. Close examination has led this writer to the interpretation that the Colebrooke Schist northeast of White Mountain, in sections 3, 4, 5, 8, 9, 10, and 11, T. 30S, R. 14W (Plate I), is involved in a large soil and rock creep or earth flow. This conclusion is based, first on interpretation of aerial photos, and second on observation in the field of
the totally chaotic nature of the material, trees inclined at high angles downslope, and abundant moisture within the material. Since Coleman (1972) placed the age of tectonic emplacement of the Colebrooke Schist as late Cretaceous, the thrust contact between the Colebrooke and the Roseburg Formation is more logically interpreted as an earth flow deposit of Colebrooke material overlying the Roseburg-Colebrooke contact.

**OTTER POINT FORMATION**

Description of the Otter Point Formation was summarized by Koch (1966) as follows:

The type section of Otter Point, in the NE 1/4 of Sec. 13, T. 36S., R. 15W., Gold Beach Quadrangle, consists of repetitiously interstratified, dark gray to black, thin mudstone and graded sandstone, some pebbly mudstone, and several thin beds of andesitic and keratophyric volcanic breccia. The sandstone has convolute bedding, fine cross-stratification (amplitude up to 3 cm), and contortions, as well as groove, flute, and load sole marks. Some of the mudstone contains abundant coalified plant debris and numerous small lenses and nodules of very argillaceous limestone.

The Otter Point in the study area consists of a matrix of sheared mudstone, argillite, and clay, containing scattered, highly sheared blocks of sandstone, metavolcanic greenstone, radiolarian chert, and glaucophane schist. Otter Point underlies about forty-five percent of the study area (Plate I and Figure 3), but exposures are very poor. These rocks form part of a melange (Hsu, 1968) that is widespread in the coastal part of the Klamath Mountains of Oregon.
Figure 3. Geologic sketch map of the Floras Creek study area. Jc - Colebrooke Schist, Jop - Otter Point, Tr - Roseburg, Tlg - Lookingglass, Qal - Quaternary alluvium, S - Serpentinite.
For convenience, the Otter Point rock types will be differentiated in this study as matrix, native blocks (sandstone blocks), and exotic blocks (metabasalt, glaucophane schist, and radiolarian chert). This subdivision has been used previously by Hsu (1968) in studies of the Franciscan Melange of Northern California. Native blocks are not distinguished in mapping, as the contacts are commonly gradational, blurred by weathering, or covered. The exotic blocks, however, are mapped with little difficulty. These blocks tend to stand in fairly high relief against the matrix due to their resistance to weathering. The exotic blocks make up about five percent of the formation.

MATRIX

The bulk of the Otter Point Formation is composed of rock referred to in this paper as matrix. The only exposures of the matrix are found in road cuts, excavations, and rarely, around large native and exotic blocks.

In fresh exposures, the matrix consists of thin discontinuous beds of argillite separated by pervasively sheared mudstone or claystone. Where fresh, the matrix is dark gray to black and weathers to blue-gray. Thin sandstone laminae are present in some exposures. Veins and stringers of secondary quartz and calcite commonly cross-cut the bedding. More weathered exposures of the matrix are characterized by blue-gray clay containing abundant
angular fragments of argillite, quartz, and calcite.

NATIVE BLOCKS

After the matrix, the predominant rocks of the Otter Point Formation in the Floras Creek drainage are numerous blocks of massive lithic sandstone (graywacke) and rhythmically bedded sandstone and argillite. These blocks of sandstone occur as various sized, one to 500 meters in maximum dimension, "inclusions" within the matrix. According to many authors (e.g. Scholl and others, 1980; Connelly, 1978; Dickenson and Seely, 1979; Hsu, 1971), these blocks represent the tectonically broken sedimentary beds that accumulated depositionally within trench slope basins, and also sedimentary masses that were transferred to oceanic crust as olistostromes, which were thrust from an adjacent accreting margin.

Lines of these blocks tend to be ridge formers as they are much more resistant to erosion than the matrix. The sandstone of the native blocks is typically medium gray to green-gray, with graded bedding, pebble lenses, and clay laminae present in some outcrops. No megafossils were found in the Floras Creek study area, but ammonite fragments and a few complete Pelecypod valves, identified by the author as *Buchia* sp., were collected in argillite of an outcrop of bedded sandstone and argillite along Sixes River Road, approximately 8 km (5 mi) south of the study area.
Figure 4. Photomicrograph of a typical Otter Point sandstone. Shale clast is approximately two millimeters in length (plane light).
Figure 5. Photomicrograph of an Otter Point chert pebble conglomerate. Clasts are chert and about five millimeters in diameter. Note the radiolarian chert in the lower left (plane light).
This would agree with the Jurassic/Cretaceous age assignment by Dott (1971). Minute carbonized plant fragments were also found in a few samples.

**Thin-section Petrography**

Quartz, plagioclase, and rock fragments are the major framework components of the sandstone in the Otter Point Formation. Trace amounts of opaques, hornblende, epidote, and sphene are also present. The main lithic fragment types are basalt, argillite (very hard and very black), phyllite, and rarely, blue schist. The sandstone matrix consists of clay with varying amounts of limonite and chlorite. Silica and clay are the cementing agents. In about 45% of the samples, the sandstone is tectonically sheared with fractures commonly filled with quartz, calcite, and chlorite (Figure 4 and Figure 5).

**EXOTIC BLOCKS**

"Exotic blocks" occur in the Otter Point Formation but are much less numerous than the sandstone blocks. These blocks are of metabasalt (Jopv), glaucophane schist (Jopsh), and radiolarian chert (Jopc) which crop out sporadically throughout the study area (Plate I).

**Metabasalt**

Stretching across the study area is a string of metabasalt blocks. These blocks generally are knob-formers and
can be identified on aerial photographs. Field mapping and aerial photo interpretation indicate that these blocks are distributed mainly within and near large shear zones. To the north of the study area, metabasalt blocks occur in fewer numbers and seem to have no regular pattern of distribution (Gullixson, 1981).

The metabasalt is divided into two types based on thin section examination. Type I has fairly well-preserved igneous texture with the plagioclase only slightly altered and ferro-magnesian minerals partially replaced by chlorite. Type II is severely altered, highly sheared, and has very poor preservation of the primary igneous texture. Also, in type II metabasalt, glaucophane is present as overgrowths on hornblende.

The type I metabasalt is massive, porphyritic, is sub-ophitic in texture and is only slightly sheared (Figure 6). Plagioclase (An-50), hornblende and hypersthene are the major minerals while the accessory minerals are chlorite, epidote, and quartz. The chlorite is found as reaction rims on hypersthene and hornblende. The hornblende is possibly secondary.

The type II metabasalt is massive and thoroughly sheared. The primary igneous texture has been almost completely lost due to severe alteration (Figure 7). The groundmass of epidote, apatite, and quartz still shows a few phenocrysts of spilitized plagioclase and hornblende.
Figure 6. Photomicrograph of type I metabasalt. White - plagioclase, gray - hypersthenes and chlorite. Field of view is about 5 mm. (polarized light)
Figure 7. Photomicrograph of type II metabasalt. Note the pervasive shearing. Field of view is about 5 mm. (plane light)
Most of the fractures are filled with quartz and/or calcite. Extensive intergrowths of acicular apatite give a felted appearance to the groundmass. Strain twinning is characteristically exhibited by the phenocrysts of plagioclase (An-15), and most of the hornblende have overgrowths of glaucophane and are partially altered to chlorite. The presence of glaucophane and apatite and the amount of shearing suggest a much higher grade of greenschist metamorphism for type II than type I metabasalts.

Pillow structures have been noted in exotic blocks in the Otter Point Formation to the south (Baldwin, 1974), but none were found in the study area. Also, no volcanic breccia was found in the area as was found in the Sixes River drainage by Lent (1969).

Glaucophane Schist

The second most abundant exotic rock type in the Otter Point Formation in this study is glaucophane schist (blueschist). Outcrops varying in size from a few meters to several hundred meters in diameter cover less than 1% of the area. The glaucophane schist is also a knob-former as it is very resistant to chemical and mechanical weathering. Because this rock is very tough and dense, it is used for the construction of jetties, breakwaters, and roads when it can be found in large enough quantities to justify quarrying operations.

In outcrop, the blueschist is typically dark olive
green to dark blue-gray in color due to a high concentration of either actinolite of sodium amphibole (glaucophane). Although compositional gneissic banding is present in some samples, a more schistose texture is commonly found. Although not always obvious in hand specimens, compositional banding is common in thin-sections. Strong lineation of elongate prismatic crystals is exhibited in all samples. Except for those samples that exhibit well developed gneissic structure, foliation defined by mica crystals is found in all samples.

The mineral composition of the blueschist is variable, but is characterized by the assemblage: glaucophane (crossite), actinolite, epidote group (epidote, zoisite, clinozoisite), with greater or lesser amounts of albite, quartz, chlorite, garnet (almandite ?), muscovite, and trace amounts of sphene, apatite, rutile, and lawsonite. Variations in mineral proportions are presumably due to differences in source rock type and metamorphic grade. Possible source rocks include graywacke and basalt (Gullixson, 1981).

Most samples contain porphyroblasts of garnet (Figure 8). These garnets appear euhedral in plane polarized light (Figure 9), but under crossed nicols they exhibit partial replacement by chlorite (Figure 10). This may be an indication of retrograde metamorphism as described by Coleman and Lanphere (1971) or possibly simple alteration.
Figure 8. Otter Point glaucophane schist. Garnet porphroblasts are two millimeters in diameter (polarized light).
Figure 9. Garnet porphroblast in plane light. Note the chlorite alteration.
Figure 10. Euhedral garnet porphyroblast within the glaucophane schist (polarized light).
Bedded Radiolarian Chert

Small blocks of rhythmically bedded radiolarian chert are scattered throughout the Floras Creek area but they account for only a very small fraction of the exotic blocks within the formation. These blocks range in size from a few meters to a few tens of meters in diameter.

The chert is typically reddish brown (locally green or tan) and occurs as 2-7 cm thick beds separated by thin siliceous shale or argillite interbeds or as homogeneous contorted sequences of 1-3 cm thick beds separated by thin shaley partings. Contorted sequences generally show chevron or kink folding with fold hinges exhibiting no noticeable thickening of fracturing.

Petrographic examination of this chert reveals replacement quartz-filled radiolaria in various stages of preservation set in very fine-grained matrix of cryptocrystalline of microcrystalline quartz. The chert is highly recrystallized and cut by abundant quartz-filled veinlets (Figure 11). Some beds exhibit laminae 1-3 mm thick which tend to have concentrations of radiolaria at the laminae boundaries.

Even though radiolaria could be found throughout the chert in various stages of preservation, only the general shapes could be discerned, mostly spheres and cones (Figure 12.).
Figure 11. Typical Otter Point radiolarian chert. Field of view is approximately five millimeters.
Figure 12. Conical and spherical radiolaria within the radiolarian chert. Field of view is about 1.5 mm.
ROSEBURG FORMATION

Rocks of the Roseburg Formation (Plate I) make up about 60% of the Tertiary rocks within the study area. Two blocks of the Roseburg Formation are exposed in the area. The most northerly exposures are the southern tip of a large block mapped by Gullixson (1981). The other block of the formation lies in a narrow, east-west-trending strip along the northern edge of the Colebrooke Schist.

Baldwin (1974) determined the Roseburg to be early Eocene in age although he stated that with additional information, the Roseburg in the south coastal area may be separable from the eastern Roseburg into another stratigraphic unit. He based his inference on work by Dott (1962) on beds near Blacklock Point, west of the town of Langlois, Oregon, and mapping by Lent (1969) of beds along Edson Creek, which is about 5 km southeast of the study area. These beds were assigned by these workers to a Late Cretaceous age.

Baldwin (1974) described the typical Roseburg sedimentary rocks as follows:

Sedimentary rocks within the Roseburg Formation include thick sections of rhythmically bedded sandstone,..., and minor amounts of conglomerate and pebbly sandstone.

Within the Floras Creek area, this description does not apply. The primary rock type within the area is massive,
fine to medium grained sandstone. Sections of rhythmically bedded sandstone and siltstone were not found in any outcrop.

Thin-section examination of the Roseburg sandstone indicates that it is massive, clay cemented volcanic litharenite. It is fine to medium grained, moderately well sorted with sub-rounded grains. The framework is made up of quartz, rock fragments, and plagioclase (Figure 13). The lithic component comprises volcanic and occasional metamorphic rock fragments (metamorphic component is primarily phyllite and rare blueschist) with the volcanic fragments being most abundant.

LOOKINGGLASS FORMATION

Rocks of the Lookingglass Formation occur only in an approximately 1.5 square km (0.6 square mi) area in sections 31, and 32 near the Langlois Mt. Road (Plate I).

Within the study area, the Lookingglass Formation consists of massive, medium to coarse grained sandstone, channeled and cross-bedded sandstone exhibiting coarse grained, pebbly sandstone and conglomerate lenses in channel fills. The clasts of the conglomerate consist of granitic and basaltic types of igneous rocks, chert, and sandstone.

The Lookingglass Formation in the study area differs from the Roseburg Formation, locally, by being much
**Figure 13.** Photomicrograph of Roseburg Formation sandstone. White and gray - quartz and plagioclase, black - rock fragments. (polarized light)
coarser-grained and showing many more common sedimentary structures such as channel fills and cross-beding. The Lookingglass also contains pebbly sandstone and conglomerate whereas the Roseburg beds do not (Bounds and Gullixson, 1981).

In thin-section, the Lookingglass sandstone is medium-to-coarse-grained, poorly sorted, and clay cemented; the grains are angular to sub-rounded (Figure 14). Framework grains include quartz, igneous rock fragments, plagioclase, and notably, no metamorphic fragments.
Figure 14. Photomicrograph of typical Lookingglass Formation sandstone. White and gray - quartz and plagioclase, black - rock fragments. Field of view of 5 mm. (polarized light)
DETRITAL MODAL ANALYSIS OF SANDSTONE

A computer program, called FOLKSS (Jacob, 1975), (Appendix A), was modified to process point-count data from sandstone thin-sections. Input are raw point-counts of framework grains of sandstone. The program produces a modal analysis of each thin-section and names the sandstone type.

Dickenson (1970) and Dickenson and Suczek (1979), presented the basic methods for interpreting detrital modes for arkoses and graywackes. Table I shows the scheme used here for classifying sand grain types reported from point-counts of Otter Point, Dothan, Franciscan, and Great Valley samples (Table II). Results from point-counts of ten thin-sections from the Otter Point Formation sandstone in the study area (Plate I), and four thin-sections of the coeval Dothan sandstone, from a sample location on Mule Creek near the Rogue River, are compared to similar data from Dickenson and others (1982) on the Franciscan Complex and the Great Valley sequence. Table I concerns only the framework grains and not the interstitial and rare constituents. Table III defines grain parameters and grain populations which are then displayed on triangular diagrams.

Following Dickenson (1982), quartz - feldspar - lithic (QFL) and monocrystalline quartz - feldspar - total lithic (QmFLt) triangular plots were constructed to compare mean framework modes; and monocrystalline quartz - plagioclase - K-feldspar QmPK) and polycrystalline quartz -
Table I. Definition of grain populations for triangular compositional diagrams.

<table>
<thead>
<tr>
<th>Triangular Diagram</th>
<th>Uppermost Pole</th>
<th>Lower Left Pole</th>
<th>Lower Right Pole</th>
</tr>
</thead>
<tbody>
<tr>
<td>QFL</td>
<td>Q Quartzose grains ((=Q_m + Q_p))</td>
<td>F Feldspar grains ((=P + K))</td>
<td>L Unstable Aphanitic Lithic grains ((=L_v + L_s))</td>
</tr>
<tr>
<td>QmFLt</td>
<td>Qm Monocrystalline Quartz grains</td>
<td>F (same as above)</td>
<td>Lt Total Aphanitic Lithic fragments ((=L + Q_p))</td>
</tr>
<tr>
<td>QmPk</td>
<td>Qm (same as above)</td>
<td>P Plagioclase grains</td>
<td>K K-feldspar grains</td>
</tr>
<tr>
<td>QpLvLs</td>
<td>Qp Polycrystalline quartzose lithic fragments ((=Q_m + Q_p))</td>
<td>Lv Volcanic and metavolcanic lithic fragments ((=L_v + L_s))</td>
<td>Ls Sedimentary and metasedimentary lithic fragments ((=Q_m + Q_p))</td>
</tr>
</tbody>
</table>
Table II. Sandstone point count data. Franciscan and Great Valley data from Dickenson and others (1982).

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>Normalized Data for Triangular Diag.</th>
<th>QFL</th>
<th>QmFLt</th>
<th>QpLvls</th>
<th>QmPK</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OTTER POINT FORMATION</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>JDB-80-10</td>
<td>39-38-23</td>
<td>18-38-43</td>
<td>46-2-52</td>
<td>32-68-0</td>
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<tr>
<td>JDB-80-12</td>
<td>59-39-2</td>
<td>56-41-3</td>
<td>80-20-0</td>
<td>58-42-0</td>
<td></td>
</tr>
<tr>
<td>JDB-80-11</td>
<td>73-26-1</td>
<td>61-26-13</td>
<td>92-8-0</td>
<td>70-30-0</td>
<td></td>
</tr>
<tr>
<td>CFG-JOP-01</td>
<td>61-0-39</td>
<td>0-0-100</td>
<td>61-38-1</td>
<td>0-0-0</td>
<td></td>
</tr>
<tr>
<td>CFG-JOP-02</td>
<td>48-11-41</td>
<td>5-11-84</td>
<td>52-45-3</td>
<td>31-69-0</td>
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<tr>
<td>CFG-JOP-04</td>
<td>72-22-6</td>
<td>53-22-25</td>
<td>73-19-8</td>
<td>71-29-0</td>
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</tr>
<tr>
<td>CFG-JOP-05</td>
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<td>49-30-21</td>
<td>41-41-18</td>
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<tr>
<td>CFG-JOP-06</td>
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<tr>
<td>CFG-JOP-07</td>
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<td>20-14-66</td>
<td>24-61-15</td>
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</tr>
<tr>
<td><strong>DOTHAN FORMATION</strong></td>
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<td></td>
</tr>
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<td>B&amp;G-JDO-01</td>
<td>49-26-25</td>
<td>26-26-48</td>
<td>47-43-10</td>
<td>50-50-0</td>
<td></td>
</tr>
<tr>
<td>B&amp;G-JDO-04</td>
<td>69-23-8</td>
<td>53-23-24</td>
<td>67-25-8</td>
<td>70-30-0</td>
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</tr>
<tr>
<td><strong>FRANCISCAN ASSEMBLAGE</strong></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F-1</td>
<td>42-53-5</td>
<td>40-53-7</td>
<td>29-14-57</td>
<td>43-57-0</td>
<td></td>
</tr>
<tr>
<td>F-2</td>
<td>35-42-23</td>
<td>28-42-30</td>
<td>23-44-33</td>
<td>40-60-0</td>
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<tr>
<td>F-3</td>
<td>38-49-13</td>
<td>29-49-22</td>
<td>39-35-26</td>
<td>37-63-0</td>
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<tr>
<td>F-4</td>
<td>35-54-11</td>
<td>35-54-11</td>
<td>3-22-75</td>
<td>40-60-0</td>
<td></td>
</tr>
<tr>
<td>F-5</td>
<td>30-51-19</td>
<td>29-51-20</td>
<td>4-39-57</td>
<td>37-63-0</td>
<td></td>
</tr>
<tr>
<td>F-6</td>
<td>33-54-13</td>
<td>29-54-17</td>
<td>24-41-35</td>
<td>36-65-0</td>
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</tr>
<tr>
<td>F-7</td>
<td>33-40-27</td>
<td>31-40-29</td>
<td>6-80-14</td>
<td>44-56-0</td>
<td></td>
</tr>
<tr>
<td>F-8</td>
<td>42-48-10</td>
<td>37-48-15</td>
<td>31-26-43</td>
<td>44-54-1</td>
<td></td>
</tr>
<tr>
<td>G-1</td>
<td>30-31-39</td>
<td>23-31-46</td>
<td>15-55-30</td>
<td>43-57-0</td>
<td></td>
</tr>
<tr>
<td>G-2</td>
<td>29-40-31</td>
<td>24-40-36</td>
<td>15-59-29</td>
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<tr>
<td>G-4</td>
<td>33-33-34</td>
<td>28-33-39</td>
<td>11-52-37</td>
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<tr>
<td><strong>GREAT VALLEY SEQUENCE</strong></td>
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</tr>
<tr>
<td>D-4</td>
<td>22-27-51</td>
<td>17-27-56</td>
<td>10-60-30</td>
<td>40-50-10</td>
<td></td>
</tr>
<tr>
<td>D-6</td>
<td>17-15-68</td>
<td>14-15-71</td>
<td>4-64-32</td>
<td>50-44-6</td>
<td></td>
</tr>
<tr>
<td>D-7</td>
<td>23-26-51</td>
<td>22-26-52</td>
<td>2-90-8</td>
<td>46-50-4</td>
<td></td>
</tr>
</tbody>
</table>
Table III. Grain parameters and populations plotted on triangular diagrams.

<table>
<thead>
<tr>
<th>Diagram</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>QFL</td>
<td>Total framework with all quartzose grains grouped together</td>
</tr>
<tr>
<td>QmFLt</td>
<td>Total framework with all aphanitic fragments grouped together</td>
</tr>
<tr>
<td>QpLvLs</td>
<td>Polycrystalline aphanitic lithic fragments only</td>
</tr>
<tr>
<td>QmPK</td>
<td>Monocrystalline mineral grains only</td>
</tr>
</tbody>
</table>

Note: "Total framework" here includes only sum of grain types, defined by Table 1.
volcanic lithic - sedimentary lithic (QpLvLs) plots were constructed to show, respectively, partial modes of mineral grains and polycrystalline lithic fragments.

**QFL Diagram**

Figure 15 shows the distribution of the mean framework modes for selected samples or suites of sandstones from the Otter Point Formation, the Dothan Formation, the Franciscan Complex, and the Great Valley sequence (or Great Valley Group: Dickenson, 1981). The Franciscan and the Otter Point data plot into fields (estimated and drawn by hand) that have no overlap.

The Franciscan data points all fall below the 50% quartz line and the samples show a somewhat constant Q-F ratio. The Otter Point data plots into a field that tends to fall in a much more quartzose area. While the Franciscan has a fairly constant quartz/feldspar ratio with a changing lithic content, the Otter Point graywackes show a much more variable ratio of quartz to feldspar.

When the Dothan and Great Valley data are plotted on the same diagram, several relations can be noticed. The Great Valley data plots in a field that overlaps the more lithic-rich portion of the Franciscan field with a little greater variability in the quartz/feldspar ratio. The Dothan data plots in a field that lies wholly within the Otter Point field.
Figure 15. Quartz - Feldspar - Lithic triangular diagram. Franciscan and Great Valley data from Dickenson and others (1982).
Both the Franciscan and the Great Valley fields overlap into the magmatic arc provenance field (Figure 15) defined by Dickenson and Suczek (1979) while the Otter Point and Dothan fields are located in a more quartzose region of the diagram than the magmatic arc provenance field.

**QmFLt Diagram**

The QmFLt diagram is used by Dickenson (1982) as a method of differentiating between trench and forearc basin deposits. This is possible because the chert component of the framework grains is removed from the quartz part of the diagram and is combined with the lithic components. The result is that the trench deposits plot a field that is more elongated toward the lithic apex of the QmFLt diagram than they do on the QFL diagram. The forearc basin sandstones show little or no change in shape or location of the plotted fields.

The Otter Point and Franciscan data fields overlap very little in the QmFLt diagram (Figure 16). Both show a fairly constant monocrystalline quartz/feldspar ratio with an extremely variable total lithic content. Again, as in the QFL diagram, the Otter Point data are more quartzose.

The Dothan samples plot totally within the Otter Point field. The shape of the Dothan data field indicates a little less variability of total lithic content and
Figure 16. Monocrystalline quartz – Feldspar – Total lithic triangular diagram. Franciscan and Great Valley data from Dickenson and others (1982).
practically the same quartz/feldspar ratio as the Otter Point. The Great Valley data plot in an area that encloses the more lithic data from the Franciscan.

**QpLvLs Diagram**

In the QpLvLs diagram (Figure 17), the Otter Point and the Franciscan data fields are different from each other. The Franciscan data describe a field that indicates great variability in the ratio of volcanic lithic fragment to sedimentary lithic fragment content. Also, the data tend to fall below the 50% Qp (polycrystalline quartz or chert) line. The Otter Point field shows a higher polycrystalline quartz content (overall) and generally, very little phyllosilicate-rich lithic fragment (Ls) enrichment.

Again as in the previous diagrams, the Dothan data falls within the Otter Point field and the Great Valley follows the Franciscan trend. Also, the Dothan and the Great Valley tend to form more compact data fields.

**QmPK Diagram**

The QmPK diagram (Figure 18) is used to show presence or absence of potash feldspar, therefore indicating provenance as plagioclase is predominant feldspar in the trench environment. The presence of potash feldspar and quartz enrichment indicates increased erosion of the arc.

The Otter Point and the Franciscan fields are very
Figure 17. Polycrystalline quartz - Volcanic lithic-
Sedimentary lithic triangular diagram.
Franciscan and Great Valley data from
Dickenson and others (1982).
Figure 18. Monocrystalline quartz - Plagioclase - K-feldspar triangular diagram. Franciscan and Great Valley data from Dickenson and others (1982).
much alike in this diagram (Figure 18). Both suites fall on the QmP line with very little or no K-feldspar present. The difference in the two fields are that the Otter Point samples are more quartz enriched than the Franciscan. This is shown by noting the location of the mean of the Qm-P proportions for each of the two assemblages. The mean of the Franciscan Qm-P proportions are 40.9% Qm and 59.1% P whereas the mean of the Otter Point proportions are 64.2% Qm and 35.8% P.

The Dothan samples plot along the Qm-P line with no K-feldspar content at all. These samples show a little bit less variation in the Qm/P ratio than the Otter Point. The Great Valley data plot near the Qm-P line but have a small (3% to 15%) K-feldspar content. It also shows a wider range in Qm/P ratio than the Franciscan does.

DISCUSSION OF MODAL ANALYSIS

Comparison of the Otter Point, Dothan, Franciscan, and the Great Valley point-data using detrital modal analysis appears to be meaningful. What this has indicated is that the Otter Point and the Dothan are closely related as the Franciscan and the Great Valley are closely related. It has also shown that the Otter Point/Dothan system is not directly related to the Franciscan/Great Valley system as far as provenance is concerned.

The most obvious difference between the two systems
is the quartz enrichment of the Otter Point/Dothan system relative to the Franciscan/Great Valley system. This is most notable on the QFL and QmFLt diagrams.

Another noteworthy difference between the two systems is that the Otter Point system, relative to the Franciscan, shows a definite lack of phyllosilicate-rich lithic fragments (Ls) on the QpLvLs diagram (Figure 17). According to Dickenson and others (1982), the absence of sedimentary or metasedimentary lithic fragments could be attributed to the lack of reworking of the sediments near the trench slope. These workers proposed that with much reworking of sediments on the trench slope, the volcanic lithics are broken down and the argillite and chert fragments are recycled.

In the QFL diagram (Figure 15), enrichment in quartzose material in the Otter Point/Dothan system relative to the Franciscan/Great Valley system is immediately apparent. This, according to Dickenson and others (1982), could possibly be the result of deeper dissection of the magmatic arc which furnished sediments to the fore-arc system. With increased erosion of a magmatic arc, increased content of quartz should be noted in the trench slope and fore-arc basin sediments (Figure 19).

The triangular diagrams (Figures 15, 16, 17, 18) show consistent overlap between detrital compositions of the Otter Point and Dothan sandstones, and between the Francisc-
Figure 19. Schematic diagram of a typical arc-trench system (no scale) showing varied sandstone depositional sites. After Dickenson and Seely (1979).
can and Great Valley sandstones. Conversely, the diagrams show a definite lack of overlap between the Otter Point/Dothan system and the Franciscan/Great Valley system. However, the differences between the two systems is primarily in the difference in the higher proportion of monocristalline quartz (Qm) in the Otter Point/Dothan system. Both systems still best fit the forearc-trench environment. The differential might be attributed to deeper erosion of the magmatic arc in the Otter Point/Dothan system. Of course, the modal data can only show that the two parts of each pair had a similar provenance, but cannot prove that the two pairs were derived from the same magmatic arc.

The data suggest that the Franciscan/Great Valley set might have been derived from a completely different arc provenance than the Otter Point/Dothan set. This could as well be attributed to widely separated parts of the same arc system, with differing degrees of dissection and erosion, furnishing the sediments for the two pairs of rock suites (Figure 20).
Figure 20. Cartoon suggesting possible relations of a subduction zone with a highly eroded highland separating two less highly eroded segments of the magmatic arc. The southern trench fill and fore-arc basin pair could possibly be the Franciscan and the Great Valley while the northern pair could possibly be the Otter Point and Dothan.
STRUCTURAL GEOLOGY

North-south trending faults characterize the coastal section of the Klamath Mountains (Dott, 1971), and the east-west trending Canyonville fault forms the northern boundary of the interior Klamath Mountains east of the study area (Benson and Perttu, 1980). Two structural trends are apparent in the Floras Creek area. The north-south trending faults in the area belong to the coastal system; the east-west trending structures may or may not be related to the Canyonville trend.

NORTH-SOUTH TRENDING STRUCTURE

The dominance of the north-south structural trend is readily discerned, both from the map of the study area (Plate I) and from east-west cross-section A-A' (Plate II). Most notable are the two very large shear zones which trend north-northeast in the western third of the mapped area. The predominant rock within these zones is serpentinite (Jsp) containing highly altered pyroxenite nodules. The serpentinite is pervasively sheared throughout the zones and exhibits slickensides aligned parallel or sub-parallel to the shear zones with very low plunges. Basalt, blueschist, and chert exotic blocks are found within the largest north-trending serpentinite zone.

The eastern and western boundaries of the Colebrooke Schist (Plate I) appear to be normal faults. These north-
to northeast-trending normal faults separate the Colebrooke from the Otter Point, and continue northward, cutting the Roseburg Formation.

EAST-WEST TRENDING STRUCTURE

In the northeastern part of the area, a generally east-west block of Otter Point is flanked on the north and south by Roseburg (Plate I). Although the contacts are mostly faults, the overall pattern suggests an east-west trendng anticline. Two large east-west trending serpentinite bodies which mark shear zones are evident in the north-central part of the area (Plate I).

Northeast-southwest cross-section B-B' (Plate II) shows the basic order of the formations within the study area. The Roseburg Formation appears to be in depositional contact with the Otter Point Formation in Sections 2, 3, 34, and 35 (Plate I).

To the southwest end of cross-section B-B', the Colebrooke Schist (Jc) is shown to overlie the Roseburg in a thrust relationship, but alternatively, this contact could be the base of a large earthflow-landslide as discussed on page 9. In the southwest part of the mapped area (Sec. 13)(Plate I), the Colebrooke Schist is exposed in thrust contact with the underlying Otter Point. This agrees with the relationship of the Colebrooke as klippen on the Otter Point as recognized by Coleman (1972). There
is no indication in the region of continuation of thrusting into the Eocene; therefore the landslide interpretation is preferred for the Colebrooke/Roseburg contact relationship.

INTERNAL STRUCTURE

In the north-central part of the area near Millard School (Plate I), there is a small (0.5 sq. km) body of Tertiary Lookingglass Formation. It appears to be in depositional contact with the Otter Point and is truncated at the western tip by the largest of the north-south shear zones. There are numerous small normal faults, all down to the south-west.

As previously mentioned, the Otter Point Formation abounds with exotic "knockers" of basalt, blueschist, and chert. Some "knockers" (predominately basalt) are contained within both the north-south and the east-west shear zones. A dispersion pattern of "knockers" could not be discerned other than the population density is higher in the western half of the mapped area.

DISCUSSION

The occurrence of the Colebrooke as a klippe on the Otter Point may be apparent to the south (Coleman, 1972), but it is not so obvious in the Floras Creek area. The thrust contact of Colebrooke on Otter Point is mapped only in the southwestern and southern parts of the area (Plate
I); elsewhere the Colebrooke is in high-angle fault contact
with the Otter Point. Along its northern boundary, the
Colebrooke appears to overlie Roseburg along an east-west
trending thrust, but as noted above, this contact is inter-
preted to be a large landslide (there is no evidence for
the alternative that thrust emplacement of the Colebrooke
continued into Eocene Roseburg time).

North-south trending faults generally cut off east
trending structures. This suggests that the north-south
trending structures are more important or younger, or both.
The two are probably correct. Similar large fault zones
have not been mapped in the Tertiary to the north (Wells
and Peck, 1961), so the major deformation in the area was
presumably late Mesozoic. On the other hand, lesser move-
ments presumably continued into the Tertiary along pre-
existing lines as indicated by fault contacts of Eocene
units (Gullixson, 1981).
CONCLUSIONS

WHAT IS THE OTTER POINT FORMATION?

Prior to the advent of the plate-tectonic theories, the origin of the Otter Point Formation and the Franciscan Complex were enigmatic. Now, both assemblages are generally regarded as subduction complexes, deposited on and deformed within and beneath the inner slope of a late Mesozoic trench along the western margin of North America (Dott, 1971).

Dickenson (1982) and Dickenson and others (1982) thoroughly investigated the compositions of sandstones of subduction complexes and in particular the provenance of Franciscan graywackes and the Great Valley sandstones of California. In these papers, they noted that the arc-trench systems of the circum-Pacific orogenic belts contain abundant sandstones within fore-arc terranes that include subduction complexes (Figure 19). Turbidites incorporated within subduction complexes include not only axially transported trench fill, but also abyssal plain sediments deposited on the sea floor beyond the trench, indicated by the presence of bedded radiolarian chert, and slope-basin deposits perched on the accretionary trench slope.

The Otter Point Formation is composed of highly sheared "knockers" of sandstone, metavolcanic greenstone,
radiolarian chert, and glaucophane schist, scattered within a matrix of sheared mudstone, argillite, and clay.

These "knockers" do not form any obvious pattern in the way that they are scattered within the matrix. Cloos (1982) accounted for this lack of organization in his explanation of the flow melanges in the Franciscan subduction complex. He concluded that many of these blocks had been buried at depth beneath the hanging wall of the overriding plate (Figure 21). He also suggested that melanges (such as the Franciscan) which contain exotic blocks in a pelitic matrix, are zones in which a forced convection or "reverse" flow occurred in sediment accreted into the wedge. The reverse or forced flow "plucked" blocks of different lithologies and metamorphic grades depending on the depth at which these blocks were removed from the hanging wall.

According to Cloos' (1982) model, the pelitic muds and shales are not metamorphosed because of the lack of Ca-silicates and carbonates. This may be true, but there is also the probability that some of the rocks, including some of the basalts, were not carried as deeply within the subduction system (Figure 21). In particular, the ideas of the basalts being carried to a variety of depths could account for the differing degrees of metamorphism of the basalts in the Otter Point Formation.

The Otter Point Formation is many ways resembles the Franciscan Complex. It consists of similar rock type
Figure 21. Schematic cross section illustrating the circulation pattern of Otter Point or Franciscan flow melange during late Mesozoic convergence. (After Cloos, 1982)
occuring in a similar fashion, that is, a native block-
exotic block assemblage within a highly sheared mud and
shale matrix. Both Otter Point and Franciscan typically
show chaotic internal structure.

When the sedimentology of the Otter Point, Dothan,
Franciscan, and Great Valley are compared, many similarities
are apparent, but differences are evident as well. All four
assemblages fall into the area of feldspathic to litho-
feldspathic graywackes. Triangular diagrams of sandstone
constituents show the similarity of the Otter Point and
the Dothan and also the similarity of the Franciscan and
the Great Valley. However, the provenances of the Otter
Point and the Franciscan graywackes are somewhat different.
Otter Point source terrane furnished a more quartz-rich
sediment than the source terrane of the Franciscan.

Workers in California (Imlay and others, 1959) have
mapped the Franciscan Complex continuing northward into
Oregon. On the other hand, workers in Oregon have mapped
the Otter Point only as far south as its contact with the
Macklyn Member of the Dothan north of the California
border.

The relationship of the Otter Point to the Dothan
Formation remains a problem. To date, there has not been
enough comparative work done to answer a basic question:
Are the Otter Point and the Dothan the same formation, or
do they have a relationship with each other similar to
that of the Franciscan and the Great Valley?

Dickenson (1982) attributed the north-south variations of detrital compositions in the Franciscan and the Great Valley to differing degrees of erosion and dissection of the magmatic arc source. Deep erosion of the source terrane would supply sediment enriched in quartz, K-spar, and metamorphic rock particles from the plutonic core and metamorphic halo. In contrast, sediments derived from a little eroded portion of the magmatic arc would consist mainly of plagioclase and volcanic lithic fragments with quartz and K-spar.

The total lack of K-feldspar in Otter Point sandstones could possibly be due to the complete albitization of that mineral. This process has been noted in the Franciscan Complex by Dickenson and others (1982), Moore and Liou (1979), and Cowan (1974), and therefore could very well be true for the Otter Point Formation.

The Otter Point sediments could have been derived from a more dissected and eroded magmatic arc complex and therefore would have received a more quartz-rich sediment, and with the albitization of the K-feldspar, only quartz, plagioclase, and the lithics would remain.

From descriptions of Well and Walker (1953), Dott (1971), and Black (1979), the Dothan Formation does not appear to be a melange. It does not contain native and exotic blocks in a sheared matrix. The sandstone is
relatively unbroken tectonically and appears to be fairly consistent lithologically. Also, the sandstone (graywacke) seems to be much more massive and less conglomeratic than the Otter Point (Dott, 1971).

The lithologic similarities of the Otter Point Formation to the Macklyn Member of the Dothan Formation could possibly suggest that these are the same rocks. On the other hand the Macklyn has the same north-northeast strike trend as does the rest of the Dothan Formation while the Otter Point tends to have a random pattern of strike directions due to the broken and chaotic nature of a melange.
REFERENCES CITED


APPENDIX A

FOLKSS Computer Program Used for Detrital Modal Analysis.
THIS PROGRAM CLASSIFIES AND NAMES SANDSTONES ACCORDING TO THE
CLASSIFICATION OF FOLK AND OTHERS (1970, NEW ZEALAND JOURNAL
OF GEOLOGY AND GEOPHYSICS, V.13,P.937-968). THE PROGRAM
CALCULATES THE PERCENT MINERAL COMPOSITION OF THE TOTAL
ROCK AND THE FRAMEWORK. IT ALSO CALCULATES THE PERCENT
COMPOSITION OF THE QUARTZ FRACTION. UNLESS
Qz TYPES ARE EXCLUDED FROM THE INPUT, IF ONLY THE
MAIN COMPONENTS (Q,F,R,C,M,P,O) ARE USED AS INPUT,
A NAME FOR THE MAIN TRIANGLE ONLY WILL BE PRINTED.
MOSI-ZERO OUTPUT WILL NOT BE PRINTED FOR ALL SANDSTONES
THE PROGRAM RECALCULATES QUARTZ (EXCEPT CHERT) PLUS FELDSPAR
PLUS ROCK FRAGMENTS TO 100 PERCENT, FOR SANDSTONES CONTAINING
ABUNDANT ROCK FRAGMENTS THE PROGRAM RECALCULATES THE
TOTAL ROCK-FRAGMENT PART OF THE FRAMEWORK TO 100 PERCENT AND,
WHERE APPROPRIATE, IT RECALCULATES THE SEDIMENTARY-ROCK-FRAGMENT
PART OF THE FRAMEWORK TO 100 PERCENT. IT THEN PLOTS THE
APPROPRIATE TRIANGLES.

THE PROGRAM MODIFIED FOR THE HARRIS 220 BY
JON D. BOUNDS, JANUARY 31, 1979, AND FOR THE HONEYWELL
66/20, SEPTEMBER, 1980.

INTEGER Y,Z
REAL KF,MR,H,MPQ
DIMENSION RECO(200),RECF(200),RECR(200),PKSR(200),FRIR(200)
& PRMR(200),PRCR(200),PRSHR(200),PRCHR(200),SPLNO(15)
NREAD=22
NWRIT=23
Z=0
I=1
READ(NREAD,5010) N
DO 9999 Y=1,N
READ(NREAD,5000),(SPLNO(Z),Z=1,15),Q,STQ,UQ,MPQ,OPQ,F,KF,PF,R,CR
READ(22,5005),(SHR,CHR,VR,PR,MR,C,CAE,SEC,OC,M,P,O)
TQ=STQ+UQ+MPQ+OPQ+F,KF,PF,R,CR
TF=KF+PF
TR=CR+SHR+CHR+VR+PR+MR+CAE+SEC+OC+M,P,O
Q=F+R+C+H+P+O
IF(Q-TQ) 20,11,20
IF(F-TF) 20,12,20
IF(R-TR) 20,13,20
11 IF(KF=PF) 20,14,20
12 IF(R=TR) 20,15,20
13 DO Q = SUM OF QTZ TYPES (TQ)
14 DO F = SUM OF FELDSPAR TYPES (TF)
15 DO R = SUM OF ROCK-FRAG TYPES (TR)
16 DO C = SUM OF CEMENT TYPES (TC)
590  13  TC=CAC+PIC+PFEC+OC
590  14  IF(C-TC) 20,14,20
610  14  GO TO 30
620  20  WRITE(NWRIT,9010)
630C
640C  *************************************************************
650C  CALCULATION OF TOTAL ROCK COMPOSITION
660  30  PQ=(Q/TCOMP)*100.
670  PSTQ=(STQ/TCOMP)*100.
680  PUQ=(UQ/TCOMP)*100.
690  PMPQ=(MPQ/TCOMP)*100.
700  POPQ=(OPQ/TCOMP)*100.
710  PFE=(F/TCOMP)*100.
720  PKF=(KF/TCOMP)*100.
730  PFF=(PF/TCOMP)*100.
740  PER=(R/TCOMP)*100.
750  PCR=(CR/TCOMP)*100.
760  PSHR=(SHR/TCOMP)*100.
770  PCHR=(CHR/TCOMP)*100.
780  PSR=PCR+PSHR+PCHR
790  PVR=(VR/TCOMP)*100.
800  PPR=(PR/TCOMP)*100.
810  PIR=((PR+VR)/TCOMP)*100.
820  PWR=(MR/TCOMP)*100.
830  PC=(C/TCOMP)*100.
840  PCAC=(CAC/TCOMP)*100.
850  PSIC=(SIC/TCOMP)*100.
860  PFEC=(FEC/TCOMP)*100.
870  POC=(OC/TCOMP)*100.
880  PM=(M/TCOMP)*100.
890  PP=(P/TCOMP)*100.
900  PO=(O/TCOMP)*100.
910  WRITE(NWRIT,6010)
920  WRITE(NWRIT,6020)PD
930  IF(PSTQ+PUQ+PMPQ+POPQ) 4630,33,32
940  32  WRITE(NWRIT,6030)PSTQ,PUQ,PMFQ,POPQ
950  33  WRITE(NWRIT,6050)PFE
960  IF(PKF+PPF) 4630,35,34
970  34  WRITE(NWRIT,6060)PKF,PPF
980  35  WRITE(NWRIT,6100)PER
990C
1000C  *************************************************************
1010  IF(PF,PCAC,PSIC,PFEC,POC) 4630,37,36
1020  37  WRITE(NWRIT,6110)PF,PCAC,PSIC,PFEC,POC
1030  38  WRITE(NWRIT,6150)PC
1040  IF(PCAC+PSIC+PFEC+POC) 4630,39,38
1050  39  WRITE(NWRIT,6160)PCAC,PSIC,PFEC,POC
1060  39  WRITE(NWRIT,6200)PM,PP,PO
1070C
1080C  *************************************************************
1090C  CALCULATION OF FRAMEWORK COMPOSITION
1100  FCOMP=Q+F+R+O
1110  FQ=(Q/FCOMP)*100.
1120  FSTQ=(STQ/FCOMP)*100.
1130  FUD=(UD/FCOMP)*100.
1140  FMPQ=(MPQ/FCOMP)*100.
1150  FOPQ=(OPQ/FCOMP)*100.
1160  FF=(F/FCOMP)*100.
FKF = (KF/FCOMP)*100.
FPF = (PF/FCOMP)*100.
FR = (R/FCOMP)*100.
FCR = (CR/FCOMP)*100.
FSHR = (SHR/FCOMP)*100.
FCHR = (CHR/FCOMP)*100.
FSR = FCR + FSHR + FCHR.
FVR = (VR/FCOMP)*100.
FPR = (PR/FCOMP)*100.
FIR = (IR/FCOMP)*100.
FHR = (HR/FCOMP)*100.
FO = (O/FCOMP)*100.
WRITE(NWRIT, 6250)
WRITE(NWRIT, 6020) FQ
WRITE(NWRIT, 6030) FSTQ, FUQ, FMPQ, FOPQ
WRITE(NWRIT, 6050) FF
WRITE(NWRIT, 6060) FK, FP
WRITE(NWRIT, 6100) FR
WRITE(NWRIT, 6110) FSR, FCR, FSHR, FCHR, FIR, FVR, FPR, FHR
WRITE(NWRIT, 6300) FO
WRITE(NWRIT, 6500) RECO(I), RECFC(I), RECR(I)
CONTINUE
DOES O + F + R = GREATER THAN 50 PERCENT OF TOTAL ROCK ?
IF (POQFR - 50.) 49, 49, 50
WRITE(NWRIT, 6310)
RECALCULATION OF ROCK FRAGS TO 100 PERCENT
50 SR = CR + SHR + CHR
50 IR = PR + UR
50 TR = SR + IR + MR
50 IF (TR) 4630, 60, 70
60 PSR(I) = 0
60 PRR(I) = 0
60 PMR(I) = 0
60 PRR(I) = 0
60 PHR(I) = 0
60 PMR(I) = 0
60 PRR(I) = 0
60 MR = (MR/TR)*100.
RECALCULATION OF SED RK FRAGS TO 100 PERCENT

IF(SR)<4630,80,90
PRCR(I)=0
PRSHR(I)=0
PRCHR(I)=0
GO TO 100

1820 90 PRCR(I)=(CR/SR)*100.
1830  PRSHR(I)=(SHR/SR)*100.
1840  PRCHR(I)=(CHR/SR)*100.

DETERMINATION OF ROCK NAME
1860 100 IF(RECQ(I)<75.) 150,149,149
1870  149 WRITE(NWRT,6400)
1880  GO TO 4800
1890 150 IF(RECQ(I)<75.) 1650,200,200
1900 200 IF((RECQ(I)/RECQ(I)-1.) 300,250,250
1910  250 WRITE(NWRT,6450)

CLASSIFICATION OF SUBFELDSARENITES
1920 650 IF(KF-PF)<4620,260,270
1950  260 IF(PF)<4620,4800,270
1980  270 WRITE(NWRT,6460)
1990  GO TO 4800
2000 280 WRITE(NWRT,6470)
2010  GO TO 4800
2020 300 WRITE(NWRT,6500)

CLASSIFICATION OF SUBLITHARENITES
2030 650 IF<PRMR(I)+PRCR(I)+PCHR(I)>4630,4800,310
2060  310 WRITE(NWRT,6500)
2070  GO TO 4800
2090 350 WRITE(NWRT,6540)
2100  GO TO 950
2110 400 IF(PRMR(I)<33.3) 800,450,450
2120  450 IF(PRMR(I)-PRIR(I)) 500,500,650
2130  500 IF(PRIR(I)-PRMR(I)) 550,550,350
2140  550 WRITE(NWRT,6580)
2150  GO TO 4800
2160 650 IF(PRMR(I)-PRIR(I)) 700,700,350
2170  700 WRITE(NWRT,6600)
2180  710 IF(VR-PRR) 715,715,720
2190  715 WRITE(NWRT,6910)
2200  GO TO 4800
2210 720 WRITE(NWRT,6920)
2220  GO TO 4800
2230 800 IF(PRIR(I)-PRMR(I)) 901,801,700
2240  801 GO TO 550
2250 C

CLASSIFICATION OF SEDIMENTARY SUBLITHARENITES.
2270 950 WRITE(NWRT,6950)PRSHR(I),PRCR(I),PCHR(I)
2280 1000 IF(PRSHR(I)<50.) 1100,1050,1050
2300 1050 WRITE(NWRT,7000)
2310  GO TO 4800
2320 1100 IF(PRSHR(I)<33.3) 1500,1150,1150
C 2330 1150 IF(PRCR(I)-PRCHR(I)) 1200,1200,1350
C 2340 1200 IF(PRSHR(I)-PRCHR(I)) 1250,1250,1050
C 2350 1250 WRITE(NWRT,7050)
C 2360 GO TO 4800
C 2370 1350 IF(PRSHR(I)-PRCR(I)) 1400,1400,1050
C 2380 1400 WRITE(NWRT,7100)
C 2390 GO TO 4800
C 2400 1500 IF(PRCR(I)-PRCHR(I)) 1505,1505,1400
C 2410 1505 GO TO 1250
C 2420C
C 2430C *******************************
C 2440C CLASSIFICATION OF FELDSARENITES
C 2450 1650 IF((RECF(I)/RECR(I))>3.) 1750,1700,1700
C 2460 1700 WRITE(NWRT,6550)
C 2470 IF(KF)4620,1710,1720
C 2480 1710 IF(PF)4620,4800,1720
C 2490 1720 IF(KF-PF)1725,1725,1730
C 2500 1725 WRITE(NWRT,6560)
C 2510 GO TO 4800
C 2520 1730 WRITE(NWRT,6570)
C 2530 GO TO 4800
C 2540 1750 IF((RECF(I)/RECR(I))<1.) 3250,1800,1800
C 2550 1800 WRITE(NWRT,6600)
C 2560C
C 2570C *******************************
C 2580C CLASSIFICATION OF LITHIC FELDSARENITES
C 2590 IF(PMR(I)+PRIR(I)+PRSR(I))4630,4800,1830
C 2600 1830 WRITE(NWRT,6750)PMR(I),PRIR(I),PRSR(I)
C 2610 IF(PRSR(I)-50.) 1900,1850,1850
C 2620 1850 WRITE(NWRT,7150)
C 2630 GO TO 2550
C 2640 1900 IF(PRSR(I)-33.3) 2400,1950,1950
C 2650 1950 IF(PRIR(I)-PRMR(I)) 2000,2000,2150
C 2660 2000 IF(PRSR(I)-PRMR(I)) 2050,2050,1850
C 2670 2050 WRITE(NWRT,7200)
C 2680 GO TO 4800
C 2690 2150 IF(PRSR(I)-PRIR(I)) 2200,2200,1850
C 2700 2200 WRITE(NWRT,7250)
C 2710 2250 IF(VR-PR) 2260,2260,2300
C 2720 2260 WRITE(NWRT,7300)
C 2730 GO TO 4800
C 2740 2300 WRITE(NWRT,7350)
C 2750 GO TO 4800
C 2760 2400 IF(PRIR(I)-PRMR(I)) 2410,2410,2200
C 2770 2410 GO TO 2050
C 2780C
C 2790C *******************************
C 2800C CLASSIFICATION OF SEDIMENTARY LITHIC FELDSARENITES
C 2810 2550 WRITE(NWRT,6750)PRSHR(I),PRCR(I),PRCHR(I)
C 2820 2600 IF(PRSHR(I)<50.) 2700,2650,2650
C 2830 2650 WRITE(NWRT,7400)
C 2840 GO TO 4800
C 2850 2700 IF(PRSHR(I)<33.3) 3100,2750,2750
C 2860 2750 IF(PRIR(I)-PRCHR(I)) 2800,2800,2950
C 2870 2800 IF(PRSHR(I)-PRCHR(I)) 2850,2850,2650
C 2880 2850 WRITE(NWRT,7450)
C 2890 GO TO 4800
C 2900 2950 IF(PRSHR(I)-PRCR(I)) 3000,3000,2650
CLASSIFICATION OF FELDSPATIC LITHARENITES

IF(PRMR(I)+PRIR(I)+PRSR(I))=4630, 4800, 3330
WRITE(NWRT, 7550)
GO TO 4800

IF(PRCH(I)-PRMR(I))<30.
WRITE(NWRT, 6750)
GO TO 2850

IF((RECF(I)/RECR(I))<300)
WRITE(NWRT, 7550)
GO TO 2850

WRITE(NWRT, 6750)
GO TO 4800

WRITE(NWRT, 7550)
GO TO 2850

WRITE(NWRT, 7550)
GO TO 4800

WRITE(NWRT, 7550)
GO TO 4800

WRITE(NWRT, 7550)
GO TO 4800
3490 GO TO 4800
3500 4140 IF(PSR(I)-PRR(I)) 4160, 4160, 4020
3510 4160 WRITE(NWRIT,9000)
3520 4180 IF(VR-PR) 4185, 4185, 4200
3530 4185 WRITE(NWRIT,9200)
3540 GO TO 4800
3550 4200 WRITE(NWRIT,9780)
3560 GO TO 4800
3570 4240 IF(PSR(I)-PRR(I)) 4245, 4245, 4025
3580 4245 GO TO 4100
3590 C
3600 C ****************************
3610 C CLASSIFICATION OF SEDIMENTARY LITHARENITES
3620 4305 WRITE(NWRIT,9550) PSR(I), PRR(I), PRR(I), PRR(I)
3630 4320 IF(PSR(I)-50.) 4360, 4340, 4340
3640 4340 WRITE(NWRIT,9780)
3650 GO TO 4800
3660 4360 IF(PSR(I)-33.3) 4520, 4380, 4380
3670 4380 IF(PRCH(I)-PRR(I)) 4400, 4400, 4460
3680 4400 IF(PSR(I)-PRR(I)) 4420, 4420, 4340
3690 4420 WRITE(NWRIT,9800)
3700 GO TO 4800
3710 4460 IF(PSR(I)-PRR(I)) 4480, 4480, 4340
3720 4480 WRITE(NWRIT,8000)
3730 GO TO 4800
3740 4520 IF(PRCH(I)-PRR(I)) 4525, 4525, 4480
3750 4525 GO TO 4420
3760 4620 WRITE(NWRIT,9000)
3770 4630 WRITE(NWRIT,9200)
3780 C
3790 C ****************************
3800 C CALCULATION OF Qtz-TYPE COMPOSITION OF Qtz FRACTION
3810 4800 IF(STQ+UQ+HPQ+OPQ) 4810, 4900, 4820
3820 4810 WRITE(NWRIT,9020)
3830 4820 RSTQ<(STQ/Q)*100
3840 RUQ<(UQ/Q)*100
3850 RMQ<RSTQ+RUQ
3860 RMPQ<(MPQ/Q)*100
3870 RDPQ<(DPQ/Q)*100
3880 RPQ<RMPQ+RDPQ
3890 RUOPO=RUO+RPQ
3900 WRITE(NWRIT,8050) RSTQ, RUQ, RMQ, RMPQ, RDPQ, RPQ, RUOPO
3910 4900 CONTINUE
3920 5000 FORMAT(15A1, 10(1X, F4.0))
3930 5005 FORMAT(13(1X, F4.0))
3940 5010 FORMAT(13)
3950 6000 FORMAT(" 'SAMPLE NO.' , '15A1', '5X', 'F6.0', '1X', 'TOTAL POINTS',"
3960 & ' COUNTED', ' ', '4X', 'ORIGINAL DATA', ' ', '7X', '0', '2X', 'STQ',"
3970 & '3X', 'UQ', '2X', 'MPQ', '2X', 'DPQ', '4X', 'F', '3X', 'K', '3X', 'PF',"
3980 & '3X', 'C', '2X', 'CAC', '2X', 'SIC', '2X', 'FEC', '3X', 'OC',"
3990 & '4X', 'M', '4X', 'P', '4X', 'Q', '/', '4X', 'F4.0', '22(1X, F4.0),'/ )
4000 & '4X', 'M', '4X', 'P', '4X', 'Q', '/ ', '4X', 'F4.0', '22(1X, F4.0),'/ )
4010 6010 FORMAT(" '10X', 'TOTAL-ROCK COMPOSITION', '/', )
4020 6020 FORMAT(" ', '14X', 'F4.0', '1X', 'PERCENT QTZ', '/', )
4030 6030 FORMAT(" ', '24X', 'F4.0', '1X',
4040 & 'PERCENT MONOCRYSTALLINE STRAIGHT QTZ', '/ ', '25X', 'F4.0', '1X',
4050 & 'PERCENT MONOCRYSTALLINE UDULOSE QTZ', '/ ', '25X', 'F4.0', '1X',
4060 & 'PERCENT METAMORPHIC POLYCRYSTALLINE QTZ', '/ ', '25X', 'F4.0', '1X
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<tr>
<th>FORMAT</th>
<th>COMMENT</th>
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<td>PERCENT OTHER POLYCRYSTALLINE QTZ (EXCEPT CHERT)</td>
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<td>PERCENT FELDSPAR</td>
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<td>PERCENT META RK FRAGS</td>
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**WARNING:** TOTAL Q+F+R LESS THAN 50 PERCENT

**THIS SAMPLE IS A QUARTZ ARENITE**

**THIS SAMPLE IS A SUBFELDSARENITE**

**THIS SAMPLE IS A PLAGIOCLASE SUBFELDSARENITE**

**THIS SAMPLE IS A K-SPAR SUBFELDSARENITE**

**THIS SAMPLE IS A SUBLITHARENITE**

**THIS SAMPLE IS A FELDSARENITE**

**THIS SAMPLE IS A PLAGIOCLASE FELDSARENITE**

**THIS SAMPLE IS A K-SPAR FELDSARENITE**

**THIS SAMPLE IS A LITHIC FELDSARENITE**

**MR + IR + SR RECALCULATED TO 100 PERCENT**

**THIS SAMPLE IS A SEDIMENTARY SUBLITHARENITE**

**THIS SAMPLE IS A PHYLLIC SUBLITHARENITE**

**THIS SAMPLE IS AN IGNEOUS SUBLITHARENITE**

**THIS SAMPLE IS A VOLCANIC SUBLITHARENITE**

**MR + IR + SR RECALCULATED**

**THIS SAMPLE IS AN IGNEOUS LITHIC FELDSARENITE**

**THIS SAMPLE IS AN IGNEOUS LITHIC FELDSARENITE**

**THIS SAMPLE IS A PHYLLIC LITHIC FELDSARENITE**

**THIS SAMPLE IS AN IGNEOUS LITHIC FELDSARENITE**

**THIS SAMPLE IS A PHYLLIC LITHIC FELDSARENITE**
FORMAT( '10X,' 'THIS SAMPLE IS A PLUTONIC LITHIC ',
& 'FELDSPARENITE ')' )
4670 7350 FORMAT( '10X,' 'THIS SAMPLE IS A VOLCANIC LITHIC ',
& 'FELDSPARENITE ')' )
4680 7400 FORMAT( '10X,' 'THIS SAMPLE IS A SHALE LITHIC ',
& 'FELDSPARENITE ')' )
4700 7450 FORMAT( '10X,' 'THIS SAMPLE IS A CHERT LITHIC ',
& 'FELDSPARENITE ')' )
4720 7500 FORMAT( '10X,' 'THIS SAMPLE IS A CARBONATE LITHIC ',
& 'FELDSPARENITE ')' )
4740 7550 FORMAT( '10X,' 'THIS SAMPLE IS A SEDIMENTARY LITHIC ',
& 'FELDSPARENITE ')' )
4760 7600 FORMAT( '10X,' 'THIS SAMPLE IS A PHYLLIC LITHIC ',
& 'FELDSPARENITE ')' )
4810 7700 FORMAT( '10X,' 'THIS SAMPLE IS AN IGNEOUS LITHIC ',
& 'FELDSPARENITE ')' )
4830 7750 FORMAT( '10X,' 'THIS SAMPLE IS A VOLCANIC LITHIC ',
& 'FELDSPARENITE ')' )
4880 7800 FORMAT( '10X,' 'THIS SAMPLE IS A SHALE LITHIC ',
& 'FELDSPARENITE ')' )
4900 7850 FORMAT( '10X,' 'THIS SAMPLE IS A CARBONATE LITHIC ',
& 'FELDSPARENITE ')' )
4930 7900 FORMAT( '10X,' 'THIS SAMPLE IS A SEDIMENTARY LITHIC ',
& 'FELDSPARENITE ')' )
4960 7950 FORMAT( '10X,' 'THIS SAMPLE IS AN IGNEOUS LITHIC ',
& 'FELDSPARENITE ')' )
5000 7920 FORMAT( '10X,' 'THIS SAMPLE IS A PLUTONIC LITHARENITE ',
& 'FELDSPARENITE ')' )
5010 7940 FORMAT( '10X,' 'THIS SAMPLE IS A VOLCANIC LITHARENITE ',
& 'FELDSPARENITE ')' )
5020 7960 FORMAT( '10X,' 'THIS SAMPLE IS A SHALE LITHARENITE ',
& 'FELDSPARENITE ')' )
5030 7980 FORMAT( '10X,' 'THIS SAMPLE IS A CHERT LITHARENITE ',
& 'FELDSPARENITE ')' )
5040 8000 FORMAT( '10X,' 'THIS SAMPLE IS A CARBONATE LITHARENITE ',
& 'FELDSPARENITE ')' )
5050 8050 FORMAT( '10X,' 'QIZ-TYPE COMPOSITION OF QIZ ',
& 'FRACTION' )
5060 14X F4.0,1X 'PERCENT MONOCRYS'TALINE ',
5070 14X F4.0,1X 'PERCENT MONOCRYS'TALINE ',
5080 14X F4.0,1X 'PERCENT TOTAL MONOCRYS'TALINE ',
5090 14X F4.0,1X 'PERCENT METAMORPHIC ',
5100 14X F4.0,1X 'PERCENT OTHER ',
5110 14X F4.0,1X 'PERCENT TOTAL POLYCRYSTALINE QIZ (EXCEPT CHERT) ',
5120 14X F4.0,1X 'PERCENT TOTAL POLYCRYSTALINE QIZ (EXCEPT CHERT) ',
5130 14X F4.0,1X 'PERCENT MONOCRYS'TALINE-UNDULOSE ',
5140 14X F4.0,1X 'PERCENT MONOCRYS'TALINE-UNDULOSE ',
5150 9000 FORMAT( '10X,' 'SOMETHING IS SCREWY VALUE OF A COMPONENT ',
& 'FELDSPARENITE ')' )
5160 1 IS NEGATIVE ',
5170 9010 FORMAT( '10X,' 'THE VALUE OF AT LEAST ONE OF THE ',
& 'FELDSPARENITE ')' )
5180 9020 FORMAT( '10X,' 'SOMETHING IS SCREWY VALUE OF A COMPONENT ',
& 'FELDSPARENITE ')' )
5190 9030 FORMAT( '10X,' 'SOMETHING IS SCREWY VALUE OF A COMPONENT ',
& 'FELDSPARENITE ')' )
5200 9040 FORMAT( '10X,' 'SOMETHING IS SCREWY VALUE OF A COMPONENT ',
& 'FELDSPARENITE ')' )
5210 9990 FORMAT( '14X,' 'NUMBER OF SAMPLES =', '15,5X,' 'TRI SCALE =', '15,' )
5230 9092 FORMAT(' ',2X,'(5X,F10.5)')
5240 9093 FORMAT(' ',11X,'RECQ','11X','RECF','11X','RECR')
5250 9094 FORMAT(' ',11X,'PRSR','11X','PRIR','11X','PRMR')
5260 9095 FORMAT(' ',10X,'PRSHR','11X','PRCR','10X','PRCHR')
5270 I=I+1
5280 9999 CONTINUE
5290 NSCALE=100
5300 WRITE(6,9091) N,NSCALE
5310 WRITE (6,9093)
5320 DO 9050 I=1,N
5330 WRITE(6,9092) RECQ(I),RECF(I),RECR(I)
5340 9050 CONTINUE
5350 CALL TRI (RECQ,RECF,N,NSCALE,1)
5360 WRITE(6,9091) N,NSCALE
5370 WRITE (6,9094)
5380 DO 9051 I=1,N
5390 WRITE(6,9092) PRSR(I),PRIR(I),PRMR(I)
5400 9051 CONTINUE
5410 CALL TRI (PRSR,PRIR,N,NSCALE,2)
5420 WRITE(6,9091) N,NSCALE
5430 WRITE (6,9095)
5440 DO 9052 I=1,N
5450 WRITE(6,9092) PRSHR(I),PRCR(I),PRCHR(I)
5460 9052 CONTINUE
5470 CALL TRI (PRSHR,PRCR,N,NSCALE,3)
5480 STOP
5490 END
5500C
5510C
5520C
5530C
5540 SUBROUTINE TRI (A,B,N,NSCALE,INX)
5550C
5560 INTEGER INX,J
5570 DIMENSION A(200),B(200),POINTS(51,101),ZPOINT(200,2)
5580 $PLTPNT(9)
5590 DATA PERIOD,'/',BLANK,'/
5600 DATA PLTPNT,'8','2','3','4','5','6','7','8','9'
5610 DATA TEMPER,'4'/
5620 DO 2 J=1,50
5630 DO 2 I=1,101
5640 POINTS(J,I)=BLANK
5650 2 POINTS(J,I)=PERIOD
5660 DO 12 I=1,101,10
5670 12 POINTS(J+1,I)=TEMPER
5680 DO 3 I=2,50
5690 K=52-I
5700 L=50+I
5710 POINTS(I,K)=PERIOD
5720 3 POINTS(I+1,L)=PERIOD
5730 POINTS(I,51)=TEMPER
5740 DO 13 I=6,46,5
5750 K=52+I
5760 L=50+I
5770 POINTS(I,K)=TEMPER
5780 13 POINTS(I+1,L)=TEMPER
5790 DO 7 I=1,N
5800 X=A(I)
5810    Y=B(I)
5820    IF (Y) 90,70,80
5830   70    Y=0.001
5840   80    IF (NSCALE-100) 90,101,90
5850   90    IF (NSCALE-10) 100,110,100
5860  100    XLOC=100.0X/2.
5870   GO TO 10
5880  110    XLOC=10.0X/2
5890   GO TO 10
5900  101    XLOC=-1.00X/2
5910   10  CONTINUE
5920    LOC=XLOC+.5
5930   LOC=51-LOC
5940    IF (NSCALE-100) 190,201,190
5950  190    IF (NSCALE-10) 200,210,200
5960  200    JLOC=-XLOC+101.-100.*Y+.5
5970   GO TO 11
5980  210    JLOC=-XLOC+101.-10.0*Y+.5
5990   GO TO 11
6000  201    JLOC=-XLOC+101.-1. *Y+.5
6010   11  CONTINUE
6020    ZPOINT(I,1)=LOC
6030   ZPOINT(I,2)=JLOC
6040    KOUNT=0
6050   DO 8 J=1,I
6060    IF(ZPOINT(J,1)-LOC) 8,16,8
6070  16    IF(ZPOINT(J,2)-JLOC) 9,17,9
6080  17    KOUNT=KOUNT+1
6090   8  CONTINUE
6100    IF (KOUNT-8) 96,96,98
6110  98    KOUNT=9
6120  96    POINTS<LOC,JLOC>=PLTPNT(KOUNT)
6130    7  CONTINUE
6140    IF(INX.EQ.1) GO TO 400
6150   400    WRITE(6,5)
6160    WRITE(6,1)
6170   DO 4 M=1,51
6180  51    WRITE (6,6) (POINTS(M,Q),Q=1,101)
6190   4  CONTINUE
6200   500    WRITE(6,502)
6210  501    DO 501 M=1,51
6220  51    WRITE(6,6) (POINTS(M,Q),Q=1,101)
6230   500    WRITE(6,502)
6240   501  CONTINUE
6250    WRITE(6,503)
6260  504    WRITE(6,504)
6270  505    WRITE(6,5)
6280   DO 505 M=1,51
6290  51    WRITE(6,6) (POINTS(M,Q),Q=1,101)
6300  500    WRITE(6,502)
6310    501  CONTINUE
6320    WRITE(6,503)
6330  504    WRITE(6,504)
6340  505    WRITE(6,5)
6350  500    WRITE(6,601)
6360   DO 600 M=1,51.
6370  601    WRITE(6,6) (POINTS(M,Q),Q=1,101)
6380  602  CONTINUE
WRITE(6,603)
   1 FORMAT( '63X,'QUARTZ'
   5 FORMAT( 'I'
   6 FORMAT( '16X,10A1)
   9 FORMAT( '10X,'FELDSP',10X,'FKFRAG'
   15 FORMAT( '9X,'(KSP+PC)' )
   502 FORMAT( '64X,'SEDRKF'
   503 FORMAT( '10X,'IGNRKF',10X,'METRKF'
   504 FORMAT( '9X,'(VOLC+PLUT)' )
   601 FORMAT( '64X,'SHLRKF'
   603 FORMAT( '10X,'CA RKF',10X,'CH RKF'
   700 DO 701 I=1,51
   701 DO 702 M=1,101
   702 CONTINUE
   701 CONTINUE
   700 CONTINUE
   701 CONTINUE
   700 RETURN
   701 END

*
APPENDIX B

Areal Extent of Aerial Photo Mapping
Figure 22. Index map of the Floras Creek area showing areas mapped on the basis of aerial photo interpretation (shaded).