TEC-5

# PRELIMINARY GEOLGOIC REPORT, PARCEL # 1
## SIMULTANEOUS FILING NOTICE NO. 1

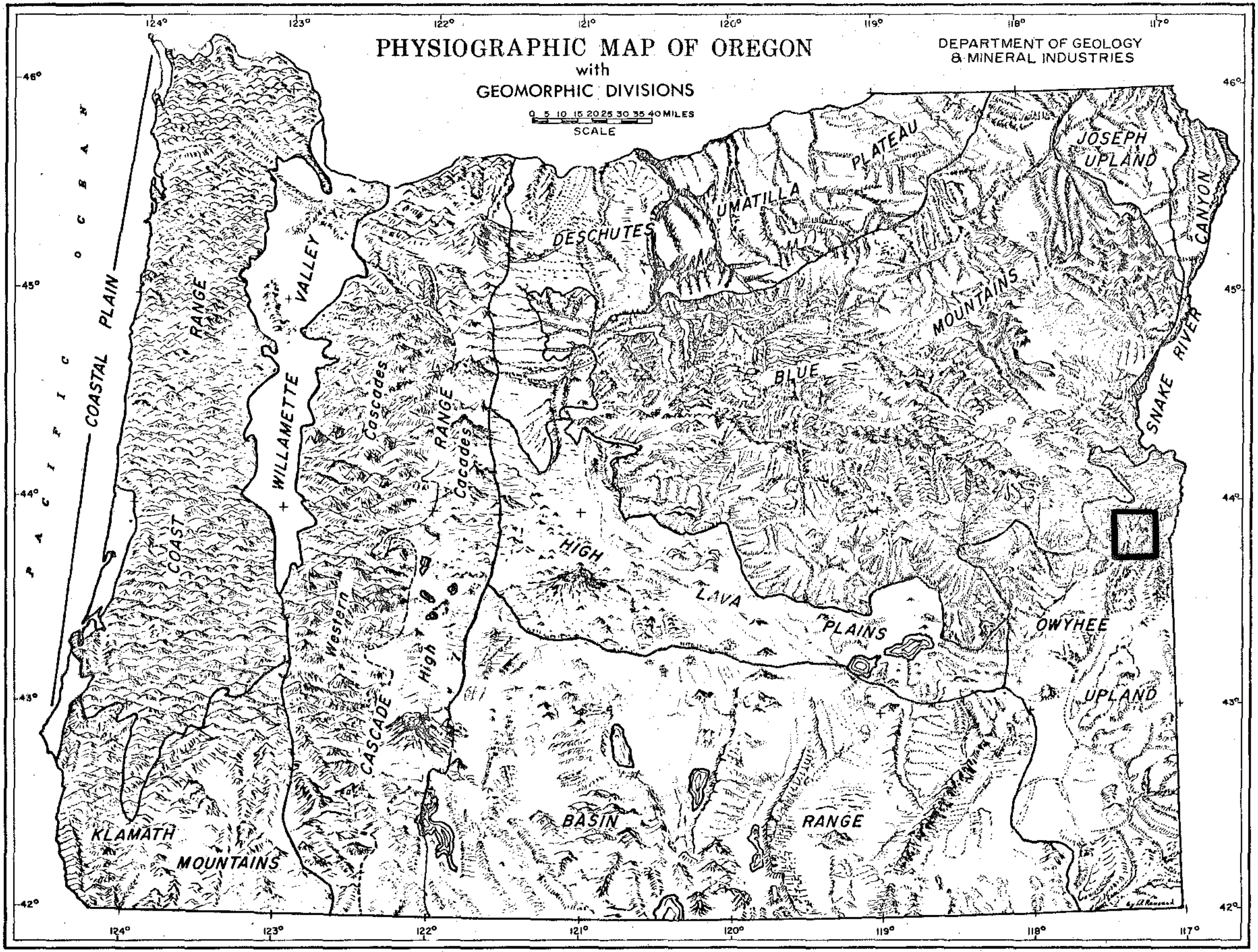
H. D. PILKINGTON, DISTRICT GEOLOGIST
AMAX EXPLORATION, INC.

## INTRODUCTION

Parcel #1 of the Oregon State Division of Lands Simultaneous Filing Notice No.1, Sec. 16 & Sec. 36 T.21S., R.45E., lies within the northern part of the Owyhee Uplands (Fig.1). The area is characterized by a moderately to highly dissected surface with a very few perennial streams. The maximum relief in the area is about 1750 feet. The lowest elevations are along the Owyhee River, east of Mitchell Butte, and the maximum elevation is over 4000 feet along Owyhee Ridge east of Owyhee Dam. Mitchell Butte, a prominent topographic feature has an elevation of 3501 feet and Deer Butte is at an elevation of 3623 feet. The two sections of land comprising Parcel #1 are separated by the valley of the Owyhee River, the only perennial stream in the area.

## STRATIGRAPHIC GEOLOGY

The Owyhee Uplands are characterized by flat-lying or gently dipping sedimentary and volcanic rocks of Miocene, Pliocene and Pleistocene age. The rocks are a complex sequence of lenticular, intercalated basalts, rhyolites, ash-flow tuffs, volcaniclastics, fluvial sediments and lacustrine sediments.



Geomorphic divisions modified from Dicken, Oregon Geography, 1950.

Figure 1. Physiographic and geomorphic map of Oregon, area of report outlined in solid black line.

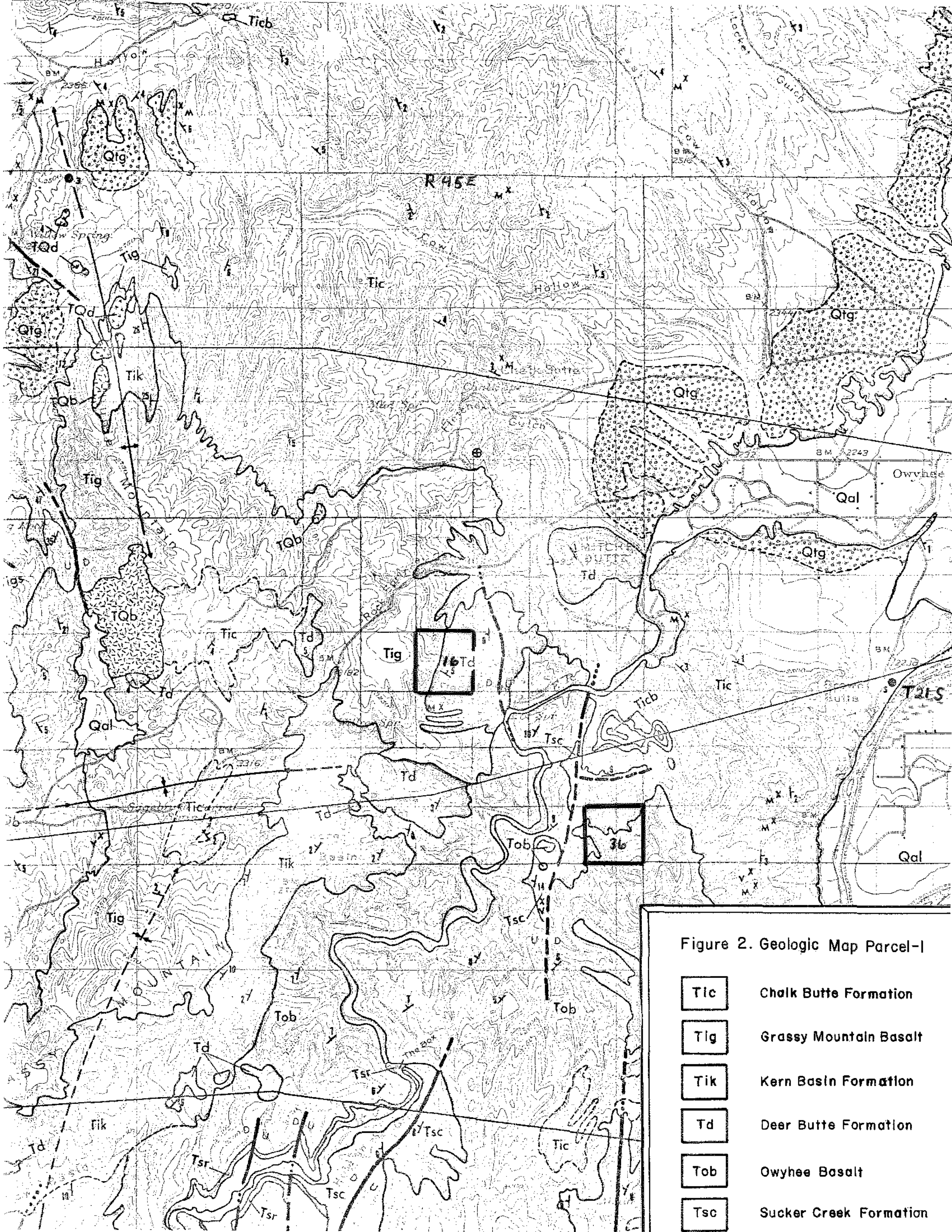



Figure 2. Geologic Map Parcel-I

Minor intrusive domes and associated flows which cut the Pliocene sediments, represent the youngest volcanic activity in this part of the Owyhee Uplands.

## Sucker Creek Formation

The oldest rocks exposed in the immediate area of Parcel #1 are those of the Sucker Creek Formation of upper Miocene age (Fig.2). The unit consists of over 2000 feet of fine-grained lacustrine and fluvial, thin bedded, light colored, tuffaceous siltstones, claystones and shales, arkosic sandstones and granite conglomerates (Corcoran et al, 1962). Intercalated rhyolite flows (Kirkham, 1931) and associated feeder vents (Corcoran et al, 1962) and ash-flow tuffs (Kittleman et al, 1965) occur in the upper part of the unit. In the lower part of the formation a series of basaltic flows occur. Vertebrate fossils indicate a Barstovian late Miocene age for the unit (Beaulieu, 1972). A basalt flow from the lower part of the section gives a radiometric age of 16.7 million years.

## Owyhee Basalt

The Owyhee Basalt unconformably overlies the rocks of the Sucker Creek Formation (Fig.2). The Owyhee Basalt consists of up to 1300 feet of multiple basalt flows and interbedded tuffs. Corcoran,et al (1962) estimate that the tuffs and ash deposits constitute nearly one half of the unit. The main exposures crop out in the canyon walls of the Owyhee River (Bryon, 1929) from Mitchell Butte southward. The basalts are fine-grained to aphanitic, dark gray to black and each flow unit is characterized by a vesicular or scoriaceous top. The thickness of individual flows ranges from 5 to as much as 100 feet. The intercalated vitric tuffs and pumiceous lappillistones are lenticular and their maximum thickness ranges up to 15 feet. The age of the Owyhee Basalt is upper Miocene, and hence correlates in a general way with the Columbia River Basalts.

## Deer Butte Formation

The Deer Butte Formation of upper Miocene age (Corcoran et al, 1962 and Kittleman et al, 1965) rests unconformably upon the Owyhee Basalt or older rocks (Fig.2). The unit is named for the strata exposed on Deer Butte. The lower part of the formation consists of fine-grained tuffaceous sandstones, siltstones, claystones, and carbonaceous shales with at least three intercalated basalt flows. The rocks are characteristically pale orange to yellow orange in color although various shades of green, gray or red do occur. The volcanic constituents are almost universally altered to mixtures of montmorillonite and halloysite (Kittleman et al, 1965). In the immediate area of Parcel #1, the thickness of the lower member is not great, however, it is reported to be as much as 500 feet, a few miles to the southwest. The upper member of the Deer Butte Formation is characterized by arkosic sandstones and granite conglomerates with interbedded volcanic sandstones, siltstones, and shales. The volcanic constituents in the coarser layers is variable, but almost always in amounts up to 10 per cent. The epiclastic debris in the arkosic sandstones and granite conglomerates represents the weathering products of a granitic terrane, probably derived from the Silver City area of Idaho, about 35 miles southeast of Deer Butte. Approximately 1250 feet of the coarse upper member are exposed on Deer Butte. Paleontologic evidence indicates an upper Miocene age. Kittleman et al (1965) places the upper part of the Deer Butte Formation into the early Pliocene on the basis of mammalian fossils collected from the Poison Creek Formation, which he considers as contiguous with the upper part of the Deer Butte.

## Idaho Group

Mapping on the west side of the Snake River downwarp by Corcoran et al (1962) indicated that the diverse lithologic units in the Idaho Formation as proposed by Cope (1883) and later amplified by Malde and Powers (1962) could be divided into mapable units. Therefore, the rocks have been elevated to group status by Corcoran et al(1962) and Baldwin (1966). The group consists of a thick sequence of fluvial and lacustrine siltstones and shales, sandstones, tuffs, diatomites, conglomerates and a few intercalated basalt flows. The rocks range in age from lower through middle Pliocene.

### Kern Basin Formation

The basal member of the Idaho Group as defined by Corcoran et al, (1962) is the Kern Basin Formation (Fig.2). The unit includes over 750 feet of poorly consolidated tuffs, tuffaceous siltstone and sandstone, graywacke and minor conglomerate. A few basaltic flows occur throughout the Kern Basin Formation. The Kern Basin Formation rests unconformably upon the Deer Butte Formation or older rocks (Fig.2).

## Grassy Mountain Basalt

The middle member of the Idaho Group is the Grassy Mountain Basalt which consists of over 1000 feet of basaltic flows and interbedded volcanic sediments. The Grassy Mountain basalts rest unconformably upon the Kern Basin Formation or older rocks (Fig.2). The distinguishing feature of the Grassy Mountain basalts is the presence of olivine.

## Chalk Butte Formation

The youngest unit of the Idaho Group is the Chalk Butte Formation of Corcoran, et al (1962). The rocks lie unconformably upon the eroded surface of the Grassy Mountain Basalts or older units (Fig.2). The Chalk Butte Formation consists of over 550 feet of poorly consolidated tuffaceous sandstones and siltstones, conglomerates, tuffs, and fresh water limestones. In general the rocks show nearly equal development of fluvial and lacustrine features. Fossil evidence suggests a middle Pliocene age for the Chalk Butte Formation (Beaulieu, 1972).

## Basic Flows and Intrusive

Small intrusive domes and associated flows are scattered throughout the area (Fig.2). The rocks range in composition from dacite to basalt. The rocks are considered to be of Plio-Pleistocene age inasmuch as they are younger than the Idaho Group.

## Quaternary Deposits

Terrace gravels of probable Pleistocene age cap benches which lie 50 to 100 feet above the present day drainage channels. The gravels are poorly consolidated basalt boulders and cobbles set in a matrix of sand or silt. The recent alluvium is confined to the flood plains of the perennial streams.

## STRUCTURAL GEOLOGY

The dominant structural feature of the Owyhee Upland is the Snake River downwarp. The downwarp is an accurate structure which extends from Yellowstone National Park southwest to Twin Falls, Idaho, thence northwest to the Oregon border. The western extremity of the depression lies along the edge of the Owyhee Uplands. The margin of the downwarp has undergone extensive normal faulting which started in middle Miocene times and continued into the late Pliocene or Pleistocene time. Sedimentation, volcanism and faulting operated simultaneously throughout one part or another of the depression from middle Miocene to middle Pliocene.

Some folding occurred after the deposition of the Idaho Group. Two post Idaho Group structures are shown in Figure 2. A broad gentle syncline extends northeastward from Burnt Mountain to Grassy Mountain and has been called the Grassy Mountain syncline by Corcoran et al (1962). The second feature is the Double Mountain anticline in the northwest part of the map area. The anticline may have been caused, at least in part, by the emplacement of the intrusive domes and associated flows. An exploratory drill hole put down by El Paso Oil & Gas Co. in 1954 penetrated several dacitic flows and andesite sills(?) before bottoming in a thick dacite at a depth of 7,470 feet.(Stewart, 1954).

The block faulting in the area trends in a general northerly direction, but a few trend northwesterly and even fewer have a northeasterly trend. The structural complexity is related to the intersection of Basin and Range structures with the Snake River downwarp. Displacement along any single fault is measured in hundreds of feet while displacement along the entire border zone is on the order of several thousand feet.

Slump blocks or landslide blocks are common in many of the tuffaceous rocks overlain by basalts. The slump blocks range from a few feet to as much as a half mile in length and result in outcrop patterns and topographic expressions which may be confused with faults. Good examples of slumped or landslide topography occur in Sec. 30, T.22S., R.46E., and Sec. 3, T23S., R.45E.

## HYDROLOGY

The Owyhee Uplands is a semi-arid area with an annual precipitation of about 10 inches but may reach as high as 15 inches per year at elevation greater than 4000 feet. Within the area of Figure 2, the Owyhee River is the only perennial stream. The annual runoff in the report area is 0.5 inches (Phillips, 1969).

### Surface Water

The Owyhee River, below Owyhee Dam, has a drainage area of over 11,000 square miles. Records over the past 34 years (Phillips, 1969) show the average stream flow to be 319 c.f.s. The quality of the surface water below Owyhee Dam is generally good, about 220 ppm dissolved solids and has a hardness of 100 ppm as defined by U.S.Geological Survey. The Owyhee Dam was constructed by the U.S.B.R., has a storage capacity of 1,120,000 acre-feet, provides water for irrigation of 85,000 acres.

## Ground Water

Although the Owyhee Uplands is a semi-arid area, the region is classified as having modest quantities of available groundwaters (Phillips, 1969). Ground water recharge appears to be fairly good and must be transported fairly rapidly through the fractured volcanic rocks. Numerous springs occur in the immediate area of Parcel #1. Most are found along the lower contact of basaltic flow units with any of the mapped stratigraphic units. In general these springs have a slightly higher dissolved solid content than the Owyhee River, and flow rates range from a trickle to as much as 20 gpm. Some attempt was made in the past to develop the spring in Sec. 16, T21S, R45E, for stock watering purposes.

Four thermal springs are recorded in the immediate area (Bowen & Peterson, 1970). There is no flow data published for the hot springs near Parcel #1, but the other published information is shown in Table 1.

Table 1. Summary of Thermal Springs, Parcel # 1.

| Name of Spring | Location | Maximum Temp. °C |
|---|---|---|
| Mitchell Butte Hot Springs | Sec.12 T21S, R45E | 61 |
| Deer Butte Hot Springs | Sec.14 T21S, R45E | 46 |
| N.Black Willow Springs | Sec.25 T21S, R45E | 19 |
| S.Black Willow Springs | Sec.35 T21S, R45E | 22 |

## SEISMIC ACTIVITY

Oregon is relatively quiet in terms of earthquake activity. The reason for the low activity is that the circumpacific earthquake belt which extends along the western coast of North America bifurcates in California. Thus the active belts pass on either side of the state. Figure 3 shows the epicenters for earthquakes in Oregon from 1841 through 1970 (Couch and Lowell, 1971). Only two epicenters have been plotted in the Owyhee Uplands and both of these are near Rockville. Berg and Baker (1963) postulate the Rockville earthquakes may have been related to geothermal activity rather than tectonic movements.

## SUBSIDENCE POTENTIAL

Geothermal production from Parcel #1 will be dependent upon the discovery of a geothermal resource. Geologically, the best potential resevoir rocks would appear the fractured volcanic flows of the more deeply buried parts of the upper Miocene rocks or the earlier Tertiary volcanic rocks which floored the upper Miocene basins. Geothermal production from such resevoir rocks should not result in subsidence problems, especially since the expected depths of production would be between 5 and 10 thousand feet.

Surface subsidence related to gravitational movements, that is the slump blocks and landslide blocks previously discussed, could represent a potential geothermal drilling and production problem. However, detailed mapping of the unstable terrain will locate possible unstable areas and if well sites must be located in the unstalbe areas, suitable soils engineering can be done to eliminate the problems.

H.D. Pilkington

H.D.Pilkington

## BIBLIOGRAPHY


Baldwin, E.M., 1964, Geology of Oregon; Ann Arbor, Mich., Edward Brothers, Inc.

Beaulieu, J.D., 1972, Geologic Formations of Eastern Oregon, East of longitude 121° 30'; Oregon Dept. Geol. & Min. Indusries Bull 73.

Berg, J.W., Jr. and Baker, C.D., 1963, Oregon Earthquakes, 1841 through 1958; Seism. Soc. Amer. Bull Vol 53 P.95.

Bowen, R.G. and Peterson, N.V., 1970, Thermal Springs and Wells, Oregon Dept. Geol & Min. Industries Misc. Paper 14.

Bryon, Kir, 1929, Geology of the Owyhee Irrigation Projects; U.S.Geol. Survey Water Supply Paper 597-A.

Cope, E.D., 1883, On the Fishes of the Recent and Pliocene Lakes of Western Parts of the Great Basin and of Idaho Pliocene Lakes; Geol. Nat.Sci; Philadelphia, Proc. P.134.

Corcoran, R.E., et al, 1962, Geology of the Mitchell Butte Quadrangle, Oregon; Oregon Dept. Geol & Min. Industries Gms 2.

Couch, R.W. and Lowell, R.P., 1971, Earthquakes and Seismic Energy Release in Oregon; Ore Bin Vol 33, No.4.

Kirkham, V.R.D., 1931, Bevision of the Payette and Idaho Formations, Jour. Geol. Vol 39, P.193.

Kittleman, L.R., et al, 1965, Cenozoic Stratigraphy of the Owyhee Region, Southeastern Oregon; Oregon Museum Nat. Hist. Bull 1.

Kittleman, L.R., et al, 1967, Geologic Map of the Owyhee Region, Malheur County, Oregon; Oregon Museum Nat. Hist. Bull 8.

Malde, H.E., and Powers, H.A., 1962, Upper Cenozoic Stratigraphy of Western Snake River Plain, Idaho; Geol. Soc. Amer. Bull Vol 73, P.1197.

Phillips, K.N., 1969, Water Resources and Development, in Mineral and Water Resources of Oregon, A.E. Weissenborn, editor; Oregon Dept. Geol. & Min. Industries Bull 64.

Stewart, R.E., 1954, Oil and Gas Exploration in Oregon; Oregon Dept. Geol & Min. Industries, Misc Paper 6.