The ORE BIN
Vol. 29, No. 7
July 1967

# Structure and Orogenic History of the Southwestern Part of the John Day Uplift, Oregon

By H. J. Buddenhagen*

Predominantly marine sediments ranging in age from Devonian to Cretaceous, unmetamorphosed, and not intruded by large igneous bodies, are exposed in the John Day Uplift** of central Oregon (figure 1). Detailed mapping of these beds and their structural features in the southwestern part of the uplift has provided important clues to the pre-Tertiary geological history of the vast lava-covered plateau region east of the Cascade Mountains. It is expected that the results of this work will be published as a bulletin of the State of Oregon Department of Geology and Mineral Industries within the next 12 to 18 months. In the meantime, the following is offered as a brief preview and summary of the more important findings and implications.

The distribution and structural relationships of the major stratigraphic units are shown on the accompanying generalized maps (figures 1 and 2). These units are listed and briefly described in the following paragraphs. For more detailed description of the stratigraphy of this area, reference may be had to the reports listed at the end of this paper.

## Stratigraphy

### Paleozoic

Devonian: fossiliferous limestone with a little gray shale; depositional relationships to older and younger formations unknown.

Mississippian: fossiliferous limestone, marl, and sandstone.

Pennsylvanian: clastic sediments, mostly of non-marine origin, consisting of greenish mud-siltstones containing sparse fossil plants; feldspathic sandstones with occasional laminae and lenses of magnetite grains; and coarse, rounded porphyry boulder conglomerates.

---

* Consulting geologist, Grants Pass, Oregon.

** The term "John Day Uplift," as used herein, refers to the inlier of pre-Tertiary formations which are exposed largely within the triangle formed by lines joining the settlements of Burns, John Day, and Paulina in east-central Oregon. The uplift is bordered on the north by the John Day River and it is drained principally by tributaries of this river. The town of John Day is located on the north edge of the uplift 12 miles west of its northeast corner.

Permian (early): limestones containing fusulinids and other fossils with interbedded green and maroon cherts, siltstones, and sandstones. Trilobite fragments were found in an isolated fault block of Permian limestone--the only known trilobite occurrence in Oregon*.

Mesozoic-Paleozoic?

Birdsong beds: interbedded fine-grained sandstones, siltstones, chert fragment grits and conglomerates, bedded chert and massive, chert-like, felsitic andesite; unfossiliferous; stratigraphic position and age uncertain. The principal occurrence is in the hills $1\frac{1}{2}$ to 3 miles west of the Weberg and H. Robertson ranch buildings.

Mesozoic

Triassic: an unfossiliferous lower section several thousand feet thick, consisting of chert fragment and volcanic wacke grits and sandstones with lenticular conglomerates, overlain unconformably by a section of marine origin containing fossils of Late Triassic age**. The latter has a limestone boulder conglomerate at the base which is overlain by thinly interbedded black organic shale, siltstone, fine-grained graded sandstone, sandy limestone, and calcareous sandstone with occasional zones of rubbly limestone and thin, agate-pebble conglomerates.

Jurassic: many thousand feet thick, predominantly thinly interbedded, sparsely fossiliferous (ammonites) tuffaceous siltstone, black shales, and volcaniclastic sandstones with a relatively thin (200- to 300-foot) basal section composed of highly fossiliferous sandy limestone and calcareous sandstone with interbedded organic black shales. The fauna of the basal beds, except the Hettangian, referred to later, includes the unique Plicatostylus and abundant pelecypods and brachiopods, as well as distinctive ammonites.

Upper Cretaceous: fossiliferous sandstone with minor interbedded siltstone and conglomerate.

Tertiary

Miocene and Pliocene: Tertiary lavas surround the uplift. In the southwest part, with which this article is concerned, these are mostly basalts, and mostly post-Columbia River Group in age. Younger ridge-capping pumiceous tuffs and rhyolitic lavas occur both within and outside the inlier in the same area. Underlying both, although not everywhere present, is a thin, widespread zone of bentonitic clay and tuffaceous sand associated with uncemented conglomerate composed of well-rounded quartzite pebbles and boulders. This zone probably correlates with the Mascall Formation of the John Day Valley. Pre-Miocene Tertiary volcanic rocks and sediments have not been recognized in the area under discussion.

---

* Identification by D. A. Bostwick.
** Fossil determinations and correlation by N. J. Silberling.

## Structure and Tectonic History

Because of the complex structure, the apparent discontinuity of the beds, and scarcity of outcroppings, the geology of the Paleozoic area is very obscure. It is known from fossil evidence that formations of Devonian to Permian age are present, but it has not been possible to establish a proper lithologic-stratigraphic column for the Paleozoic section based on observed superposition of beds; and the basement on which the oldest Paleozoic sediments were deposited is unknown. Consequently, deciphering the geology of the Paleozoic area is akin to working a jigsaw puzzle with many of the pieces missing. It is clearly evident, however, that these beds have been extremely compressed and much faulted.

### Paleozoic-Triassic episodes

Although specific unconformities in the Paleozoic section, indicative of diastrophic episodes, cannot be detected with assurance because of the complex and obscure structure, it cannot be doubted that tectonic activity has occurred during the late Paleozoic-Early Triassic interval, perhaps repeatedly.

The non-marine origin of much of the Pennsylvanian section, with its coarse conglomerates, in contrast with the fossiliferous limestones and sandstones of the Mississippian, indicates an intervening period of uplift and diastrophism.

The absence of Late Permian deposits suggests that the area was either above sea level during this time interval, with consequent non-deposition, or that sediments which may have been deposited during this period were uplifted and eroded during Early or Middle Triassic time. The latter possibility is supported by the reported occurrence of a Late Permian fusulinid in a limestone boulder from an Upper Triassic conglomerate (Bostwick and Nestell, 1965).

Additional evidence of diastrophism in the Late Permian-Early to Middle Triassic interval is present in the area between Williams Reservoir and Grindstone Creek (to the north), where there is a strong angular unconformity between Early Permian beds and overlying limestone boulder-bearing conglomerates of probable Upper Triassic age.

Within the Triassic itself, Paleozoic limestone boulder conglomerate at the base of the fossiliferous marine section suggests the presence of a land mass rising at that time and exposing Paleozoic limestones to erosion near a subsiding basin; but the fine-grained character of most of the subsequent Upper Triassic sediments indicates that the deformation was probably not great.

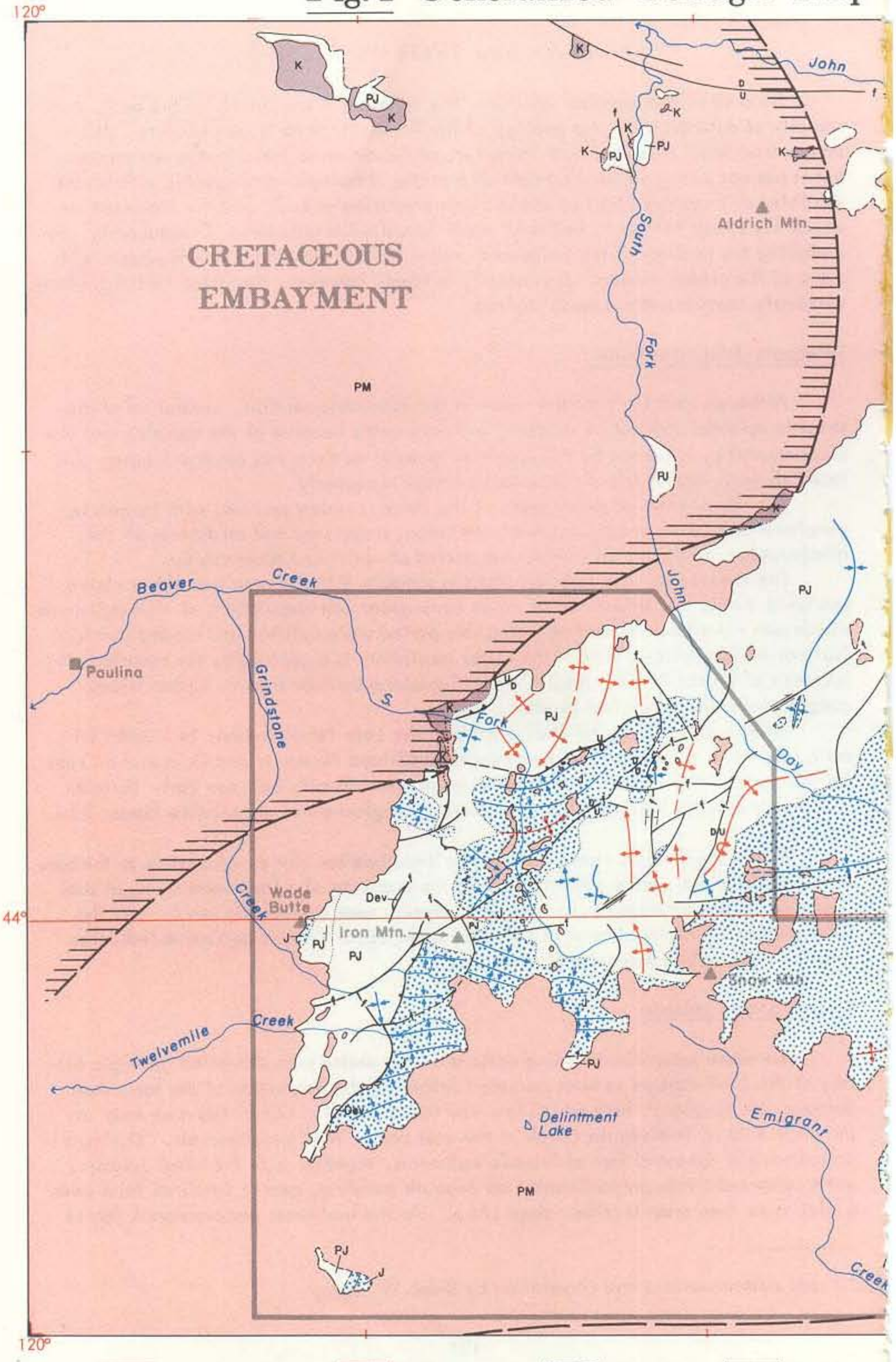
### Lower Jurassic episode

The major mountain-building episode in the entire post-Devonian geologic history of the area appears to have occurred following the deposition of the lowermost Jurassic (Hettangian)* beds which are now found cropping out in this area only on the north side of Twelvemile Creek at the east end of Williams Reservoir. During this period several thousand feet of Triassic sediments, together with the basal Jurassic, were compressed into predominantly north-south trending, nearly isoclinal folds over a wide area (see cross section, page 134). As the east-west compressional forces

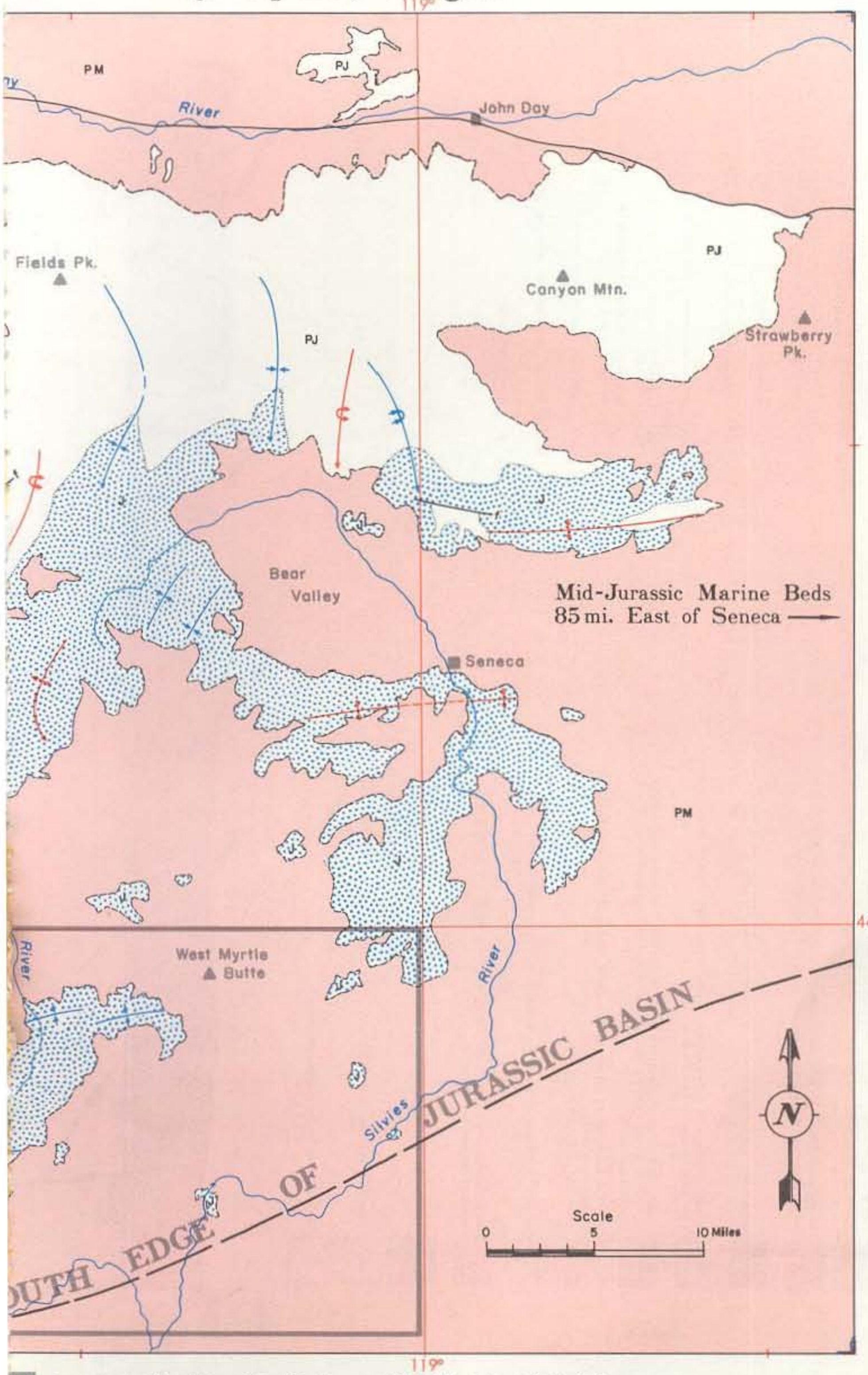
---

* Fossil determinations and correlation by Ralph W. Imlay.

# Fig. 1 Generalized Geologic Map



e John Day Uplift, Oregon




Area mapped by the author. Geology outside this area adapted from maps by C.E. Brown – T.P. Thayer & W.R. Dickinson – L.W. Vigrass

# Explanation

**wt** — Youngest volcanic rocks, mainly welded tuff; probably correlates with Rattlesnake and Danforth. Not mapped on south side of uplift.

**T** — Tertiary undifferentiated. Predominantly basalt, mostly post-Columbia River, but includes thin, widespread quartzite boulder conglomerate and bentonitic clays.

**K** — Upper Cretaceous marine sandstone, conglomerate, and shale, interbedded.

**J** — Jurassic undifferentiated, predominantly marine volcaniclastic and tuffaceous sediments; porphyritic andesite and basalt in lower part.

**Ŧu, Ŧ** — Triassic undifferentiated, predominantly clastic sediments with marine fossils in upper shales and limestone; Ŧu? in Paleozoic area beds containing coarse limestone and sandstone boulders.

**bs, a, c** — Age ? Probably Triassic and Permian. No fossils. bs: predominantly fine-grained sandstone to grit with chert fragments; a: andesite and dacite, massive, felsitic, chert-like, buff; c: bedded cherts.

**P** — Permian: fossiliferous limestone and associated maroon and green cherts.

?

**IP** — Pennsylvanian: clastic, mostly non-marine sediments ranging from fine-grained sandstone to coarse boulder beds.

**M** — Mississippian. Marine limestone and sandstone.

**Dev** — Devonian. Fossiliferous limestone.

**?** — No information on, or uncertain correlation.

Unconformity.

Fault, concealed where dotted.

Fault interpreted to be thrust or reverse type; tooth on over-thrust block.

Depositional contact.

Strike and dip of bedding

Vertical or near vertical bedding (shown only in Paleozoic area).

Overturned bedding

Direction of gentle (2°-5°) dip in Tertiary formations; determined by photogeology.

Axes of folding: syncline, anticline.

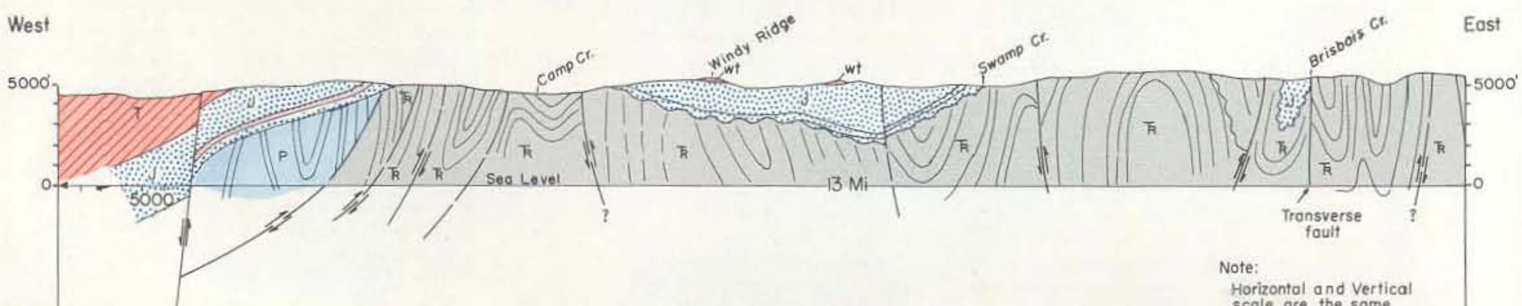
Axes of overturned folds: anticline, syncline

Invertebrate fossil

Plant fossil

Main roads.

Other roads




East-West Cross Section

continued to be active, low-angle, westerly-dipping thrust faults developed on which Paleozoic and Birdsong beds overrode the Triassic to the east. The large limestone blocks at the northeast end of the Paleozoic area and the steeply dipping bedded chert capping the three hills directly south of the Williams Reservoir are considered to owe their position to this faulting. They now remain as outliers, or klippe, as a result of subsequent erosion of the surrounding area (figure 2).

The irregular lobate contact between Paleozoic-Triassic rocks on the west and the Triassic-Jurassic beds on the east, which bears about N. 20° E. from the vicinity of the Burger Ranch in the southwest corner of the map to near the north edge of the map (figure 2) marks the outcrop area of this thrust-fault zone. The overthrust mass appears to have broken into several blocks, probably separated by nearly vertical transverse faults, which have moved eastward differentially, some moving farther than others, and at different times.

## Upper Jurassic-Lower Cretaceous episode

Relatively soon after this mountain-building episode, a major easterly-trending trough, as much as 30 miles wide and more than 100 miles long, developed, in which thousands of feet of marine Jurassic sediments accumulated. There is no record of uppermost Jurassic or Lower Cretaceous sedimentation in this trough, so it is concluded that the sea had withdrawn prior to this time, probably because of regional uplift. It was during this depositional hiatus that north-south compressional forces became dominant, resulting in folds in the Jurassic with generally easterly-westerly trends, as shown on the accompanying maps. The thrust-fault contact between the Triassic and Jurassic, extending easterly from near the Colpitts Ranch, and between the Jurassic and older formations in the Burger Ranch-Iron Mountain area, also probably occurred during this period of tectonic activity.

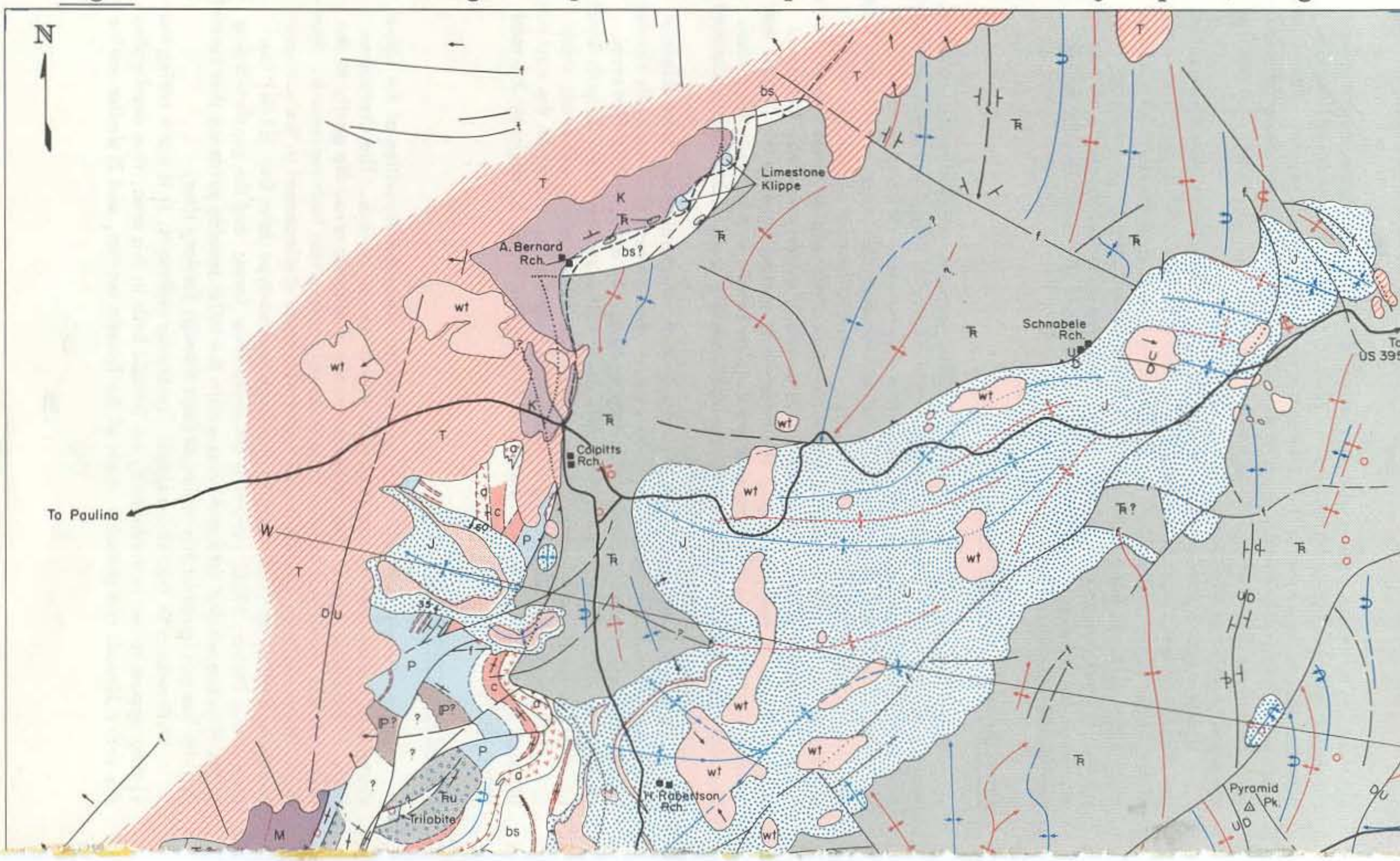
The pre-Jurassic rocks, with their north-south structural grain, were affected by this north-south compression in various ways: development of 1) markedly sinuous trends of structural axes and vertically dipping beds; 2) deep, saddle-like cross folding, for example, the one about a mile and a half southwest of the Colpitts Ranch, which preserves Jurassic beds in a west-plunging syncline; and 3) extremely steep anticlinal plunge dips terminating in thrust-type cross-faults, present on the west side of lower Brisbois Creek south of the east end of the Paulina-U.S. Highway 395 road shown on figure 2.

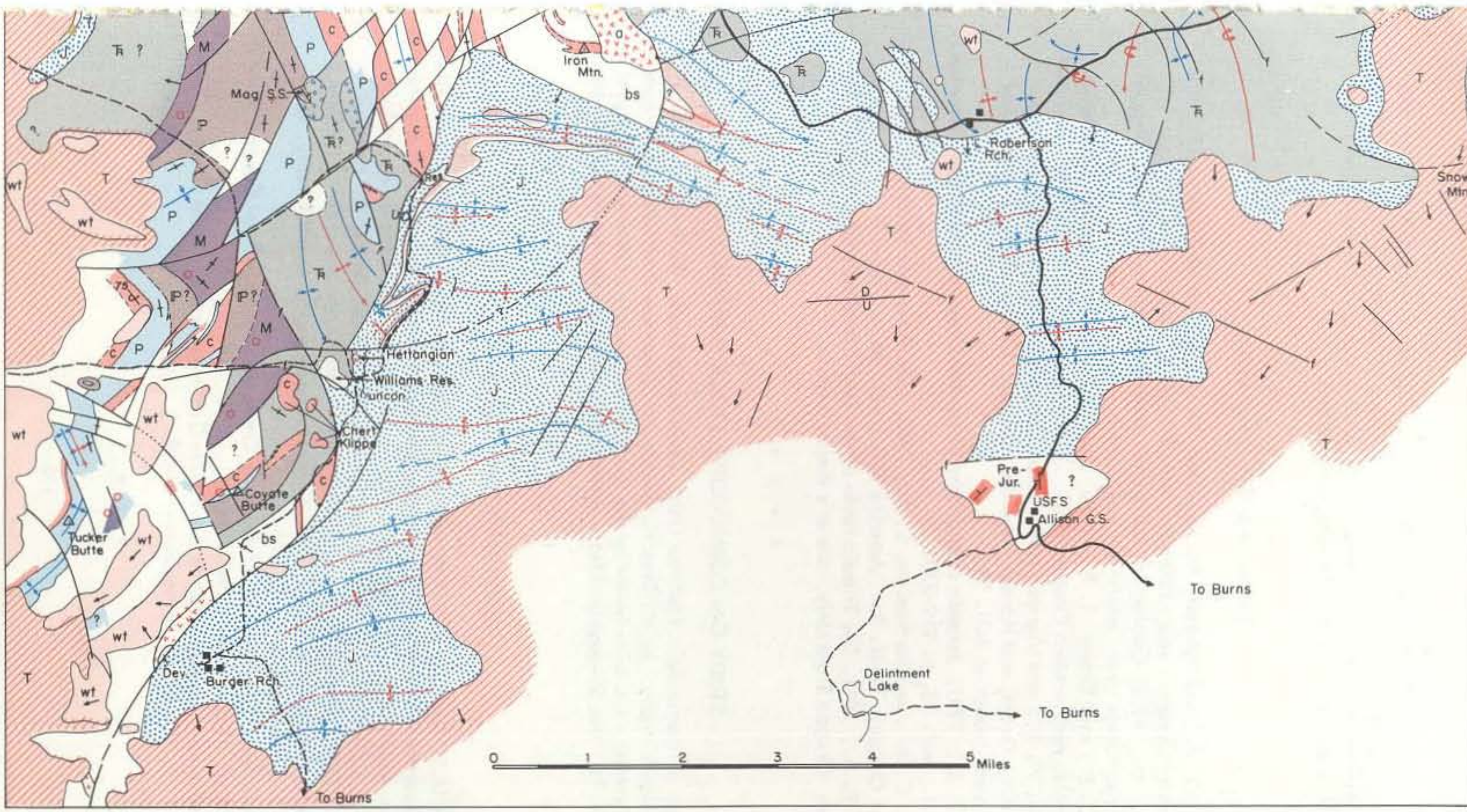
## Post-Cretaceous activity

Except for regional uplift, tectonic activity since the deposition of the Upper Cretaceous has been minor compared with that of earlier periods. The Cretaceous beds, cropping out only in the northwest corner of the map area, dip gently to the northwest and appear not to have been involved in important fault movements. However, the prevalence of normal type faults with small displacement in the surrounding upper Tertiary volcanic terrain, the large reverse-type John Day (River) fault (Brown and Thayer, 1966) involving Columbia River lavas; and the gentle warping of the Pliocene welded tuffs and lavas within the inlier provide evidence that tectonic activity has continued in this region at least through Tertiary time.

With respect to the marine Upper Cretaceous sediments, it is worth noting that: 1) they appear to rest unconformably on Triassic beds in this area, thus overlapping the entire Jurassic and probably much of the Triassic section, and 2) similar marine

Fig.2 Generalized Geologic Map of the S.W. part of the John Day Uplift, Oregon




Iron Mtn.
bs
Mag. S.S.
Robertson Rch.
Snow Mtn.
Hettangian
Williams Res.
Duncan
Chert Klippe
Coyote Butte
Tucker Butte
Pre-Jur.
USFS
Allison G.S.
To Burns
Dey
Burger Rch.
Delintment Lake
To Burns
To Burns
0 1 2 3 4 5 Miles

Upper Cretaceous deposits occur in north-central and northwestern Washington and in southwestern Oregon. The implication is that much of the terra incognita below the Tertiary lavas westerly from this area is underlain by unmetamorphosed Cretaceous, and probably also Jurassic and Triassic, marine beds.

## Selected Bibliography


Bostwick, D. A., and Nestell, M. K., 1965, A new species of Polydiexodina from central Oregon: Jour. Paleont., vol. 39, p. 611-614.

Brogan, J. H., 1952, Geology of the Suplee area, Dayville quadrangle, Oregon: Oregon State Univ. master's thesis, unpub.

Brown, C. E., and Thayer, T. P., 1966, Geologic map of the Canyon City quadrangle, northeastern Oregon: U.S. Geol. Survey Misc. Geol. Inv. Map I-447.

Dickinson, W. R., and Vigrass, L.W., 1965, Geology of the Suplee-Izee area, Crook, Grant, and Harney Counties, Oregon: Oregon Dept. Geology and Mineral Industries Bull. 58.

Lupher, R. L., 1941, Jurassic stratigraphy of central Oregon: Geol. Soc. America Bull., vol. 52, p. 219-270.

Merriam, C. W., and Berthiaume, S. A., 1943, Late Paleozoic formations of central Oregon: Geol. Soc. America Bull., vol. 54, p. 145-171.

Nesbitt, R. A., 1951, The Triassic rocks of the Dayville quadrangle, central Oregon: Oregon State Univ. master's thesis, unpub.


* * * * *

## STUDY ON CORNUCOPIA STOCK PUBLISHED

"Petrology of Cornucopia Tonalite Unit, Cornucopia Stock, Wallowa Mountains, Northeastern Oregon," by William H. Taubeneck, Department of Geology, Oregon State University, has been issued by the Geological Society of America as Special Paper No. 91. The 56-page booklet is a study of the nature and origin of the tonalite.

* * * * *

## USGS MAPS ON OPEN FILE

The three U.S. Geological Survey maps listed below have been placed on open file in the Department's Portland office, where they are available for consultation. Material from which copies of these maps may be made at private expense is available from the U.S Geol. Survey, 830 N.E. Holladay St., (P.O. Box 3202) Portland, Oregon. 97208. Maps are accompanied by explanation, and the scale is 1:62500.

Preliminary geologic map of the Courtrock quadrangle, Grant County, Oregon, by T. P. Thayer and C. Ervin Brown.

Preliminary geologic map of the Long Creek quadrangle, Grant County, Oregon, by T. P. Thayer and C. Ervin Brown.

Preliminary geologic map of the Prairie City quadrangle, Grant County, Oregon, by T. P. Thayer, C. Ervin Brown, and R. L. Hay.

* * * * *