MALHEUR

State Department of Geology and Mineral Industries

1069 State Office Building
Portland 1, Oregon

Marine Jurassic outliers in the Juniper Mountain area of eastern Oregon[1/]

Norman S. Wagner[2/], Howard C. Brooks[2/], and Ralph W. Imlay[3/]

Baker, Oregon and Washington, D. C.

1/Publication authorized by the directors of the United States Geological Survey and the State of Oregon Department of Geology and Mineral Industries.

Manuscript received , 1962.

2/Geologist, Oregon State Department of Geology and Mineral Industries

3/Geologist, U. S. Geological Survey

ABSTRACT

Middle Jurassic fossils have been found at a number of localities within a thick sedimentary sequence in northern Malheur County, eastern Oregon. The fossils, mostly ammonites, furnish correlations with the Weberg, Warm Springs, and Snowshoe formations of east central Oregon and with the early and middle parts of the Bajocian stage of Europe. That pre-Bajocian Mesozoic strata are present, also, is indicated by other fossil evidence. In addition, many parts of the sequence have yielded no fossils and hence strata younger than Bajocian may be present.

Knowledge concerning the Jurassic paleogeography of Oregon has recently been advanced significantly by discoveries of several areas of fossiliferous marine Jurassic sedimentary rocks near the eastern border of the state. Prior to these discoveries Jurassic rocks had been found in Oregon only in its southwestern corner in the Klamath Mountains and in its east central part within a triangular area (Izee-Suplee) whose corners are marked by the towns of John Day, Burns and Paulina. The recently discovered Jurassic occurrences in eastern Oregon are located; (1) about eleven miles southwest of Ironside, Malheur County (Lowry, unpublished manuscript), (2) about ten miles south of Ironside, Malheur County, (3) in the area of Juniper Mountain west and southwest of Brogan, Malheur County, and (4) in the Snake River Canyon, Wallowa County, near the northeast corner of the state (Morrison, 1961, p. 105-110). In addition Jurassic beds may be present between Brogan and Huntington, but the fossil evidence consists only of one fragmentary ammonite found about 4 miles north of Brogan (Ernest Wolff, unpublished thesis). Figure 1 shows the relative position in Oregon of all the above mentioned Jurassic areas.

This paper deals primarily with the Juniper Mountain area and particularly with the Jurassic fossil collections made therein. The first collections were made by Wagner and Brooks during the summer of 1960 while making a reconnaissance map of the area. Additional collections were made during the summer of 1961 with the help of Imlay and other visiting geologists. Figure 2 shows the pre-Tertiary rock exposures in the area mapped by Wagner and Brooks, and the approximate positions of the localities from which Mesozoic fossils were obtained. All fossil identifications were made by Imlay.

The Juniper Mountain area contains windows of pre-Tertiary rocks that are old topographic highs representing the most southeasterly of the pre-Tertiary exposures of the Blue Mountains uplift in northeastern Oregon. These rocks are surrounded widely by volcanic, lacustrine, and fluviatile formations of Miocene to Pleistocene age, including at least two basalt units, a rhyolitic tuff, and a basaltic tuff-agglomerate. Over most of the area the younger units of the blanketing Cenozoic are horizontal to gently dipping. Steep dips are present locally, however, owing mainly to faulting or to tipping of fault blocks. Physiographically the area is part of a deeply incised volcanic plateau that is locally modified by faulting.

Stratigraphy and Structure of Pre-Tertiary beds

The pre-Tertiary rocks of the Juniper Mountain area from oldest to youngest include (1) a sequence of acidic to intermediate meta-volcanics that contain some intercalated shale, sandstone and conglomerate; (2) a massive limestone; and (3) a very thick sequence of more or less metamorphosed shale, sandstone, graywacke and conglomerate. The massive limestone appears to be separated from the adjoining rocks units by slight unconformities and perhaps, also, by faulting along its lower contact.

At present the meta-volcanics and associated sedimentary rocks are considered to be of Late Triassic age on the basis of structural position and a scant amount of poorly preserved fossils (personal communication, David Bostwick, Oregon State University, 1960). The overlying limestone is considered as probably Late Triassic or possibly Early Jurassic, but it has furnished no fossils. The highest sequence locally has furnished fossils of Middle Jurassic age, which are discussed herein.

The strata containing the Jurassic fossils consist of a repetitious sequence of black, grey and tan shales, greywackes, and conglomerates. In nearly all exposures the beds strike northeast to east and dip steeply north. Field observations made during the course of mapping failed to disclose the usual stratigraphic or structural criteria indicative of repetition by folding or faulting. Therefore, prior to the identification of the fossils, the repetitious lithology was considered to be the result of normal cyclic sedimentation and the sequence was thought to be thousands of feet thick, becoming progressively younger to the north. Doubt was cast on the validity of these observations, however, by the folding indicated in the area of the fossil localities when the fossils found at localities 1 and 2 proved to be slightly older than those at localities 3,4, and 5.

Because of the difficulty in proving the existence of isoclinal folding in many of the pre-Tertiary rock sequences of northeastern Oregon further study of this area with its potential fossil control might prove very worthwhile.

MESOZOIC FOSSIL LOCALITIES IN MALHEUR COUNTY, OREGON

The geographic locations of the fossil localities in the Juniper Mountain area of Malheur County are shown in figure 2. The fossils found at these localities are listed below.

Localities	Fossils
1. Near top of ridge about 100 feet north of fence in SW¼ sec. 5, T. 16 S., R. 41 E.	Tmetoceras sp. Pleydellia? sp. Posidonia ornati Quenstedt
2. About 100 feet north of locality 1.	Tmetoceras sp. Pleydellia? sp. Lytoceras? sp. Posidonia ornati Quenstedt Astarte sp.
3. Near center NE¼ sec. 7, T. 16 S., R. 41 E.	Witchellia of. W. albidus Buckman Docidoceras? sp Posidonia ornati Quenstedt
4. S. E. corner NW¼ sec. 7, T. 16 S., R. 41 E.	Witchellia sp.

5.	Center of south line of SE¼ NW¼ sec. 5, T. 16 S., 41 E	Stephanoceras (Skirroceras?) sp. Plicatula? sp. Isognomon? sp.
A.	Just above massive limestone, SE¼ NW¼ sec. 9, T. 16., R. 41 E.	Astarte? sp., Oxytoma sp., Oxytoma sp., Entolium? sp., Pleuromya? sp., Isognomon? sp., Gervillia sp., Linguloid and rhynchonellid brachiopods.
B.	About 75 to 100 feet north of massive limestone in N. E. ¼ NE¼ sec. 9, T. 16 S., R. 41 E.	Oxytoma sp., Lima? sp. Chlamys? sp., Entolium? sp., Cercomya? sp., Isognomon? sp., Myoconcha? sp., Crucilobiceras? sp.

Some occurrences of Jurassic fossils west and northeast of the Juniper Mountain area in Malheur County are of interest because they show that Jurassic rocks are fairly widespread in eastern Oregon. The fossils found at these localities are listed below.

Localities	Fossils
On Duncan Ranch, about 8 miles south of Ironside, in NE corner sec. 9, T. 16 S., R. 39 E.	Witchellia cf. W. albidus Buckman Docidoceras? sp. juv. Posidonia ornati Quenstedt
Near Rail Canyon, about 8 miles southwest of Ironside in S. W. corner sec. 11, T. 16 S., R. 38 E.	Stephanoceras sp. Witchellia sp. Parabigotites? sp. Posidonia sp.
Near Becker Creek, about 13 miles W. S.W. of Huntington, in sec. 36, R. 42 E., T. 14 S.	Tmetoceras? sp.

In the Juniper Mountain area the basal Middle Jurassic is represented definitely at localities 1 and 2 by the ammonite Tmetoceras, which occurs world wide in the lower part of the Bajocian. This genus in the Izee-Suplee area of east central Oregon occurs in the basal beds of the Weberg formation (Lupher, 1941, p. 253) on the west side of the Mowich Anticline, and about 100 feet above the base of the Snowshoe formation on the east side of the Mowich anticline, as based on field observations by Imlay.

Slightly younger beds of early middle Bajocian age are represented by fossils from localities 3 and 4. This age is based on the presence of the ammonite Witchellia which in Europe ranges through the zones of Sonninia sowerbyi and Otoites sausei into the lower part of the zone of Stephanoceras humphriesianum. In the Izee-Suplee area Witchellia occurs in the middle and upper parts of the Weberg formation and in the overlying Warm Springs formation. It occurs, also, in the lower and middle parts of the Snowshoe formation above the basal 100 to 200 feet, according to field observations by Imlay.

The middle Bajocian is represented, also, by fossils at locality 5 as shown by the occurrence of the ammonite Stephanoceras. This genus in Europe ranges from the upper part of the zone of Sonninia sowerbyi into the zone of Strenoceras subfurcatum (basal upper Bajocian). The specimens found at Juniper Mountain locality 5 are

all fragmentary, but bear large tubercles near the middle of the flanks as in the subgenus Skirroceras which is common in the middle part of the Snowshoe formation in central Oregon. In Europe Skirroceras occurs in the upper part of the range of Witchellia in the Otoites sauzei zone, but ranges higher to the top of the middle Bajocian. Likewise in Oregon it ranges higher than Witchellia.

The age of the strata represented by localities A and B is uncertain because most of the fossils collected are either wretchedly preserved or belong to long-ranging genera. However, the presence of the pelecypod Oxytoma favors a Jurassic or a late Triassic age. Likewise, one ammonite fragment matches fairly well with the genus Crucilobiceras from the Lower Jurassic of the Izee-Suplee area.

The fossil occurrences west of Juniper Mountain on the Duncan Ranch and near Rail Canyon are of middle Bajocian age, also, because the same ammonites are present as at localities 3 to 5 on Juniper Mountain. The ammonite found near Becker Creek southwest of Huntington is too poorly preserved for a positive generic identification but its characteristics favor assignment to Jurassic rather than to Triassic genera.

All these occurrences in Malheur County are good evidence that Jurassic beds were once continuous eastward from the Izee-Suplee area of central Oregon at least as far as Brogan. Furthermore, the great thickness of probable Jurassic rocks near Brogan suggests that the Jurassic extended somewhat further east. In this regard it is only 25 to 30 miles from Brogan to Mineral, Idaho, where both Lower Jurassic (McKee (and others), 1956, p. 2) and Upper Jurassic (Callovian) (Livingston, 1932, p. 33, 34; Lupher, 1941, p. 265) fossils have been found. Evidently Jurassic seas covered most of eastern Oregon and at least part of western Idaho.

REFERENCES CITED

Livingston, D. C., 1932, A major overthrust in western Idaho and northeastern Oregon: Northwest Science, v. 6, p. 31-36.

Luper, R. L., 1941, Jurassic Stratigraphy of central Oregon: Geol. Soc. America Bull., v. 52, p. 219-270, 4 pls., 3 figs.

Lowry, W. D., Publication pending, Geology of the Ironside Quadrangle: Oregon Dept. Geology and Mineral Industries.

McKee, E. D. (and others), 1956, Paleotectonic maps of the Jurassic system: (U. S. Geol. Survey Misc. Geol. Inv. Map 1 - 175, 6 p., incl. geol. map.

Morrison, R. F., 1961, Angular Unconformity marks Triassic-Jurassic Boundary in Snake River area of northeastern Oregon: Ore.-Bin, Oregon Dept. Geology and Mineral Industries, v. 23, no. 11, p. 105-111, ill.

Wolff, Ernest., 1959, The Geology of the Upper Willow Creek-Cow Valley area of northern Malheur County, Oregon; University of Oregon Masters thesis.

PRE-TERTIARY OUTLIERS IN THE JUNIPER MOUNTAIN AREA OF NORTHERN MALHEUR COUNTY, OREGON

by
Norman S. Wagner

During the past summer, our department, State Department of Geology and Mineral Industries, undertook an investigation of some magnetic iron prospects in the vicinity of Brogan, Oregon. This led to the mapping of several previously unmapped exposures of pre-Tertiary age in an area otherwise comprised predominantly of Tertiary volcanics. Study of the pre-Tertiary exposures led in turn to the discovery of marine sediments of Jurassic age.

This discovery of Jurassic strata is geologically important for two reasons. One is that these strata constitute a link in a chain of exposures which now serve to show that the Jurassic seas extended from central Oregon to western Idaho. Secondly, recognition of a Jurassic section so close to Brogan will undoubtedly be of ultimate value in resolving some of the stratigraphic problems existent in neighboring portions of Baker and Malheur counties where some lithologic units are thought to be Jurassic, yet lack fossil control to prove the correlation with certainty. The objective of this talk is to summarize our findings with respect to the Brogan area pre-Tertiary as a whole, and especially with respect to the Jurassic discovery.

May we have the first slide, please.

Slide 1 - This slide shows the location of the project area with reference to the distribution of known exposures of pre-Tertiary rock in the eastern half of the State - excepting for a small pre-Tertiary exposure straddling the Oregon-Nevada boundary in the Pueblo Mountain area of Harney County.

(a) The red color represents areas occupied by granite or related igneous rock.

(b) The blue represents areas occupied by all other types of pre-Tertiary material - sediments and volcanics and their metamorphic equivalents, and including also some occurrences of gabbro, peridotite and serpentine.

(c) All uncolored areas represent terrain blanketed by material of Tertiary age - excepting for the small exposure on the Nevada line as previously mentioned.

As you can see, the project area occupies a position on the extreme southern margin of the principal belt of pre-Tertiary exposures in the northeastern portion of the State.

Slide 2 - Here we have the project area detail.

(a) The yellow represents areas occupied by lakebed sediments of Tertiary age.

(b) The uncolored area is occupied almost wholly by volcanics of Tertiary age.

(c) All remaining colors - green, red, blue, and gray - represent rock of pre-Tertiary status.

Limestone unit

By way of describing these units, consider first the area designated by blue. This represents a massive limestone which is abundantly jointed, and hence blocky. The strike is generally east-west with a steep dip to the north. In this respect, the attitude coincides generally well with the regional pattern prevalent in the instance of the other sediments in the area. However, some divergence between the strike of the limestone and the strike of the adjoining sediments does exist in places along both the northern and southern contacts. Such divergences are particularly conspicuous along the eastern portion of the southern contact. Our conclusion at this time is that this situation is due to faulting and that the

limestone is fundamentally conformable with the underlying sediments. Along the northern contact the strike divergences are much less pronounced, but nonetheless present, locally. In this instance we incline to the presumption that an unconformable relationship of mild proportions probably exists between the limestone and the overlying sediments.

From a lithologic standpoint, this limestone can be described as one that has not undergone any appreciable amount of recrystallization. It has been silicified, however, especially along joint trends in the western portion of the exposure.

Metavolcanic unit

The area designated by the green color is occupied by a lithologic complex made up of both metavolcanics and sediments. The metavolcanics are by far the most prevalent. They include an assortment of lavas of rhyolitic and andesitic affinity but for the most part they are represented by a rock apparently altered from a rhyolitic tuff. The iron prospects which gave rise to this mapping are located in these volcanics.

The sedimentary phase of this unit is made up of shales, sandstones, normal conglomerate and an odd looking boulder conglomerate which appears to have originated as a mudflow rather than as a product of clean-cut aqueous deposition. One of the shale members of this unit is vivid red in color. The approximate distribution of this particular member is indicated on the slide by the red color. The other sedimentary members are not shown, however, for two reasons. First, they tend to be lenticular and not too cleanly exposed. Secondly, and most pertinent, the available base map lacks the topographic control needed for accurate plotting. Under the circumstances we studied the sediments but did not try to map them.

These sediments are all located in the northeastern portion of the green area - in part immediately south of the red shales, and from there east to the eastern boundary of the exposure.

Graywacke-shale unit

This group of rocks is located to the north of the limestone and is represented on the slide by the gray color. It is made up entirely of clastic sediments - namely, siltstones, shales, sandstones and conglomerates. By and large, the shales range from tan to gray to black, while the sandstones and conglomerates are predominantly drab tan to olive green in color, and sometimes blackish. Much of the sandstone is probably graywacke. Limestone interbeds in the form of well defined bodies are notably absent. However, some of the graywacke does exhibit a limy tendency in places, and limestone nodules have been encountered in two or three narrow zones of very restricted extent.

From the standpoint of succession these shales, graywackes and conglomerates are repeated many times each in the section, yet all observed strikes have been consistently close to east-west, and all dips have been consistently steep to the north. Under the circumstances, the repetition of lithologies must be due either to faulting and tight folding, or to a repetitious cycle of environments during deposition. As to which condition predominates, all that we can justly say at this time is that we have as yet seen no conclusive evidence of overturning. In short, the weight of evidence encountered thus far suggests we are dealing with a naturally thick section. An interesting sidelight is that these sediments exhibit increasingly greater foliation and schistocity in the northern portion of the map area than they do in the southern portion. The degree

of metamorphism is low, but the difference between northern and southern exposures is nonetheless noticeable.

Correlation

The question of geologic age constitutes the next topic to be considered. On this score let me direct your attention to the four numbered circles situated in the large pre-Tertiary area indicated in the southwest corner of the map. These circles mark the locations at which fossils have been found. You will note that one circle occurs within the sediments of the "green" unit; secondly, that the remaining three circles all occur within the area occupied by the graywackes and shales of the "gray" unit; and third, that no fossil locality is indicated within the "blue" limestone area despite the fact that we describe the limestone as being relatively fresh and un-recrystallized. You might also note that the three fossil localities spotted in the "gray" unit all occur pretty close to the same place in the section insofar as the strike is concerned.

With respect to fossil locality #1, you will recall that I mentioned a "boulder conglomerate" as one of the sedimentary members of the so-called "volcanic" unit. This "boulder conglomerate" is the host rock for the fossils. It is so because some of its cobbles and boulders are made of limestone.

The fossil content of these cobbles consists largely of shell fragments in a decidedly poor state of preservation. Nevertheless the fossil remains are present, and the significant point is that despite a fairly intensive search, we found no comparable fossil remains in the massive limestone of the neighboring exposure. The inference is, therefore, that the limestone cobbles originated from some other source. Furthermore,

since the red shales and other sediments with which the boulder conglomerate is associated appear to dip under the massive limestone, and since neither the limestone nor the clastic sediments appear to be overturned, a second inference is that the parent source must be an older limestone.

Considered as a whole, this unit of volcanics and sediments, including the red shale and red conglomerate, is strikingly similar lithologically to rocks exposed below Huntington in the Snake River Canyon, in the vicinity of the old Gypsum mine and the Bay Horse mine. Because these Snake River rocks have been considered to be Permo-Triassic in age, and because certain Triassic conglomerates in central Oregon contain limestone cobbles bearing Permian fusulinids, we had hoped that thin-sectioning might serve to disclose fusulinids in some of the limestone pebbles from this location.

However, critical study by Dr. Bostwick of Oregon State College revealed no evidence of fusulinids. Instead, Dr. Bostwick reports the presence of a coral he tentatively identifies as Spongiomorpha, a genus that occurs in late Triassic rocks in the western United States. Therefore, until additional fossil evidence is collected to permit a more exact dating, the boulder conglomerate and its associated sediments must be regarded tentatively as having formed in very late Triassic time, or possibly even during the early Jurassic.

Fossil site #2 is next on the list. Small clams rate as the most prevalent kind of fossil found here. Furthermore they are fairly abundant and easy to find. However, our collection turned out to contain no forms that were sufficiently distinctive to permit dating closer than Mesozoic. Under the circumstances there is nothing more that can be said about this particular locality until the area is revisited and a more diversified collection is made.

Fossil sites #3 and #4 are the important ones inasmuch as both have yielded ammonites which were classifiable. Locality #3 is situated on the crest of a narrow bare ridge. This is occupied principally by sandstones and sandy shales. Ammonite specimens, or fragments thereof, are found here as discreet objects, weathered free from the host rock. Some of the collected specimens were essentially complete and as much as 3 inches in diameter. The fragmental pieces indicate that even larger specimens are present. At locality #4 the host rock is a large talus slope of black shale fragments located near the bottom of a deep draw. The specimens collected here were small, usually only an inch or so in diameter, and for the most part in the form of impressions.

Dr. Ralph Imlay of the U.S. Geological Survey examined these collections and reports that the ammonite Witchellia constituted the most distinctive form in both collections, and that specimens of both mature and immature individuals were represented. Other forms identified with less certainty were Euhoploceras and Docidoceras. Dr. Imlay further reports that the immature Witchellia specimens from locality #4 were identical with specimens from the Warm Springs formation, and the upper part of the Weberg formation, in the Suplee area of central Oregon. He classes the collection as a whole as belonging to the Middle Jurassic.

Recapitulation

It should be evident that our study in this area has barely scratched the surface insofar as development of the full geologic picture is concerned. Just the same, a recapitulation of our findings to date may be summarized thus: One, we have mapped the existent areas of pre-Tertiary exposure; two, we have delineated the distribution of certain lithologically distinctive

units within these areas; and, three, we have established that some of the sediments contain fossils of late Triassic to mid-Jurassic affinity.

To a less positive extent our findings to date indicate that all varieties of the pre-Tertiary sediment appear to occur with a strike that is predominantly east-west, or a little north of east, and with dips that are consistently steep to the north. A second indication is that the sedimentary series in which the Jurassic fossil localities occur may be thick as a consequence of deposition rather than by repetition due to folding. This should be recognized as an area of investigation which will entail a substantial amount of additional study before any final conclusions can be offered. However, the possibility of finding additional fossil localities rates as one of the problems of most immediate interest as the discovery of additional fossil localities will in itself help to clarify the structural picture. Hunting for new localities is something we hope to be able to do this coming summer.

Slides of area

If we may have the next slide, please, we will quickly show some views of the area.

(3) Even though we appear to be on the ground, this is nevertheless an aerial view taken from the margin of the escarpment just south of Brogan and looking west across the lava plateau. Juniper Mountain is on the skyline on the right side of the picture. The limestone occurs in the foothills on the left. Both the mountain and the hill behind the limestone are covered by lavas. This lava escarpment swings and comes directly toward us just outside the bounds of the picture

on the left. The distance between the camera and Juniper Mountain is about 7 miles. The intervening country is a lava plateau now utilized for grazing purposes only, although during earlier days of Oregon's history it was occupied by many homesteads as is evidenced by the next slide.

(4) This is on the lava plateau about halfway to the mountain. Next slide.

(5) Here we have a closeup aerial view of the limestone looking westward more or less along the strike. The red shales occur in the foreground in the lower left. The boulder conglomerate is located just a little left of directly under the camera. Ammonite locality #3 is located on the skyline in the upper right-hand corner of the picture. The main portion of Juniper Mountain lies just outside the picture on the right.

(6) This shows all formations on a line of sight almost directly down the dip, or just a little to the west therefrom. The volcanic unit is in the immediate foreground this side of the tree-covered hill. The tree covered hill is the limestone outcrop. The area beyond the limestone is occupied exclusively by the shales and graywackes all the way back to the lavas capping Juniper Mountain. If you will now visualize yourselves as flying across the limestone and onward to a point this side of Juniper Mountain, and somewhat below dead-center of this picture, you will be oriented for the next two slides.

(7) Here we are looking westward, out of the left window, at the Juniper Mountain Jurassic and its lava capping.

(8) This is a shot from the same spot looking out the right window back eastward across the lava plateau toward Brogan. The day these pictures were taken the smoke from a forest fire filled the valley so thickly that I seriously considered not taking the pictures. In other words, I was very surprised and pleased to have the pictures turn out as well as they did.

(9) As a concluding slide, we again have a map of Oregon. The dark blue color represents the approximate locations of areas in the southwestern and central portion of the State where Jurassic sediments have been known to occur for a long time. The same goes for the one isolated and very small area in Idaho. The red "X's" indicate the approximate locations in eastern Oregon at which Jurassic fossils have been found during recent years. The light blue indicates the general location of a belt of lithologically similar sediments. Some of these will undoubtedly correlate as Jurassic after the Jurassic of the Brogan and Ironside areas is more thoroughly studied and its bounds become more fully recognized.

. . . . Thank you.