DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

TO ACCOMPANY MAP GQ-438

GEOLOGIC MAP OF THE ALDRICH MOUNTAIN QUADRANGLE GRANT COUNTY, OREGON

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Tertiary volcanism and deformation

Introduction

The Aldrich Mountain quadrangle extends part way across the transition zone between the Columbia plateau and Basin and Range provinces in east-central Oregon. The Aldrich Mountains form the central part of a major east-west anticlinal uplift that includes the Ochoco Mountains to the west and Strawberry Mountains to the east (Brown and Thayer, in press), and for about 120 miles this uplift essentially marks the boundary between the Columbia Plateau and Basin and Range provinces (Cohee, 1961; Thayer, 1957). The John Day structural trough, the companion syncline on the north, extends about 35 miles east and 20 miles west of the quadrangle. The Aldrich and Ochoco Mountains are separated by a synclinal cross fold whose axis lies 2 miles west of the quadrangle and whose east limb extends to Aldrich Mountain. It is possible, therefore, to trace the later Tertiary rocks continuously over the uplift.

Because the geology of the pre-Tertiary rocks has already been described (Brown and Thayer, 1963; Thayer, 1940, 1963; and Thayer and Brown, 1960) or will be treated elsewhere, discussion here is limited to the Tertiary rocks.

Clarno Formation

Rocks assigned to the Clarno Formation (Merriam, 1901) consist mostly of poorly bedded volcanic mudflows and reworked volcanic debris in which angular to partly rounded blocks are embedded in a matrix of ashy sand and mud. Some well-rounded cobble conglomerate is present. Lenticular deposits of fine-grained white water-laid ash are scattered through the formation, and some beds contain leaf remains. No lava flows or intrusive igneous masses related to the Clarno Formation were identified within the quadrangle. The maximum local thickness of the formation appears to range from 1500 to 2000 feet; about 1500 feet of beds, which apparently dip 10° or less, forms steep heavily timbered slopes near Dry Creek Butte, and approximately 2000 feet of beds is exposed east of lower Fields Creek. Elsewhere, complex structure and poor exposures preclude estimates of thickness. Petrologically, the formation is characterized by markedly porphyritic fragmental debris of andesitic and dacitic composition in which hornblende phenocrysts are conspicuous, although pyroxene probably is more abundant. Biotite also forms phenocrysts in some of the dacitic material. Both dark-gray basaltic and light-colored rhyolitic rocks are subordinate in amount and are only locally abundant.

Lithologically these rocks are similar to known Clarno Formation that underlies the John Day Formation in the Courtrock and Monument quadrangles, 20 miles to the north. Fossil leaves found in a lens of sandy tuffaceous material interlayered in mudflow conglomerate along the old road just west of Dry Creek in the SE 1/4 NW 1/4 sec. 26, T. 13 S., R. 28 E. confirm this correlation. Four species were tentatively identified by J. A. Wolfe of the U. S. Geological Survey:

Ficus goshenensis Chaney and Sanborn
Ocotea sp. cf. O. eocernua Chaney and Sanborn
Sapindaceae, n. gen.? and sp.
Tetracera sp. cf. T. oregona Chaney and Sanborn

Wolfe commented (written communication, 1963):

"If the Ocotea and Tetracera are the species indicated, this flora is no older than zone 7 of the Puget Group (Wolfe and others, 1961, p. C-231). Both species are known from the uppermost Clarno near Clarno. However, Ficus goshenensis is known previously only from the middle Oligocene Goshen flora. There is nothing in this flora that prohibits a correlation with the uppermost part of the Clarno near Clarno."

Columbia River Group

Within the Aldrich Mountain quadrangle the Columbia River Group (Brown and Thayer, in press) includes the Picture Gorge Basalt (Waters, 1961, p. 591), the Mascall Formation (Merriam, 1901, p. 306), and basalts that are believed to be equivalent to both formations. North of the John Day fault, and south of it as far west as Dry Creek, the Picture Gorge Basalt and Mascall Formation are distinct lithologic units, as at their type localities about 6 miles west of the quadrangle. The individual basalt flows average 50-100 feet thick, have good columnar jointing, and petrologically are rather uniform, as described by Waters (1961, p. 591); they are characterized by dark-gray shades on fresh surfaces and weather to a distinctive dark reddish brown. The Mascall Formation lies conformably on the Picture Gorge Basalt; the contact is completely exposed in a cut on U.S. Highway 26, at the south edge of sec. 18, T. 13 S., R. 29 E., where the beds are overturned 80° to the south near the John Day fault. At its type locality the Mascall Formation consists almost entirely of water-laid tuff, but toward the east it becomes conglomeratic and contains rhyolitic welded tuff. A 50 to 75-foot welded rhyolite tuff lies on the Picture Gorge Basalt at the White Hills leaf locality (Chaney, 1959, p. 11) west of Belshaw Creek, and conglomerate makes up most of about 500 feet of beds exposed east of Bridge Creek. Clasts in the conglomerates are mostly less than 2 inches in diameter, are well rounded, and many are polished; nearly all are composed of pre-Tertiary rocks. Impure lignitic material has been found at several places in the Mascall Formation; the tunnel north of U. S. Highway 26 and a mile east of Cummings Creek marks an unsuccessful attempt to mine several thin coal seams (Collier, 1914, p. 32-36).

South of the John Day fault and west of Dry Creek no Mascall Formation has been recognized, the basalt unit thickens, and the individual lava flows vary much more in thickness and appearance. Where standing essentially vertically along the John Day fault, the basalts

thicken westward from 2500 feet at the east edge of the quadrangle to about 6000 feet at Flat Creek. Probably at least 50 flows occur in the Flat Creek section. There, massive brown-weathering flows similar to the Picture Gorge (Waters, 1961, p. 594) form the lowermost 1000 feet of the section and are separated from the overlying basalts by about 500 feet of very poorly exposed bouldery beds. The boulders in these beds are predominantly gray-weathering basalt and range up to 3 feet in size. In the remaining 4500 feet of the section the flows range from about 20 to 200 feet in thickness, and from medium-grained diabasic and ophitic to finely intergranular in texture; many contain glassy feldspar phenocrysts, are fresh, and are medium to light gray on both freshly broken and weathered surfaces. The flows in the entire southwestern part of the quadrangle consist of the same general gray- and brown-weathering varieties. Between upper Flat Creek and the Aldrich Mountain Lookout the flows in the lower 400 to 500 feet and the top two flows below the Lookout are the dark gray, brown-weathering type, but most of the rest are fresh and weather gray. The flows exposed along the road from Aldrich Mountain to Murderers Creek are pale gray, as are most of those exposed in Murderers Creek northeast of Shake Table, in the NE 1/4 sec. 17, T. 15 S., R. 28 E. Of the 900-foot section in Murderers Creek, only 150-200 feet consists of brown-weathering flows, and the upper 450 feet comprises 15 fresh porous flows in which glassy white phenocrysts of plagioclase abound.

Although the fresh gray-weathering basalts in the Aldrich Mountains might be mistaken for basaltic andesites of the Strawberry Volcanics (Thayer, 1957, p. 237), their close genetic relation to the Picture Gorge Basalt is clear. Waters' (1961, p. 594) descriptions of the Picture Gorge Basalt fit them well except for their consistent freshness; olivine content ranges from 0 to about 8 percent, all the pyroxene appears to be monoclinic, and saponite and chlorophaeite are the chief secondary minerals. The interposition of dark flows rich in chlorophaeite (Waters, 1961, p. 595) with light-colored fresh flows is believed to show that the original water content of the magma varied considerably. The lighter gray lavas, however, may also be chemically transitional to the Strawberry basaltic andesites (Thayer, 1957, p. 244).

The great thickness of the basalts in the vicinity of Flat Creek is believed to mark the axis of a broad northwest-trending lava ridge which was built by eruptions from the Monument dike swarm (Thayer, 1957, p. 234). The numerous basalt dikes in the eastern part of the quadrangle form the southern end of this swarm, and as a group trend directly toward the thickest part of the basalt section. The thicker and longer dikes are similar lithologically to the Picture Gorge Basalt, but whether the smaller ones include gray-weathering types was not determined. Some large masses of basalt having obscure structure, such as the one that forms Coyote Butte in sec. 29, T. 135., R. 28 E., may also be intrusive. The upper flows are believed to be equivalent in age to parts of the Mascall Formation, because similar basalts interfinger with the Mascall near its type locality west of Picture Gorge (Merriam, 1901, p. 306) and with water-laid tuffs north of John Day that contain a Mascall flora (Thayer, 1957, p. 236).

Rattlesnake Formation

The Rattlesnake Formation (Merriam and others, 1925, p. 53) consists essentially of fanglomerate and poorly sorted finer materials deposited under semiarid conditions in structural lowlands formed by post-Mascall deformation. The course of the ancestral John Day River is marked by well-rounded channel gravels northwest of Stewarts Crossing. A welded rhyolite tuff in the middle of the formation forms prominent rimrocks within the quadrangle, extends 60 to 65 miles along the John Day structural trough, and covers a large area south and west of the quadrangle. Although in most places the overlying gravels have been stripped from the tuff member, exposures about a mile west of the quadrangle boundary show the tuff to lie in the middle of a section of gravel about 700 feet thick which is faulted against Picture Gorge Basalt. Northwest of Stewarts Crossing, sec 4., T. 13 S., R. 27 E., the tuff attains a maximum thickness of about 70 feet but originally may have been considerably thicker; it has been eroded away south of the John Day River.

Although isolated now, the welded tuff in the Murderers Creek basin in the southwest part of the quadrangle is believed to have been continuous with that along the John Day syncline. The tuff is 70 feet thick 1.5 miles northwest of Stewart Ranch, about the same as in the bluffs in the northwest corner of the quadrangle. Everywhere in the John Day syncline, the lower part of the tuff looks ashy and pumice fragments are relatively little compressed; the central part is vitreous in hand specimen and is highly compressed; and the upper part appears ashy but is considerably devitrified. In the Murderers Creek basin part of the flow is stony in appearance, the upper part is much more devitrified than along the John Day River, and the pumice fragments range up to 3 inches, as compared with 2 inches farther north. Because of this coarsening the tuff is believed to have erupted somewhere farther to the southwest, to have flowed down the valley of the South Fork of the John Day River, less than 2 miles west of the quadrangle, and to have spread out to east and west in the tributary valleys. Although in places the tuff may have been deposited by more than one flow (R. L. Smith, oral communication, 1962), it forms a single stratigraphic unit.

Mammalian fossils found in gravels below the tuff member (Merriam and others, 1925, p. 53; and Shotwell, 1956, p. 719), and in deposits lying in valleys cut in the gravels (Merriam and others, 1925, p. 58) show that the Rattlesnake Formation in this area is middle and probably late Pliocene in age.

Tertiary deformation and geologic history

The Aldrich Mountain anticline probably originated in early Oligocene time when the Clarno Formation was folded strongly and faulted extensively. In the north limb of the anticline beds were folded locally as much as 60° before deposition of the Columbia River Group, but along the crest of the fold most dips are still less than 10°. Faulting that preceded deposition of the Columbia River Group is shown west of Coyote Butte, where basalts lie on Clarno rocks northeast of the fault and on pre-Tertiary rocks southwest of it. The John Day Formation, which to the north and northwest lies between the Clarno Formation and the Picture Gorge Basalt, has not been found in the Aldrich Mountain quadrangle. Apparently this area remained a rugged highland despite the long period of post-Clarno erosion (Waters and others, 1951; Hay, 1963), and it probably formed part of the southern rim of the basin in which the John Day Formation was deposited. Despite their great thickness in the vicinity of Flat Creek, the basalt flows probably were buried under debris now represented by the Mascall Formation, which was derived from active volcanoes and high-standing pre-Tertiary rocks to the east and southeast. Originally the Mascall Formation must have been much thicker than the present remnants suggest, and it probably extended southward across the present Aldrich Mountains as well as northward (Brown and Thayer, in press).

The present structural configuration of the region was blocked out, probably in early to middle Pliocene time, by rejuvenation of the Aldrich Mountain anticline, related folding, and development of the John Day fault system. The John Day fault is a steep reverse fault that approximately follows the troughline of the John Day syncline. It cuts off the vertical north limb of the Aldrich Mountain anticline, and most of the faults within about 3.5 miles to the south are also regarded as reverse. The faults north of the John Day fault form a system of conjugate fractures along lines of maximum shear under north-south compression; large horizontal mullions on the Belshaw fault indicate a major strike-slip component of movement. The unfaulted contact of Mascall Formation on Picture Gorge Basalt at the south edge of sec. 18, T. 13 S., R. 29 E. limits the vertical displacement of the John Day fault to not more than the thickness of the remaining Mascall Formation there, probably 1000-1500 feet. Continuation of faulting into late Pliocene or Pleistocene time is shown by offsets of the welded tuff member of the Rattlesnake Formation in the northwest corner of the quadrangle. Variations in the altitude and dip of the welded tuff in the Rattlesnake Formation are the most reliable indications of gentle post-Rattlesnake warping.

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INT. DUP., D.C. 65- 70152