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SUMMARY OF EOCENE STRATIGRAPHY AT THE BASE OF JIM MOUNTAIN, NORTH FORK OF THE SHOSHONE RIVER, NORTHWESTERN WYOMING

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Four Eocene formations are exposed in sequence on the south side of Jim Mountain in the valley of the North Fork of the Shoshone River. At the base of the sequence, approximately 300 meters (1000 feet) of red-banded fluvial and lacustrine sediments of the Eocene Willwood Formation unconformably overlie marine Cody Shale (Cretaceous). The Willwood Formation is overlain by approximately 200 meters (650 feet) of fluvial volcanoclastic sediments of the Aycross Formation, which is in turn overlain by a thick sequence of about 1200 meters (4000 feet) of volcanoclastics and lava flows of the Wapiti Formation. Lava flows of the Trout Peak Trachyandesite overlie the Wapiti Formation. The entire sequence is well exposed in the vicinity of Wapiti (Figure 1), on the Cody-Yellowstone highway some 30 kilometers (18 miles) west of the town of Cody, Wyoming.

In 1982 we began an intensive study of the Willwood, Aycross, and Wapiti Formations along Wall Creek, Dunn Creek, Jim Creek, and Dry Creek in the Jim Mountain area as part of an ongoing program of research on the early Cenozoic fossil vertebrate faunas, paleoenvironments, and paleogeographical history of the northern Bighorn Basin and vicinity (Gingerich et al., 1980). Field work was initially concentrated on stratigraphy and sedimentology, and a serious effort was also made to locate remains of fossil vertebrates for data purposes and for corroboration of paleoenvironmental interpretations. A full discussion of our results will be published at the conclusion of field work in the Jim Mountain area, however preliminary results are sufficiently important to warrant this initial summary.

Van Houten (1944) included 300 meters (1000 feet) of yellow sandstone and variegated red-banded mudstone exposed along the North Fork of the Shoshone River in his original description of the Willwood Formation. He noted that the Willwood Formation in the vicinity of Jim Mountain rests directly upon Cretaceous Cody Shale and that it is in turn overlain by "early basic breccia." Previously, Jepsen (1939) had published an abstract noting the remains of two fossil mammals of the order Perissodactyla discovered in sediments incorporated in Van Houten's Willwood Formation. One of these, *Homogalax* sp., came from near the base of the Willwood section on Jim Creek, and the other, *Lambdotherium* sp., came from higher levels. Both of these genera are indicative of the middle to late early Eocene (Wasatchian land-mammal age), providing the only age information for the Willwood Formation in the Jim Mountain area available prior to initiation of our work.

Nelson and Pierce (1968) introduced the names Wapiti Formation and Trout Peak Trachyandesite for the fine-grained volcanoclastics, volcanic breccias, and lavas mapped within the Pat O'Hara Mountain Quadrangle (Pierce and Nelson, 1968; this quadrangle includes our study area) and also studied on Ptarmigan Mountain nearby. Previously, rocks included in these formations were referred to as "early basic breccia" and "early basalt sheets," respectively. The Wapiti Formation surrounds and buries blocks of limestone of the Heart Mountain detachment fault, and prior to our work it was thought to rest directly upon the Willwood Formation over most of the mapped area (Nelson and Pierce, 1968).

The Eocene stratigraphic section exposed on the south side of Jim Mountain is shown diagrammatically in Figure 2. Here the base of the Willwood Formation is marked by a thin (0-1 meter, 0-3 feet) quartzite conglomerate bed, which is overlain by a thicker wedge of fine clastic sediments, probably of lacustrine origin, rich in plant megafossils. Above the lacustrine unit, fluvial sediments are represented by massive sheet sandstones and variegated red-banded mudstones. The basal sheet sandstone, a complex of large channel sandstones, point-bar sequences, and interbedded lignites, was probably deposited in a meandering stream system. Remains of large crocodilians (cf. *Leidyosuchus* sp.) and other abundant reptilian taxa corroborate this sedimentological interpretation and confirm the presence of a large perennial supply of water.

The specimen of *Homogalax* reported by Jepsen (1939) is an advanced species of the genus best known from middle Wasatchian sediments in the Bighorn Basin. *Homogalax* disappeared from the central Bighorn Basin at a time when lignite-forming sediments were no longer

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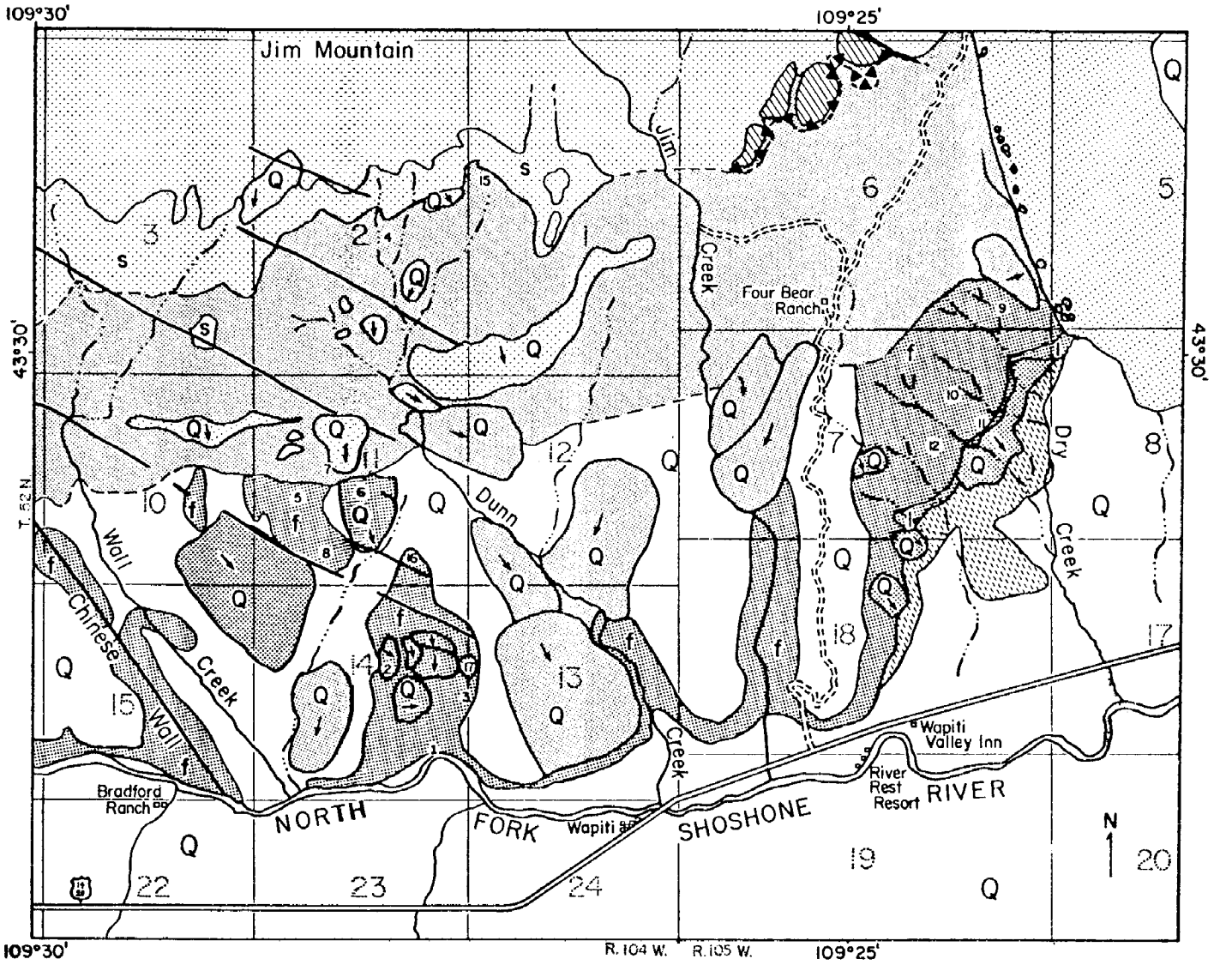

QUATERNARY

- Q — Undifferentiated terrace gravel and landslide deposits on Willwood and Cody Shale
- Q — Slumps, slides and faulted masses of Wapiti
- Q — Landslides of Aycross
- Q — Slumped masses of Willwood

TERTIARY

- (s) — Wapiti Formation, including pale yellow fluvial volcanoclastics (s)
- Aycross Formation
- (f) — Willwood Formation, fluvial (f) and lacustrine (l) facies

CRETACEOUS

- Cody Shale

MISSISSIPPIAN

- Madison limestone

- Trachyandesite dike
- Trace of Heart Mountain fault
- Formation contact. Dashed if inferred
- Allochthonous block. Arrow indicates inferred movement.

- Principal roads
- 1-17 North Fork fossil locality

N

0 1 2 km
0 1 mi

Figure 1: Map showing landslides and fossil localities in the Jim Mountain area on the North Fork of the Shoshone River in northwestern Wyoming. Geology modified from Pierce and Nelson (1968).

deposited and thus the presence of *Homogalax* in the Jim Mountain Area, in association with lignites, may indicate more about environmental conditions than the precise age of the enclosing sediments. *Lambdotherium* is a genus known only from the late Wasatchian. It is found in mudstones overlying the basal sheet sandstone complex in the Jim Mountain section, and it ranges upward to a level 130 meters (425 feet) above the base of the Willwood Formation in this section. Hence, most or all of the lower 130 meters (425 feet) of the Willwood Formation in the Jim Mountain area is late early Eocene (late Wasatchian) in age.

Near the top of the Willwood Formation, at a level 280 meters (918 feet) above the base, teeth of two middle Eocene perissodactyls, *Palaeosyops* sp. and *Helaletes* sp., were recovered. These genera are not known from Wasatchian faunas, but mark the beginning of the Bridgerian land-mammal age. They provide the first evidence of a Bridgerian fauna in the upper part of the Willwood Formation, and the first evidence that Willwood deposition continued into the early part of the middle Eocene (at least in the North Fork area, west of Rattlesnake Mountain).

Strata here referred to the Aycross Formation were formerly included as a breccia-rich facies of the lower Wapiti Formation because of their apparent interbedding with coarse volcanic breccias (Nelson and Pierce, 1968). Careful study of the "interbedded" breccias indicates that they are allochthonous slide and slump blocks of breccia derived from the overlying Wapiti Formation. As the map in Figure 1 shows, sliding and slumping has affected all of the Eocene formations exposed in our study area. The Aycross Formation unconformably overlies the Willwood Formation in the Jim Mountain area. It is composed of at least 200 meters (650 feet) of fluvial volcanoclastics with distinctive bright green sandstones, quartzite conglomerates, and bentonites. A middle Eocene (Bridgerian) age for the Aycross Formation in the Jim Mountain area is indicated by the presence of *Palaeosyops*, the tillodont *Trogosus*, and other mammalian taxa diagnostic of the Bridgerian land-mammal age. The upper contact of the Aycross Formation with the overlying Wapiti Formation is an angular unconformity, and it is unlikely that the Wapiti Formation intertongues laterally with the Aycross Formation here as suggested in the Carter Mountain area by Bown (1982) and Eaton (1982).

Breccias and lavas of the Wapiti Formation on Jim Mountain appear to have been derived from a composite stratovolcano located in Sunlight Basin to the north of Jim Mountain. Dikes radiating from a central intrusive vent (Nelson et al., 1980) support this idea. Other stratovolcanos undoubtedly produced breccias of similar lithology at different times elsewhere in the Absaroka volcanic field. For example, lavas and breccias on Ptarmigan Mountain are connected along Wapiti Ridge to a craterlike structure, clearly visible in Skylab photographs (Breckenridge, 1975). It is apparent that attempts to date and correlate different lava flows in time must be supported by radiometric ages for each flow, since lithological correlations will not necessarily indicate synchroneity of lava eruptions from different vents and/or volcanos. The use of

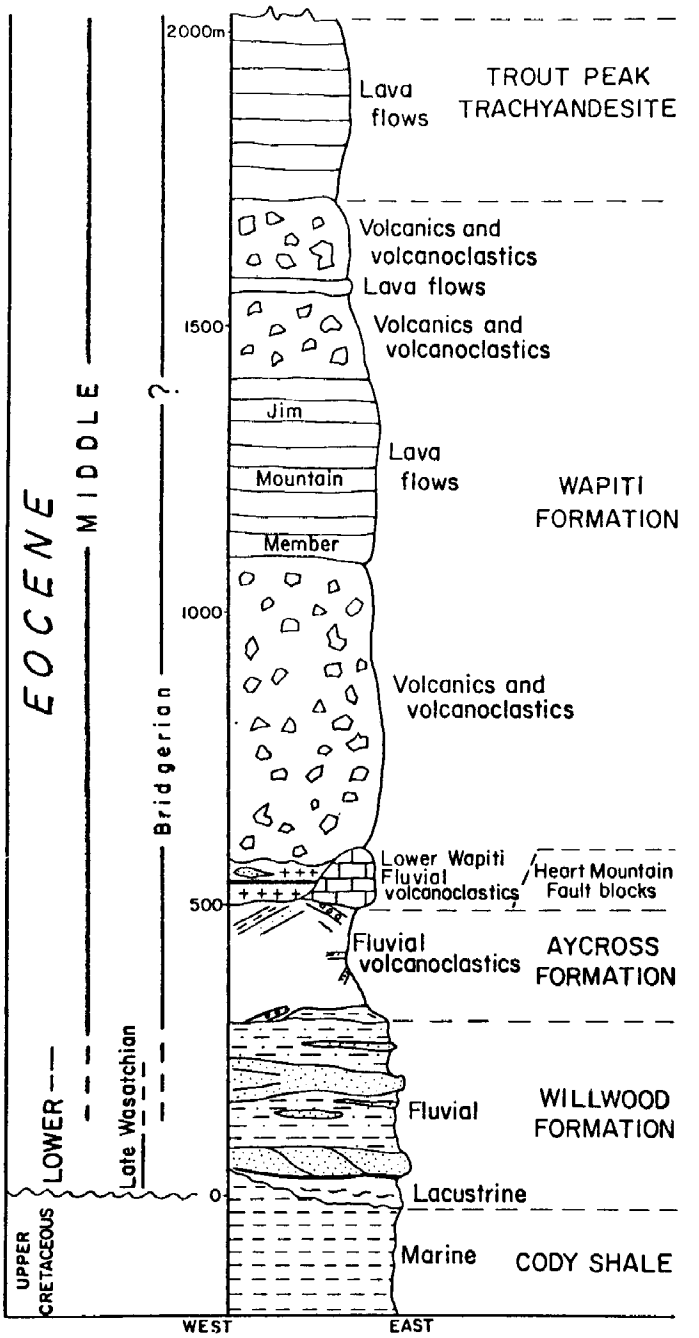

Figure 2: Schematic stratigraphic section showing Eocene Formations exposed in the Jim Mountain area along the North Fork of the Shoshone River. Stratigraphy above 580 meters from Nelson and Pierce (1968).

paleomagnetic profiles to date lava flows and correlate them in time should also be considered in this context, particularly for an interval when the polarity of the earth's magnetic field changed as many times as it did in the middle and late Eocene (Shive and Pruss, 1977). For all of these reasons, we consider correlations of lava flows between Jim Mountain and Trout Peak with those on Ptarmigan Mountain and Carter Mountain (e.g., Shive and Pruss, 1977; Pruss, 1975; Eaton, 1982) to be poorly substantiated.

Eaton (1982) has shown that blocks of Madison Limestone displaced as part of the Heart Mountain detachment fault are overlain by Bridgerian (middle Eocene) sediments on Carter Mountain. In our study area, east of Jim Creek, Heart Mountain detachment blocks rest upon the Aycross Formation of early or middle Bridgerian age, and they are overlain by breccias of the Wapiti Formation (although west of Jim Creek, fluvial volcanoclastics of the Wapiti Formation rest directly on the Aycross Formation). Hence the age of emplacement of the Heart Mountain detachment blocks appears to be constrained to a time within the Bridgerian land-mammal age. The entire Bridgerian may represent as little as two million years (49.5 - 47.5 Ma. Berggren et al., 1978), and it appears that detachment of the Heart Mountain thrust occurred within this interval.

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REFERENCES CITED

Berggren, W.A., McKenna, M.C., Cardenbol, J., and Obradovich, J.D., 1978, Revised Paleogene polarity time scale: Jour. Geol., v. 86, p. 67-81.

Bown, T.M., 1982, Geology, paleontology, and correlation of Eocene volcanoclastic rocks, southeast Absaroka Range, Hot Springs County, Wyoming: U.S. Geol. Surv. Prof. Paper 1201A, 75 p.

Breckenridge, R.M., 1975, Bighorn Basin Skylab S-190A multispectral photograph: In 27th annual field conference, Wyoming Geol. Assoc., Guidebook, in pocket.

Eaton, J.G., 1982, Paleontology and correlation of Eocene volcanoclastic rocks in the Carter Mountain area, Park County, southeastern Absaroka Range, Wyoming: Univ. Wyoming Contrib. to Geol., v. 21, no. 2, p. 153-194.

Gingerich, P.D., Rose, K.D., and Krause, D.W., 1980, Early Cenozoic mammalian faunas of the Clark's Fork Basin - Polecat Bench area, northeastern Wyoming: *In* Gingerich, P.D. (ed.), Early Cenozoic paleontology and stratigraphy of the Bighorn Basin: Univ. Michigan Papers on Paleont., no. 24, p. 51-68.

Hay, R.L., 1956, Pitchfork Formation, detrital facies of Early Basic Breccia, Absaroka Range, Wyoming: Amer. Assoc. Petrol. Geol. Bull., v. 40, p. 1863-1898.

Jepsen, G.L., 1939, Dating Absaroka volcanic rocks by vertebrate fossils: Geol. Soc. Amer. Bull., v. 50, no. 12, part 2, p. 1914.

Nelson, W.A., and Pierce, W.G., 1968, Wapiti Formation and Trout Peak Trachyandesite, northwestern Wyoming: U.S. Geol. Surv. Bull., 1254-H, 11p

Nelson, W.H., Prostka, H.J., and Williams, F.E., 1980, Geology and mineral resources of the north Absaroka wilderness and vicinity, Park County, Wyoming: U.S. Geol. Surv. Bull., 1447, 101 p. and pocket maps.

Pierce, W.G. and Nelson, W.H., 1968, Geologic Map of the Pat O'Hara Mountain quadrangle, Park County, Wyoming: U.S. Geol. Surv. geologic quadrangle maps of the United States, map GQ-755.

Pruss, E.F., 1975, Paleomagnetic study of basalt flows from the Absaroka Mountains, Wyoming: *In* 27th annual field conference, Wyoming Geol. Assoc. Guidebook. p. 257-266.

Shive, P.N. and Pruss, E.F., 1977, A paleomagnetic study of basalt flows from the Absaroka Mountains, Wyoming: Jour. Geophys. Res., v. 82, no. 20, p. 3039-3048.

Van Houten, F.B., 1944, Stratigraphy of the Willwood and the Tatman Formations in northwestern Wyoming: Geol. Soc. Amer., v. 55, no. 2, p. 165-210.