

ARTICLES

Chronology of the Wasatchian Land-Mammal Age (Early Eocene): Magnetostratigraphic Results from the McCullough Peaks Section, Northern Bighorn Basin, Wyoming¹

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ABSTRACT

The McCullough Peaks section of the Willwood Formation in the northern Bighorn Basin, Wyoming, has produced a rich fossil record of early Eocene mammals spanning much of the Wasatchian land-mammal age. The Wasatchian is an especially significant period in mammalian evolution since it marks the first appearance of several modern orders of mammals including Perissodactyla, Artiodactyla, and true Primates. Magnetostratigraphic analysis of paleosol horizons in the McCullough Peaks region is used to correlate Wasatchian land-mammal zones to the geomagnetic polarity time scale. A total of 135 paleomagnetic samples were analyzed from 37 levels in a 1480 m section that ranges from Wasatchian zone Wa-0 (earliest Sandcouleean subage) to the base of zone Wa-7 (earliest Lostcabinian subage). Progressive thermal demagnetization of samples from red (B type) and mottled red/gray (AB type) soil horizons provides the most reliable results. The characteristic magnetization is carried by hematite with unblocking temperatures between 400°C and 680°C. Fine-grained hematite and magnetite are also present and carry a strong present-day overprint. Magnetostratigraphic correlation indicates that Wasatchian zone Wa-0 (earliest Sandcouleean subage) to middle zone Wa-5 (*Bunophorus* interval-zone) correlate with Chron C24r, middle zone Wa-5 to middle zone Wa-6 (Lysitean subage) correlate with Chron C24n.3n, late zone Wa-6 correlates with Chron C24n.2, and early zone Wa-7 (Lostcabinian subage) correlates with Chron C24n.1r. These results indicate that the last zone, Wa-7 (Lostcabinian subage), may represent as much as one-half of the Wasatchian land-mammal age, while earlier zones Wa-0 to Wa-6 (Sandcouleean-Lysitean subages) together span only 2.4 m.y. of early Eocene time.

Introduction

The lower Eocene Willwood Formation in the Bighorn Basin is characterized by repeated highly fossiliferous red and gray mudstones (paleosol horizons) interbedded with channel sandstones and sheet sandstone complexes (Van Houten 1944; Neasham and Vondra 1972; Bown and Kraus 1981, 1987). The Willwood Formation outcrops in a 1480 m stratigraphic section in the McCullough Peaks region of the northern Bighorn Basin (figure 1). Fossil mammals have been collected from this area for more than 80 years, making it one of the best known records of early Cenozoic mammalian evolution. In recent years 4496 fossil mammals have been catalogued from 160 localities at 105 different levels in the McCullough Peaks section. These fossil collections indicate that the McCullough Peaks section lies within the Wasatchian land-mammal

age (figure 2) and ranges from zone Wa-0 (earliest Sandcouleean subage) to the base of zone Wa-7 (earliest Lostcabinian subage). The combination of extensive exposure and well-constrained biostratigraphy makes the McCullough Peaks an excellent area to correlate Wasatchian faunal zones to the geomagnetic polarity time scale (GPTS). Correlation of mammalian faunal zones to the GPTS has proven important in linking the marine and terrestrial stratigraphic records and in establishing the geochronology of land-mammal ages. An independent chronology for these faunal zones is essential for studies of the timing and rate of early Cenozoic mammalian evolution (Gingerich 1993; Clyde and Gingerich 1994).

Previous magnetostratigraphic analyses of Paleocene and Eocene sections in western North America (Butler et al. 1981, 1987; Rapp et al. 1983; Flynn 1986) have correlated the Tiffanian, Clarkforkian, earliest Wasatchian, and early Bridgerian

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