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Late Oligocene Biostratigraphy at Badlands National Park

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Badlands NP in southwestern South Dakota preserves one of the most complete sequences of fossil mammals. Since Dr. Hiram Prout first described a fossilized titanothere jaw fragment (Prout, 1846), paleontologists have searched extensively the Oligocene sediments. Research in the White River Badlands continues to reveal new information related to the geology and paleontology.

Paleontologists working in Badlands' fossil rich sediments have established a comprehensive biochronology based upon fossil mammal assemblages. The stratigraphic sequence includes the basal Chadron Formation, overlain by the Brule Formation and then topped by the Sharps Formation. The Brule is subdivided into two members in South Dakota – the lower Scenic Member and the upper Poleslide Member. The Sharps Formation base is defined by the Rockyford Ash Member, which is widespread throughout southwestern South Dakota.

The lower portion of the Sharps Formation has yielded a significantly less diverse assemblage of fossil vertebrates by comparison to the other stratigraphic zones within the White River Group (MacDonald, 1963; MacDonald, 1970). An abundantly rich mammalian assemblage is known from the stratigraphic zones directly above and below the Lower Sharps. Furthermore, faunal assemblages from the strata above and below the Lower Sharps exhibit distinct taxonomic differences. Thus the rarity of described paleontological material from the Lower Sharps limits biostratgraphic zonation at the Whitneyan/Arikareean Land Mammal Age (LMA) boundary and warrants further investigation of this intermediate zone.

Extensive field surveys of the well exposed portions of the Lower Sharps throughout southwestern South Dakota during the 1985 and 1986 field seasons confirmed a poorly fossiliferous horizon.

A series of channel sandstone units in the Cedar Pass Area of Badlands NP was examined closely during an independent survey. The channel deposits contained an abundance of fossil vertebrate material. Detailed study of these sandstone deposits indicated that the channels had downcut through the Rockyford Ash Member of the Sharps Formation into the Poleslide Member of the Brule Formation. Therefore, the assemblage of fossils contained within the sandstones represent a Lower Sharps fauna.

A paleomagnetic study of the lower portion of the Sharps Formation and the upper portion of the Poleslide Member of the Brule Formation was undertaken in order to further demonstrate a post-Rockyford Ash age of the downcutting channels at Cedar Pass (Fig. 1). Previous Oligocene paleomagnetic studies performed by Donald Prothero have yielded consistent data, and a well defined magnetic polarity time scale has been established (Prothero, et al, 1983). The magnetostratigraphic patterns recorded can be utilized with other lithologic and paleontologic data to more precisely correlate geochronologically equivalent zones.

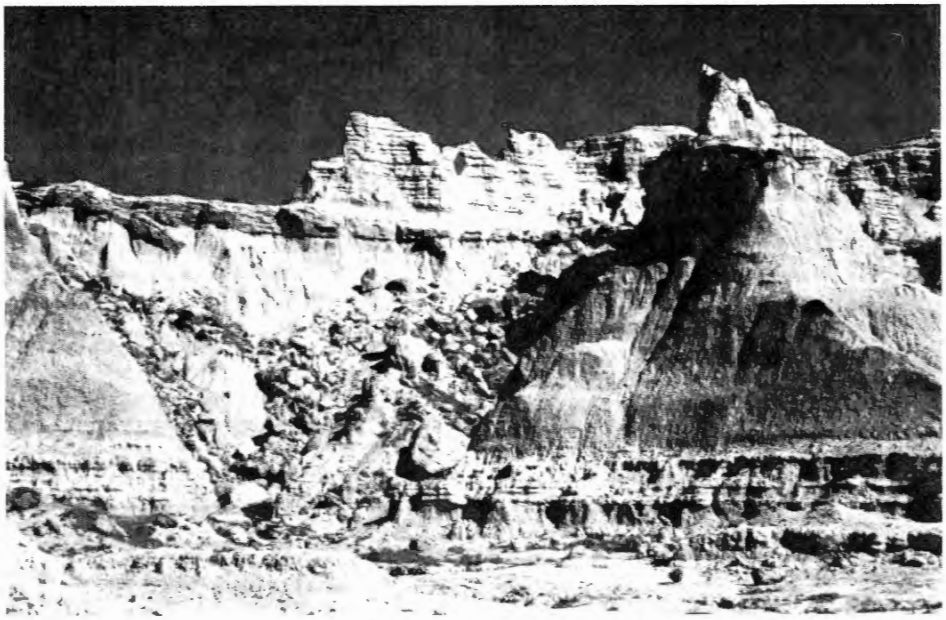


Figure 1. *Lower Sharps channel sandstones downcut into the Poleslide Member of the Brule Formation in the Cedar Pass Area, Badlands NP.*

Regional paleomagnetic sampling indicates that the upper portion of the Poleslide Member, to the base of the Rockyford Ash, is a zone of reversed polarity (reversed magnetozone); whereas, from the base of the Rockyford Ash through the lower half of the Sharps Formation is a zone of normal polarity (normal magnetozone). The magnetic polarity boundary at the base of the Rockyford Ash provided the opportunity to test whether the paleomagnetic character of the downcutting channel sandstones reflects a pre-(reversed) or post- (normal) Rockyford Ash correlation.

Paleomagnetic samples were collected within the Poleslide Member of the Brule Formation and the Sharps Formation at Cedar Pass. Samples were obtained from both the channel sequences downcutting through the Rockyford Ash and in adjacent areas where the Brule-Sharps sequence and contact still were preserved.

Natural Remnant Magnetization (NRM) was measured for each sample through the use of a large bore ScT cryogenic magnetometer at the University of Pittsburgh. Two orientations were measured on each sample. Thermal demagnetization treatment was performed at a range of temperatures and each sample measurement was recorded after each thermal treatment. Zijderveld vector demagnetization diagrams (Fig. 2) were plotted for each sample (Zijderveld, 1967).

All samples obtained from the upper portions of the Brule Formation, where channelling did not interrupt the sequence, exhibit a reverse polarity. The samples obtained from the sequence above the base of the Rockyford Ash in the Sharps Formation, where channelling did not interrupt the sequence, show a normal polarity. The last set of samples was obtained directly from the downcutting channel sequence in areas where the Rockyford Ash was cut through and no longer present. These samples all were collected at elevations that were

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Thank You!

This issue, which is largely devoted to paleontological research and interpretation in the national parks, contains 8 more pages than usual. The extra costs involved have been picked up by the 3 NPS Regions in which the bulk of these articles originated, namely the Western, Southwestern, and Rocky Mountain Regions.

The previous (Spring 1992) issue of Park Science, featuring Caribbean area research, also contained extra pages, subsidized by the NPS Southeast Region. To all 4 of these Regions, a heartfelt vote of thanks for helping make these issues possible. (The Pacific Northwest Region also deserves recognition for consistently picking up the rising costs of publication.)

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both above and below the level of the Rockyford Ash at Cedar Pass. Each of these samples exhibits a normal polarity, regardless of the elevation at which it was collected.

The paleomagnetic polarity pattern determined from the measurements obtained at Cedar Pass strongly supports that the downcutting channel sequences were developed during a post-Rockyford Ash event within the Lower Sharps Formation. Therefore, the fossil material collected from the channels provides a significant contribution to the previously scanty record.

The biostratigraphic range under investigation in this study lies at a stage overlapping two biochronological zones of North American Land Mammals. The Whitneyan/Arikareean Land Mammal Age boundary lacks an associated lithostratigraphic marker and has not been firmly established. The assemblage of fossil mammals collected from the channel deposits provides integral information that supports the establishment of the Whitneyan/Arikeean boundary in the Lower Sharps. The Lower Sharps can be characterized as a concurrent range zone for the last appearance of numerous representative Whitneyan fossils and the first appearance of many Arikareean mammals.

The fossils collected from the Cedar Pass channels provide a broader window into the poorly understood lower Sharps fauna. This enigmatic biozone clearly displays a pivotal assemblage of fossil mammals. Given 150 years of study in the White River Badlands, much work remains. Mammalian biochronology augmented with paleomagnetic data will prove instrumental to greater understanding of the depositional history of the continental Tertiary and the evolution of mammls.

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NPS Staff and Consulting Paleontologists *meet in San Diego at the Society of Vertebrate Paleontology meetings: (l to r) Rachel Benton, Fossil Butte NM; Elizabeth Barnosky, Yellowstone NP; Neil King, Hagerman Fossil Beds NM; Mary Thompson, Idaho Museum of Natural History; Ted Fremd, John Day Fossil Beds NM; Dale Hanson, BLM, Montana; Laurie Bryant, BLM, Idaho; Ann Elder, Dinosaur NM; Vince Santucci, Petrified Forest NP; Dan Chure, Dinosaur NM, and William Akersten, Idaho Museum of Natural History.*

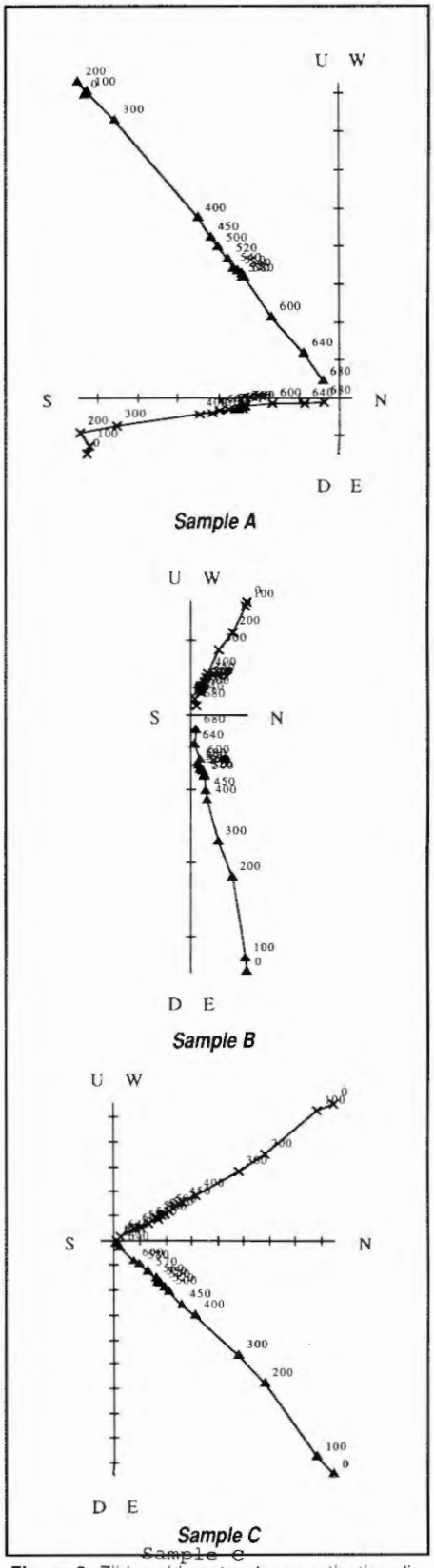


Figure 2. *Zijderveld vector demagnetization diagrams. (A) Sample obtained from below the Rockyford Ash in the Upper Brule, showing a reversed polarity; (B) sample collected abover the Rockyford Ash in the Sharps, indicating a normal polarity; and (C) sample taken from the channel sediments downcutting through the Rockyford Ash, displaying a normal polarity.*