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Rodent community change at the Pliocene–Pleistocene transition in southwestern Kansas and identification of the *Microtus* immigration event on the Central Great Plains

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ABSTRACT

A dense fossil rodent database and new paleomagnetic data from the Meade Basin of southwestern Kansas document the transition from a Pliocene community characterized by cricetids of southern aspect and archaic arvicolids with rooted molars to a Pleistocene community with cricetids of temperate aspect and arvicolids with ever-growing molars. This new information suggests a revised date for the Blancan–Irvingtonian North American Land Mammal Age boundary between 2.06 and 1.95 Ma, coincident with the extinction of the *Sigmodon minor* lineage and the immigration of *Microtus*. Carbon and oxygen isotope compositions of paleosol carbonates indicate the faunal changes occurred during the final expansion of C_4 grasses in the Great Plains to modern abundance and a strong cooling trend reflecting the end of the early Pliocene warm interval and onset of northern hemisphere glaciation. Although extinctions balance originations through the study period, pulses of enhanced extinction and origination occurring near the Pliocene–Pleistocene boundary strongly suggest environmental change as the likely forcing mechanism for rodent community compositional shifts. The Meade Basin rodent sequence provides the most complete history of any terrestrial vertebrate group in North America for this period of time.

1. Introduction

Paleontological fieldwork in the Meade Basin of southwestern Kansas over the past 10 years has revealed a dense record of stratigraphically superposed fossiliferous localities especially rich in small mammals. Building on the framework set by the late C. W. Hibbard and his students (Hibbard, 1938, 1941, 1950, 1953, 1955, 1956, 1964; Paulson, 1961; Woodburne, 1961; Schultz, 1969; Zakrzewski, 1975), the authors have re-sampled most of Hibbard's collecting localities for vertebrate remains, discovered new quarries, remapped and redefined regional sediments, analyzed paleosol carbonates for carbon and oxygen isotopic signatures, and developed a more extensive paleomagnetic record. This interdisciplinary research program is beginning to reveal the intricacies of small mammal community change from the earliest Pliocene (and eventually the latest Miocene) through modern time. In this paper we will show that the rodent community of southwestern Kansas changed from one characterized by cricetid rodent species of southern aspect and arvicolids with rooted molars during the Pliocene to one dominated by cricetids of temperate aspect and arvicolids with rootless molars during the Pleistocene. We will further suggest that the Blancan–Irvingtonian North American Land Mammal Age boundary (NALMA) is best defined by the *Microtus* immigration event, constrained in the Meade Basin to the period between 1.95 and 2.10 Ma (million years

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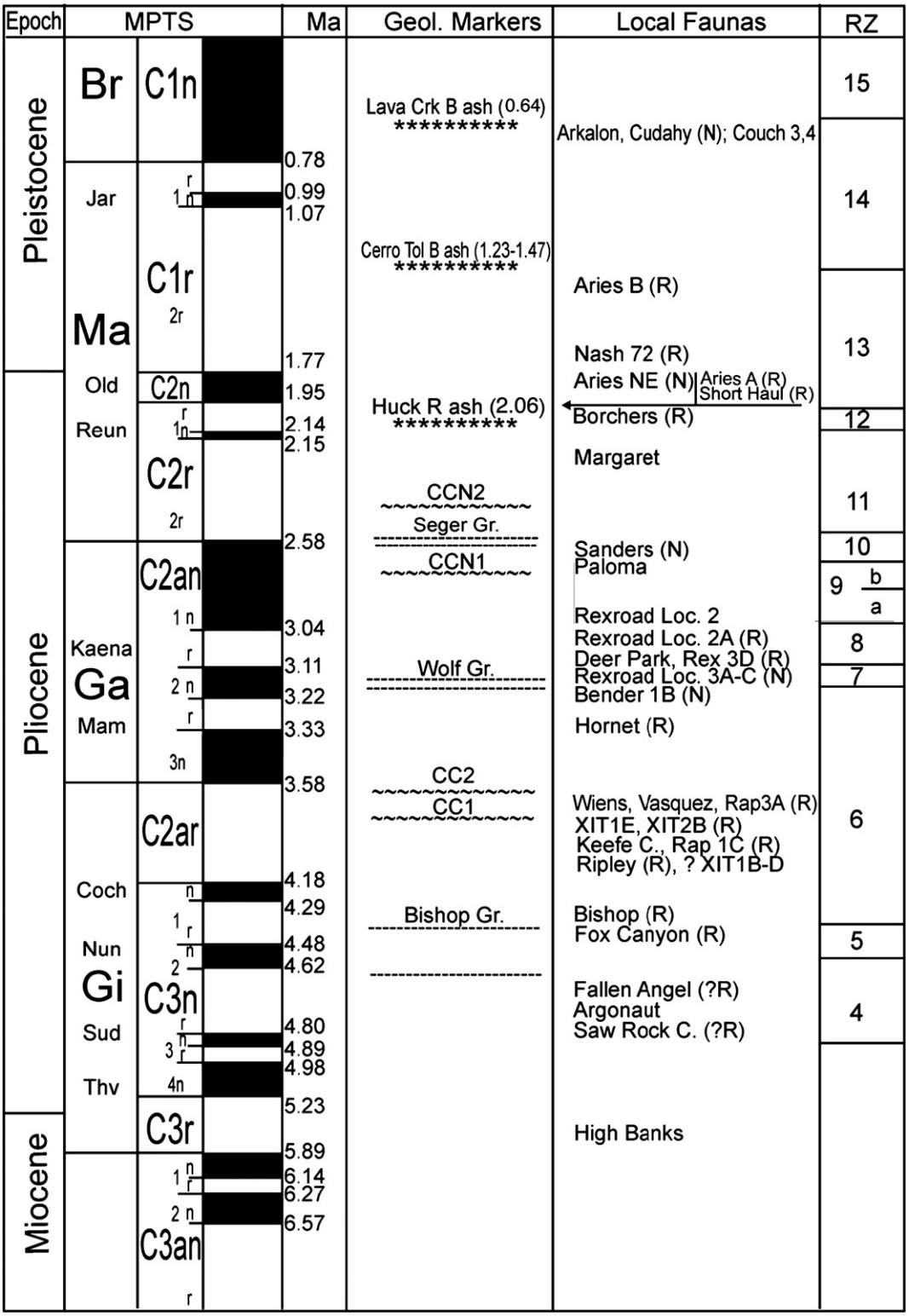

Fig. 1. Stratigraphic, paleomagnetic, and biostratigraphic consensus chronology for mammalian local faunas from the Meade Basin of Kansas. MPTS = magnetic polarity time scale, Ma = millions of years ago, Geol. = geological, RZ = rodent zones (following Martin, 2003), Crk = Creek, Tol = Toledo, Huck R = Huckleberry Ridge, Gr. = gravel, CC, CCN = calcium carbonate marker layers, (N) and (R) = normal and reversed magnetism, Loc. = Locality, Rap = Raptor, Keefe, Saw Rock C. = Keefe and Saw Rock Canyon, ? = questionable placement or record.

ago). Enhanced rodent species turnover at this boundary and during the Pleistocene suggests that volatility characterizing the climatic record subsequent to about 2.6 Ma is the forcing mechanism for this change.

The assemblages of rodents analyzed for this study, called "local faunas," are listed chronologically in Fig. 1, with accompanying information on stratigraphic marker units, dated ashes, and paleomagnetic (pmag) data. Each locality from which the rodent fossils were excavated represents one quarry no more than 1.0 m in depth. If superposed quarries were discovered in the same outcrop, they were given letter designations (thus Rexroad 3A–D; Deer Park A–B, etc. "A" represents the lowest site). Chronology of local faunas below the Gauss Geomagnetic Chron is less secure because of limited