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LETTER TO THE EDITOR

The Thornton Beach Mammoth and the Antiquity of *Mammuthus* in North America

In this journal, Madden (1980, 1983) reviewed the oldest isotopically dated occurrences of the mammoth, *Mammuthus*, in North America. Agenbroad (1984) also reviewed these occurrences, and both he and Madden identified a specimen of *Mammuthus* from the Merced Formation at Thornton Beach near San Francisco, California as the oldest North American mammoth for which direct isotopic-age control is available.

Hall (1965, p. 156) originally reported the Thornton Beach mammoth, and it was identified as "*Mammuthus columbi* (?)" or "*Mammuthus haroldcooki*" by D. E. Savage. The fossil, UCMP (University of California Museum of Paleontology, Berkeley) 68128 from UCMP locality V-6422, is from a horizon about 10 m below a volcanic ash bed for which a K–Ar age of 1.5 ± 0.8 myr was reported (Hall, 1965; Sarna-Wojcicki, 1976). Madden (1980, 1983) and Agenbroad (1984) thus accepted the age of the Thornton Beach mammoth as 1.5 myr, or slightly older.

Neither of these authors, however, mentioned Meyer *et al.* (1980), who reported a zircon fission-track age of 0.45 ± 0.08 myr for the Merced Formation ash bed. They based this age on calculations from samples taken from outcrops of the ash bed at two localities: (1) locality 1, an abandoned quarry approximately 2 km east of Thornton Beach State Park; and (2) locality 2, on the coastal cliffs just north of Thornton Beach State Park. The average fission-track age for the ash bed at locality 1 (based on 10 separates) reported by Meyer *et al.* (1980) is 0.48 ± 0.10 myr, whereas K–Ar ages of plagioclase separates from the ash at locality 1 are 0.45 ± 0.18 and 1.1 ± 0.5 myr Meyer *et al.* (1980) reported average fission track ages (based on 5 separates) of the ash bed of 0.47 ± 0.10 myr, whereas K–Ar ages of plagioclase separates are 0.75 ± 0.5 and 2.1 ± 0.3 myr. Meyer *et al.* (1980) argued that the older K–Ar ages for the Merced Formation ash resulted from detrital and possible accidental contamination of the ash. Thus, they concluded that 0.45 myr (weighted average of 15 samples) is the correct age for the ash. I accept this age, not the much older age accepted by Madden (1980, 1983) and Agenbroad (1984).

This younger age for the ash bed in the Merced Formation indicates that the Thornton beach mammoth is about 1 myr younger than previously claimed. The morphology of the mammoth fossil, illustrated here for the first time (Fig. 1), is consistent with a much younger age of about 0.45 myr. UCMP 68128 is very weathered lower jaw fragments of a single individual preserving incomplete last molars on both horizontal rami. On the last molar, the number of plates is 11+, maximum length is 239+ mm, maximum width is 78 mm, maximum crown height is 115+ mm, lamellar frequency is 5 per 100 mm, and average enamel thickness is 3.2 mm (see Madden, 1981 for measurement protocol). My measurements differ only slightly from those of Madden (1980), but I do not fully agree with his conclusion that the Thornton Beach mammoth "could represent *M. meridionalis* or (an early) *M. columbi*, and can only be identified as an indeterminate mammoth ('*Mammuthus* sp. indet.')" (Madden, 1980, p. 149). Agenbroad's (1984) identification of the Thornton Beach mammoth as a 1.5-myr-old *M. meridionalis* also cannot be substantiated. Indeed, for all measurements, UCMP 68128 falls within or very close to the range of *M. imperator* as redefined by Madden (1981), a species with an isotopically established age of >0.03 myr (Agenbroad, 1984). With an age of 0.45 myr, the Thornton Beach mammoth is thus the oldest isotopically dated *M. imperator*, not the oldest isotopically dated mammoth from North America.

Three other mammoth occurrences vie for the honor of oldest North American *Mammuthus:*

1. Parts of a last molar of a probable *M. meridionalis* from the Wellsch Valley, Saskatchewan are from deposits dated paleomagnetically to the Olduvai Event, about 1.7 myr (Stalker and Churcher, 1972; Harington and Shackleton, 1978).

2. Tooth plates of *Mammuthus* from the Bruneau Formation of Idaho have bracketing K–Ar ages of 1.36 and 1.5 myr (Malde and Powers, 1962; Evernden *et al.*, 1964; Armstrong *et al.*, 1975; Madden, 1980).

3. A lower jaw with both last lower molars of *M. meridionalis* from the Sierra Ladrones Formation in New Mexico is in a fluvially reworked bed of Guaje Pumice (Ar/Ar age of 1.61 myr) and is associated with other early Irvingtonian mammals (Lucas and Effinger, 1991; Lucas *et al.*, 1993).

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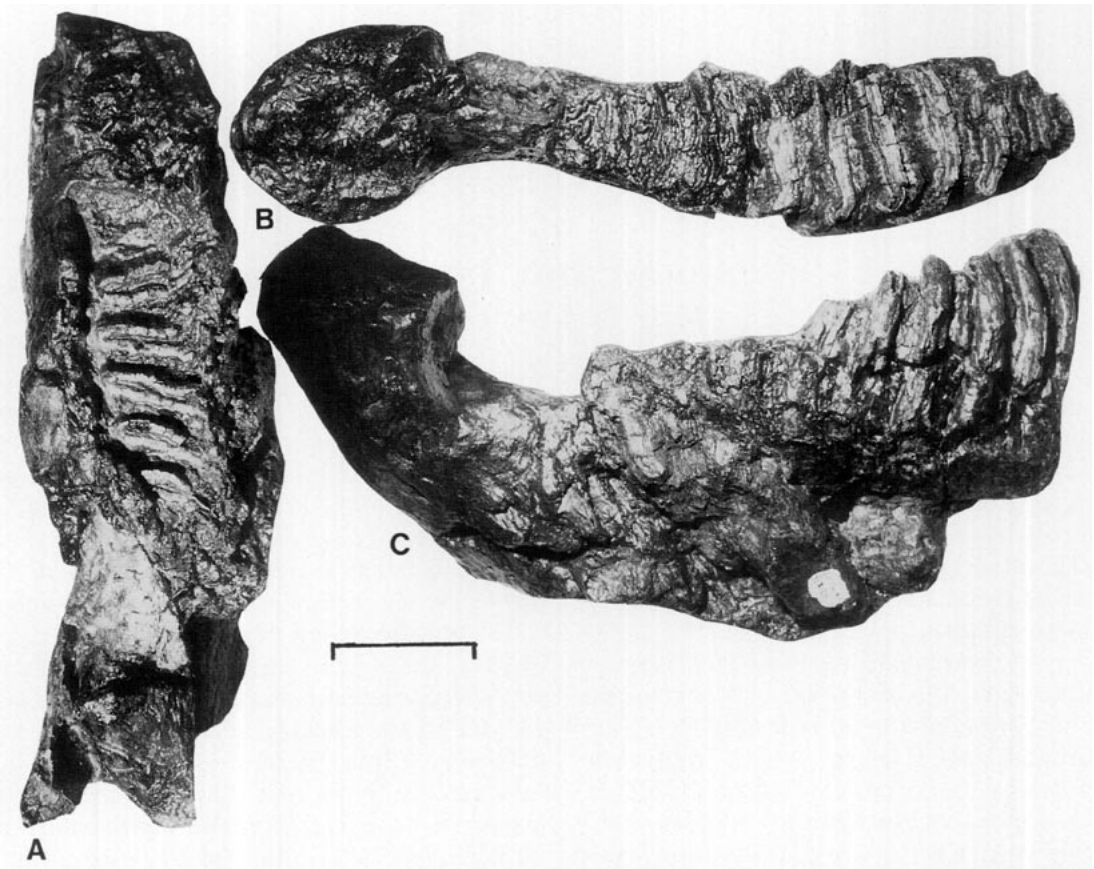

FIG. 1. The Thornton Beach mammoth, UCMP 68128. A, Occlusal view of left horizontal ramus with incomplete last molar. B and C, Occlusal (B) and medial (C) views of right horizontal ramus with incomplete last molar. Scale bar = 50 mm.

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