

## PLIO-PLEISTOCENE MAMMALIAN BIOSTRATIGRAPHY AND BIOCHRONOLOGY AT TIJERAS ARROYO, BERNALILLO COUNTY, NEW MEXICO

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Most of the vertebrate fossils from Tijeras Arroyo, located just south of the Albuquerque International Airport in Bernalillo County, are derived from the Sierra Ladrones Formation and are early Irvingtonian in age (Lucas et al., 1993). However, one locality (New Mexico Museum of Natural History and Science [NMMNH] site L-1458) at the base of the exposed stratigraphic section in Tijeras Arroyo (Fig. 1) has produced two species that are indicative of a Blancan age. The fossils from this site were derived from a sandstone comprising unit 1 in the stratigraphic section of Lucas et al. (1993, fig. 2). The lowermost part of the section in Tijeras Arroyo, including unit 1, was recently referred to the Ceja Member of the Arroyo Ojito Formation (Connell and Hawley, 1998; Connell et al., 1999).

Both mammals identified from site L-1458 in the Tijeras Arroyo section, *Hypolagus* cf. *H. gidleyi* and *Equus* cf. *E. cummingsii*, are typical of Blancan faunas, and do not occur in the Irvingtonian. The extinction in the late Pliocene (about 2.2 Ma) of several characteristic Blancan genera, including *Hypolagus*, *Borophagus*, *Rhynchotherium*, and *Nannippus*, is considered one of the most important biochronological events in the late Blancan (Lindsay et al., 1984). The presence of *Hypolagus* thus indicates that site L-1458 is older than 2.2 Ma. *Equus* cf. *E. cummingsii* appears to be absent from early Blancan faunas, so L-1458 is probably middle or early late Blancan in age.

Ten stratigraphically higher localities in Tijeras Arroyo have produced a significant vertebrate fauna of early Irvingtonian age (Lucas et al., 1993; Morgan and Lucas, 2000). More than 75 m of the Sierra Ladrones Formation are exposed in Tijeras Arroyo, consisting of sandstones, pumiceous sandstones, and gravels, with minor amounts of mudstone and diatomite. These sediments represent axial river deposits of an ancestral Rio Grande. The most distinctive lithologic characteristic of these beds is the presence of reworked Guaje Pumice derived from the Bandelier Tuff, Ar/Ar dated at 1.61 Ma (Izett and Obradovich, 1994), in the units associated with an Irvingtonian fauna (units 3-8 of Lucas et al., 1993). An extensive flora of leaves and pollen from a localized volcanic ash bed was collected in the Tijeras Arroyo section (NMMNH Site L-1445). The Tijeras Arroyo flora indicates that the cottonwood forest or bosque currently found along the banks of the Rio Grande in New Mexico dates back to at least the early Pleistocene (Knight et al., 1996).

The land tortoise *Hesperotestudo* and five species of mammals, including *Glyptotherium* cf. *G. arizonae*, *Equus scotti*, *Equus* sp., *Camelops* sp., and *Mammuthus meridionalis* occur together in the Tijeras Arroyo section above the Blancan site (L-1458) discussed above (Lucas et al., 1993; Morgan and Lucas, 2000). These species constitute a fairly typical fauna of early Irvingtonian age. Three additional species of mammals, a small species of *Equus*, the llama *Hemiauchenia macrocephala* and the mammoth *Mammuthus imperator*, occur somewhat higher in the Tijeras Arroyo section than the remainder of the fauna, but probably are Irvingtonian as well.

A caudal osteoderm of a glyptodont from Tijeras Arroyo (Lucas et al., 1993) probably is not diagnostic at the species level, although this specimen almost certainly represents *Glyptotherium arizonae*. Tentative referral of this osteoderm to *G. arizonae* is reasonable as its association with *Mammuthus* rules out a Blancan age, and the Rancholabrean *G. floridanum* is restricted to the Atlantic and Gulf coastal plains (Gillette and Ray, 1981). The large horse *Equus scotti* is the most common mammal in the Tijeras Arroyo Irvingtonian fauna, represented by mandibles, isolated teeth, and postcrania (Lucas et al., 1993; Morgan and Lucas, 2000). *E. scotti* is the typical large horse in late Blancan and early Irvingtonian faunas in the southwestern United States (Hibbard and Dalquest, 1966), and occurs in medial Blancan through early Irvingtonian faunas in New Mexico (Tedford, 1981; Morgan et al., 1998). A complete equid metacarpal from Tijeras Arroyo is more slender than metacarpals of *E. scotti*, and represents a second, smaller species of *Equus* (Hibbard and Dalquest, 1966; Harris and Porter, 1980). A partial skull of a small *Equus* occurs higher in the Tijeras Arroyo section.

Lucas and Effinger (1991) and Lucas et al. (1993) referred a mandible with left and right m3 from Tijeras Arroyo to the primitive mammoth *Mammuthus meridionalis* on the basis of its low plate count and extremely thick enamel. This is one of only two records of mammoths from New Mexico referred to *M. meridionalis*, indicating that this fauna is almost certainly early Irvingtonian. The other record consists of several partial teeth, tentatively referred to *M. meridionalis*, from an early Irvingtonian fauna in the Mesilla basin (Vanderhill, 1986). Lucas et al. (1993) referred a left M3 in a maxillary fragment from Tijeras Arroyo to the mammoth *Mammuthus*

*imperator*. The teeth of *M. imperator* are more advanced than *M. meridionalis* in having a higher plate count, higher lamellar frequency, and thinner enamel. The *M. imperator* specimen was found about 12 m higher in the section than the remainder of the Tijeras Arroyo fauna, and thus is somewhat younger, although an Irvingtonian age is still likely (Lucas et al., 1993).

The presence of mammoths in unit 6 of Lucas et al. (1993) and above clearly establishes an Irvingtonian age for the upper part of the Tijeras Arroyo section, as *Mammuthus* is one of the defining genera of the Irvingtonian NALMA. The first appearance of *Mammuthus* in the New World occurred sometime in the early Pleistocene (early Irvingtonian) between about 1.8 and 1.6 Ma. The mammoth jaws from Tijeras Arroyo represent one of the oldest well-documented records of *Mammuthus* from North America, based on an Ar/Ar age of 1.61 Ma on Guaje Pumice from the Sierra Ladrones Formation in Tijeras Arroyo (Lucas et al., 1993; Izett and Obradovich, 1994; Lucas, 1995, 1996). Although the pumice date provides a maximum age for this site, evidence from other pumice deposits of exactly the same age farther south in the Rio Grande Valley (Mack et al., 1996, 1998) indicates that the pumice is very close in age to the fossils. The association of *M. meridionalis* with *Glyptotherium arizonae* and *Equus scotti* is indicative of an early Irvingtonian age for the Tijeras Arroyo fauna. Correlative early Irvingtonian faunas include the Tortugas Mountain LF (Lucas et al., 1999, 2000) and Mesilla Basin Fauna C (Vanderhill, 1986) from the Mesilla basin in southern New Mexico, Gilliland in Texas (Hibbard and Dalquest, 1966), and Holloman in Oklahoma (Dalquest, 1977).

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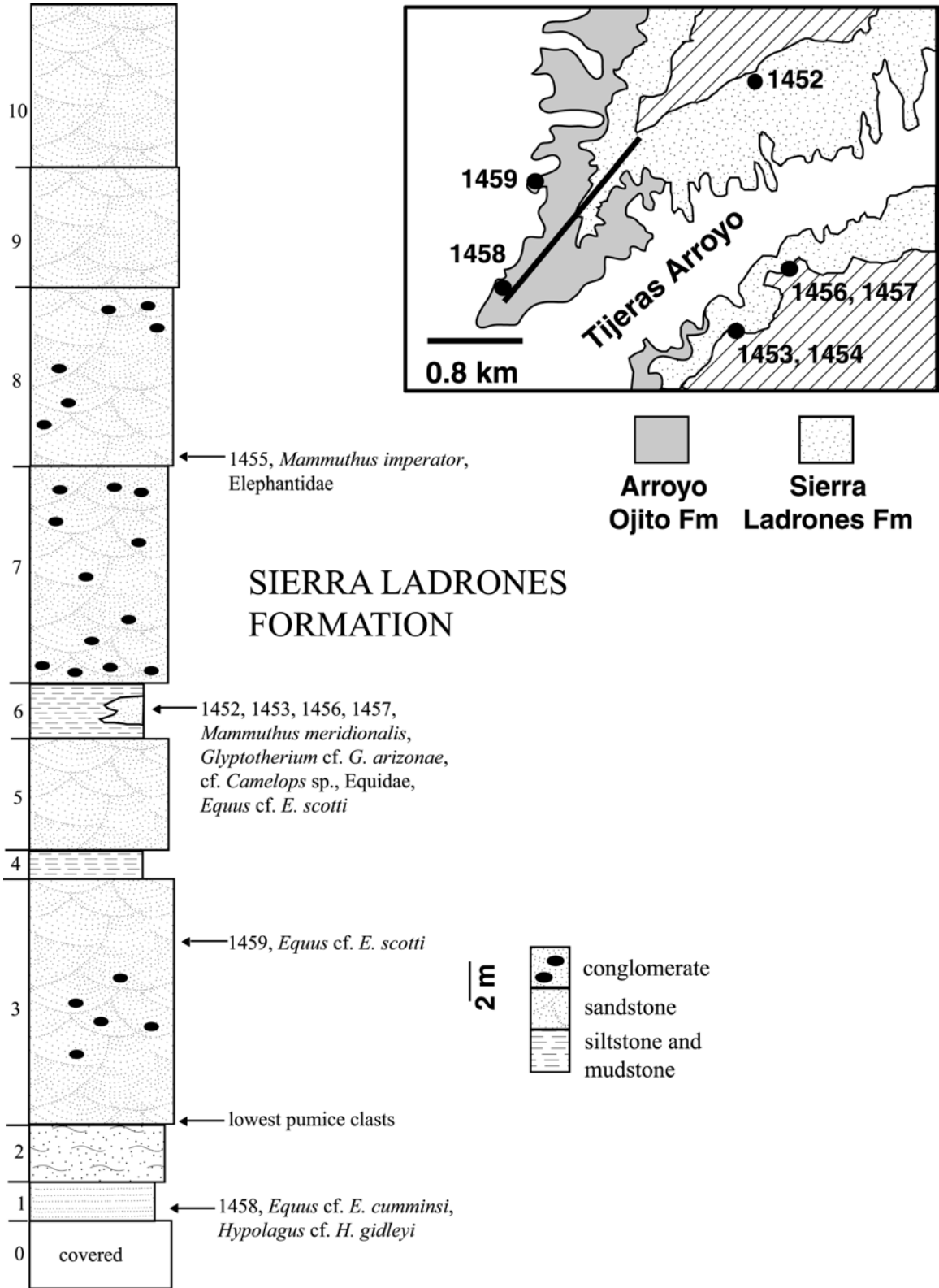


Figure 1. Stratigraphic column of Sierra Ladrones and Arroyo Ojito Formation strata at mouth of Tijeras Arroyo.

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