10. Magnetic Stratigraphy of the Duchesnean Part of the Galisteo Formation, New Mexico

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ABSTRACT

Two sections of the Galisteo Formation in central New Mexico, which contain the Duchesnean Troque local fauna, were sampled for magnetic polarity stratigraphy. The section at Arroyo del Humo is of mixed polarity, and probably correlates with Chron C17r to C17a (27.3-33.1 Ma), based on similarities with other well-dated Duchesnean faunas. The section of the type Galisteo Formation in the Cerillos area is mostly of reversed polarity, and probably correlates with Chron C17r (28.0-30.5 Ma) based on comparisons of its faunas to other late Duchesnean faunas.

INTRODUCTION

In the southwestern United States, the sharpest pulse of the Laramide orogeny began during the middle Eocene. In northern New Mexico and Colorado, the northwesterly moving Colorado Plateau impinged upon the basement buttresses of the Rocky Mountain foreland, producing significant orogeny. This formed a series of en-echelon, asymmetric downwarps, and tilted and subsided blocks that Chapin and Caster (1981) referred to as Echo Park-type basins, and Dickinson et al. (1988) refers to as axial basins.

One of these basins was the Galisteo-Rito basin of north-central New Mexico. Its principal basin fill, the Galisteo Formation, is as much as 1300 m thick and consists of fluvial sandstones, mudstones, and conglomerates (Gorsham and Ingerson, 1979) (fig. 1). Two Eocene fossil mammal local faunas (6.1) we know from the Galisteo Formation. The lower part of the unit produces the Cerillos local fauna of Wasatchian age, and the upper part produces the Troque local fauna of Duchesnean age (fig. 1; see also Lucas, 1987). The Troque local fauna is one of the most diverse and better known Duchesnean mammal faunas from western North America (Lucas, 1992). Here, we establish the magnetic-polarity stratigraphy of the Duchesnean interval of the Galisteo Formation at two different localities from these strata and the fossil mammals to other Duchesnean strata outside of New Mexico.

MAGNETIC STRATIGRAPHY

In the spring of 1988 and the summer of 1990, magnetic sampling was conducted in the two main sections of the Galisteo Formation which contain Duchesnean mammals. In the Cerillos area (fig. 1), samples of the type Galisteo were taken, starting with Lucas' (1982, fig. 2) unit 73 (magnetic site 241, fig. 2) and continuing with the base of unit 82 (magnetic site 259), for a total of 200 m of section. Fossil localities C5 and C6 of the Duchesnean Troque (7.4 and 82, respectively. Sampling was also conducted in the upper Galisteo exposure in the Arroyo del Tuerto (fig. 5), beginning with the top of Lucas' (1982, fig. 7) unit 1 (magnetic site 230) and continuing with the base of the Esparzaño Formation (magnetic site 340), a total of 70 m of section. Note that this is the base of the Esparzaño Formation as defined originally by Stetson (1943) used by Lucas (1982), which is the most readily mappable contact between two lithostratigraphic units. Debow and Spill (1957), Kaatz et al. (1981), and Smith et al. (1991) placed the Galisteo-Esparrizo contact at the lowest occurrence of volcanic detritus in the Arroyo del Tuerto section, which is at the base of unit 3 of Lucas (1983, fig. 7), a basaltic mudstone, but this is not so readily mappable as a contact between the two formations.

Horizontally oriented blocks of rock were sampled with simple hand tools. A minimum of three samples was taken at each site. In the type Galisteo section, sites were spaced approximately 10 m apart stratigraphically; in the shorter Arroyo del Tuerto section, sites were spaced about 5-6 m apart. Samples were mounted on a hard saw equipped with a tungsten-carbide blade, and analyzed at the California Institute of Technology paleomagnetic laboratory. Poorly oriented specimens were boiled with sodium-silicate solution to preserve them during thermal demagnetization.

After measurement of the NRM (natural remanent magnetization), a suite of samples was subjected to AF (alternating field) demagnetization. Many samples, such as 240A (fig. 2A), showed a steady decline in
intensity during AF demagnetization. This suggests that a low-coercivity armor such as magnetite is the main carrier of remanence. Under thermal demagnetization (Fig. 3), most samples had lost nearly all their remanence by 600°C, which is above the Curie point of magnetite. However, some samples (Fig. 3) still had significant remanence left at 600°C, suggesting that significant hematite was present. A few samples (Fig. 3) showed no intensity even at 600°C, most of their remanence having apparently been in hematite.

Analyses of IBH (induced remanence magnification) acquisition factor confirmed that both magnetite and hematite were present in many samples. Scott et al. (1980) determined that the remanence in these rocks is carried mostly by magnetite. Other specimens (Fig. 3) showed no evidence of IBH remanence, even at fields of 10 kA/m. Some samples clearly contained much hematite. A modified Littler-Carter ARM (anisotropous remanence magnification) test (e.g., Kemna et al., 1979) was also conducted during the IRM analysis (see Plotner et al., 1999, for details). This test showed that AF demagnetization of both ARM and IRM is hard to 180 mT peak fields, and no ARM remains in a 1 kA/m oscillating field. In almost all samples, the ARM-H pattern remains demagnetized at higher peak fields, showing the ARM H (open squares), indicating that the remanence carried by single-domain or pseudo-single-domain grains.

Finally, thin sections of ARM samples were examined under reflected light. In most cases, red-brown magnetic grains were visible with remanence of remanence could be seen. In addition, several samples had a strong and
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LITERATURE CITED


