Magnetostratigraphy of Paleogene Deposits in Coastal San Jorge Basin and Implications for South American Land Mammal Ages

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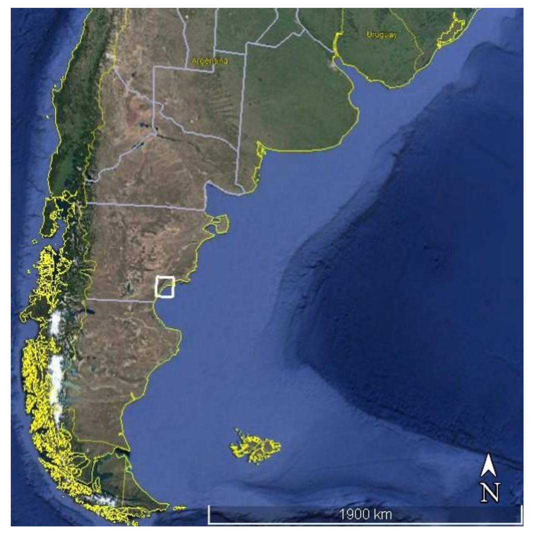
Introduction and Background

- Several global climate events occurred during the Paleogene period (ca. 66-23 Ma), including recovery from the end-Cretaceous extinction [1] and the Paleocene-Eocene Thermal Maximum [2]; these had a major effect on global biodiversity
- The coastal San Jorge Basin in Patagonia, Argentina contains important Paleogene age mammal fossil assemblages [3] that form the basis for parts of the South American Land Mammal Age (SALMA) framework [4], but there are few precise independent geochronological constraints on these assemblages
- This study uses magnetostratigraphy to correlate the fossil-bearing San Jorge Basin stratigraphic sequence to the Geomagnetic Polarity Timescale to better understand how these fossil mammal assemblages fit into the context of Paleogene climate change



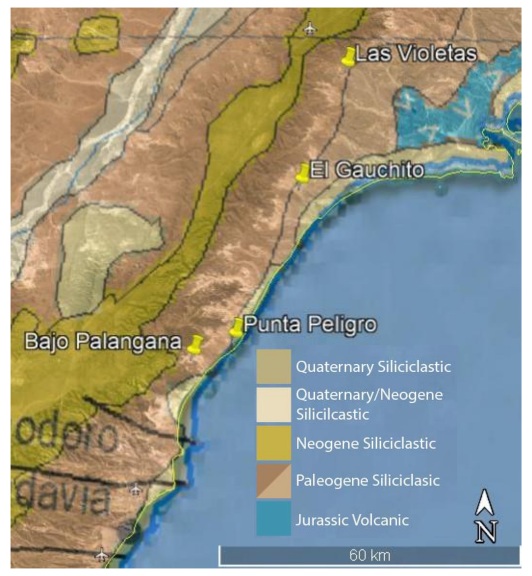


Figure 1: There were four localities from which samples were collected in the coastal San Jorge Basin: Las Violetas, El Gauchito, Punta Peligro, and Bajo Palangana [5,6].

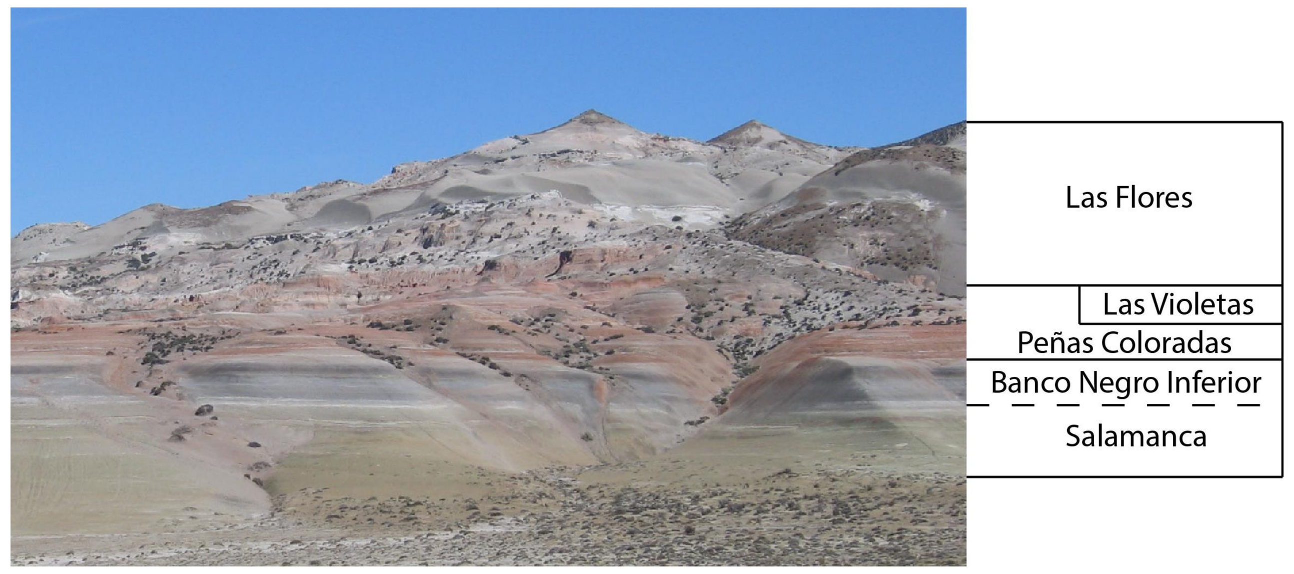


Figure 2: There are four formations outcropping in the coastal San Jorge Basin: Salamanca Formation (including the Banco Negro Inferior paleosol), Las Violetas Formation, Peñas Coloradas Formation, and Las Flores Formation.

Methods

- Oriented samples were collected from Las Violetas, El Gauchito, Punta Peligro, and Bajo Palangana
- Natural Remnant Magnetization of the samples were measured using a 2G SQUID Rock Magnetometer in the UNH Paleomagnetism Lab
- Samples were demagnetized using alternating field and thermal methods to remove overprints
- Isothermal Remnant Magnetization (IRM) was applied to understand magnetic mineralogy [7]

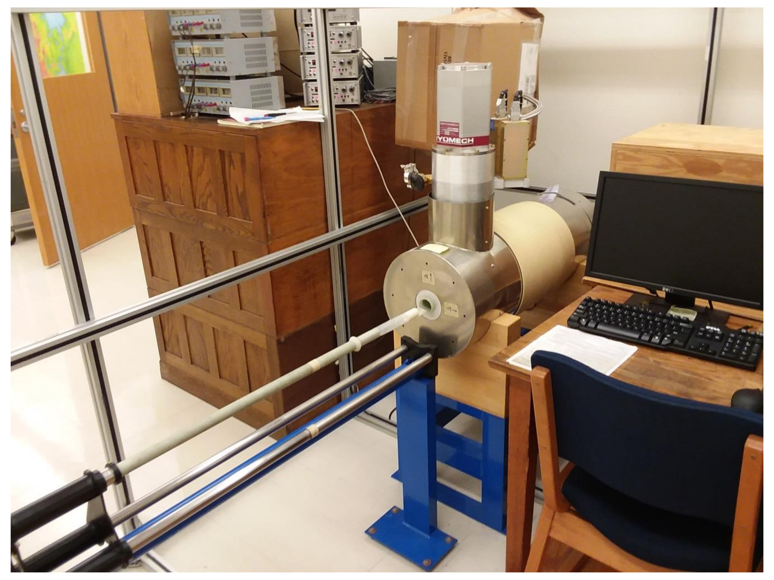


Figure 3: Samples were measured with the 2G SQUID Rock Magnetometer in the UNH Paleomagnetism Lab.

Results

Isothermal Remnant Magnetization (IRM)

- IRM was applied to five sites from Bajo Palangana
- The three samples from Las Flores exhibited behavior characteristic of low coercivity minerals (such as magnetite)
- The two samples from Peñas Coloradas indicated that high coercivity minerals (such as hematite), were dominant

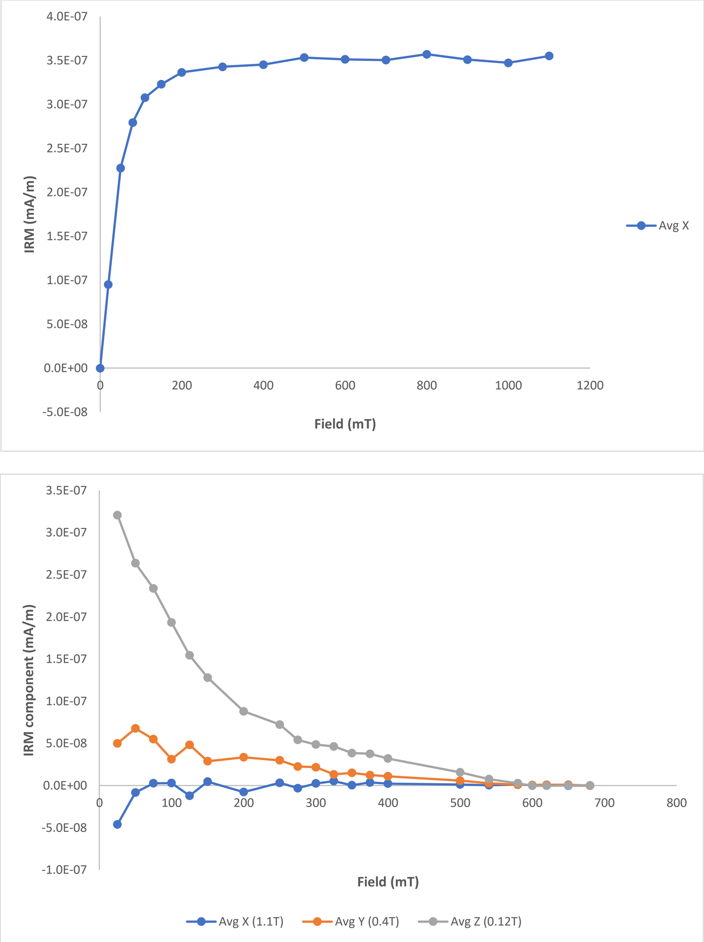


Figure 4: IRM results for site BP1720, which indicates that low coercivity minerals dominate. The top diagram shows magnetic acquisition, while the bottom diagram shows demagnetization.

Paleomagnetism

- 173 samples from 66 sites yielded data that were indicative of Characteristic Remnant Magnetization (ChRM)
- The reversal test, which determines if the polarities are antipodal, was applied to these data; they failed the reversal test, suggesting that overprints were not fully removed.
- Alpha sites, which yield more reliable indications of ChRM than other sites, were used for the reversal test

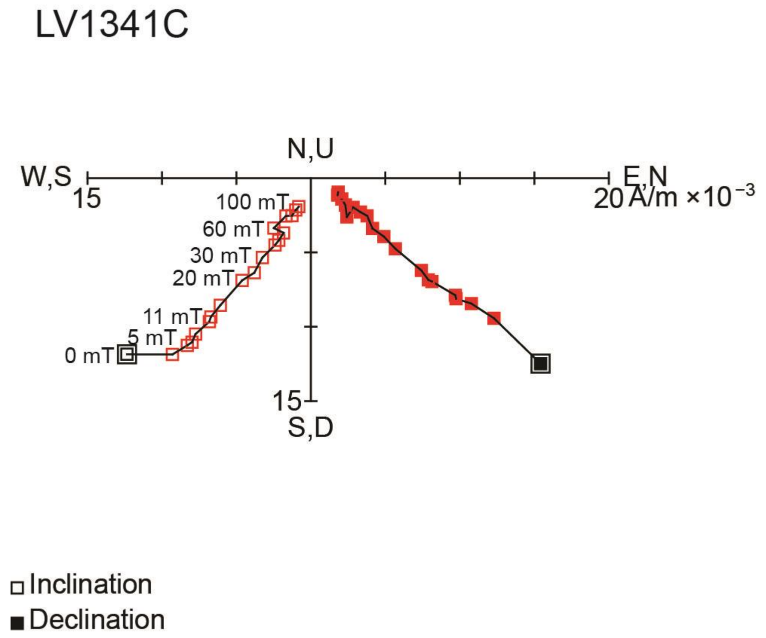


Figure 5: Vector endpoint diagram showing stable Alternating Field demagnetization of reverse polarity sample from Las Violetas Formation. Data were plotted using the PuffinPlot software [8].

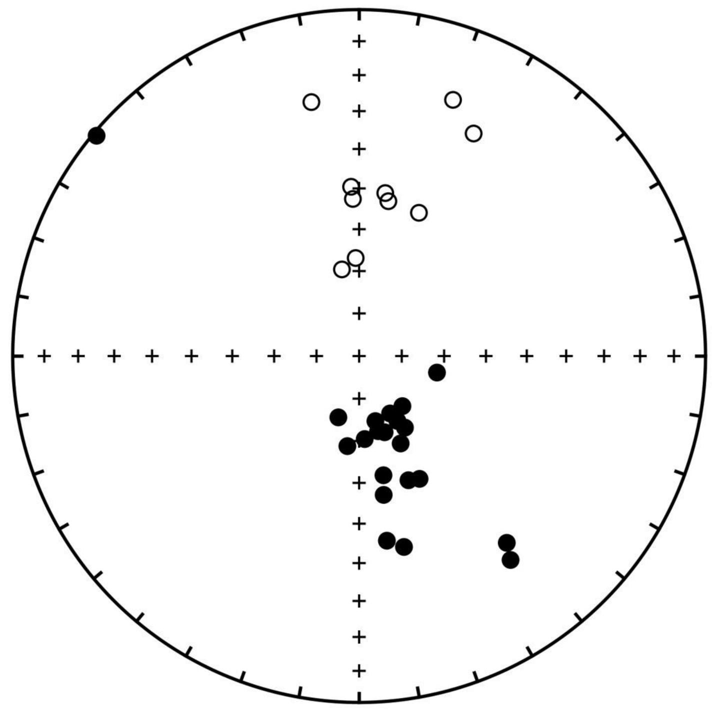


Figure 6: An equal area plot with polarity vectors for each alpha site. The grouping of open points in the north are reverse sites, and the group of closed points in the south are normal.

Discussion and Conclusions

- Magnetostratigraphic correlation was determined from magnetic reversals and radiometric ages
- Due to unconformities, there are multiple possible correlations
- The magnetostratigraphy can be correlated with the location of mammal fossils in the coastal San Jorge Basin, providing geochronological constraints for the Paleogene SALMAs

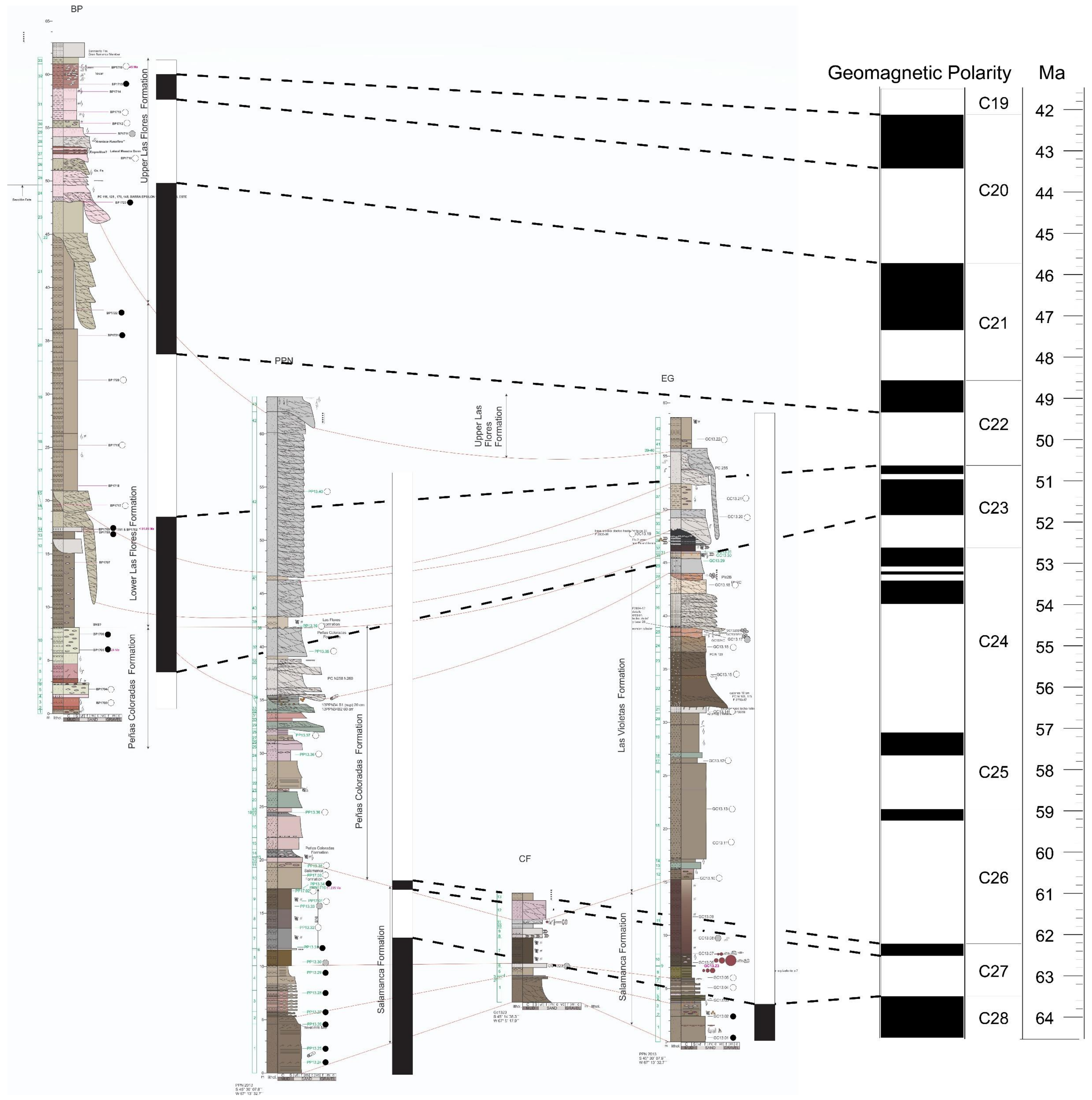


Figure 7: A tentative correlation of magnetic reversals in the coastal San Jorge Basin to the Geomagnetic Polarity Timescale. This correlation shows the preservation of the C28n/C27r reversal through the C20n/C19r reversal, representing at least 21.3 Ma.

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References: [1] Schulte, P. et al., 2010, Science, 327:1214-1218. [2] McInerney, F.A., and Wing, S.L., 2011, Annual Review of Earth and Planetary Sciences, 39: 489-516. [3] Simpson, G.G., 1935, American Museum Novitates, 793:1–25. [4] Woodburne, M.O. et al., 2013, Journal of Mammalian Evolution, 21:1-73. [5] US Dept. of State Geographer, 2021, Google Earth Pro: Satellite image software: Google LLC. [6] Gómez, J. et al., compilers, 2019, Commission for the Geological Map of the world (CGMW), Columbian Geological Survey, and Geological Survey of Brazil, Scale 1:5,000,000. [7] Lowrie, W., 1990, Geophysical Research Letters, 17: 159-162. [8] Lurcock, P.C., and Wilson, G.S., 2012, Geochemistry, Geophysics, Geosystems, 13: n/a-n/a.