Using Magnetostratigraphy to Find the Cretaceous-Paleogene Boundary in La Colonia Formation, Patagonia, Argentina

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TRIO

Introduction

- The Cretaceous-Paleogene (K-Pg) boundary marks one of the largest mass extinctions in Earth's history. It occurred approximately 66 million years ago within Chron C29r, an interval of reversed geomagnetic polarity (Fig. 1) [1].
- An asteroid impact at what is now Chicxulub, Mexico [1] and extreme basaltic volcanism associated with the Deccan Traps in India occurred at this time [2]. One or both of these was the primary cause of the K-Pg extinction.
- There are few known records of the K-Pg boundary in South America; those that have been found are located in Brazil, Argentina, and Columbia [3,4,5]. This results in poor understanding of the effects of the event on this continent.
- This project seeks to determine if the fossiliferous La Colonia Formation (Fig. 2), Patagonia, Argentina, preserves Chron C29r and therefore the K-Pg boundary.

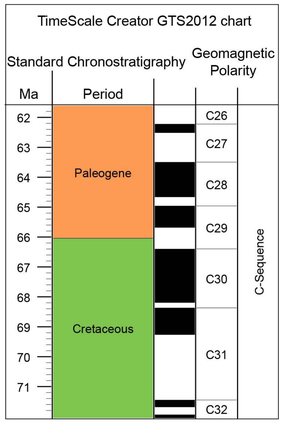

Figure 1: Geologic timescale with geomagnetic polarity; the K-Pg boundary falls within Chron C29r [6]

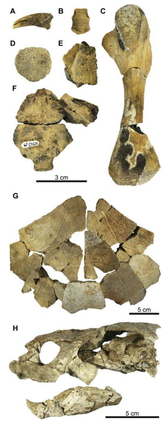

Figure 2: Late Cretaceous age turtle fossils from La Colonia Formation [7]

Geological background

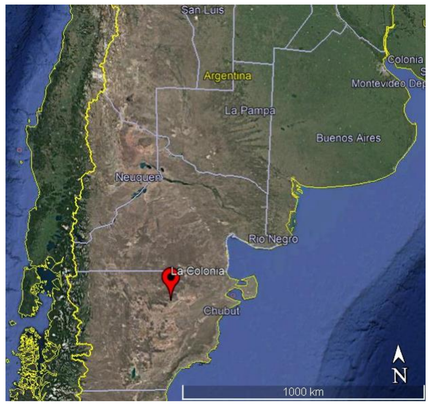

Figure 3: Location of La Colonia Formation in Chubut, Patagonia, Argentina [9]

Figure 4: La Colonia Formation (image credit: Dr. Will Clyde)

- The sedimentary La Colonia Formation (Figs. 3 and 4) has a known age of Late Cretaceous to early Paleogene [8].
- Sediments are of estuarine and deltaic origin [8].
- Vertebrate fossils found here include turtles, plesiosaurs, mammals, and dinosaurs [7].
- Plant fossils provide information about the extinction and depositional environment [8].
- The lowermost unit consists of conglomerate and sandstone, then grades from sandstone to siltstone in the middle, and claystone and marine sediments at the top [8].

Methods

- Paleomagnetic analysis was conducted on 8 cm^3 hand samples collected from 38 sites at La Colonia.
- Polarity was measured using a 2G SQUID cryogenic magnetometer in the UNH paleomagnetism lab (Fig. 5).
- Samples were demagnetized by the alternating field (AF) method, using a tumbling AF demagnetizer.
- Isothermal remnant magnetization (IRM) was conducted on some samples to determine magnetic mineralogy of La Colonia.
- A total of 122 samples were analyzed (Fig. 6).

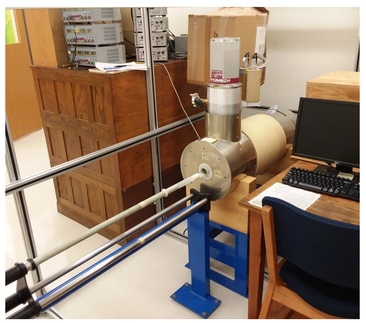

Figure 5: The magnetometer at the UNH paleomagnetism lab

Figure 6: Samples from La Colonia

Results

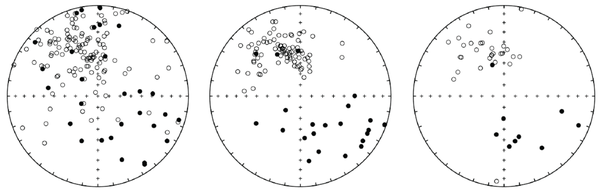

Figure 7: From left to right: Natural Remnant Magnetization of all samples before demagnetization, Characteristic Remnant Magnetization (ChRM) of samples after demagnetization, ChRM of site means [10]

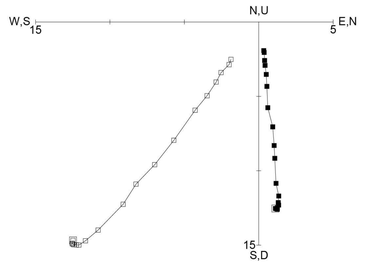

Figure 8: Demagnetization data for sample LP1802A shown on a vector endpoint diagram showing clear reverse polarity [10]

- Chron C29r is preserved in La Colonia, as seen from the magnetometer measurements (Figs. 7 and 8), indicating the presence and approximate location of the K-Pg boundary (Fig. 9).
- Paleomagnetic data confirm field observations that the upper part of one of the subsections is affected by a slump.
- IRM results indicate that magnetite was the dominant ferromagnetic mineral (Fig. 10).
- Chrons C30n, C30r, and parts of C29n and C31n are present in addition to Chron C29r.

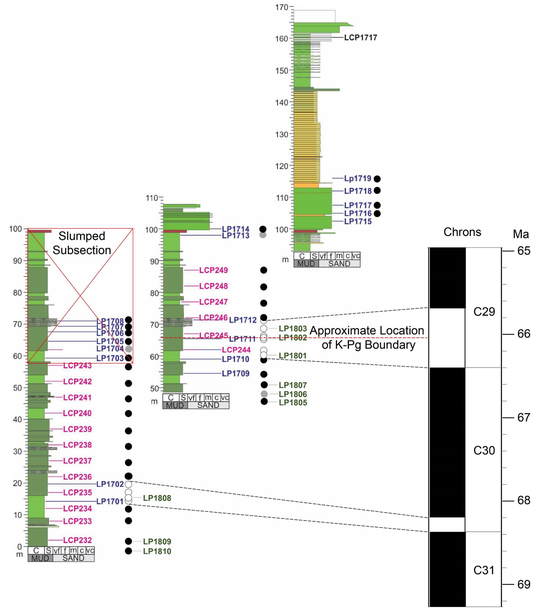

Figure 9: Stratigraphic section with polarities at each site (white represents reverse, black represents normal)

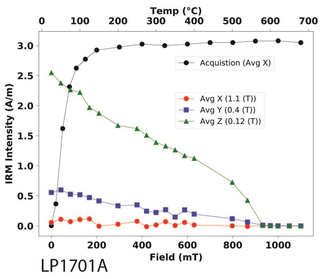

Figure 10: IRM results for sample LP1701A, which are typical for La Colonia. This pattern indicates that magnetite is the dominant ferromagnetic mineral.

Conclusion

- The identification of Chron C29r indicates the presence of the K-Pg boundary in La Colonia Formation.
- This finding contributes to understanding of K-Pg boundary in South America by adding to the number of known records there.
- It also provides context for the geology and fossils of La Colonia.
- This adds to known sites to study the K-Pg mass extinction.

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