

C34/C33 LIMIT IN PROXIMAL MARINE SANTA MARTA FORMATION AND ITS CORRELATION WITH DISTAL RABOT FORMATION IN JAMES ROSS BASIN, ANTARCTICA

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ABSTRACT

The Santa Marta Formation (Santonian - middle Campanian) is located in the northwestern tip of the James Ross Island, in the Antarctic Peninsula. The Rabot Formation (early-middle Campanian), that is equivalent to the upper part of the Santa Marta Formation, crops out at the southeastern sector of the island. Due to diachronic extinctions and endemism, biostratigraphic correlation of the James Ross Basin infill presents many uncertainties. We present here a preliminary magnetostratigraphic composite section of four outcrops of the Santa Marta Formation which suggests that the C34n/C33r reversal, and therefore the Santonian-Campanian boundary, is recorded at the lower levels of the Santa Marta formation. This is consistent with previous magnetostratigraphic results on the Rabot Formation and agrees with biostratigraphic correlations based on ammonites associations.

Keywords: Magnetostratigraphy, Antarctica, James Ross Basin, Cretaceous

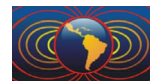
RESUMEN

La Formación Santa Marta (Santoniano-Campaniano medio) se encuentra en el extremo noroccidental de la Isla James Ross, en la Península Antártica. La Formación Rabot (Campaniano temprano-medio) es equivalente a la parte superior de la Formación Santa Marta y aflora en el sector sureste de la isla. Debido a endemismo y extinciones diacrónicas, la correlación bioestratigráfica del relleno de la Cuenca James Ross ha sido siempre una tarea problemática. En este trabajo, presentamos una columna magnetoestratigráfica preliminar, compuesta por cuatro secciones de la Formación Santa Marta, que sugiere que la reversión C34n/C33r, equivalente al límite Santoniano-Campaniano, se encuentra registrada en los niveles inferiores de la Formación Santa Marta. Esto es consistente con resultados magnetoestratigráficos previos obtenidos en las formaciones Santa Marta y Rabot y con la correlación bioestratigráfica basada en amonites.

Palabras Clave: Magnetostratigrafía, Antártida, Cuenca James Ross, Cretácico

Introduction

The James Ross Basin (Late Jurassic-Eocene) is a back-arc basin developed to the East of a magmatic arc located in the Antarctic Peninsula. The basin infill is exposed in the James Ross Archipelago, to the Northeast of the Antarctic Peninsula. The Santa Marta Formation (Santonian-Middle Campanian) represents a deltaic regressive sequence (Olivero, 2012) and it is located in the northwestern tip of the James Ross Island. The Rabot Formation (early-middle Campanian) also represents a regressive sequence, equivalent to the upper part of the Santa Marta Formation but corresponds to a deeper marine environment and crops out at the southeastern sector of the James Ross Island (Fig. 1). Due to diachronic extinctions and endemism, biostratigraphic correlation across the basin has many uncertainties. Magnetostratigraphy is a powerful



tool that could provide a precise chronological framework and diminish the uncertainties in the correlation between proximal and distal facies of the basin. We present here a preliminary magnetostratigraphic composite section of four outcrops of the Santa Marta Formation. Previous magnetostratigraphic studies (Milanese *et al.*, 2013) carried out in the southeastern sector of the James Ross Island on the Rabot Formation allowed us to find the magnetic polarity change between chrons C33r and C33n along the exposed succession of this formation. Kirschvink *et al.* (2010) obtained preliminary magnetostratigraphic results on Santa Marta Formation that encouraged us to continue and improve the previous study.

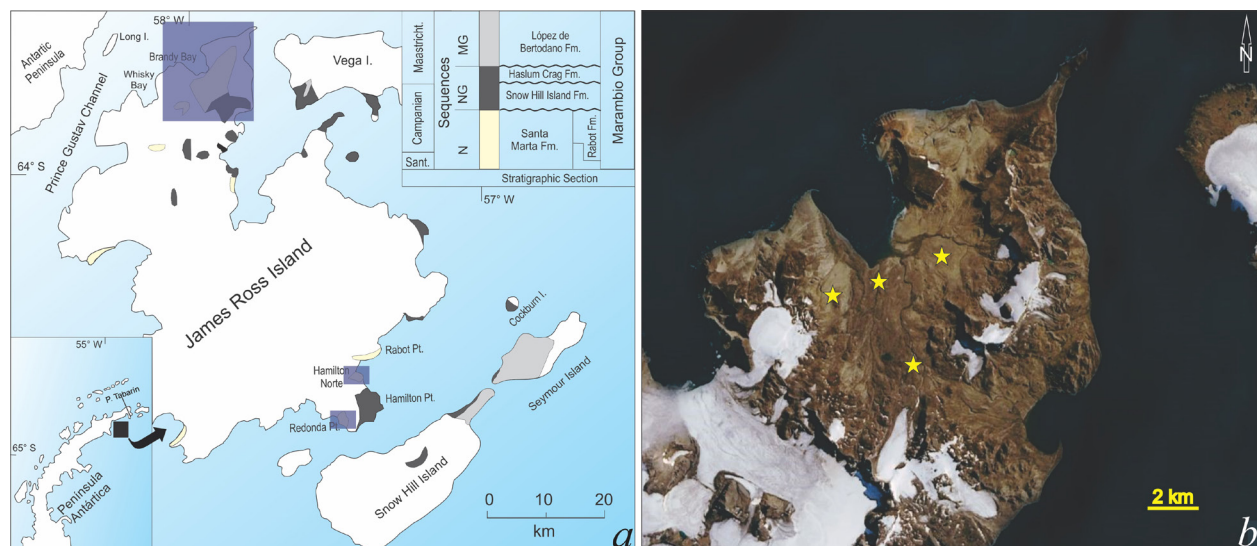


Figure 1: a) Geological scheme and stratigraphy of the Marambio Group in James Ross Archipelago. In the big blue box is the area of this study. The two small blue boxes show previous sampling localities (Milanese *et al.*, 2013). b) Detail of the study area and the four sampled partial sections (yellow stars).

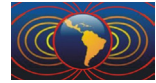
Objectives

The age of the Santa Marta and Rabot formations have been assigned by ammonites assemblages (Olivero, 2012). In order to provide a precise chronological framework for sedimentation of this unit and the ammonite assemblages, we carried out a composite magnetostratigraphic column on the Santa Marta Formation. This would also permit to analyze degree of diachroneity between the proximal (Santa Marta) and distal (Rabot) facies of the Santonian-Campanian infill of the James Ross Basin.

Methodology

Magnetostratigraphic sampling was carried out along four partial sections of the Santa Marta Formation at Brandy Bay. Approximately 150 oriented block samples from different stratigraphic levels were collected. Sampling was performed in a way that a composite section of most of the formation could be obtained.

Detailed stepwise demagnetization of all samples (1 cm high specimens) were carried out at the Laboratory of Paleomagnetism of California Institute of Technology, using an automatic 3-axis DC-SQUID moment magnetometer system, housed in a magnetically shielded room. The demagnetization routine started with two low temperature steps (samples were immersed in liquid N₂) to remove viscous magnetizations carried by multi-domain magnetite and three alternating field (AF) steps (from 2.3 to 6.9 mT) to remove secondary magnetizations acquired during collection and transportation of samples. After these, main demagnetization process was thermal, from 60°C reaching up to 575° in 15-10°C steps. Most samples showed unstable behavior over ~450°C.



Characteristic remanence (ChRM) directions were calculated by means of principal components analysis (PCA, Kirschvink, 1980). Only those with maximum angular deviation (MAD) values under 10° were accepted. In some cases, great circle analysis (McFadden and McElhinny, 1988) was performed to isolate the remanence direction. Small viscous components were removed with the first steps of low-temperature demagnetization, AF or thermal cleaning up to 150°C . A small number of specimens showed unstable behavior. Most others showed univectorial decay towards origin of coordinates with unblocking temperatures generally under 450°C . Polarity of the characteristic remanence along the four sections permitted to compute a local magnetostratigraphic column for the composite section.

Results

The basal local column corresponds to Hidden Lake Formation (Coniacian), which underlies the Santa Marta Formation. Consistent with the assigned age of this formation, based on ammonite records, the Normal Polarity Superchron C34 was found along the whole formation. The location of the expected Santonian-Campanian boundary, which coincides with C34n/C33r polarity change (Gradstein *et al.*, 2012), along the Santa Marta Formation was the main objective of the study, considering the low frequency of polarity changes at this time. In fact, the long normal interval was recorded in the two lower columns. The first polarity change appears near the base of the third column. Although correlation between lithological and magnetic columns still needs to be adjusted, preliminary interpretations suggests it to be located at approximately 270 m from the base of the Santa Marta Formation, in the Alpha Member. Above that limit, many small normal polarity intervals appear within a long reverse interval (200 m of stratigraphic thickness, approximately). Due to an interval of unreliable magnetic behavior of the samples, there is a gap of approximately 60 m within the long reverse section. The appearance of a few very short intervals along the upper reverse section of the formation is under study, although a recent overprint of certain levels is the most likely preliminary interpretation.

Discussion

Macrofauna and palinology indicate a Coniacian age for the Hidden Lake Formation (Riding and Crame, 2002). Considering this, the basal long normal interval that includes the top of Hidden Lake and the base of the Santa Marta Formation, should correspond to the C34 superchron. We found a long reverse interval after C34 that permit to assign the stratigraphic position of the), C34/C33r limit, dated in 83.64 Ma (Gradstein *et al.* 2012).

In previous works (Milanese *et al.*, 2010; 2013), we could record the C33r/C33n reversal in the southeastern sector of the James Ross Island on the Rabot Formation. This new magnetostratigraphic record permits to calibrate more precisely the Late Cretaceous infill of the James Ross Basin and its ammonite assemblages and to correlate successions at different locations in the basin.

Acknowledgments

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