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Magnetostratigraphy of the Rabot Formation, Upper Cretaceous, James Ross Basin, Antarctic Peninsula

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ABSTRACT

Problems of endemism and diachronous extinctions make global correlation of coeval strata in the mid Campanian-Maastrichtian of the James Ross Basin problematic. To provide a more precise chronological framework, we present two magnetostratigraphies of Campanian strata from the Rabot Formation that crops out at Hamilton Norte (200 m thick) and Redonda Point (340 m thick) in James Ross Island. Sampled sections consist of poorly-consolidated, drab-colored fine sandstones and mudstones. Bulk susceptibility logs of both sections show a similar pattern of relatively low values at the lower and upper levels with significantly higher values at mid-levels that confirms the lithostratigraphic correlation between sections. Rock magnetic studies suggest that this change is not attributable to a ferrimagnetic fraction but to a paramagnetic contribution of presumed detrital origin. Stepwise thermal demagnetization showed dominant unblocking temperatures higher than 400 °C. Progressive hybrid low-temperature cycling, low-field AF and thermal demagnetization in a controlled N_2 atmosphere, reveals a two-polarity characteristic component of possible primary origin. Rock magnetic experiments suggest that detrital titano-magnetite is the most likely remanence carrier. Anisotropy of magnetic susceptibility results show sedimentary fabrics, indicating that beds were not significantly buried or compacted. Magnetostratigraphies produced at each locality demonstrate a consistent change from reverse to normal polarity remanence in the middle of the sections. Biostratigraphic constraints identify this reversal as the C33r/C33n transition, indicating a 79.90 Ma depositional age for this level of the Rabot Formation. The remanence directions yield a mean whose corresponding paleopole is consistent with two recently obtained Upper Cretaceous reference paleopoles for the Antarctic Peninsula. Our data support the lack of tectonic rotation or oroclinal bending of this region since the Late Cretaceous.

1. Introduction

The James Ross Basin (JRB), located at the northeastern tip of the Antarctic Peninsula (Fig. 1), comprises more than 6 km (del Valle et al., 1983) of marine sedimentary deposits Barremian to Eocene in age. Strata from James Ross Basin are of great scientific value because they preserve one of the most important, rich and continuous records of marine life for the Late Cretaceous in the Southern Hemisphere, also being of great importance for regional stratigraphic correlations (Feldmann and Woodburne, 1988; Reguero et al., 2013; Francis et al., 2016). The Cretaceous strata of the basin include the basal Gustav Group (Barremian-Coniacian), which corresponds to deep marine deposits (Ineson, 1989), and the Marambio Group (Santonian-Danian) which records deposition in transitional to platform environments (Macellari, 1988; Lirio et al., 1989; Medina et al., 1989; Pirrie et al., 1997; Whitham et al., 2006; Olivero et al., 2008; Olivero, 2012a).

Even though fossils are abundant, both the ammonites and palinomorphs present several global correlation problems due to their endemic distribution or diachronic extinctions patterns (Pirrie et al., 1997; Olivero, 2012a). The scarcity of suitable

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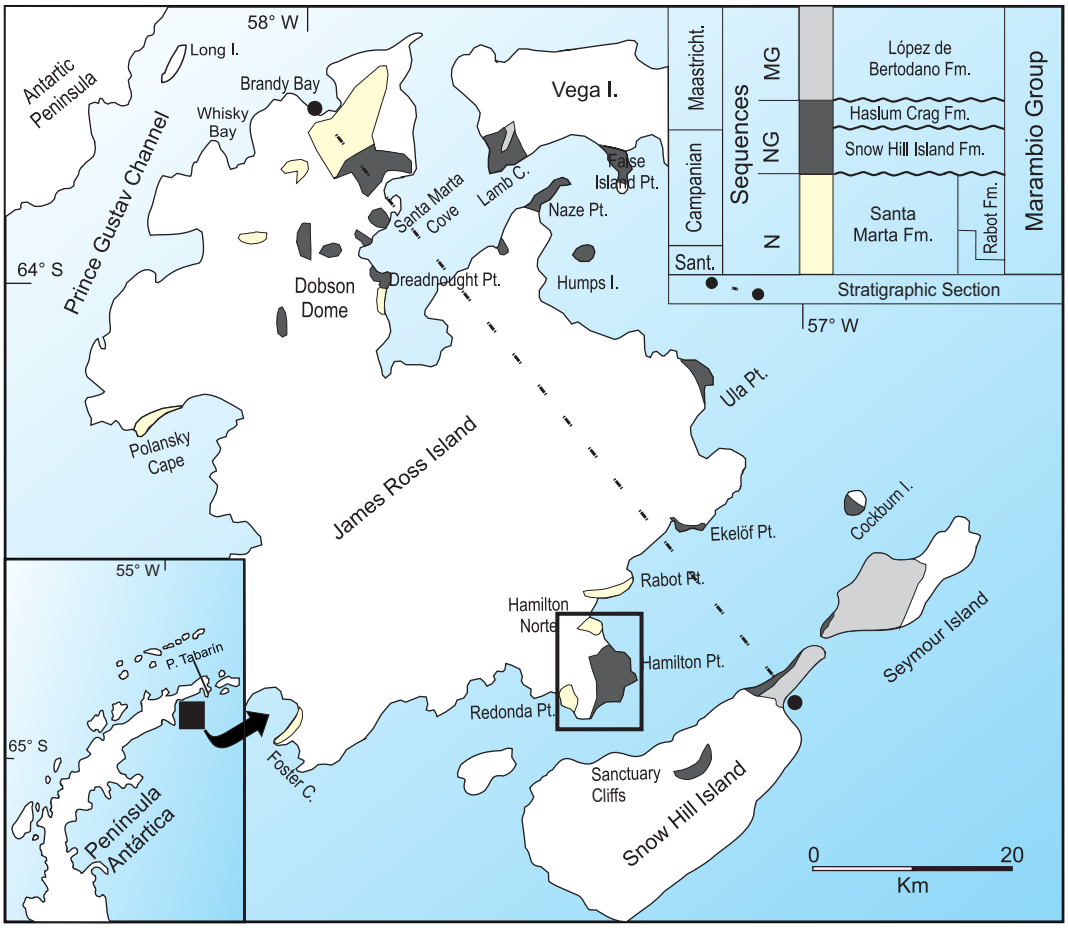

Fig. 1. Upper Cretaceous Marambio Group in James Ross archipelago. Black box shows the study area detailed in Fig. 3 (modified from Olivero, 2012a).

material for Ar/Ar or U/Pb dating makes magnetostratigraphy a valuable tool to provide a precise chronological framework for biostratigraphic, paleogeographic and paleoclimatic studies in the Antarctic Peninsula. Furthermore, magnetostratigraphy allows to compute sediment accumulation rates that provide significant information on the tectonic, paleoenvironmental, and climatic setting. In parallel, paleomagnetic pole positions provide paleolatitude constraints on the development of the basin fill and on major tectonic processes like crustal block rotation and oroclinal bending. Preliminary results obtained on the SE sector of JRB (Milanese et al., 2013) and previous work carried out on Seymour Island by Tobin et al. (2012) are an encouraging precedent for further paleomagnetic research on rocks of the JRB. This study is focused on two partial sections of the Rabot Formation exposed in Hamilton Norte (*HN*) and Redonda Point (*Re*) in southeastern James Ross Island (Fig. 1).

2. Geological framework

The James Ross Basin is interpreted as a back-arc basin developed to the east of a magmatic arc located along the Antarctic Peninsula. The arc was formed by the southeastward subduction of the proto-Pacific oceanic plate beneath the southern margin of Gondwana (Whitham, 1993; Hathway et al., 2000), with volcanism starting ~180 Ma ago. The JRB experienced continuous subsidence, providing the accommodation space for the deposition of more than 6 km (del Valle et al., 1983) of highly fossiliferous marine, deltaic and estuarine sediments from Barremian to Late Eocene time (Andersson, 1906; Rinaldi et al., 1978; Farquharson, 1984; Ineson et al., 1986; Olivero et al., 1986, 2008; Crame et al., 1991; Riding et al., 1998; Marenssi et al., 2002; Olivero, 2012a).

Our study was carried out on the Santonian-Danian Marambio Group (Rinaldi et al., 1978; Macellari, 1986; Olivero et al., 1986), which comprises 3 km of alternating mud, fine-grained sandstones and subordinated conglomerates and coquinas that have been interpreted as prograding deltaic lobes or platform deposits (Olivero et al., 1986, 2008; Pirrie, 1989; Crame et al., 1991; Pirrie et al., 1997; Olivero, 2012a) developed during a tectonic inversion stage of the basin (Ineson, 1989; Buatois and Lopez Angriman, 1992; Whitham et al., 2006).

Several different stratigraphies have been published for the Marambio Group (Fig. 2). In this work we follow the nomenclature proposed by Olivero (2012a). The Rabot Formation, exposed in the SE sector of the James Ross Island, is approximately equivalent to the Beta Member of the Santa Marta Formation (Olivero et al., 1986) exposed in the NW sector of the island. Proximal facies of the basin are located to the western sector while distal facies are represented by outcrops located to the East.

The Rabot Formation (Lirio et al., 1989) is well exposed in the type section at Rabot Point, as well as in Hamilton Norte and Redonda Point (Fig. 1). It is composed of members I, II and III (Lirio et al., 1989) or by the approximately equivalents units a, b and c according to Pirrie et al. (1997). This unit consists of an intercalation of mud, sandstones, tuffs and minor conglomerates. It represents