ABSOLUTE AGES OF MARINE SEDIMENTARY STRATA FROM JAMES ROSS BASIN

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ABSTRACT

A magnetostratigraphic study was carried out in the SE sector of the James Ross Basin (Antarctica). The magnetostratigraphy was obtained along five cross-sections, three of them located in the SE sector of James Ross Island and two in Snow Hill Island. They belong to the upper part of the deep marine sedimentary succession that constitutes the Marambio Group (Upper Cretaceous). Ammonite assemblages give the main chronological reference framework. Even though the fossil content is abundant, endemism and diachronic extinctions are the main problems in the definition of a precise age framework and global correlations for the Upper Cretaceous units. In this scenario, the magnetostratigraphy provides the required chronological resolution for the global correlation problems of James Ross Basin, identifying seven geomagnetic polarity reversals and obtaining an absolute age constraint for the whole succession between 74.309 Ma (Middle Campanian) to 71.449 Ma (Early Maastrichtian).

Keywords: Magnetostratigraphy, Upper Cretaceous, Antarctica.

1. Introduction

The James Ross Basin is located in the NE sector of the Antarctic Peninsula (Fig. 1) and comprises more than 6 km of marine deposits, from Barremian (Early Cretaceous) to Eocene. This succession contains one of the richest continuous records of marine life during Late Cretaceous in the Southern Hemisphere and is an important piece in regional and global stratigraphic correlations (Francis *et al.*, 2016; Reguero *et al.*, 2013). Although fossil record is abundant, ammonites present endemism and diachronic extinctions in Antarctica, which makes global biostratigraphic correlations a challenging task (Olivero, 2012; Pirrie *et al.*, 1997). Suitable material for

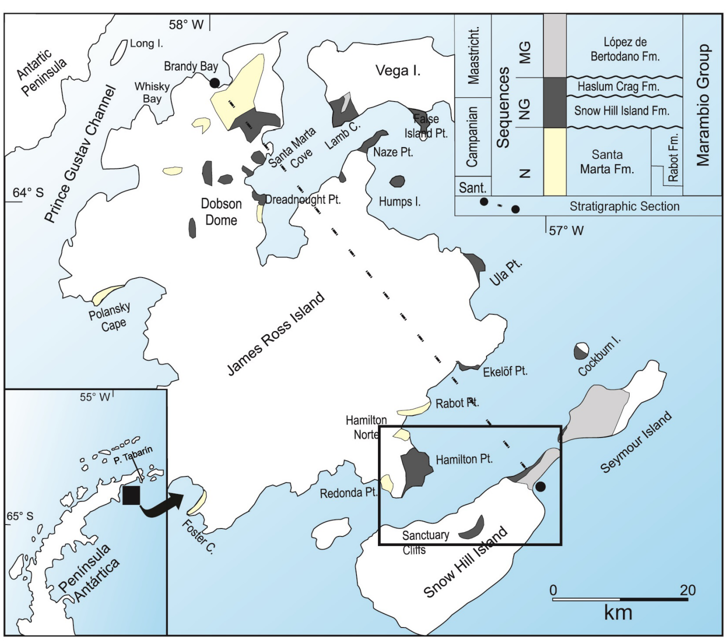

Figure1. Geological scheme of James Ross Basin. In the black box, the study area detailed in Figure 2.

Ar/Ar or U/Pb dating is scarce, which makes the magnetostratigraphy an irreplaceable tool for getting the absolute age framework for the Upper Cretaceous of the James Ross Basin, to solve the regional stratigraphic correlations and to understand the tectonic evolution of the basin. Milanese *et al*. (2017) have identified the C33r/C33n reversion, determining an age of 79.9 Ma (Middle Campanian) for the Rabot Formation, the basal unit of the Marambio Group in the SE sector of the James Ross Basin and situated stratigraphically below Snow Hill Island, Haslum Crag and López de Bertodano formations, analyzed in this study. From the encouraging results obtained so far, the main goal of this study has been to obtain a complete magnetostratigraphy of the youngest units of the Marambio Group.

2. Geological Setting

James Ross Basin is interpreted as a back arc basin located to the East of a magmatic arc developed in the Antarctic Peninsula as a result of the subduction of the proto-Pacific plate under the western margin of Gondwana (Hathway et al., 2000, Whitham, 1993). Volcanism started at ~180 Ma and behind the arc 6 km of highly fossiliferous marine, deltaic and estuarine deposits were accumulated from the Barremian to the Eocene. This study was carried out in the Marambio Group (Santonian-Danian), which comprises more than 3 km of mudstones, fine sandstones and scarce conglomerates. It has been interpreted as a system of prograding platform deposits (Olivero, 2012; Olivero *et al.*, 2008, 1986, Pirrie *et al.*, 1997) developed during an inversion stage of the basin. Figure 1 summarizes the distribution of outcrops and the stratigraphy of the Marambio Group in the study area. Stratigraphic correlations are based in ammonite bioestratigraphy (Olivero, 2012), that establishes a distribution of proximal facies to the NW (near to the magmatic arc) and distal facies to the SE.

3. Methodology

A detailed paleomagnetic sampling was carried out during South Hemisphere summers of 2015 and 2016. Five independent sections were sampled (Fig. 2), three of them located in the SE sector of the James Ross Island and two in Snow Hill Island. About 450 paleomagnetic cores were collected using a gasoline-powered drill. The demagnetization routine started with two low-

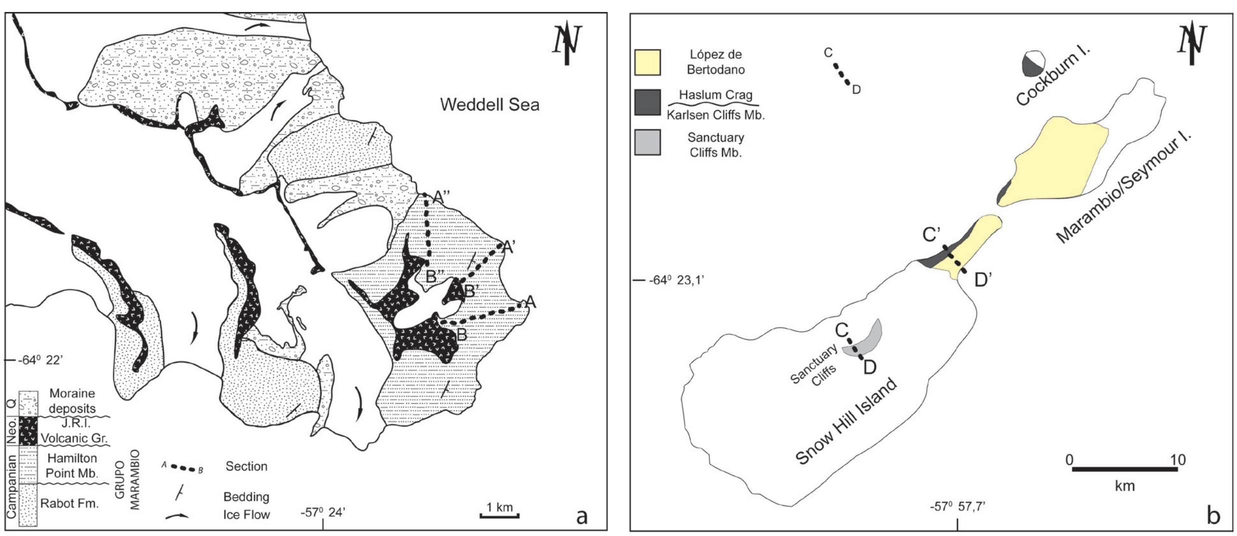

Figure 2. Studied sections in SE James Ross Island (a) and in Snow Hill Island (b).

temperature cycling steps (samples were cooled to 77 K in liquid N_2 in a near-zero field space) to remove viscous magnetizations carried by multidomain magnetite, followed by three low-intensity alternating field (AF) steps (from 2.3 to 6.9 mT) to remove secondary magnetizations acquired during collection and transportation of samples. Main demagnetization process was thermal, from 60 °C reaching up to 575 °C in 15-10 °C steps, with samples being demagnetized in a trickle of N_2 gas above 120 °C to minimize oxidation. Most samples showed unstable behavior above ~400 °C. Magnetic components were isolated using Principal Component Analysis (P.C.A., Kirschvink, 1980) and, in a few cases, remagnetization circles (McFadden y McElhinny, 1988).

4. Results

From previous studies in the Rabot Formation (Milanese *et al.*, 2017) PSD titanomagnetite is interpreted as the most likely remanence carrier. Blocking temperatures are above 400 °C. Most samples showed unstable magnetic behaviors above this temperature, probably due to new magnetic minerals formation (Pan *et al.*, 2000). Examples from magnetic behaviors are illustrated in Fig. 3.

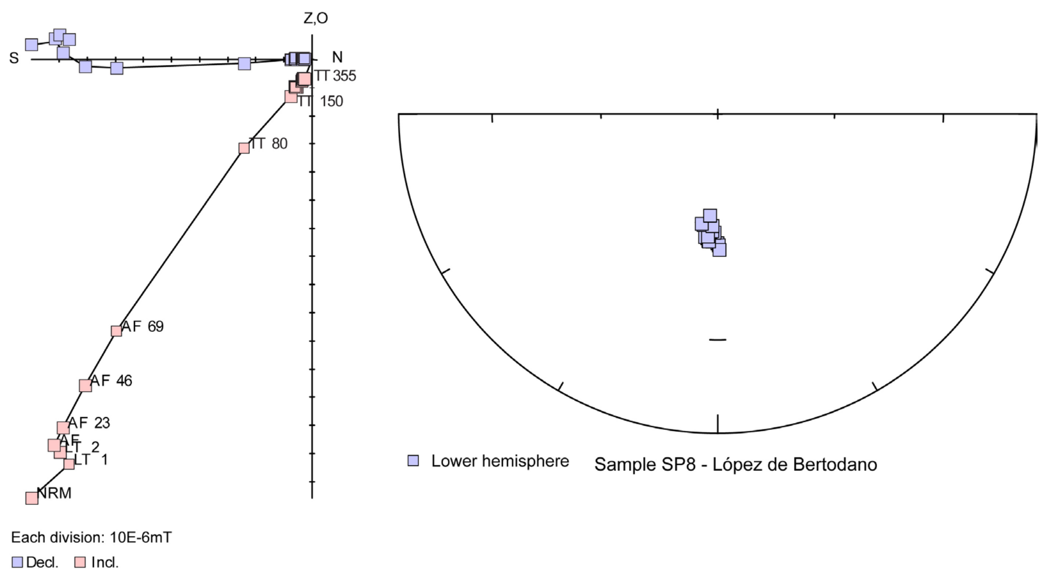

Figure 3. Samples magnetic behavior. A viscous component is observed, eliminated in the low temperature steps, and a characteristic direction decaying straight to the origin (a). To de right, stereographic projection (b).

A viscous component is eliminated in the first demagnetization steps (below 150 °C) and then a characteristic component decays straight to the origin. The obtained polarity pattern identifies 7 reversals, defining a succession that, according to ammonite assemblages from Olivero (2012)the Upper Cretaceous-Danian Marambio Group reflects the development of a shelf extended for more than100km into the Weddell Sea. The expansion of the shelf area was punctuated by three major transgressive-regressive cycles: the N (Santonian-early Campanian, correlates with chrons C33n, C32 and C31r from the Global Polarity Time Scale of Gradstein *et al.* (2012) (Fig. 4).

5. Conclusions

Seven polarity reversals corresponding to chrons C33n, C32r.2r, C32r.1n, C32r.1r, C32n.2n, C32n.1r, C32n.1n, C31r were identified in the youngest units of the Upper Cretaceous Marambio Group, getting absolute age intervals from Late Campanian to Early Maastrichtian. The magnetostratigraphic column establishes a Late Campanian age for Hamilton Point Mb., Early

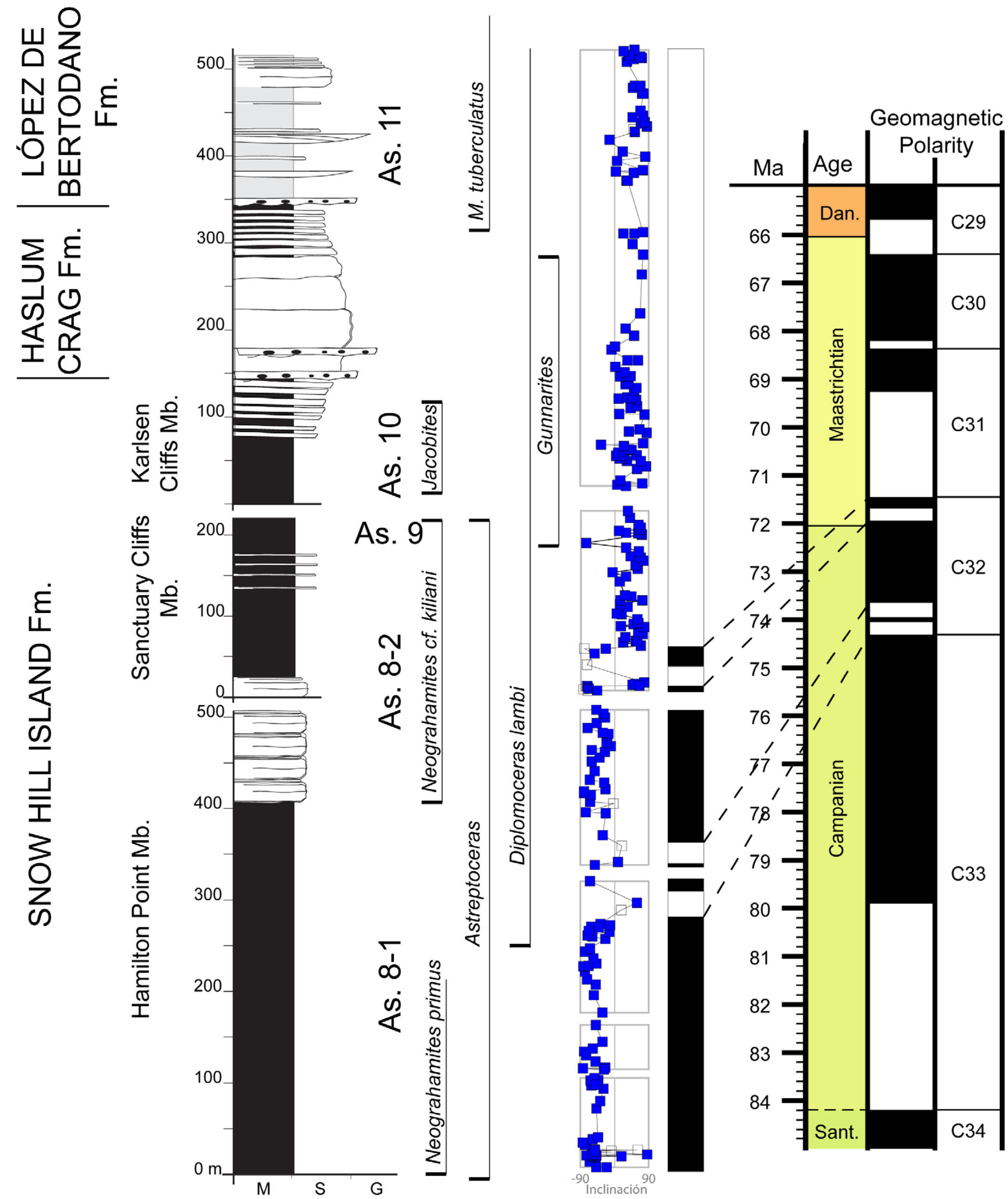

Figure 4. Magnetostratigraphy. Lithological profiles of upper units of Marambio Group in the SE sector of James Ross Basin. To the right, ammonite assemblages and magnetic inclinations. Correlation with Global Polarity Time Scale from Gradstein *et al.* (2012) in dashed line.

Maastrichtian for Sanctuary Cliffs and Karlsen Cliffs members and Middle Maastrichtian for Haslum Crag Fm. and for the basal units of López de Bertodano Fm., that is exposed in Snow Hill Island.

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