Paleomagnetism of postglacial back-arc basalts in Gastre (northwestern Patagonia)

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Introduction

Paleomagnetic studies performed on Late Cenozoic basalts from Cráter, Moreniyeu and Mojón Formations outcroping in Northwestern Patagonia (fig. 1) are presented in this study.

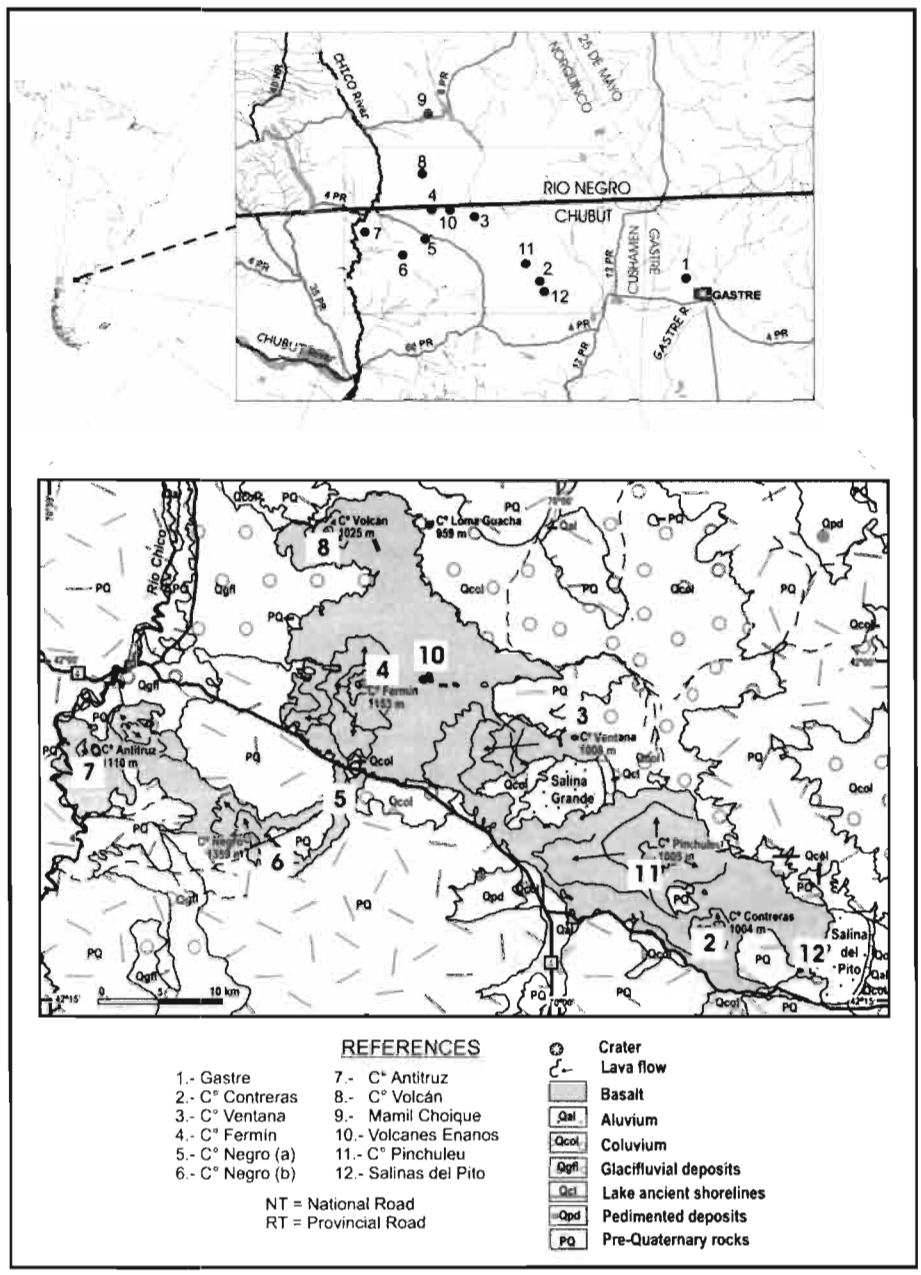

Figure 1: a) Sampling localities. b) Crater Formation outcrops and sampling localities.

Holocene Crater Formation basalts (Ravazzoli y Sesana, 1997) are constituted of lava flows that fill Quaternary valleys and cover postglacial sediments (Haller, 2000). These lava flows form a small volcanic field located 300 km to the East of the present trench, where the Nazca Plate is subducted under the South-America plate at 9-7cm/yr with a moderate oblique component (Hervé et al, 2000).

The Crater Basalt field covers an area of 257 km^2 and consists of at least nine strombolian centers that erupted basaltic magma above fluvioglacial terraces. Each vent produced 4-6 individual lava flows (Haller et al, 2001). The centers distribution is controlled by fractures associated with the Gastre mega-fracture. The Gastre fracture system (Coira et al, 1975) is a NW-SE shear zone, least 30 km wide, active since the Triassic (Massaferro et al, 2002).

The volcanoes morphology is well conserved, only a few scoria cones are partially weathered. The lava flows thickness vary from 1to 10m. They are mainly AA type and minor amount are pahoehoe lavas. Generally the outer zones of the lava flows are very vesicular. The principal petrographic and geochemical characteristics for Crater Formation have been studied by Haller (2000), Haller et al (2001) and Massaferro et al (2002).

The basalts of the Mojón Formation (Ravazzoli y Sesana, 1997), considered of Pleistocene age, conform an extensive lava flow located near Mamil Choique (41°46'S, 70° 08'W), Río Negro province. These basalts are petrographically very similar to Crater Formation basalts but the last ones are more vesicular and less altered.

The Moreniyeu Formation is assigned to the Early Holocene (Proserpio, 1978) and its outcroppings conform an elongated basalt flow near Gastre, Chubut province.

Paleomagnetic Study

Oriented samples were collected from eight effusive centers belong Crater Formation in Sierra del Medio area (fig 1a y b, and Table I). For each flow 3 sites of lava flows were sampled collecting 3 hand samples of each one. To analyze the stability of the magnetic remanences 3 specimens from each sample were obtained. Two specimens were subjected to alternating field (AF) and other one to thermal detailed demagnetization techniques. Most of the samples have viscous components. The AF procedure was more effective to destroy viscous components and to define the characteristic remanent magnetizations (ChRM) (fig. 2). Demagnetization curves show that the main remanence carrier is SD to MD Ti-poor magnetite. All the analyzed samples from Crater Formation have ChRM with negative inclination related to virtual geomagnetic poles (VGP) with normal polarity (fig. 2a). The dikes from Cerro Fermín also have a positive inclination secondary component that correspond to reverse polarity fields. A similar component was found in samples from some Cerro Negro sites (fig. 2b). The Moreniyeu and Mojon flows carry a positive inclination ChRM (fig. 2c) their define reverse polarity VGPs with almost coincident positions. This result is interesting because the assignee ages to these formations are different.

Radiometric K-Ar ages were performed several years ago on rocks from outcrops of Crater Formation located at Cerro Fermín (0.8±0.1Ma) and Cerro Negro (1.9±0.4 Ma) , and from Moreniyeu Formation in Gastre (1.6±0.2Ma) and Mojón Formation at Mamil Choique (3.3±0.4Ma). Figure 3 shows the geomagnetic polarity timescale (MPS) (from Cande & Kent, 1995) together with the polarities of the lava flows from the Cerro Fermín (CF), Cerro Negro (CN), Gastre (MY) and Mamil Choique (MJ) localities. The polarities registered on

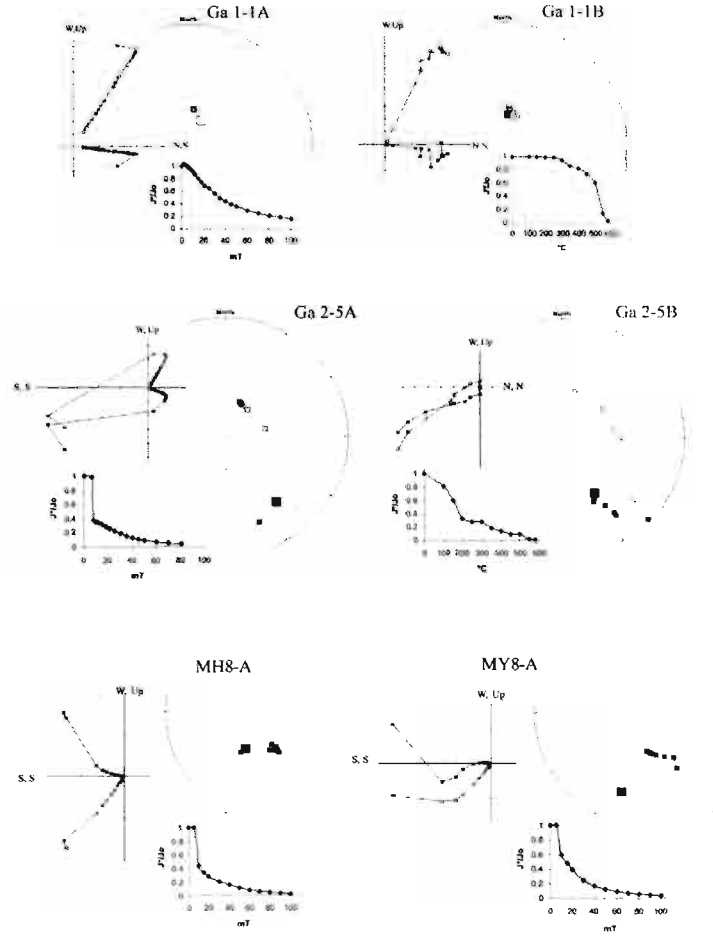

Figure 2: Orthogonal vector plots, stereoplots and magnetic intensity for demagnetization showing different magnetization behaviours (AF demagnetization: specimens Ga1-1A, Ga2-5A, MH8-A, MY8-A. Thermal demagnetization: specimens Ga1-1B y Ga2-5B).

late Cenozoic basalts outcropping in Cerro de Fraile (Singer et al, 2004) and Lago Buenos Aires (Brown et al, 2004) localities (SC and LBA, fig.3) (Santa Cruz province, Argentina) are plotted for comparison.

Conclusions

The comparison between the polarities found in these localities and the MPS expected polarities suggest that the Cerro Fermín volcanites extruded during the Brunhes Chron. Thus, their ages might be between 0.78 and 0.70 Ma (fig.3). For the basalts from Cerro Negro, the relation between age data and their normal polarity suggests that these flows were extruded during the Olduvay Subchron. These data indicate ages between 1.95 and 1.78 Ma (fig.3). The reverse polarity found for Moreniyeu Formation and the polarity expected accord to MPS for the range 1.8 -1.4 Ma are both coincident. For the Mojón Formation, the relation between their reverse polarity and the radiometric age suggests that this flows extruded during the Mammoth Subchron or during the Kaena Subchron. Thus, their age is possibly bracketed between 3.33-3.22 Ma or 3.12-3.04 Ma.

Tabla 1: Lava flows sampled at each locality: N= Number of lava flows sampled.

Formation	locality		N
Moreniyeu	1	Gastre	1
Crater	2	Cerro Contreras	4
	3	Cerro Ventana	1
	4	Cerro Fermín	6 and 2 dikes
	5	Cerro Negro (a)	2
	6	Cerro Negro (b)	1
	7	Cerro Antitruz	1
	8	Cerro Volcán	3
	9	Salina del Pito	1
	10	Volcanes Enanos	2
	11	Cerro Pinchuleu	2
Mojón	12	Mamil Choique	1

The magnetic characteristics of the basalts from Crater, Moreniyeu and Mojón Formation are adequate to carried out a detailed paleomagnetic study. This study, supported by radiometric age can contribute to recognize different volcanic events and to correlates areal and temporally lava flows in the area of study.

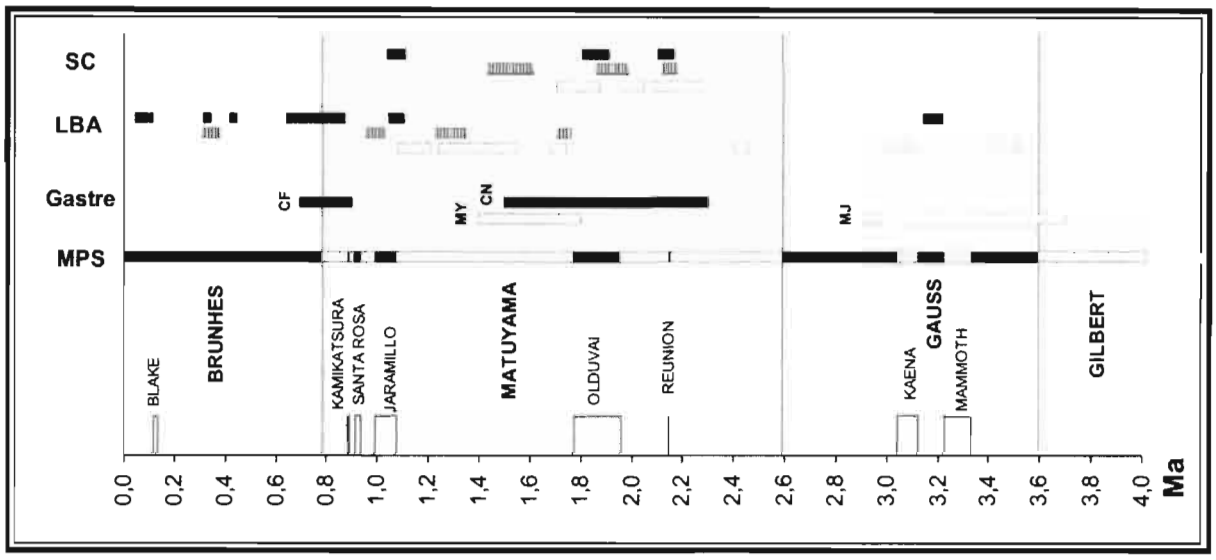

Figure 3: Comparison of the data obtained in this study for the lava flow of Cerro Fermín (CF), Cerro Negro (CN), Gastre (MY) and Mamil Choique (MJ) with the Geomagnetic polarity timescale (MPS) (Cande & Kent, 1995), and with the polarity for Later Cenozoic Basalts from Cerro Fraile (SC) (Singer et al, 2004), and Lago Buenos Aires (LBA) (Brown et al, 2004), Santa Cruz province.

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