Mantle Xenoliths found at Santa Martha Cove, James Ross Island, Antarctica

Joaquín Bastías[1]*, Francisco Hervé[1,2], Francisco Fuentes[2], Manuel Schilling[3], Aude Poiron[4], Francisco Gutiérrez[1], Cristián Ramírez[3].
1.-Departamento de Geología, Universidad de Chile, Plaza Ercilla 803, Santiago, Chile
2.- Escuela de Ciencias de la Tierra, Universidad Andrés Bello, Salvador Sanfuentes 2357, Santiago, Chile
3.-Servicio Nacional de Geología y Minería, Santa María 0104, Santiago, Chile.
4.- Brown Sur 750, Santiago, Chile.

**E-mail: joaquinbastias@ug.uchile.cl*

Abstract. The preliminary examination of ultramafic xenoliths found in a Cenozoic basalt lava-dyke host from the James Ross Island Volcanic Group, at Santa Martha Cove, Antarctic Peninsula, shows a mineralogical affinity with mantle xenoliths. Different analyses are expected to perform to understand the nature of the mantle conditions beneath James Ross Island by the time of this intrusion.

Key words: Mantle xenoliths, James Ross Island Volcanic Group, Santa Martha Cove, James Ross Island, Antarctica

1 Introduction -

In the recent 2012 XLVIII Chilean ECA (Antarctic Scientific Expedition), Project ACT-105 visited the Santa Martha Cove (SMC), in the south-east coast of James Ross Island (JRI), north-east of the Antarctic Peninsula.

The outcrops of the James Ross Island Volcanic Group (JRIVG, Nelson, 1966) are widespread at SMC. In the outcrops of the JRIVG an area of 200 meter wide and, at least, 600 meter long rich in mantle xenoliths (fig 1), up to 2cm in diameter, was found.

Previous studies have examined mantle xenoliths at JRI. Keller and Strelin (1992) reported the presence of ultramafic xenoliths at Ekelof Point, 40 km. to the southeast of SMC, consisting mainly of spinel lherzolites from the upper mantle.

2 Sampling and analyses

The mantle xenoliths were found in a basaltic lava-dike? host, displaying typical igneous columnar structures, present in widespread area because of the intense regolith usually found in this part of Antarctica.

Petrographic observations, EPMA, Laser-Ablation, major and minor elements are expected to perform to characterize the xenoliths for the first time in SMC.

3 Discussion and conclusions

The Mesozoic evolution at JRI includes a south-east subduction of the Phoenix plate, now part of the Antarctic plate, under the continental margin of Antarctic Peninsula, collision of the Phoenix plate spreading center with the continental margin, and subsequent, slowing of the plate convergence in the Tertiary (McCarron and Larter, 1998). Intrusions of Cenozoic volcanic rocks occurring east of the Antarctic Peninsula in Western Antarctica are often referred to as JRIVG, particularly the outcrops at SCM are dominated by this group. They record a monumental struggle between fire and ice, where ice sheets covered the volcanoes.

The James Ross Island Volcanic Group intrudes Cretaceous marine sediments (Crame et al., 1991). They are principally composed of alkali basalts erupted in a back-arc extensional setting, that occurred during the slowing stages of the Drake Passage oceanic crust subduction at the South Shetland trench (Fig. 1, Barker and Austin, 1998). They comprise lava-fed deltas built of hyaloclastic breccias, pillow–lavas and subaerial lava flows at the top (Smellie, 1989). The age ranges from late Miocene to early Pleistocene (Sykes, 1988), and the cessation of the volcanic activity coincides with the opening of the Bransfield Strait, about 170 km to the northwest of SMC, that separates the South Shetland Islands from Graham Land in Antarctic Peninsula. According to Kosler (2009) the variability in elemental and isotopic composition is not consistent with the JRIVG derivation from a single mantle source, but rather suggests that the magma was mainly derived from a depleted mantle with subordinate OIB-like enriched mantle component. The isotopic data suggest melting in the mantle during the extension and a possible roll-back of the subducted lithosphere of the Antarctic Peninsula.

The study and characterization of the mantle xenoliths from Santa Martha Cove will give an important and different knowledge in the geological evolution of James Ross Island. Furthermore, studying these xenoliths together with other found in the Antarctic Peninsula, we

will characterize (a) compositionally the Subcontinental Lithospheric Mantle (SCLM) beneath the Peninsula and (b) melt production and mantle refertilisation processes above the subduction zones of the Peninsula.

Acknowledgment

The ACT-105 project is financed by Conicyt and INACH. UNAB project "*Identificando relaciones petrológicas y tectónicas entre la Península Antártica y Patagonia mediante xenolitos del manto*" of F. Hervé and F. Fuentes will support part of the analytical work. Special thanks to the crew of the ship Almirante Oscar Viel, who performed an incredible job in the rescue of the group from a storm during the fieldwork.

References

Barker, D. H. and Austin Jr., J. A. 1998. Rift propagation, detachment faulting, and associated magmatism in Bransfield Strait, Antarctic Peninsula. J. Geophys. Res. 103: 24107-24043

Crame, J. A.; Pirrie, D.; Riding, J.; Thomson, M. R. 1991. Campanian-Maastrichtian (cretaceous) stratigraphy of the James Ross Island area, Antarctica. J. Geol. Soc. London. 148:1125-1140.

Keller, R. A. and Strelin, J. A. 1992. Alkali basalts and ultramafic xenoliths on James Ross Island, Antarctic Peninsula. Antarctic Journal U.S., Review:22-23.

Kosler, J.; Magna, T.; Mlcoch, B.; Mixa, P.; Nyvlt, D.; Holub, F.V. 2006. Combined Sr. Nd, Pb and Li isotope geochemistry of alkaline lavas from northern James Ross Island (Antarctic Peninsula) and implications for back-arc magma formation. Chemical Geology. 258: 207-218.

McCarron, J.J. and Larter, R. D. 1998. Late Cretaceous to early Tertiary subduction history of the Antarctic Peninsula. J. Geol. Soc. London. 155: 255-268

Nelson, P. 1966. The James Ross Island Volcanic Group of north-east Graham Land. British Antarctic Survey Scientific Reports. 54: (1-89)

Scasso, R. A.; Olivero, E. B.; Buatois, L. A. 1991. Lithofacies, biofacies, and ichnoassemblage evolution of a shallow submarine volcaniclastic fan-shelf depositional system (Upper Cretaceous, James Ross Island, Antarctica). Journal of South American Earth Sciences.

Smellie, J. L. 1987. Geochemistry and tectonic setting of alkaline volcanic rocks in the Antarctic Peninsula: a review. J. Volcan. Geother. Res. 32: 269-285.

Sykes, M. A. 1988. New K-Ar determinations on the James Ross Island Volcanic Group, nrth-east Graham Land, Antarctica. British. Antarctic.Survey Bulletin. 80: 51-56.

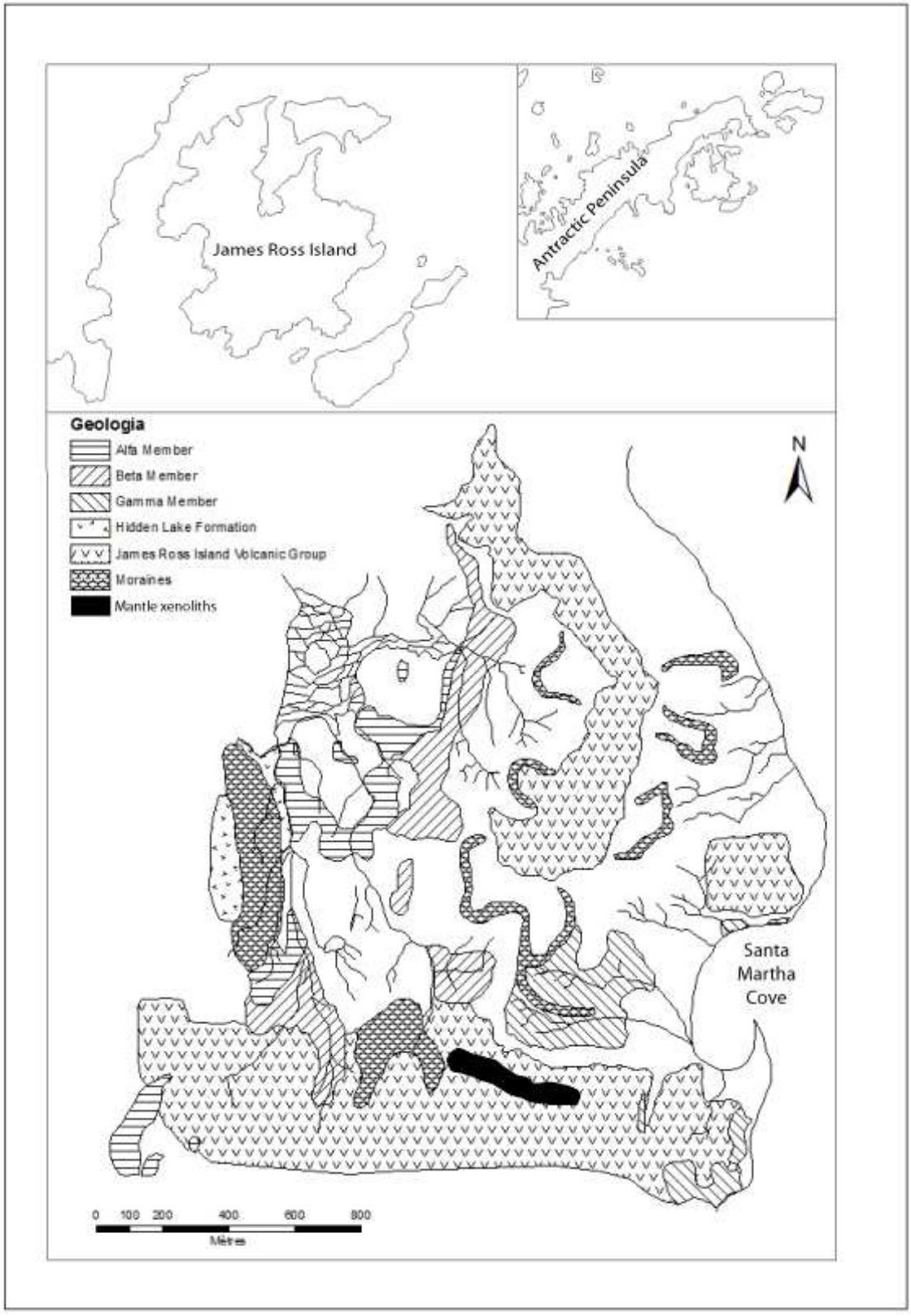

Figure 1. Geological map from Santa Martha Cove, modified from Scasso et al. (1991). Alfa member, Beta member and Gamma member comprise the Santa Martha Formation.