Magmatic constraints on a Holocene continental back-arc volcano: The Santa Maria volcano

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1- Introduction

- Payenia is a Quaternary Basaltic Province in central west Argentina and constitutes one of the volcanic areas with the highest volcanic density in Patagonia.
- Most of its volcanism is from the Pleistocene while Holocene volcanism is only restricted to the area west of the Payún Matrú caldera (Figure 1).
- The aim of the current investigation is to better comprehend the recent magmatic processes. Thefore we conducted the study on one of the most recently active volcanos, Santa Maria. In addition, the purpose is also to provide some age constraints for this volcano.

Setting and Background

- Most of the volcanism in this basaltic province is intraplate and alkaline with a strong ocean island basalt (OIB)-like composition.
- The Santa Maria volcano is located ~440 km inland from the Chile-Perú trench and ~125 km east of the Andean Arc.
- This cinder cone and corresponding a'a flow have been regarded as one of the youngest eruptions of the Holocene.
- In this contribution, geochemical analysis and surface exposure dating methods have been applied.

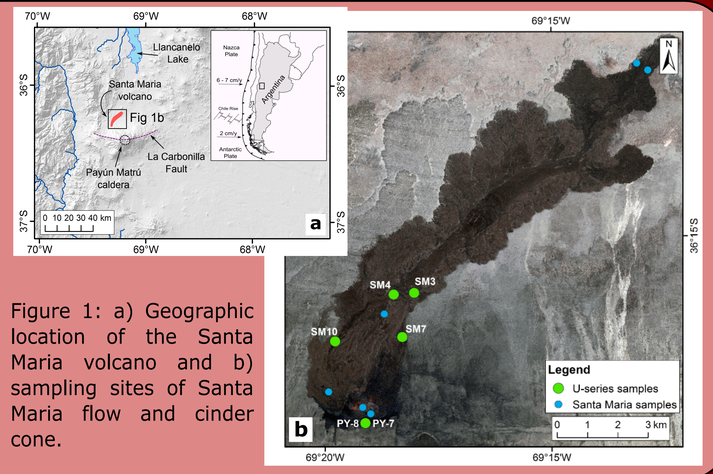

Figure 1: a) Geographic location of the Santa Maria volcano and b) sampling sites of Santa Maria flow and cinder cone.

2 - Results

- The samples from Santa Maria volcano are classified as trachy-basalts in a total alkali vs silica diagram. These samples have elevated La/Yb compared with other basalts from the same basaltic province.
- No subduction-related signatures have been directly inferred as the samples are enriched in high field strength elements such as Nb and Ta, which are depleted in arc-related rocks.
- Santa Maria has an OIB-like composition similar to that of the local OIB source.
- U-series analysis show that all the samples have a similar Ra concentration arguing for a single magmatic source for all the samples; this analysis also indicates that there is a Ra excess.
- The calculated surface exposure ages for this volcano have large errors as the concentration of cosmogenic isotopes ^{3}He and ^{21}Ne is low, which is directly related to their young age. The ages calculated are 2.02 ± 1.03 ka and 1.73 ± 1.61 ka for samples SM7 and SM10, respectively.

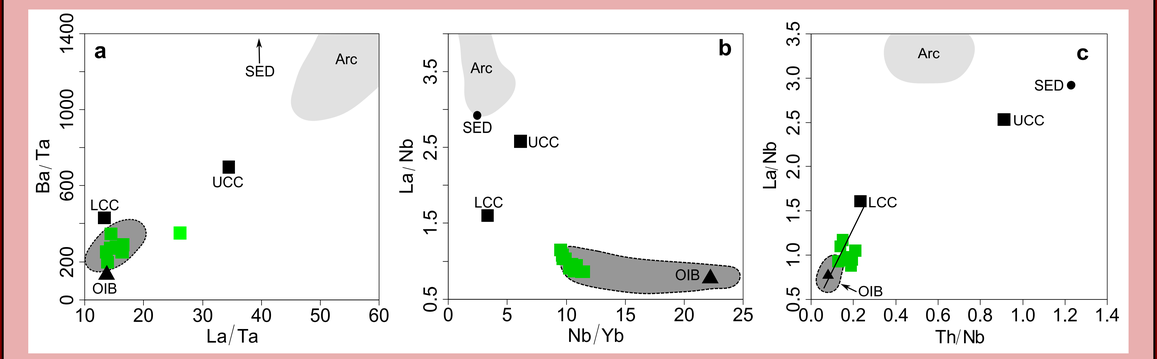

Figure 2: Trace-element and U-series diagrams. a) Ba/Ta vs La/Ta, b) La/Nb vs Nb/Yb, c) La/Nb vs Th/Nb. In figures a) to c) the light grey field is the arc, the dark grey is the local OIB end-member, UCC and LCC mean upper and lower continental crust, respectively, SED represents the slab sediments end-member, the OIB is the ocean island basalt end-member.

3- Discussion

- The OIB-like composition of the samples may have been slightly modified by other components possibly the lower continental crust or a minimal subduction-related signature in order to produce the trends observed in Figure 2.
- The importance of the results is in assessing possible mechanisms for a high ^{226}Ra excess. These could be hydrothermal alteration, magma chamber differentiation, slab dehydration and/or deeper processes.
- Correcting the Ra content for a maximum eruption age of 4000 years increases the ($^{226}Ra/^{230}Th$) by a factor of 5; however, the general trends are not altered, while an age correction does not have an effect on the rest of the activity ratios.
- Hydrothermal alteration and magma chamber differentiation are processes not capable of producing the high Ra excess observed. While the negative correlation of ($^{226}Ra/^{230}Th$) with Th suggests that differentiation was taking place (Figure 3); however, the magma should have had excess Ra before entering the magmatic chamber.
- Slab dehydration should be accompanied by enrichment in other fluid mobile elements, which is not the case.
- Deep magmatic processes refer mainly to partial melting in the presence of garnet, possibly at intermediate pressure in order to produce the small ^{232}Th and ^{238}U enrichment and high K.

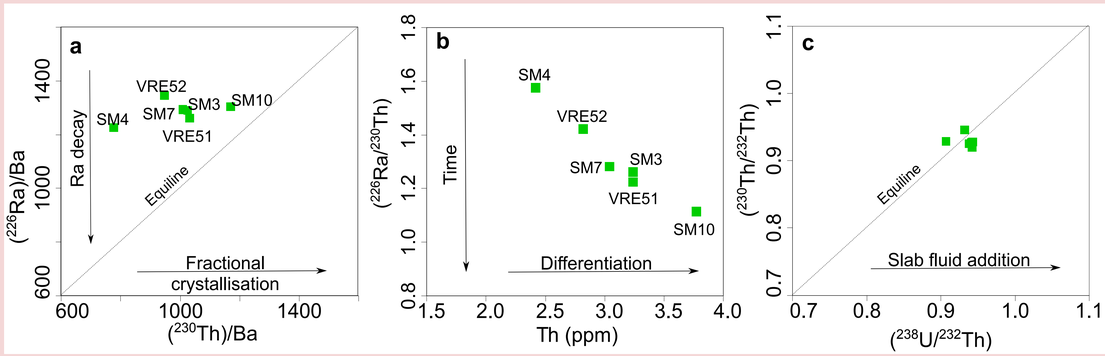

Figure 3: a) (^{226}Ra)/Ba vs (^{230}Th)/Ba , b) ($^{226}Ra/^{230}$ Th) vs Th, c) ($^{230}Th/^{232}Th$) vs ($^{238}U/^{232}Th$)