

The Australandean Volcanic Zone (South Patagonia)

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Abstract

New geochemical data of volcanics of the Mt. Burney and Viedma volcano complete a review on petrology of the six volcanic centers of the Australandean Volcanic Zone (AVZ: 49 - 55°S). Volcanic products of recent activities of 1988 were observed on the Viedma icefield. The volcanics of the AVZ are acid andesites to dacites; basalts are missing; every volcano of the AVZ shows small geochemic development. Volcanics of Cook island occupies a special position, related to volcanics of rift zones. From Mt. Burney in 52°S to Viedma volcano in 49° S, the volcanics show increasing K, Rb, Ba contents as well as K/Rb and $^{86}\text{Sr}/^{87}\text{Sr}$ ratios. Volcanics of Mt. Burney belong to a low-K andesites and dacites. More to the north, lavas and pumices of Lautaro, Viedma and Aguilera are med-K dacites. Crustal contamination and magma mixing with fused crustal rocks are discussed for this SN development.

Introduction

The volcanism in the south Patagonian Andes has remained almost unknown and only few reports are available. Volcanic eruptions on the Patagonian Ice Cap were first reported at the beginning of this century by QUENSEL (1910). Ash deposits in the Argentine pampas, which originated in volcanic centers of the inaccessible Andes, were collected during a Swedish expedition (1932-34) and examined by SALMI (1941) and more recently by STERN (1990). Some rocks of the Lautaro, Aguilera, Mt. Burney and Cook island (fig. 1) have been geochemically analysed by STERN et al. (1976, 1984) and FUTA & STERN (1988). The volcano Reclus (50°57'S) has been described by South Chilean geologists (HARAMBOUR 1988 and MARTINIC 1988). In the area of the Patagonian Icefield, on the Viedma glacier, a volcanic center and products of recent eruptions were described by KILIAN (1990).

Tectonic setting

The Austral Volcanic Zone (AVZ) extends between 49° and 55°S. The Lautaro, Aguilera and Viedma volcanoes are situated at the northern end, Reclus, Mt. Burney and Cook Island are located more to the south (fig. 1). All these Cenozoic volcanoes are situated near the convergent plate boundary between the oceanic Antarctic plate and the continental South

American plate. The convergence rate (3 cm/year: Minster et al. 1974), the tectonic and volcanic activity are lower than to the north of the plate triple junction, where the Nazca plate is subducted at a rate of 5 to 10 cm/year. South of the plate triple junction, there is a volcanic gap of 300 km at the continental margin.

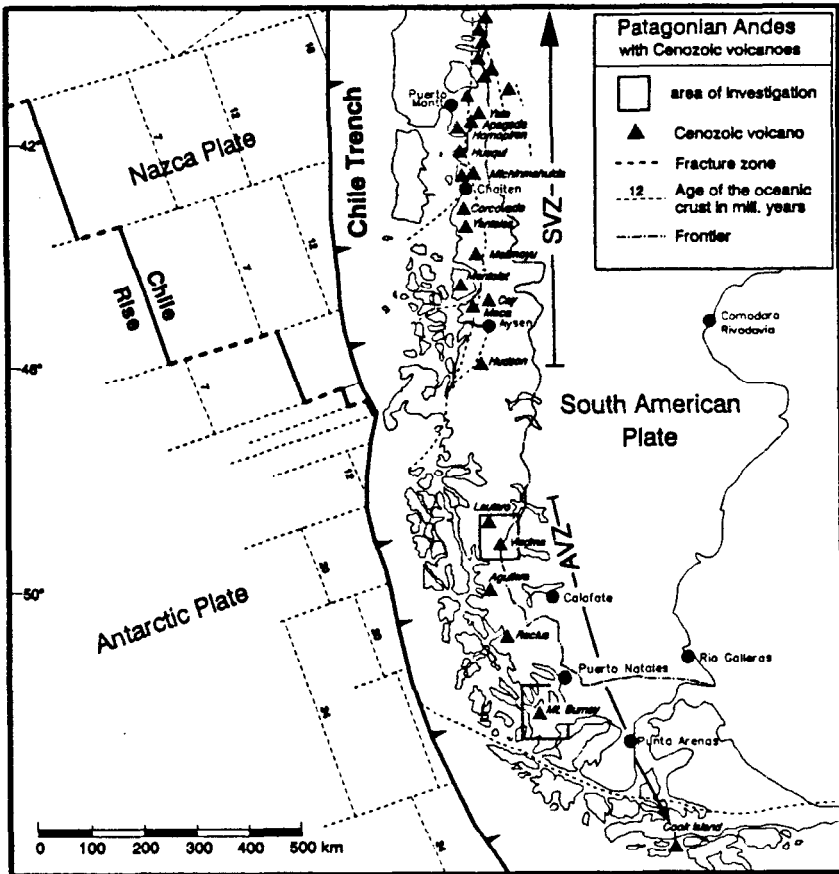


Fig. 1: Cenozoic volcanoes and plate tectonic structure of the Patagonian Andes.

Volcanic activity on the Viedma icefield of 1988

An extended area was observed on the Viedma icefield (Patagonia) showing intensely ice melting, caused by the fall of hot pumices and large ash fractions after volcanic eruptions. Hot mud flows were formed, covering a large area of the glacier. By the hot mud flows a valley net was formed in the ice surface with a depth of up to 35 m. The probable center of eruption was located at $49^{\circ}22'S$ and $73^{\circ}19'W$ in an elevation of 1100 m. Pyroclastic deposits of previous periodic eruptions were mapped; pumices and lavas were examined. The eruptions must have taken place recently between Sept. and Nov. 1988.

Petrography

Minerals in volcanics of Viedma and Mt. Burney were determined by microscope and electronmicroprobe measurements (65). Characteristic phenocrysts of volcanics of Lautaro, Viedma, and Aguilera are plagioclase (1.5 - 4 mm), amphibole (0.5 - 2 mm) and a few biotite (0.5 - 1.5 mm) and additionally a second phenocryst generation of idiomorph hypersthene. Plagioclase normally shows small anorthit zonation in the range between an 42 to an 60. A slightly inverse zonation often occurs. Large plagioclase phenocryst in many cases show a strongly corroded middle zone with the highest anorthite contents (an 63) of our microprobe measurements. Some xenolithes, consisting of orthoclase, plagioclase and pyroxene, occur in lavas of Viedma and Aguilera and indicate contamination. Plagioclase, biotite and amphibole phenocrysts are often rim corroded. Plagioclase phenocrysts of lavas of Mt. Burney often show slightly inverse anorthite zonation in the range an 45 to 65. Hypersthene is the most common mafic mineral with higher Mg/Fe ratio (mg⁶⁵) than in K-dacites of Viedma.

Geochemical and petrological aspects

The volcanics of the AVZ range from 59 to 68 wt.% SiO₂ and are acid andesites and dacites in the K₂O/SiO₂ diagramm (fig. 2). The analyses of the Viedma, Lautaro and Aguilera volcanoes show the highest K₂O levels of the AVZ. To the south, the K₂O, Rb, Ba, and Zr levels of rocks from the volcanoes Reclus and Mt. Burney decrease and correspond in the latter case to a low-K calcalkaline series. High-Al basalts and basic andesites, typical rock types of the SVZ (33 - 46° S), are missing in the AVZ. Apparently uniform plots of each individual volcanic center of the AVZ in the K₂O/SiO₂ diagramm (fig. 2) confirm the suggestion of FUTA & STERN (1988) and STERN et al. (1984), that there is no local development of the melts, but marked regional NS change in the chemistry becoming more primitive towards the south. Wide ranged calcalkaline series are missing. Orogenic medium-K calcalkaline volcanics of continental margin type in 49° S of Lautaro, Viedma and Aguilera volcanoes change to low-K series of island arc type in 52° S from the Mt. Burney volcano. This SN development to more continent related series is considered due to crustal contamination, indicated by xenolithes in the lavas of Viedma and Aguilera volcanoes. But also magma mixing with small amounts of partial fused crustal rocks can not be excluded. Volcanics of the Cook island (tab. 1) located more to the south (55°S) show more relations to MORB type than to orogenic series (FUTA & STERN 1988), with relatively high MgO and Al₂O₃ contents as well as Sr, La concentrations but low TiO₂, HREE, Zr and very low K₂O, Ba, Rb, Cs levels.

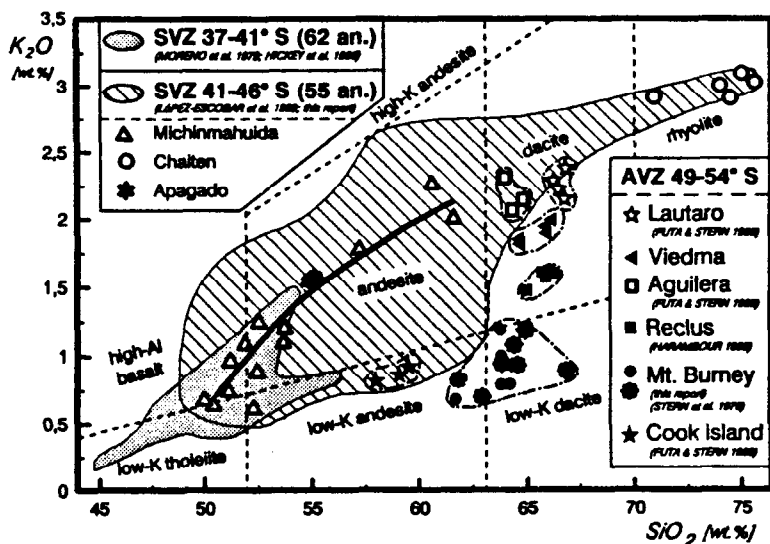


Fig. 2: K_2O/SiO_2 diagram with distribution and plots of volcanics of the Southandean Volcanic Zone.

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