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GEOCHEMICAL CONSTRAINTS ON CRUSTAL STRUCTURE FROM NEOGENE VOLCANIC ROCKS OF THE SALAR DE ANTOFALLA

VOLCANIC FIELD AND ADJACENT ANDEAN CORDILLERA (24'-26'S, 67'- 69W)

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andesites. Fe-Ti-oxides are common to all samples. Disequilibrium textures comprise resorbed quartz and plagioclase grains.
The monogenetic mafic rocks sampled are localized predominantly at the eastern side of the Salar
de Antofalla but also occur at its southern end and to the northwest. They are basaltic to andesitic in composition and have typically a microcrystalline/glassy matrix with 5-10 vol-% phenocrysts. These comprise olivine, clinopyroxene and orthopyroxene in basalts/'basaltic andesites and mostly plagioclase with olivine, clinopyroxene and orthopyroxene as microlites in the andesites. As noted by former workers (Pichler & Zeil, 1972, Kay et al., 1994) quartz and plagioclase often occur as xenocrysts up to 2 cm showing disequilibrium textures as pyroxene rims and embayment by resorption.
The oldest rocks of this type overlying discordantly folded evaporites were dated with 5,6 f 0,3
Ma (K-Ar on whole rock sample).

WHOLE ROCK GEOCHEMISTRY

1. Major and trace elements
According to their whole rock composition the volcanic rocks of the SAF region classify as high-
K calcalcaline basalts to dacites. Major and trace elements show similar ranges and trends displayed by the Cerro Galan complex (Francis et al., 1989). Archibarca rocks show at given silica content enrichment in A2O3 relative to Beltran and Tebenquicho rocks. This correlates with slightly higher CaO and Sr contens and has to be interpreted as a higher plagioclase content. Archibarca rocks show also higher HFSE (Zr, Nb, Ta, Y) and lower compatible element (Sc, Ni, Cr, V) contents and have a tendency to higher LaISm and lower LatYb ratios relative to Beltran and Tebenquicho rocks. This could be due to variation in source composition, crystal fractionation or magma mixing.
At given Si02 or K20 values Ba contents are higher in Archibarca rocks but Th, Pb, Rb and CS are lower. It has to be noted that potassium feldspar is absent in ALV rocks. Furthermore in a plot Nb/Ta vs Zr/Hf which tries to avoid fractionation effects of biotitelhornblende and zircon, each volcanic complex displays a distinct range (Fig.2). Both facts points to variation of source composition rather than fractionation effects.

2. Isotopes
Monogenetic mafic rocks (50 - 60 wt% Si02) of SAF area have iR7~rlS6Sr = 0,7051 - 0,7089 and
ALV rocks (59 - 65 wt% Si02) have 87~r/s6~r = 0,7077 - 0,7091 and 143~d/144~d = 0,51231 - 0,51243 (ALV rocks have not been time corrected due to uncertain age. However, age corrected values would not be far outside the error limits), which is within the range of basaltic to andesitic rocks of the CVZ. The Pb

isotopic data of mafic and ALV rocks fall in the typical range of the southern CVZ: 208~b/20?b 38,446 - 39,167, '07pb lZo4I'b 15,594 - 15,703, 206~b/204~b 18,55 1 - 18,988.
The 87~r186~r initial ratios of mafic rocks correlate with Si02, which is commonly interpreted as a feature of open system AFC processes (Francis et al., 1989) in which crustal components are melted and assimilated by parental mantle magmas. Sr and Nd isotopic ratios of ALV rocks are within the range of the monogenetic rocks and can be interpreted also as mixed or AFC melts triggered by injection of mantle melts. This is indicated also by the d180 value = 7,92 of a dacitic lava sample of Cerro Beltran.
We compare these data with Sr, Nd and Pb isotopic compositions of four contemporaneous stratovolcanoes of the Andean Cordillera 50 - 90 km to the west (Azufre, Cordon del Azufre, Lastarria, Llullaillaco) (Fig. 3, Fig. 4). As pointed out by Wittenbrink & Kraemer (1996) intermediate to acid lavas from these centers were derived by interaction of already altered basaltic andesites and crustal melts during their ascent within the middle crust.

Andesites - rhyolites of the Cordillera reach lower Sr and Pb and higher Nd isotopic ratios compared to rocks of SAF region (0,7059 - 0,7071, 208~b/204~b 38,634 - 38,827, 207~b/204~b 15,627 - 15,638, 206~b/20?b 18,688-1 8,873, 0,51253 - 0,5 1242 respectively). At given Pb and Si02 contents the volcanics of the SAF region are displaced to higher Pb isotopic composition than arc rocks. The enriched

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207Pb1204Pb

Andean Cordillera

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Fig. 4 Pb isloplc ralios in Salar de Anlofalla volcanlc region and adjacent Andean arc

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Andean Cordillera

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Archibarca 1

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Fig. 2 HFS element ratios in Archibarca. lineament rocks

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Fig. 1 Location sketch map

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I Fig. 3 Sr-Nd isotopic ratios

.l09

87Sr186Sr

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isotopic ratios of the SAF back arc region can be explained by higher ThPb-, UIPb-, 87~r186~r and lower '43~dl''%d ratios of contaminant(s).
This could be interpreted as variable age andlor composition of the underlying basement rocks. Ramos (1986) postulated two allochthonous terranes of Precambrian and Paleozoic age to have been accreted between the two regions. However, new data on high-grade metamorphic rocks of basement outcrops in N Chile and NW Argentina show similar conditions of metamorphism and a peak-metamorphism age of 500 Ma. This does not support the idea of terrane accretion (Lucassen et al., 1996) and, thus, the isotopical zonation can not be explained by basement rocks of different age.
As noted by Feeley & Davidson (1995) at Ollague volcano assimilation processes in upper crustal regions are of minor importance in the magmagenesis of andesites and dacites. Thus, we conclude that compositional variation within the deep crustal precambrian basement block is most probably to account for the isotopical zonation between the SAF back arc region and the Andean Cordillera. The trace element pattern of ALV rocks also indicates the stated variation of source rock composition.

CONCLUSIONS:

Andesitic to dacitic rocks which extruded at stratovolcanoes of the Archibarca lineament have
crustal sources of variable composition mixed with ascending basaltic mantle melts. Compared to contemporaneous intermediate to acid volcanic rocks from the Andean Cordillera 50 - 90 km in the west they reach higher Pb and Sr and lower Nd isotopic ratios.
The zonation of isotopic composition between these two regions is attributed to variation of underlying precambrian rocks of the same crustal basement block. It is not due to allochthonous terranes which have been postulated elsewhere.

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