A SIMILAR MAGMA SOURCE FOR IGNIMBRITES AND NON-IGNIMBRITIC LAVAS FROM SOUTH-CENTRAL ANDES.

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RÉSUMÉ. Les ignimbrites contemporaines et avoisinantes des strato-volcans des Andes Centrales du Sud ont des rapports $^{87}Sr/^{86}Sr$ compris entre 0.7062 et 0.7096 semblables à ceux (0.7056 - 0.7089) des laves non-ignimbritiques de ces volcans. La zonation géochimique déjà observée pour les laves non-ignimbritiques, est la même pour les ignimbrites, impliquant bien des sources magmatiques et des processus de genèse communs pour ces deux types de laves.

KEY WORDS : Ignimbrites, Non-ignimbritic lavas, South-Central Andes, $^{87}Sr/^{86}Sr$.

INTRODUCTION

Ten Plio-Quaternary calc-alkaline strato-volcanoes and groups of small volcanoes have been studied in the South Central Andes (SCA), southern part of the Central Volcanic Zone, between latitudes 22°—24°30'S (Déruelle, 1982; Déruelle et al., 1983; Harmon et al., 1984). Field evidence shows that these volcanoes erupted contemporaneously with large ignimbritic lavas. Numerous data on these ignimbrites indicate ages younger than 10.7 Ma (De Silva, 1989a and references therein). Non-ignimbritic lavas were probably produced from mantle-derived magmas subsequently modified by crustal contributions as in the MASH model (Hildreth and Moorbath, 1988). The origin of ignimbrites is still controversial but crustal anatexis is generally invoked to explain the large volumes of ignimbrite erupted (De Silva, 1989b, Francis et al., 1989).

GEOLOGICAL SETTING

Ignimbrites studied here were sampled in adjacent areas around strato-volcanoes and groups of small volcanoes (Fig. 1). They have generally typical ignimbritic texture with Y-shaped shards and abundant glass, and phenocrysts of plagioclase, hornblende, biotite, Fe-Ti oxides, orthopyroxene, K-feldspar, quartz and rare clinopyroxene. Ignimbrites (58.6<SiO_2 wt %<73.6) are mostly dacites, rhyolites, and high-silica andesites whilst non-ignimbritic lavas are mostly dacites, andesites and rare rhyolites (55.2<SiO_2 wt%<71.2). In SCA, ignimbrite chemical composition (major elements, Rb, Sr, Ba, and transition elements) is similar to that of non-ignimbritic lavas with similar silica content (Déruelle, 1989).

SR-ISOTOPE RESULTS

Sr-isotopes were measured at Oxford on 27 ignimbrites. The ignimbrite Sr-isotope ratios (Fig. 2) range between 0.7062 and 0.7096, similar to that (0.7056—0.7089) of non-ignimbritic lavas (39 samples, Harmon et al., 1984) from the same area. The range of Sierra de Lípez non-ignimbritic lavas (0.7090—0.7149) is clearly distinct from that other volcanoes of SCA. The only analyzed ignimbrite value from Sierra de Lípez (0.7108) falls within this range.

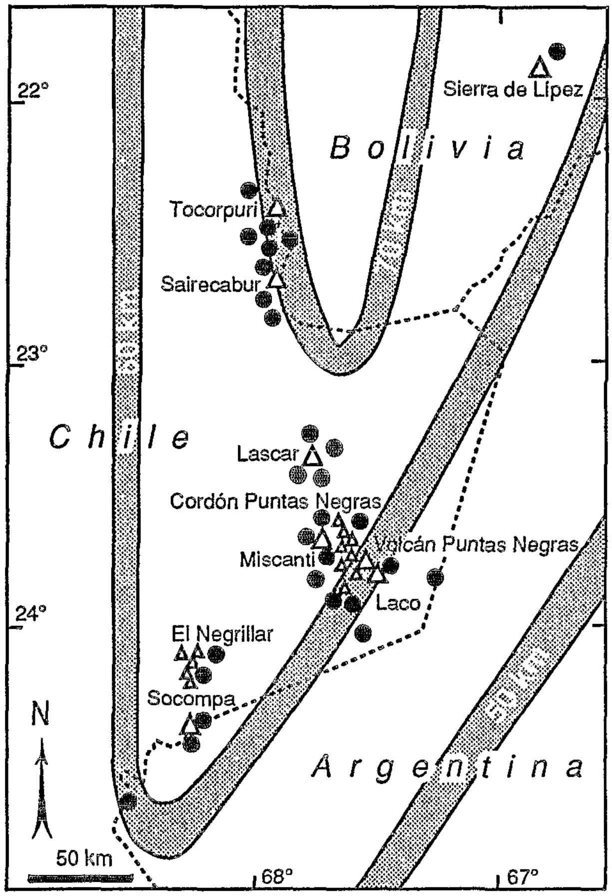

Fig. 1. Localisation of ignimbrites (●) studied in the present work. Thickness of continental crust is after James (1971).

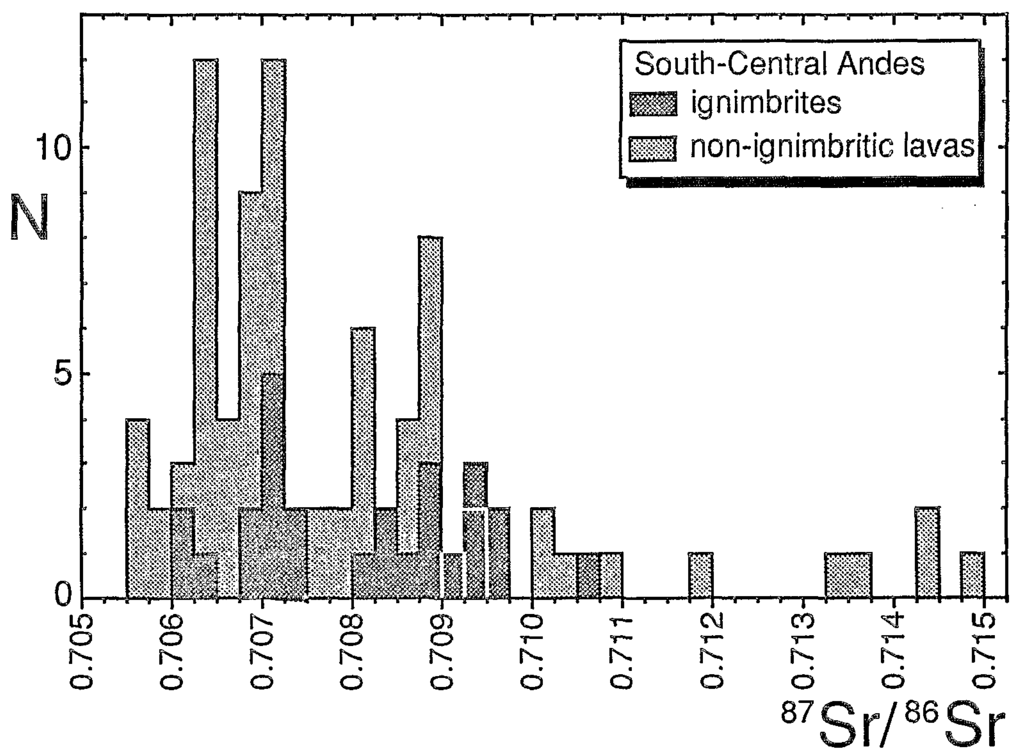

Fig. 2. Histogram of whole-rock $^{87}Sr/^{86}Sr$ ratios for SCA ignimbrites and non-ignimbritic lavas.

DISCUSSION

There is a zonation of Sr-isotope data (Fig. 3) in the five main volcanic areas of the SCA (Sierra de Lípez, Tocorpuri—Sairecabur, Lascar, Miscanti—Cordón Puntas Negras—Volcán Puntas Negras—Laco, and Socompa—El Negrillar). This zonation is neither directly related to crustal thickness nor to depth of subducted slab (150 km ± 25 km) although geophysical data are imprecise (Fig. 1). There is an overall northwest increase in the ratios. This increase may be related to age and nature of the continental crust, which is Precambrian in Bolivia and Paleozoic in Chile. Similar conclusions have been drawn from isotopic data on non-ignimbritic lavas from the area (17°30'S to 22°S) just to the north of SCA (Wörner et al., 1992). The present work for the first time includes data on ignimbrites.

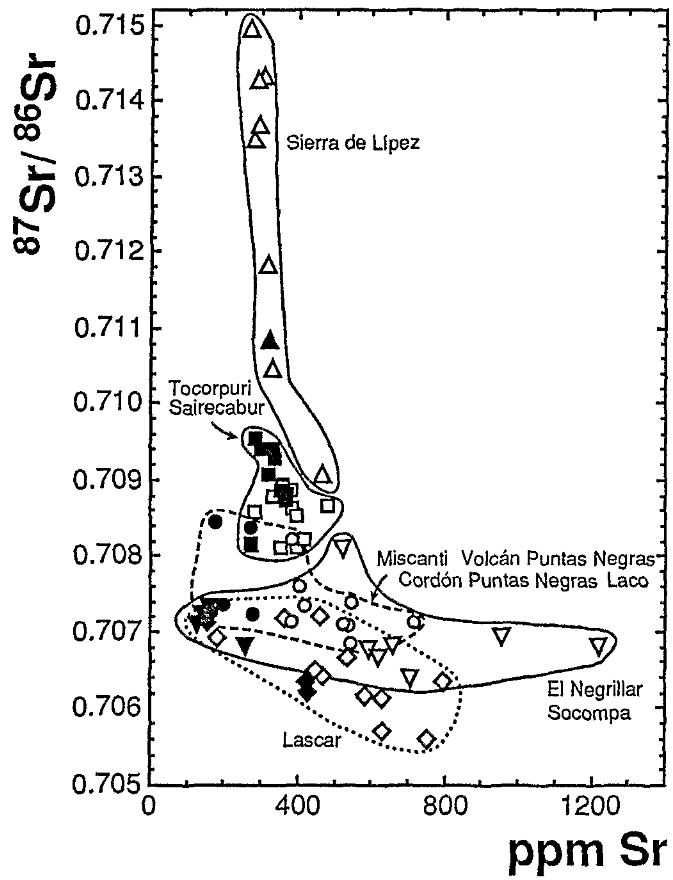

Fig. 3. Sr *vs* $^{87}Sr/^{86}Sr$ plot for SCA ignimbrites (filled symbols, present work) and non-ignimbritic lavas (empty symbols, data after Harmon et al., 1984).

CONCLUSION

The similarity of Sr-isotope values for ignimbrites and non-ignimbritic lavas from specific volcanic centers of SCA implies a common magmatic source for these two types of lavas. It is concluded that the parental magmas to both ignimbrites and non-ignimbritic lavas resulted from a MASH process between mantle- and crust-derived melts in deep reservoirs at or near the mantle-crust boundary. Further low-pressure crystal fractionation was important during ignimbrite differentiation. The difference between ignimbrites and non-ignimbritic lavas results from the controlling influence of a volatile phase during explosive ignimbritic eruption.

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