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VARIACIONES PETROQUIMICAS REGIONALES EN LAS LAVAS DE PLATEAU DE LA PATAGONIA EXTRA-ANDINA DE LA PARTE SUR DE SUD AMERICA

REGIONAL GEOCHEMICAL VARIATION IN THE EXTRA-ANDEAN PATAGONIAN PLATEAU LAVAS OF SOUTHERN SOUTH AMERICA

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The evolution of the Andes has involved both arc and back-arc magmatic activity. Back-arc volcanism in the Chilean-Argentina extra-Andean region of southern South America, between 33-52°S, has been sporadic from Upper Cretaceous to the Quaternary (Ramos et al., 1982). This activity has produced the Patagonian Plateau Lavas, extensive lava plateaus associated with both stratovolcanos and fields of volcanic cones, which form an alkaline to subalkaline volcanic province covering over 120.000 km^2 (Fig.1). Although the Patagonian Plateau Lavas are located in a back-arc intraplate tectonic position and they were erupted along deep fracture zones both parallel and oblique to the Andean axis, this region has not evolved into a back-arc basin with a well defined rift such as is common in the western Pacific and formed behind the magmatic arc of the southern Andes in the Middle Cretaceous.

North to south variations in the petrochemical characteristics of the recent orogenic volcanos of the Andes have been well documented. Regional north to south petrochemical variations also occur in the Plio-Pleistocene volcanic rocks which form the upper units of the Patagonian Plateau Lavas. Late Cenozoic lavas in the central and southern areas of Patagonia are dominantly subalkaline quartz and olivine tholeiite through mildly alkaline, alkaline olivine basalts, basanites and nephelinites. Some very alkalic leucite and sodalite basalts have been reported from the Buenos Aires and Somuncura plateau. The presence of mantle derived ultramafic xenoliths in the central and southern outcrops of the Patagonian Plateau Lavas indicates a mantle source for these magmas. Available Sr, Nd, Pb and O isotopic data are consistent with a derivation from a mantle source in an intraplate enviroment. The $^{87}Sr/^{86}Sr$ ratio of the olivine basalts from southern Patagonia are lower than olivine basalts erupted from the Andean orogenic volcanic centers of south-central Chile. The basalts from this part of Patagonia are all enriched in ligth rare earth elements compared to heavy rare earths, with chondrite normalized Ce/Yb ratios ranging from 4 to 20 as alkalinity increases. Variations in alkalinity and Ce/Yb may reflect different degrees of partial melting of the mantle source of the magmas.

In contrast, sodic trachy-andesitic and caldera related rhyolitic rocks are a significant component, along with olivine basalts, in the northern Patagonian Plateau Lavas. Late Cenozoic volcanic centers in this region of Patagonia have both calc-alkaline (Tromen) and alkaline (Payún Matrú) affinities. In general the Late Cenozoic magmas erupted in this part of Patagonia have higher SiO_2, Rb, Ba, Y and Rb/Sr and lower

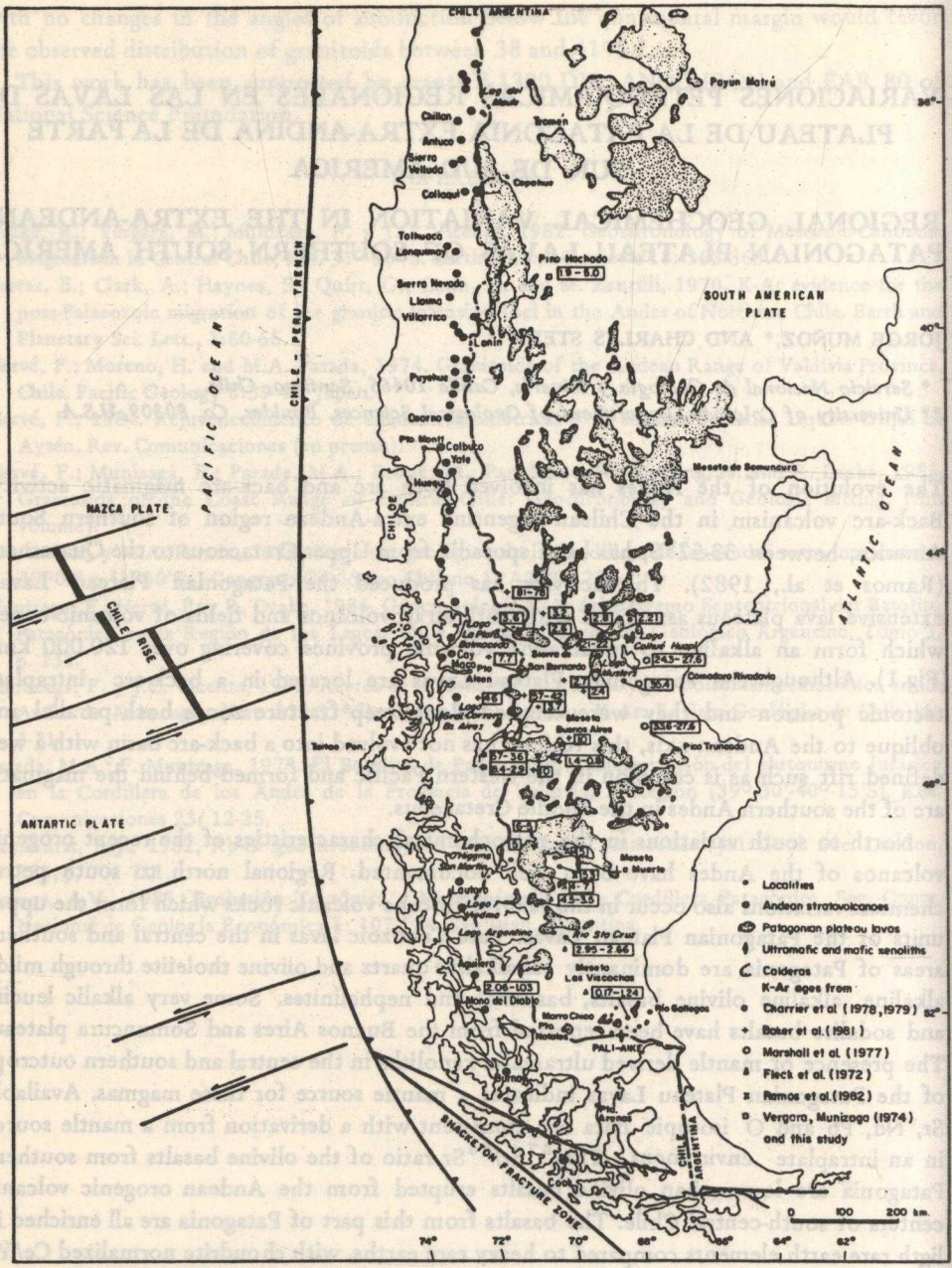

Fig. 1. Ages and distribution of the extra-Andean Patagonian Plateau Lavas and location of orogenic calc-alkaline stratovolcanoes in the Andean Cordillera. The figure was modified from Ramos et al. (1982).

Fig. 1. Edades y distribución de las lavas de Plateau extra-andinas y ubicación de los estratos orogénicos calco alcalinos de la Cordillera Andina. La figura fue modificada de Ramos y otros, (1982).

TABLE 1

CHEMICAL AND NORMATIVE COMPOSITION OF PATAGONIAN PLATEAU LAVAS
COMPOSICION QUIMICA Y NORMATIVA DE LAVAS DE PLATEAU PATAGONICAS

SiO_2	58.29	47.15	50.60	46.24
TiO_2	1.37	2.38	1.58	3.10
Al_2O_3	17.65	15.98	14.83	12.46
FeO	7.37	10.91	10.48	11.69
MnO	0.16	0.16	0.17	0.18
MgO	1.79	8.22	9.15	11.00
CaO	4.12	6.60	8.57	10.27
Na_2O	5.60	4.20	2.99	3.29
K_2O	3.13	2.01	1.36	1.42
P_2O_5	0.53	0.77	0.26	0.69
Total	100.01	98.38	99.99	100.34
Rb	73	46	32	23
Sr	442	840	555	645
Y	42	23	19	177
Zr	487			
Nb	27			
Cr	5	266	414	
Co	15	37	30	
Ba	625			
Rb/Sr	0.165	0.055	0.058	0.036
Sr^{87}/Sr^{86}	0.7036-0.7039	0.7033-0.7052	0.7036	0.7031
Qz	0.6			
Or	18.4	11.9	8.1	8.4
Ab	49.9	19.4	26.1	16.2
An	13.6	18.9	23.1	15.0
Ne		8.8		6.3
Cpx	2.5	15.3	14.3	25.0
Opx	10.5		8.7	
Ol		15.3	13.8	17.1
Mt	1.5	3.0	3.2	4.7
Il	1.9	4.6	2.2	5.9
Ap	1.9	1.8	0.5	1.5

1. Pino Hachado Volcanic Complex, seven trachy-andesites, one dacite and one basalts (Muñoz and Stern, 1985); 2. Buenos Aires Plateau, elevent basalts (Baker et al)., 1981); 3. Las Vizcachas Plateau, four basaltic intrusive (Muñoz, 1981); 4. Pali-Aike Volcanic Field, fourthy-three basalts (Skewes and Stern, 1979).

1.Complejo volcánico Pino Hachado, 7 traquiandesitas, una dacita y un basalto (Muñoz y Stern, 1985); 2. Meseta Buenos Aires, once basaltos (Baker et al., 1981); 3. Meseta Las Vizcachas, cuatro intrusivos basalticos (Muñoz, 1981); 4. Campo Volcánico Poli-Aike, cuarenta y tres basaltos (Skewes y Stern, 1979).

MgO, CaO, TiO_2, Sr, Cr, and Ni than magmas erupted contemporaneously in southern Patagonia (Muñoz and Stern, 1985). No mantle derived ultramafic xenoliths have been reported from nothern Patagonia. Sr, Nd, Pb, and O isotopic ratios for Late Cenozoic magmas erupted in northern Patagonia are consistent with derivation from an intraplate

mantle source but are also within the range of orogenic magmas erupted from Andean stratovolcanos in central-south Chile. No $^{87}Sr/^{86}Sr$ ratios as low as, or $^{143}Nd/^{144}Nd$ ratios as high as those from southern Patagonia have been observed in the Late Cenozoic magmas in nothern Patagonia. These data suggest that magmatic evolution in northern Patagonia has involved more complicated near surface processes, such as fractional crystallization or crustal contamination, than occurred in southern Patagonia.

In summary arc and back-arc provinces are petrochemically quite distinct in southernmost Patagonia, but in northern Patagonia the transition from arc to back-arc magmatic activity is more complex and less defined. The regional variations observed in the Patagonian Plateau Lavas are apparently independent from regional north to south petrochemical variations observed in recent Andean orogenic centers. For instance in the southermost Andes crustal assimilation plays a significant role in the petrogenesis of the arc but not the back-arc magmas. Also, a gap in arc volcanism occurs between 46-49°S, just south of the Chile Rise-Trench triple junction, but no such gap is apparent in the Late Cenozoic Patagonian Plateau Lavas in this same region. Full understanding of the underlying causes of variations in back-arc magmatic activity and their implications for the magmatic evolution of the Andes awaits more detailed geochronological and petrochemical studies of the back-arc volcanic associations, particularly in Patagonia.

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