COMPOSITIONAL FEATURES AND GEODYNAMIC EVOLUTION OF VOLCANIC AND PLUTONIC COMPONENTS IN THE LOWER CRETACEOUS MAGMATIC PROVINCE (COASTAL RANGE OF CENTRAL CHILE)

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INTRODUCTION

A Lower Cretaceous belt, *c*. 1200 km long and mainly composed of magmatic rocks, is exposed along the Chilean Coastal Range between latitudes 25°and 36°S. At the La Serena area, c. 29-30°S (Fig.1A), the Lower Cretaceous volcanism is represented by the Arqueros Formation which consists of basaltic andesites and marine limestone. Between 32° and 33°30'S (Fig.1B) the main units of this belt are the basic volcanic Veta Negra Formation and the Las Chilcas Formation, both largely accumulated in a subsiding basin thicker than 10 km. A pervasive and non-deformative very-low grade regional metamorphism (prehnite-pumpellyite facies) affects the volcanic products of both formations (Aguirre *et al* 1989).

Plutons belonging to this Lower Cretaceous magmatic belt are numerous. The Caleu pluton, located in the Coastal Range of central Chile *c*. 40 km northwest from Santiago, is an excellent example (Parada et al., 2002). It has good exposures covering an area of about 340 km^2 and consists in three N-S elongated zones, which define an across-pluton compositional variation characterized by a westward increasing in SiO_2 content. These three zones are: Gabbro-Diorite Zone Tonalite Zone and Granodiorite Zone.

COMPOSITIONAL FEATURES OF VOLCANIC AND PLUTONIC COMPONENTS

The magmatic development of this province is marked by two contrasting events: an older volcanic episode represented by the Veta Negra and Arqueros formations and a younger plutonic event characterized by granitoid magmatism. From latitudes 33°30' to 29°, the basic lavas are chemically homogeneous contents classifying as high-K to shoshonitic basaltic andesites and andesites (Levi *et al*., 1988, Vergara *et al*., 1995, Morata *et al.*, 2000). N-MORB normalized trace element patterns both for volcanic and plutonic rocks are characterized by LILE enrichment, systematic HFSE decrease and a marked Nb-Ta depletion, typical of subduction related magmatism. In spite of some chemical similarities between the volcanic and plutonic products (*e.g*. high Al_2O_3 and K_2O and low MgO), conspicuous differences between them can be recognized (Table 1).

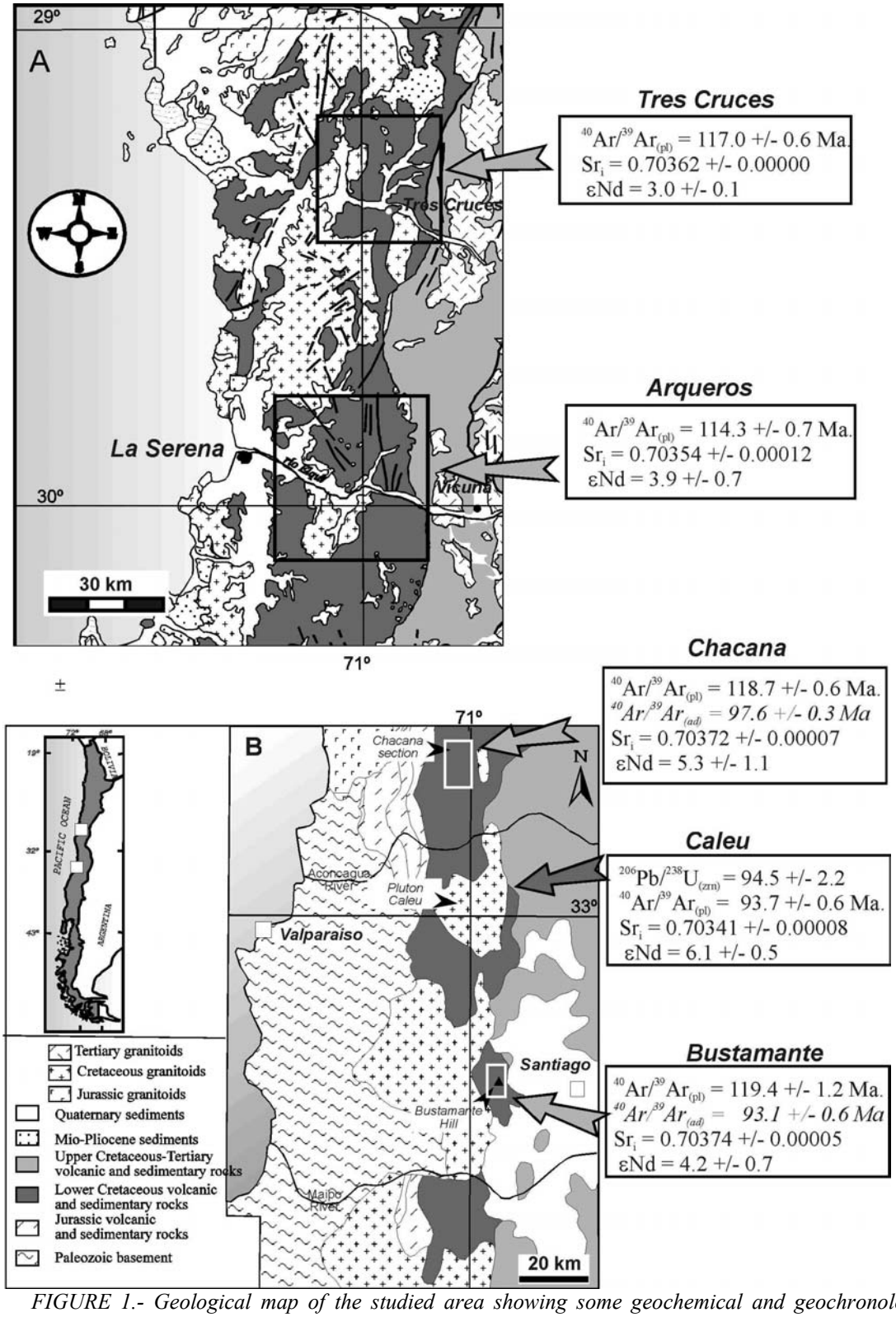

FIGURE 1.- Geological map of the studied area showing some geochemical and geochronological data.

It is of particular interest to compare the Veta Negra volcanic products with the spatially related Caleu pluton that put in evidence the fact that the Veta Negra flows are more basic and less isotopically depleted than the Caleu granitoids.

Table 1.- Summary of geochemical features and ages of the tectonic processes of the Lower Cretaceous magmatic rocks. Average and standard deviation with number of samples in parenthesis.

	Tres Cruces[(1)]	Arqueros[(1)]	Chacana[(1)]	Bustamante[(1)]	Caleu[(2)]
Latitude S	29°20'	29°50'	32º30'	33º25'	33º
Formation/pluton	*Arqueros*	*Arqueros*	*Veta Negra*	*Veta Negra*	*Caleu*
$\%SiO_2$	54.09±1.87(6)	53.73±1.87(8)	58.45±1.95(5)	52.39± 0.80(2)	60.33±5.72(43)
$\%Na_2O$	3.05±0.41(6)	3.96±0.80(8)	3.49±0.17(5)	3.22±0.64(2)	3.90±0.47(43)
$\%K_2O$	4.10±1.00(6)	2.61±0.87(8)	4.24±0.97(5)	2.33±0.05(2)	2.59±1.13(43)
%MgO	3.78±0.70(6)	3.05±1.29(8)	2.50±0.48(5)	3.67±0.31(2)	2.59±1.16(43)
$\%Al_2O_3$	17.64±1.12(6)	18.16±0.87(8)	16.04±1.39(5)	18.98±1.25(2)	16.90±1.43(43)
Sr_i	0.70362± 0.00000(2)	0.70354± 0.00012(4)	0.70372± 0.00007(2)	0.70374± 0.00005(2)	0.70341± 0.00008(13)
εNd^t_{CHUR}	3.0±0.1(2)	3.9±0.7(4)	5.3±1.1(2)	4.2±0.7(2)	6.1±0.5(13)
Age (Ma)	117.0±0.6	117-115	118.7±0.6	119.4±1.2	94.5±2.2
Rate of subsidence			≥0.25 mm/year	0.18 mm/year	
Age of metamorphism (Ma)			97.6±0.3	93.1±0.6	
Age of exhumation (Ma)					94-90

(1) Data from Morata *et al*. 2001

(2) Data from Parada *et al.* 2001, 2002.

GEODYNAMIC CONSIDERATIONS

The geochronological record shows the existence of a magmatic gap between 115 and 94.5 Ma, which could be explained by a decrease in intensity of the decompression melting mechanism at the origin of the Veta Negra volcanism as a consequence of progressive infilling and subsidence of its basin. Subsidence was interrumpted by fast exhumation at 94-90 Ma (Table 1) which would have been triggered by a mechanism of crustal density inversion between upper crustal basic and denser rocks, and lower crustal, felsic and lighter basement such as advocated by Martínez *et al*. (2001), to explain the presence of metamorphic core complexes in the Papua New Guinea region.

A coincidence in age between plutonism and low-grade metamorphism of the volcanic rocks (see Table 1) suggests that this last was not solely produced by burial but was related to a regional increase in thermal gradient associated with the magmatic event at the origin of the Caleu pluton. The compositional differences between the Caleu granitoids and the Veta Negra flows, already mentioned, are attributed to a lower melting

degree of deeper asthenospheric protoliths in the genesis of the former. This process would result from renewal of decompression melting associated with crustal root attenuation during the period of fast exhumation.

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