

Fe-rich silicates in the Cobquecura pluton: An indicator of a-type granitoids in the Triassic magmatism of south-central Chile

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Introduction

The tectonomagmatic evolution of the southwestern margin of South-America is characterized by significant changes between the Late Paleozoic and Andine (Late Jurassic- Recent) Cycles. These changes have been attributed to a pause of subduction, with generation of extensional sedimentary basins with associated magmatism (i.e., Charrier, 1979; Mpodozis & Kay, 1992). However, recent studies at 40°S dated the activity of the accretionary prism as Carboniferous to Late Triassic (Willner *et al.*, 2004), opening the discussion about the dominant tectonic regime during this time.

The Late Triassic magmatism south of 33°S, at the southwestern margin of South-America, is exposed in small and discontinuous outcrops around Pichilemu, Constitución, and Hualpén (Hervé *et al.*, 1988; Fig. 1). They are located at the western side of the Coastal Cordillera and intruded the Western Series of the metamorphic basement. Predominant rocks are monzogranites with associated mafic dikes.

New K/Ar ages in amphibole (ferroedenite and Mg-hornblende) (Table 1) reveal that the Cobquecura Pluton is another Late Triassic body west of the Coastal Cordillera. However, it has important compositional differences to the other Triassic bodies in this segment.

Geological Setting

The Cobquecura Pluton crops out discontinuously along the coast between Tregualemu and Santa Rita (35°57' to 36°12'S). Its lithology is predominantly gabbroic with minor amounts of tonalite, quartz- monzodiorite, granodiorite and granite. It intruded into slates and metapsammities of the 'Serie I Curepto' defined by González-Bonorino & Aguirre (1970), which is equivalent to the low grade zone of the Eastern Series (low P/T) (Aguirre *et al.*, 1972). On the contrary, the compositions of the Constitución Granite and the Pichilemu Granite are mainly granitic, and they intruded slates and metabasites of the Western high P/T Series (Hervé *et al.*, 1988). Partially, the Cobquecura Pluton is covered by Quaternary and Tertiary sediments.

Table 1: K/Ar ages of intrusive rocks from Cobquecura.

Sample	Rock	Mineral	Spike (No.)	K ₂ O (wt%)	⁴⁰ Ar * (nl/g STP)	⁴⁰ Ar * (%)	Age (Ma)	2σ-Error (Ma)
03-08	Fayalite granodiorite	Ferroedenite	3331	0,88	6,372	87,87	211,6	4,5
03-27	Gabbro	Mg-Hornblende	3329	0,63	4,584	88,01	212,6	4,9

Petrography and Mineral Chemistry

The most interesting rock among the different lithologies is a fayalite- granodiorite. It crops out around Iglesia de la Piedra, north of Cobquecura. Its texture is phaneritic medium- grained, with a color index close to 30. It is composed principally by plagioclase, quartz, amphibole, olivine and pyroxene. Associated with this granodiorite are intrusive breccias, gabbros and monzodiorites.

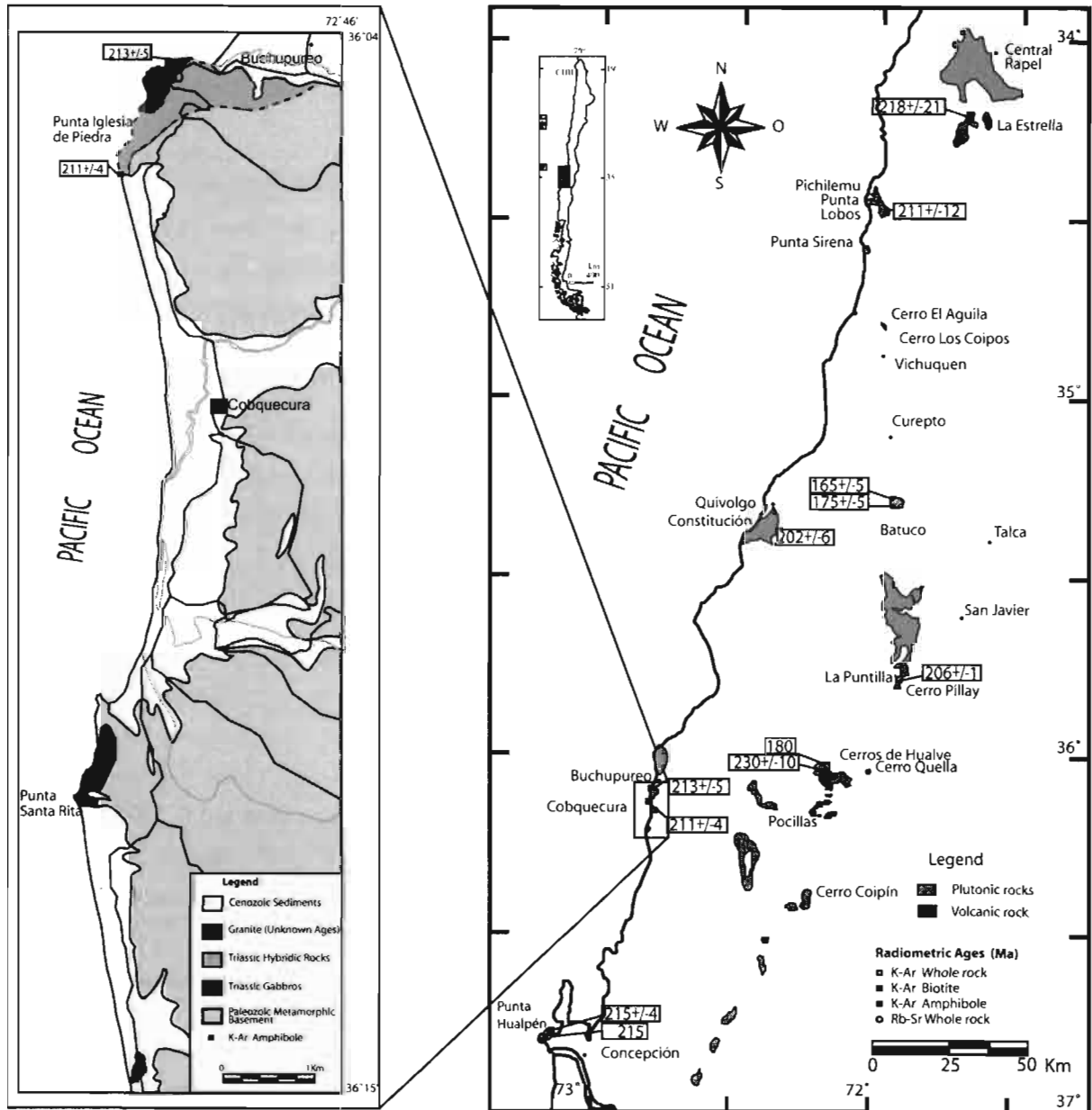


Figure 1: Left: Geologic map of Cobquecura with new K/Ar ages. Right: Distribution of Upper Triassic- Lower Jurassic magmatism in the Coastal Cordillera between 34° and 37°S; after Godoy (1970), Corvalán (1976), Hervé & Munizaga (1978), Dávila *et al.* (1979), Gajardo (1981), and Gana & Hervé (1983). Radiometric ages are taken from Hervé & Munizaga (1978), Dávila *et al.* (1979), Gana & Hervé (1983), Hervé *et al.* (1988), and Creixell *et al.* (2002).

Electron microprobe analysis of mafic silicates of the olivine granodiorite show a predominantly Fe-rich composition of fayalite (Fa₉₄-Fa₉₅), hedenbergite (Wo₄₅En₇Fe₄₇), amphibole with mainly ferroedenitic composition (Fe/Mg+Fe between 0,85 and 0,92), and biotite (Ann₉₀ – An₉₆). The composition of mafic minerals in the fayalite granodiorite contrasts with the composition in the mafic lithologies, which are richer in Mg.

The feldspars are plagioclase and K-feldspar. The plagioclase has normal zonation with compositions of $An_{33}-An_{19}$ with patches in the core richer in Na (An_{18}). The feldspar is sanidine with a composition of $Or_{69}Ab_{30}An_1$, which occasionally changes to K-richer composition.

Discussion

The mineralogical association of fayalite, quartz and ilmenite have been related to reducing conditions that occur below the FMQ buffer with low H_2O activity (Stephenson & Hensel, 1978; Mücke, 2003) and its occurrence is frequently cited for Precambrian anorogenic granites (e.g., Stephenson & Hensel, 1978; Frost *et al.*, 1999).

These conditions, together with low contents of Eu and Sr and high contents of Ga (15 to 26 ppm) are typical for A-type granitoids (Whalen *et al.*, 1987). Our first geochemical results indicate a transitional environment between volcanic arc and anorogenic granites in Pearce's Diagram (Pearce *et al.*, 1984).

Other late Triassic to early Jurassic A-type to transitional A-Type granitoids were described from 28°-33°S, where they are associated with I-Type granitoids (Gana, 1991; Parada *et al.*, 1991; Mpodozis & Kay, 1992).

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