6th International Symposium on Andean Geodynamics (ISAG 2005, Barcelona), Extended Abstracts: 376-378

Temporal and isotopic variations within the Jurassic to Neogene Patagonian batholith

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Introduction

The Patagonian Batholith (Figure 1) exhibits strong spatial age and isotopic variation along and across its 1200 km north to south extension on the Pacific margin of South America. These variations are controlled by - varying subduction parameters and continental tectonic features.

The differences and similarities between the North Patagonian batholith, north of about the Chile Triple Junction where the Nazca – Antarctica – South America plates meet at present, with the South Patagonian Batholith, will be presented below. This analysis is made using previously published research, and a large new, mostly unpublished database.

Age

North Patagonian Batholith (NPB)

A Rb – Sr geochronological and geochemical study of the NPB was presented by Pankhurst et al (1999). The results for 25 plutonic bodies revealed a complex age pattern, which are from west to east: a single Late Cretaceous body (76 Ma), Early Cretaceous (c.135 Ma), Eocene (c.45 Ma) and Early Miocene (15 – 25 Ma), reverting to mid-Cretaceous (120 – 90 Ma) in the main Andes. Small bodies of Late Miocene /Pliocene (c. 10 – 5 Ma) peraluminous leucogranite occur sporadically. Satellite plutons are dated as Pliocene (c. 3Ma) in the Taitao Peninsula west of the main body of the NPB, and more varied Jurassic (Parada et al, 1999), Cretaceous and Late Miocene bodies occur east of the NPB.

South Patagonian Batholith (SPB)

The construction of the SPB (Hervé et al, submitted) began with a voluminous bimodal Late Jurassic body emplaced along the present eastern margin in a limited time span (157 – 149 Ma). The loci of plutonic emplacement then shifted to the west in the earliest Cretaceous (145 – 137 Ma) and culminated in the late Early Cretaceous (136- 111 Ma) along the present western margin of the batholith. Late Cretaceous (99 – 78 Ma) and Paleogene (64 – 40 Ma) are represented by geographically restricted plutons mainly emplaced within the previously established margins of the batholith. Neogene (22 – 16 Ma) plutonism occurred within and immediately east of the SPB, and some still younger plutons (12 Ma) were emplaced as satellite bodies further east.

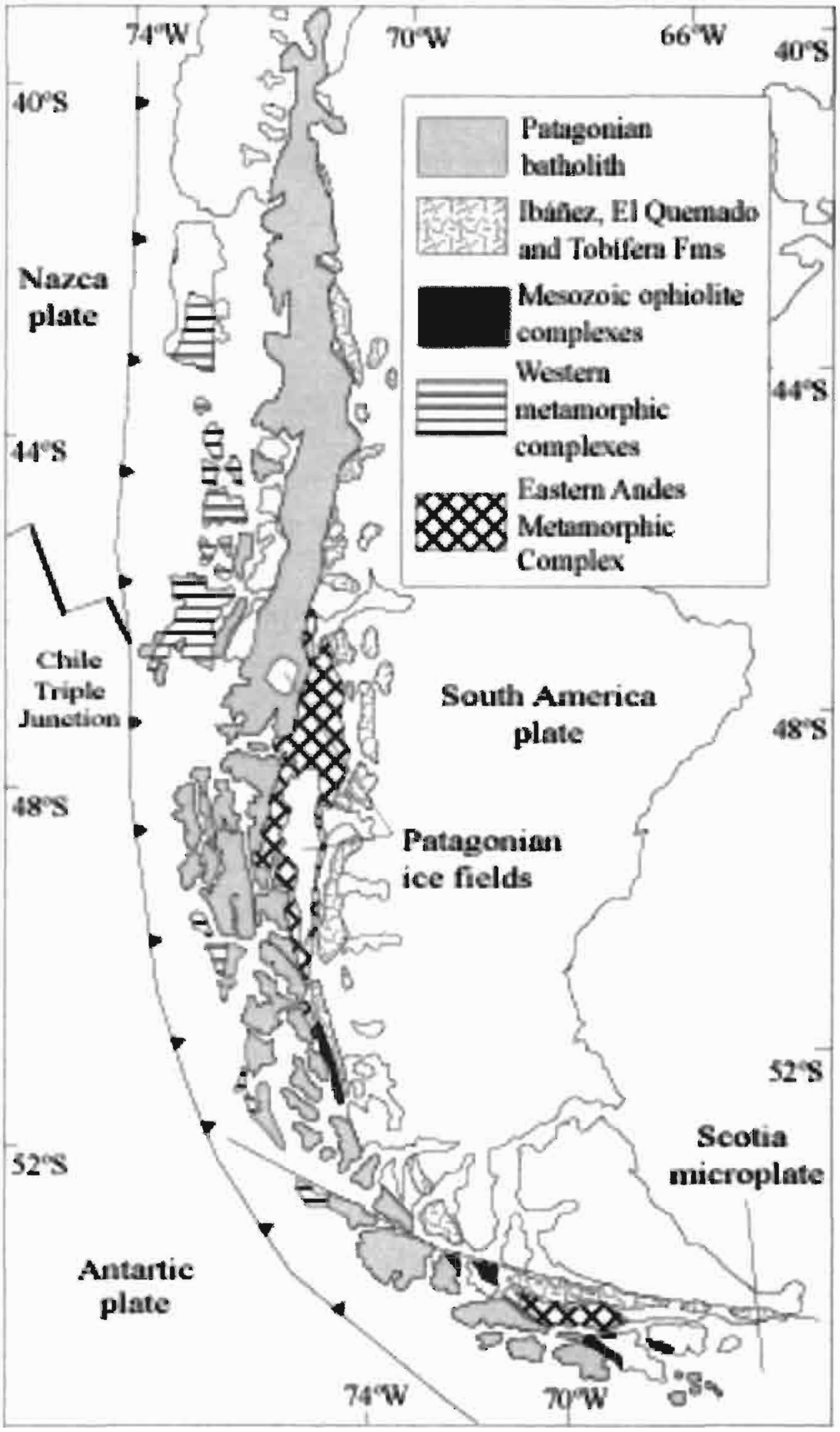

Figure 1. The Patagonian Batholith and related geological units.

Geochemistry

The igneous suite is typically metaluminous and calc-alkaline to calcic, with hornblende – biotite granodiorite and tonalite dominant in the Cretaceous and Cenozoic plutons. The Late Jurassic bimodal body of the SPB is dominated by leucogranites.

Initial $^{87}Sr/^{86}Sr$ ratios in the NPB (0.7037 – 0.7060) are somewhat more restricted than the SPB values (0.7032 – 0.7092). The distribution in εSr – εNd plots follows conventional S–I type trends from long-term LIL-enriched to LIL-depleted sources. The SPB has a marked extension into the LIL – enriched (crustal sources quadrant), entirely due to the extension of the age spectrum in the SPB to ages over 150 Ma, these Late Jurassic granitoids being absent from the NPB. Data for the two segments of the batholith match remarkably closely for ages younger than 140 Ma.

Tectonic considerations

The geological environments in which the NPB and the SPB were emplaced have some significant differences, which might have influenced the assembly of the two segments of the batholith.

The NPB was intruded directly into the Chonos Metamorphic Complex, an accretionary complex of Late Triassic age. East of the NPB, the Early Jurassic subduction-related Subcordilleran Batholith was formed (Rapela et al, in press). In constrast, the SPB was intruded into the exotic Madre de Dios oceanic terrane, of early Permian age, which collided with the Gondwana margin in the Early Permian- earliest Jurassic interval. No Early Jurassic magmatic arc is known east of the SPB. It is thus possible that the continental margin was different in terms of composition, crustal thickness and other parameters during the initiation of subduction in Late Jurassic times. This might have determined the presence of voluminous Late Jurassic plutonic activity in the SPB and not in the NPB. Magmatic and emplacement conditions in the two segments became equivalent from the Early Cretaceous onwards.

The Liquiñe – Ofqui Fault Zone (LOFZ) which controlled the emplacement of Neogene plutons in the central part of the NPB has no equivalent in the SPB.

A relationship between peaks of fast convergence of the oceanic plate and South America with the occurrence of the Eocene and Miocene magmatic pulses of the NPB (Pankhurst et al 1999) seems also to be valid for the SPB.

Acknowledgements

This research has been funded by Fondecyt projects, including 1010412 to FH and BAPRTD to MC.

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