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CONTRASTING TECTONOMAGMATIC STYLES IN THE LATE PALEOZOIC AND JURASSIC BATHOLITHS OF CENTRAL CHILE

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INTRODUCTION AND GEOLOGICAL SETTING

The Coastal Range of central Chile is largely composed of intrusive rocks covered by volcanic sequences. These rocks range in age from the Late Paleozoic to Early Cretaceous, where a pattern of progressive eastward decrease in age is well developed. Four main magmatic belts are recognized in the coastal range: Late Paleozoic, Late Triassic-Early Jurassic, Middle-Late Jurassic and Early Cretaceous. All these belts are nearly N-S trending along the Coastal Range but at 33º S, Late Paleozoic to Middle-Late Jurassic plutonic belts are oriented NNW-SSE to NW-SE, coinciding with occurrence of parallel lineaments that crosscut all the coastal structure, continuing to the Andean foothills. In the present contribution, we show new geological data concerning Late Paleozoic to Late Jurassic belts of central Chile, mainly concentrated in the area between 33º and 33º45' S and we discuss these antecedents in terms of magma emplacement styles and to decipher the tectonic setting where these intrusions were developed.

THE LATE PALEOZOIC BATHOLITH: COMPOSITION AND STRUCTURE

The Late Paleozoic batholith is exposed in the coastal range continuously south of 33º S. To the north, similar rocks occur in the Elqui - Limarí batholith, located in the Andean Frontal Cordillera north of 31º S (Nasi et al., 1985). In the coastal segment between 33º and 33º45'S, the batholith is composed by Late Carboniferous intrusions dated around 300 Ma (e.g. Hervé et al., 1988; Gana and Tosdal, 1996). These rocks consist mostly of tonalites, granodiorites and minor granites, characterized by sub-vertical foliation (mostly between 125-181º/72º-90ºSW) and SE-plunging mineral lineation (125º-175º/31º-52º). Between localities of Las Cruces and Cartagena, garnet-bearing gneisses are the dominant metamorphic components of the batholith. Field observations and geothermometry suggest that the foliation in the plutonic rocks was developed near the magmatic

state. This is also corroborated by a new biotite $^{40}Ar/^{39}Ar$ age in gneissic tonalites at El Tabo, giving a minimum age for foliation development of 272+3 Ma. Metamorphic rocks consist of garnet-bearing gneisses with L-S fabric, characterized by a dominant E-W sub-vertical foliation and S to SE-plunging stretching lineation. Granitic gneisses at Las Cruces consist of leucocratic and mafic metamorphic bands, composed of a mineral association of garnet + plagioclase + sillimanite + cordierite + K-feldspar + biotite and quartz, representing a high-Tº association, nears the migmatitic state.

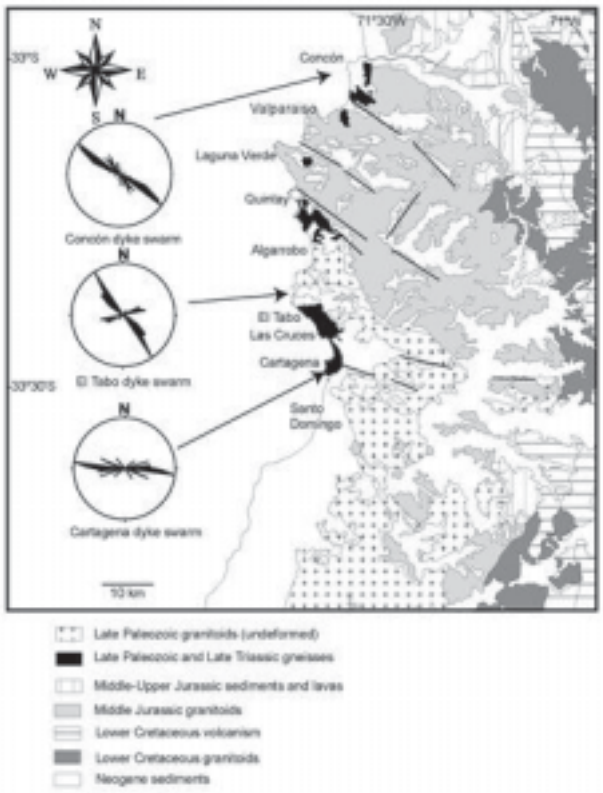

Figure 1: Geological map of the studied area. Rose diagrams for main dike swarms are included

MIDDLE JURASSIC BATHOLITH: DIKE SWARMS AND PLUTONIC COMPONENTS

The Middle-Late Jurassic batholith is composed of gabbroic to granitic intrusions and associated mafic dike swarms. The plutonic components have been dated between 163 and 154 Ma by zircon and titanite U-Pb dating (e.g. Godoy and Loske, 1988; Gana and Tosdal, 1996). At Laguna Verde, gabbros and diorites show L-S deformational fabric with foliation between 107º-160º/65º-90ºSW and SE to SW-plunging lineation (110º-256º/46º-77º). These structures show evidences of syn-plutonic deformation and shearing along NW-trending foliation planes. The age of

mafic dike swarms has been constrained by new $^{40}Ar/^{39}Ar$ ages in hornblende north of Valparaiso between 163 and 157 Ma (Creixell et al., submitted) and in Cartagena at 157+3 Ma. These Jurassic mafic dikes show field, petrographic and AMS evidences of syntectonic emplacement, associated to displacement along NW and E-W trending host fractures. The structural disposition of the swarms coincides with the orientation of the regional lineaments. Mylonitic fabric superimposed in granitoid gneisses near Cartagena show top-to-the-south shear indicators with normal displacement and south-plunging stretching lineations. These rocks have been dated near 157 Ma (Hervé et al, 1988 and our unpublished data).

Younger dike swarms, mainly recognized between localities of Algarrobo and El Tabo are dated at 140 Ma by a new $^{40}Ar/^{39}Ar$ in hornblende. These rocks consist of mutual crosscutting sets of subvertical NW and NE-trending mafic dikes, associated to fragile deformation in the wall rocks during emplacement.

LATE PALEOZOIC VS. MIDDLE JURASSIC BATHOLITHS: CONTRASTING STYLES OF MAGMATISM AND DEFORMATION

Plutonic and metamorphic Late Paleozoic rocks of the area show evidences of syntectonic emplacement. The dominant NW-trending foliation pattern in these rocks is also associated to sub-vertical shear zones that in some cases make the contact between different plutonic facies. The style of syn-plutonic deformation is dominated by plane strain with locally abundant indicators of contractional shearing occurred coeval with emplacement of the plutons. The occurrence of metagranitoids and migmatites can be interpreted as the result of metamorphism of granitoids in deeper levels of the continental margin. Migmatitic fabrics are only local features and probably do not represents, at this scale, zones of melt extraction and transport from anatexis, as observed in others convergent orogens (i.e. Brown and Solar, 1998).

The style of deformation of the Middle Jurassic batholith is characterized by transtensional deformation that generates space for intrusion of dike swarms. The transtension was also associated with northward block tilting at the northern part of the area. The dike swarms are nearly coeval, but mostly postdate extensional shearing in granitoid gneisses at Cartagena. Both the dike swarms and

shear fabric in gneisses indicates that N-S to NNW-SSE extension dominated the development of the batholith during the Middle Jurassic. Minor dike swarms also show evidences of emplacement during transpression that probably follows after the main stage of transtension. The clear coincidence of the Middle Jurassic structures with compressive fabric of the Late Paleozoic rocks suggests that extension was tectonically controlled by the fabric of the basement. Exhumation of the basement during this period of extension can be the cause of emplacement of Early Cretaceous dikes at shallower crustal levels in the same area.

CONCLUSIONS

The Late Paleozoic Batholith was emplaced during development of a contractional orogen. This tectonism imprinted a strong synplutonic deformation on the granitoids. In the other hand, Middle-Late Jurassic Batholith was developed during extensional deformation, associated to transtension controlled by the anisotropy of the basement. The direction of the extension was nearly NNW-SSE and was associated to exhumation of the basement, dike swarm intrusions and block tilting.

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