ARC RELATED IGNEOUS AND METAIGNEOUS ROCKS IN THE COASTAL CORDILLERA OF NORTHERN CHILE: CONTINUOUS REPLACEMENT OF THE CRUST?

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RESUMEN

Durante la fase jurásica de actividad magmática, la corteza continental pre-andina de la Cordillera de la Costa del norte de Chile (región de Antofagasta) fue reemplazada por rocas intrusivas precoces y sus equivalentes metamórficos, por rocas intrusivas tardías y por rocas volcanicas. El lapso de tiempo de este episodio magmático parece estar restringido a 50 m.a. Terminó alrededor de 150 m.a. y empezó aproximadamente hace unos 200 m.a. Sin embargo, las edades del inicio del magmatismo y del subsequente metamorfismo son imprecisas. Los detalles del marco tectónico y de la evolución de esta adición de magma a gran escala en la corteza no estan aún claros.

Key Words: Arc magmatism, magmatic arc metamorphism, crustal growth by magmatism, tectonic setting of the magmatism

GEOLOGICAL SETTING (Coastal area between 23^{20} - 24^{20}S)

Metaplutonic rocks (metabasites) and plutonic rocks are exposed along the coastline south of Antofagasta and at the southern tip of the Mejillones peninsula. The metabasites constitute low pressure granulites (two pyroxene plagioclase gneisses), relicts of their magmatic protolith and foliated amphibolites derived from the pyroxene gneisses. Layered gabbros (numerous small intrusions) and a quartz diorite pluton (large homogeneous intrusion) intruded into the metamorphic unit. Mafic dyke swarms crosscut the foliation and other textures in the metabasites and the quartz diorite. They were not deformed under ductile conditions. To the south (24^{o}) relicts of volcanic rocks ("Formacion La Negra") are widespread (continental deposits as lava flows). Contacts of the volcanic rocks with their basement are not well known, except in some places, where tectonic and intrusive contacts were observed. Preandean continental crust is not found between south Mejillones and Paposo.(for details: Lucassen & Franz, 1992 and references therein)

METAMORPHISM DURING MAGMATIC ACTIVITY

The recrystallization of the early magmatic rocks under granulite facies temperatures was enhanced by the intrusive magmatic activity. The magmas were essentially dry and the recrystallization occured on the cooling path of the area. No relicts of a prograde temperature path were found for granulite and subsequent amphibolite facies rocks. Temperatures in the pyroxene gneisses

mobile elements in the volcanic rocks, they are not related to any other rock unit of the area.
In all rock types including volcanics and gabbros Sr isotope ratios are low (< 0.7040) and REE distribution patterns are flat (La/Yb typically between 2-3 for most samples). We suggest magmas from the upper mantle as the major component in all rocks.

REGIONAL IMPORTANCE OF THE RESULTS

The composition of the crust from a deep section of the arc as outlined above might be representative for the upper 20 km of the present crustal profile in the Coast Range. Geophysical data of the gravity field and the seismic velocities from a north-south profile (20-26°S) in the Coast Range prove the existence of abundant high density mafic rocks (2850-3000 kg m^{-3}) in the upper 5 - 22 km of the crust (Strunk, 1990 and references therein). In E-W direction the high density rocks are restricted to the Coast Range, but they extend over at least 600 km in N-S direction. No major parts of typical continental crust are obvious either in the gravity field or in the distribution of seismic velocities.
A comparision of geochemical data of igneous rocks from the Coastal Cordillera shows striking similarities between data from the literature and our data. The volcanic rocks are not related to any other rock unit on the regional scale.

PROBLEMS

Replacement of the continental crust by prevailing basic intrusions and their metamorphic equivalents at midcrustal levels requires a considerable stretching and thinning of the crust. The intrusion mechanism must have prevented contamination of the basic magmas by a crustal component, and therefore magmatic underplating is preferred. The regional distribution of high density

development of the rocks at the same geographical position (thrust tectonics can be excluded). Therefore uplift and erosion of the Coastal Cordillera is required before deposition of the volcanics and before the emplacement of at least some of the late intrusive rocks. The cause and exact timing of this hypothetical event and its relation to the subduction process is yet unclear.
We are working on thermal models of the arc crust with the given data and attempting to obtain age relations of the early history of the Jurassic arc by additional radiometric dating with the aim of testing various hypotheses of the magmatic and tectonic history of the arc crust.

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