The Jurassic-Cretaceous sequences of the Coastal Range near Iquique: reappraisal of the stratigraphy and new evidence for the Lower Cretaceous tectonic conditions

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Introduction

This contribution is part of the SERNAGEOMIN regional geology mapping program, which is currently being conducted in the Coastal Cordillera, Central Depression and Precordillera of the Tarapacá Region (20º - 21ºS). Here, we review the stratigraphy of the Jurassic-Cretaceous volcanic-sedimentary units in the Costal Cordillera of the Iquique area (Fig. 1). The integration of field observations and new U/Pb SHRIMP zircon ages allows us to constrain important tectonic and sedimentation processes during the middle Mesozoic in this area.

Geological Setting

In the Coastal Range, near the area of Iquique (20º-20º30’S), there is an important development of Mesozoic volcanic-sedimentary sequences, which consists of: Oficina Viz Formation that represents the Aalenian-Bajocian volcanic arc [1], Caleta Lígate [2] and Huantajaya formations (sensu [1]), both of which represent the western facies of the Jurassic back-arc marine basin [3], and Punta Barranco Formation [2], which corresponds to an Hauterivian-Barremian continental volcano-clastic sequence (Fig. 1).

Oficina Viz Formation is a monotonous continental volcanic sequence up to 1000-1500 m thick, composed of basalt and basaltic andesites with minor tuffs. The lavas present abundant amygdales with quartz, chalcedony and epidote. Reliable 40Ar/39Ar ages on plagioclase are between 176 and 170 Ma [4] (Fig. 2). This formation has been traditionally correlated with the La Negra Formation [1].

Caleta Lígate Formation is a marine sedimentary sequence, comprised mainly of fossiliferous calcareous sandstone, with a maximum thickness ca. 300 m [5]. At the base of this formation, there are volcanic and pyroclastic breccias, with rhyolitic blocks, and
ignimbrites with fiammes. The thickness of these lithologies increases to the west (coastal area) (see Fig. 2), indicating proximity of the volcanic center(s) toward the west. Submarine volcanism represented by pillow lavas and dikes intruding wet sediments are restricted to the coastal area and to the upper section of the formation. The fossiliferous content indicates a Bajocian age. Based on the previous definitions [1; 5], the Huantajaya Formation has been divided in two members, El Godo and Santa Rosa (Fig. 2). The El Godo Member is mainly composed of fossiliferous shales, but presents a submarine volcanic component to the west (coastal area) such as pillow lavas, olistoliths and wet intrusions. It has an estimated maximum thickness of 850 m [5]. The Santa Rosa Member is composed of fossiliferous massive limestones. This last member crops out only to the east of the area and represents platform facies. Its minimum estimated thickness is ca. 200 m [5]. Fossil content indicates a Bajocian-Oxfordian age for the El Godo Member and an Oxfordian age for the limestones of the Santa Rosa Member.

Punta Barranco Formation is a continental-volcanic sequence with ca. 1200 m of thickness [1]. This formation is divided in two members: a lower member composed of red continental sandstones and conglomerates, and a thick upper member consisting of volcanic breccias and trachytic andesites (Fig. 2). The contact between the base of the formation and the underlying Jurassic units is a paraconformity. Along this contact, a basal conglomerate with limestone clasts occurs. Sedimentary transport directions measured from imbricated clasts of the lower member conglomerates are predominantly towards the SSE. U/Pb SHRIMP zircon ages from a trachytic andesite yield a weighted mean age of 128.7 ± 1.5 Ma (Barremian) for the base of the upper member of the Punta Barranco Formation. A minimum age for this formation is constrained by intrusion of the Molle Granite at 113.0 ± 0.9 Ma (Aptian) (Fig. 1).

Tectonic

This area is characterized by three main Mesozoic structures: EW-striking normal faults with nearly subvertical dip, NS and NNW-SSE east-dipping faults. Field observations indicate an interconnection of these three structural systems (Fig. 1). In the Mesozoic these systems had a normal component, in agreement with the regional extensional tectonic regimen generally visualized for this period [6]. In contrast, in the Neogene these structures were reactivated as reverse faults, producing shortening [7]. In the study area, the major E-W structures, the south-dipping Zofrã Fault and the north-dipping Los Verdes Fault (Fig. 1), delimit a prominent graben to which the Punta Barranco Formation is confined. Measured transport directions indicate that the depocenter of the basin was towards the SSE.
Summary

The occurrence of a basal conglomerate with limestone clasts in the Punta Barranco Formation is evidence for erosion and exhumation of the Jurassic sedimentary marine sequence at least during initial accumulation of the Punta Barranco Formation. The distribution of the Punta Barranco Formation is confined by E-W structures, which set the limits of a small Lower Cretaceous sedimentary basin in this area. This suggests that the E-W normal faults were active during deposition of the sedimentary and volcanic rocks of the Punta Barranco Formation, forming grabens that allowed their accumulation. The Barremian age in the volcanic (upper) member of Punta Barranco Formation constrains the maximum span time for erosion and exhumation of the Upper Jurassic sequence (Oxfordian) in 25 m.y., during the middle Mesozoic.

Acknowledgements

This project is financed by SERNAGEOMIN and Gobierno Regional de Tarapacá. This study benefits from discussions and constructive comments with our work team (N. Blanco, P. Cornejo, N. Marinovic and A. Tomlinson). C. Marquardt and V. Muñoz are thanked for a useful introduction to the geology of the area. We also thank A. Rubilar and A. Mourgues for their valuable support in the field and paleontological studies.

References