CRETACEOUS AND EARLY TERTIARY IN NORTHERN CHILE BETWEEN 21° AND 23° S.

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Resumen

Se presentan los resultados de un estudio en afloramientos clástico-continentales y volcánicos del Cretácico - Terciario inferior. Estos depósitos representan diferentes estados en la actividad magmática del desarrollo del margen continental sudamericano en este sector de los Andes, configurando dominios paleogeográficos diferentes para cada arco magmático.

Key Words: Chile, paleogeography, sequence, chronology

Introduction

The study area is located in the Central Andes, in the Chilean Pre-Cordillera (Sierra de Moreno - Sierra del Medio) between 21° and 23°, II Región of Antofagasta, Chile (Fig. 1). The study is based on vertical sections and geological mapping of the areas concerned. This investigation has permitted descriptions and a redefinition of the vertical and horizontal extension, age and regional significance of the "formations" previously described as "Cretaceous". The object of the investigation was to describe the sequences and analyse their stratigraphical and paleogeographical significance within the evolution context of this part of the Andes. As a result of this study four sequences could be distiguished on the basis of lithology, stratigraphic relations and age.

Stratigraphy

The sequences, from Kimmeridgian to Eocene,(fig.2) correspond to:

a) The Western Sequence (Kimmeridgian to Barremian/Aptian?) occurs only on the western flank of the Sierra de Moreno with fine grained 5000 m thick sediments (sandstones and siltstones). It is of fluvial-deltaic character, marine in its lower part, and shows paleocurrents from E and NE. The sequence develops conformably from Jurassic marine sediments (Oxfordian and/or basal Kimmeridgian) and is conformably overlain by andesites of Volcanic Sequence 1 (see below). These sediments correspond to the middle and upper part of the Chacarilla Formation of GALLI & DINGMAN, 1962.

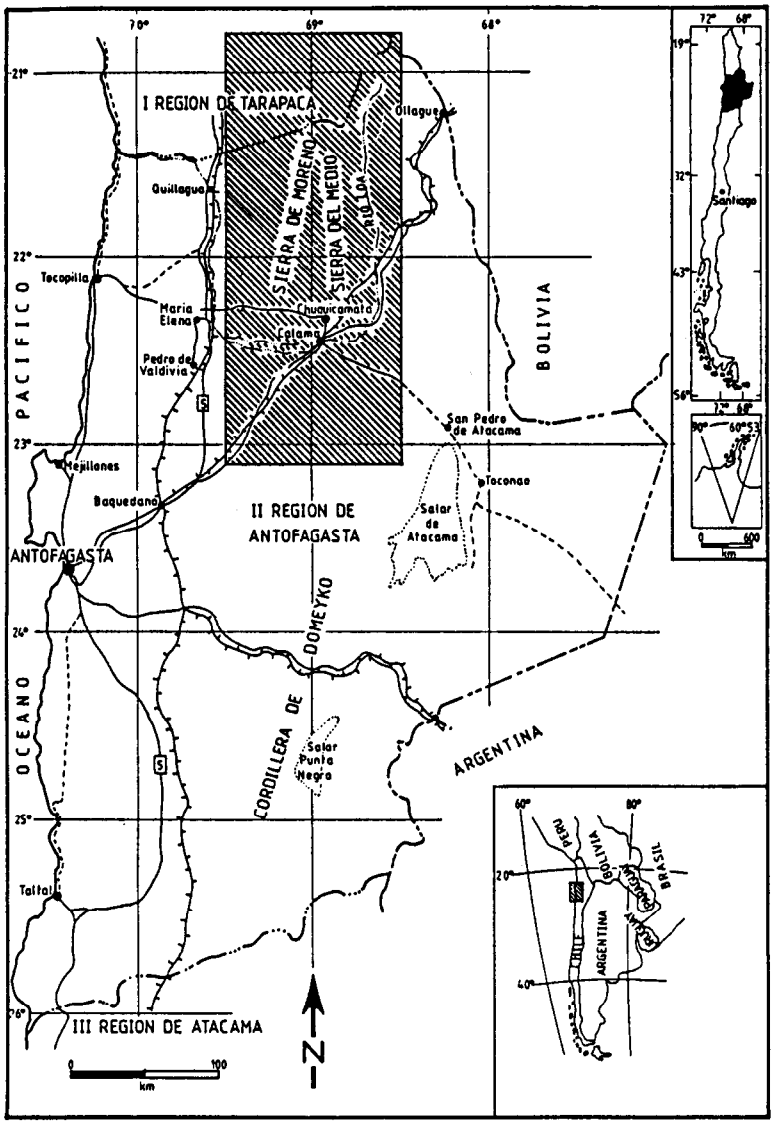

Fig. 1: Location of the investigated area in the Pre-Cordillera of Northern Chile

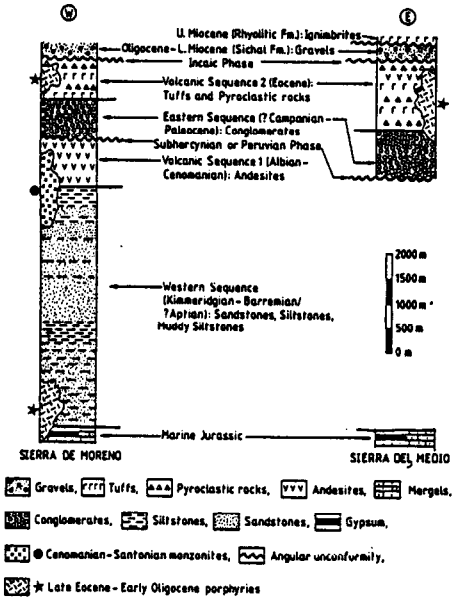

Fig. 2: Generalized lithostratigraphic columne of the Sierra de Moreno and Sierra del Medio in the Pre-Cordillera of N-Chile.

b) Volcanic Sequence 1 (Albian to Cenomanian) occurs only on the western flank of the Sierra de Moreno. Its 1000 to 1500 m thick volcanic rocks are composed of lava beds and volcanic breccias. The sequence develops conformably from the Western Sequence and is uncomformably overlain by Oligocene-Miocene gravels (Sichal Formation, sensu MAKSAEV, 1978) and/or has a fault contact with the Eastern sequence (see below), its age is based on a WR Rb/Sr isochron with maximum of 104 ± 19 Ma (ROGERS, 1985). Furthermore, one of the authors (R. Döbel) dated monzonitic stocks of Quebrada Arcas which had intruded into these volcanic rocks (K/Ar-age in biotite: 99.4±5.1 Ma) and dikes related to these stocks that had intruded into the Western Sequence (Ar/Ar in hornblende: 92.4±2.3 ma). On the basis of the stratigraphic relations, these volcanic rocks can be assumed to form part of the Cerro Empexa Formation (GALLI & DINGMAN, 1962).

c) The Eastern Sequence (Campanian? to Early Eocene) outcrops along the Sierra del Medio and is composed of coarse grained 1500 m thick alluvial-fan deposits (conglomerates) with paleocurrents from S and SW. The contact to the underlying marine Jurassic sediments (Callovian and/or Oxfordian) is formed by an erosional unconformity. The sequence is conformably overlain by Volcanic Sequence 2 (see below). This Eastern Sequence corresponds to the Tolar Formation (MAKSAEV, 1978) - lower/middle part of the Purilactis Formation (sensu CHARRIER & REUTTER, 1988).

d) Volcanic Sequence 2 (middle/upper Eocene) outcrops in the Sierra del Medio and in the southern part of the Sierra de Moreno. It is composed of 1000 to 1500 m thick tuff and pyroclastic deposits of calc-alkaline composition. This sequence develops conformably from the Eastern Sequence and is overlain unconformably by Oligocene - Miocene gravels (Sichal Formation, MAKSAEV, 1978). Its volcanic rocks were dated (Döbel) with the Ar/Ar - method in biotite and hornblende (between 47.8±0.8 and 38.5±0.9 Ma). These results correlate with the radiometric ages of HUETE et al. (1977) for similar rocks (WR K/Ar in biotite, between 55.6±0.8 and 41.2±0.6 Ma). On the basis of the stratigraphic relations and radiometric dating the volcanic rocks can be said to correspond to the Icanche Formation of MAKSAEV, 1978.

Conclusions

- On the basis of the compositions of sandstones (Triangular-Diagrams, after DICKINSON, 1985) it is possible to deduce the following: the Western Sequence is of recycled orogenic provenance i.e. these detritic sediments were deposited during a transitional period between two tectonic regimes (island arc to continental margin?). The Eastern Sequence shows also a recycled orogenic provenance but with the existence of a consolidated magmatic arc. - Volcanic Sequence 1 is associated with inter- mediate intrusives with ages of between 100 and 80 Ma (ROGERS, 1985). It corresponds to the end of a magmatic activity associated with the effects of tectonic movements of the

Subhercynian or Peruvian Phase (sensu MEGARD 1987) of Santonian age.

- From these results, together with the geographic position of the outcrops in each sequence, it can be concluded that the magmatic arc had been displaced from W to E, which would confirm the existence of three successive magmatic arcs from Jurassic to Eocene times:
1) Jurassic (Hettangian to Oxfordian) - in the Coastal Cordillera

2) Albian to Cenomanian - in the current Chilean Pre-Cordillera.

3) Campanian? to Eocene - in the current Chilean Pre-Cordillera

- This displacement and the evolution of the different magmatic arcs shows a cyclicity of events. Every cycle starts with very active volcanism, the intrusion of plutons that produce alteration and mineralization, accompanied by very active tectonic movements, produced along major faults (Atacama Fault, West Fissure, sensu REUTTER & SCHEUBER, 1988). Tectonic and magmatic activity finally becomes relatively calm and thick continental sedimentary series are deposited.

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