CRETACEOUS TO PALEOGENE GEOLOGY OF THE SALAR DE ATACAMA BASIN, NORTHERN CHILE: A REAPPRAISAL OF THE PURILACTIS GROUP STRATIGRAPHY

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INTRODUCTION

The transient subsiding Salar de Atacama basin in Northern Chile is one of the largest negative topographic anomalies occurring along the western slope of the Central Andes. More than 6.000 m of Cretaceous-Oligocene sedimentary sequences, described in the literature under the name of "Purilactis Group" (Charrier and Reutter, 1994; Hartley et al., 1992), form most of the basin fill. Although recognized at the subsurface in the Toconao 1 well (Muñoz et al, 1997) the main outcrops of the Purilactis Group occur at the El Bordo Escarpment, a prominent 120 km long, NS cliff confining the basin to the West, and forming the western edge of the (Late Paleozoic) basement block of the Cordillera de Domeyko (Figure 1a). Numerous publications have described the stratigraphy of the Purilactis Group. However, because of the lack of fossiliferous horizons and/or interbedded volcanics suitable for dating, many doubts concerning nomenclature, internal stratigraphical architecture and age, still remain. An ongoing tectonic and paleomagnetic study (see Arriagada et al, this volume) that includes the classical localities of Barros Arana and El Bordo on the western border of the Atacama basin has permitted to obtain new K-Ar ages in previously undated volcanic horizons. This, and the restudy of outcrops to the east, south and north of the Salar de Atacama (Poquis, Quebrada Pajonales, Agua Colorada, Ayquina, Tuina etc).allows to propose a new stratigraphic system for the Purilactis Group.

A Revised Stratigraphy for the Purilactis Group

Figure 1b is an integrated stratigraphic column for the Purilactis Group assembled according to the observations and new data collected along the El Bordo Escarpment. Part of the evidence and new data supporting the proposed stratigraphic system can be summarized as follows:

1) Lower units of the Purilactis Group include the classical Tonel and Purilactis formations (Dingman, 1963). East of Cerro Quimal, the Tonel Formation unconformably overlies the Paleozoic basement of the

Cordillera de Domeyko. There, 60 m of basement-clast breccias are covered by finely bedded red sandstones, and near the top (Cerros de Tonel) massive evaporite horizons were deposited in a playa-lake environment (Hartley et al, 1992). A faulted (détached) unconformity marks an abrupt upwards transition to the Purilactis formation proper that is a sequence of 2800 m of sandstones, red mudstones and minor conglomerate deposited in proximal fluvial, alluvial fan lobes and lacustrine environments (Hartley et al., 1992). Paleomagnetic studies indicate the prevalence of rocks exhibiting only normal polarity (Arriagada et al, this volume) suggesting that both units could have been deposited during the long Cretaceous Normal Chron (119-84 Ma).

2) Proximal alluvial fan coarse-grained conglomerates with volcanic and granitoid clasts up to 1 m in diameter occur at the core of the Barros Arana Syncline ("upper Purilactis formation," Dingman, 1963, "Cinchado formation", Hartley et al., 1992) which is here refered to as the Barros Arana Strata (Figures 1). These units testify to a drastic change in sediment energy transport that could be associated with uplift of the adjacent Cordillera de Domeyko. At Cerros de Ayquina, aprox. 45 km to the north, these units rest directly on top of the Paleozoic basement. They could be, in part, equivalent to the red beds of the Tolar-Tambillos formations, which have been interpreted as syn-post orogenic deposits associated with a regionally significant Late Cretaceous compressional event that occurred between 109-83 Ma (Ladino et al., this volume).

3) South of Cerro Quimal, (Cerro Totola, Cerro Negro, Cerro Pintado, Figure 1) a 800 m thick sequence of basaltic andesitic lava flows interbedded with welded rhyolitic ignimbrites, and coarse volcaniclastic sediment (Cerro Totola Strata) rests unconformably over older Cretaceous units. Nine new K/Ar ages (whole rock, amphibole and biotite) between 70-65 Ma indicate a Maestrichtian age. Further south, in Cerro Pintado, the same lavas are interbedded with red sandstones, conglomerates and impure, marine, bioclastic limestones. The latter could represent the westernmost exposures of marine sediments that record the regionally widespread Maestrichtian transgression of the Salta Group (Lecho and Yacoraite formations Salfity et al, 1985).

4) A Paleocene-Eocene clastic sequence ("Orange Unit") unconformably overlies the Cerro Totola lavas in the southern El Bordo Escarpment area. This fining upward sequence begins with aprox. 400 m of conglomerates that is succeeded by 500 m of semiconsolidated sandstones alternating with thin evaporite (gypsum) beds. Near Pan de Azúcar, 50 km south of the Salar de Atacama, this unit includes andesitic lava horizons that have been dated (K-Ar) at around 57-58 Ma (Gardeweg et al 1994). This sequence can be correlated with the Chojfias formation of the Zapaleri-Poquis region and the Santa Bárbara Subgroup on the Argentine Puna (Salfity et al., 1985).

5) A more than 1000 meter thick section of Eocene (Oligocene?) conglomerates, (Loma Amarilla strata) that rests on top of the "Orange Unit" east of Cerros Negros (Figure 1) represents one of the more regionally important map-scale units of the Purilactis Group. Internal progressive unconformities occur in

the basal part of the sequence where very coarse conglomerates alternate with tuffaceous horizons dated (K-Ar, 39Ar/40Ar) between 42-39 Ma (Ramírez and Gardeweg 1982, Hammerschmidt et al 1992). Mpodozis et al (1993) suggested that these deposits could be syntectonic to the Eocene "incaic" deformation. This event was associated with left lateral transpression, clockwise block rotations and generalized uplift of the Cordillera de Domeyko basement block (Mpodozis et al, 1993, Arriagada et al, this volume). Although still poorly studied, small outcrops of volcaniclastic conglomerates near Cerro Negro could represent sediments associated with the reactivation of Incaic faults. These outcrops could represent the youngest unit of the Purilactis Group (Cerro Puntiagudo Strata, Figure1)

Discussion and Conclusions

The Purilactis Group is a stratigraphic succession of seven regionally distinguishable, map-scale, sedimentary and volcanic sequences generally bounded by angular and/or erosional unconformities. Available radiometric ages suggest a Lower Cretaceous to Oligocene (?) age for the Purilactis Group as a whole. Despite formal nomenclature differences, the stratigraphic section along the El Bordo Escarpment is consistent with the stratigraphy of the deep Toconao 1 well in the central Atacama basin (Muñoz et al, 1997). However, only the uppermost units of the Purilactis Group are present in the well, where Cerro Totola strata equivalents rest directly over Paleozoic basement. This sequence shows that partially overlapping depocenters were formed during the complex evolution of the Atacama-Purilactis basin. This revision of the Purilactis Group stratigraphy provides a new framework to constrain paleogeographic interpretations and/or regional correlations for the Cretaceous-Paleogene of the Central Andes.

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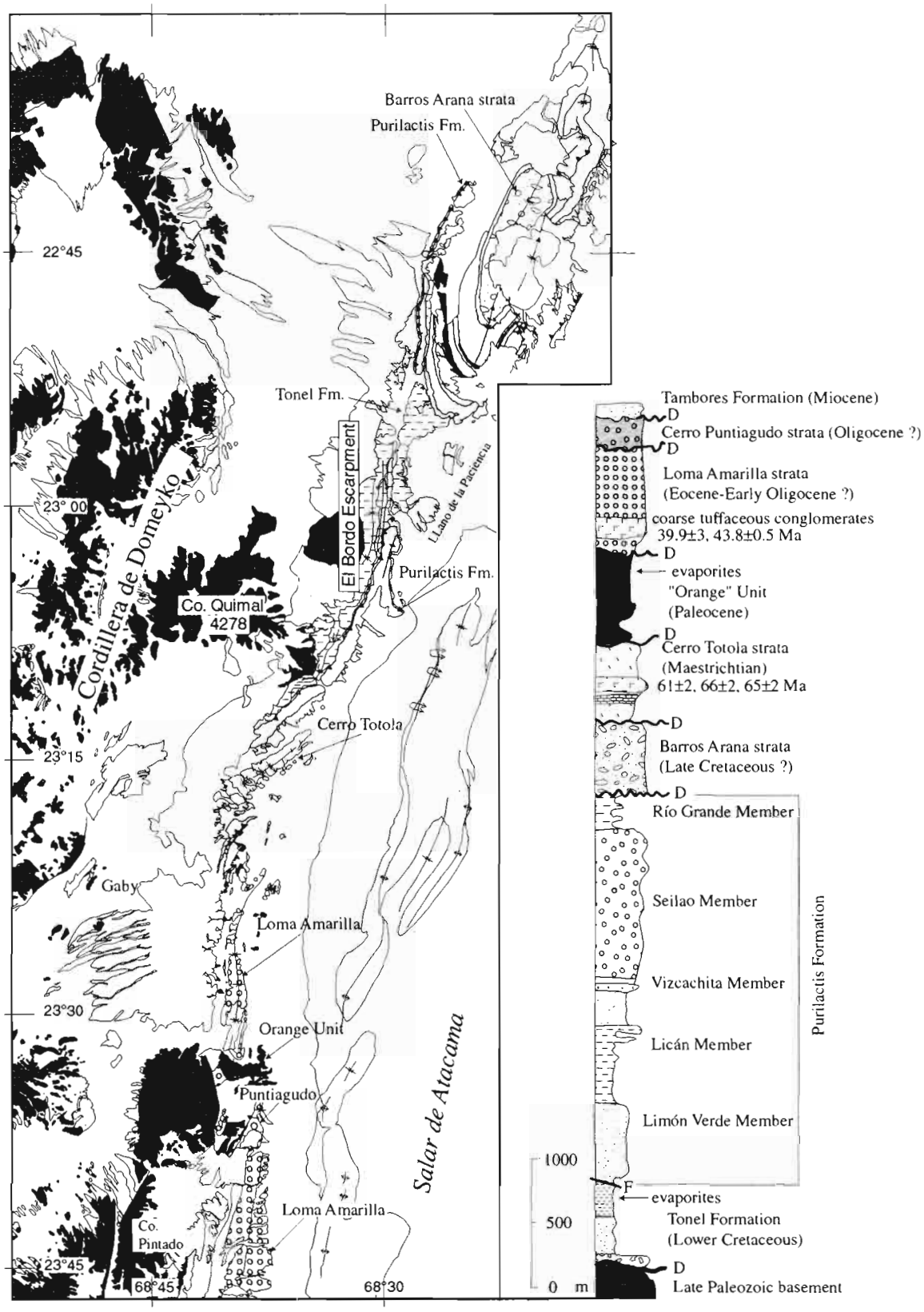

Figure 1: Simplified geological map and stratigraphic section of the El Bordo Escarpment area.