UPPER CRETACEOUS-LOWER EOCENE POTASSIC VOLCANISM IN AN EXTENSIONAL REGIME IN THE PRECORDILLERA OF COPIAPO, CHILE

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RESUMEN: Durante el Cretácico superior al Eoceno inferior (80-55 Ma) se desarrolló, en el norte de Chile (23-28° S), un extenso volcanismo calcoalcalino, potásico, que representa una asociación magmática formada en un régimen tectónico extensional, con posterioridad a la deformación compresiva del Cretácico superior, documentada en la Precordillera de Copiapó.

KEY WORDS: Northern Chile, Lower Tertiary, Synextensional magmatism.

INTRODUCTION

In Northern Chile, occupying large parts of the Central Depression and the andean Precordillera of the Copiapó-Antofagasta Region (23-28° Lat. S) there are extensive exposures of Upper Cretaceous-Lower Eocene volcanic rocks, which were generally interpreted as the relicts of a "Paleogene magmatic arc" (Naranjo y Puig, 1982; Boric et al.,1990). This volcanic association was deposited discordantly over Jurassic - Lower Cretaceous sedimentary and volcanic sequences of extensional intra- and back-arc settings affected by an event of compressive deformation in the Upper Cretaceous (Mpodozis and Ramos, 1990, Mpodozis and Allmendinger, 1992). Recent studies carried out in the Precordillera of Copiapó indicate that this late Cretaceous-Early Eocene event (K-Ar ages between 80 to 52 Ma) is associated with the formation of large collapse calderas in an extensional tectonic setting (Rivera and Mpodozis, 1991).

In this work we discuss the volcanic stratigraphy, geochronology and geochemistry, and the tectonic significance of a part of the volcanic-plutonic complex that is exposed in the region of El Salvador - La Coipa, northeast of Copiapó (Fig. 1).

VOLCANIC STRATIGRAPHY

In the region of El Salvador-La Coipa, the volcanic and intrusive products of this period are represented by two major volcanic cycles that consist of lava flows and explosive pyroclastics deposits of trachybasalt-rhyolite suites, that in some zones, are related to collapse calderas and rhyolitic dome fields, synchronous with more basic volcanic activity. The first cycle corresponds to the Cerro Los Carneros Sequence (80-66 Ma), which is initiated with a section of rhyolitic tuffs (ages K-Ar, 80-70 Ma) intruded by olivine-pyroxene gabbros; continuing, between 70 and 66 Ma, with the effusion of potassic trachybasalts and flow banded, sanidine-biotite trachyandesites, culminating with the eruption of hornblende bearing dacitic pyroclastics (66-63 Ma), intruded by olivine-pyroxene gabbros, monzodiorites and dacite porphyries (64-60 Ma). The second cycle (Cerro Valiente Volcanic Sequence, 63-55 Ma) ranges from Paleocene to Lower Eocene (63-52 Ma) and includes extensive lava flows of trachybasalt to clinopyroxene (±olivine, biotite) and trachyandesites. During this period, explosive rhyolitic volcanism related to large collapse calderas and extrusive rhyolitic flow-banded domes is associated with extremely welded (reomorphic) ignimbrites and high silica rhyolitic lavas with sanidine and biotite. The distal facies pyroclastics of these domes and calderas interfinger with the trachyandesite and basaltic lavas. The event ends with the intrusion of monzonitic porphyries (55 Ma) and the emission of dacitic lavas, tuffs and hornblende andesites. Collapse and downsag caldera includes the Los Amarillos, El Salvador (60-55 Ma), Sierra San Emilio (62-57 Ma), San Pedro de Cachiyuyo and Sierra Banderita (Fig. 1). The complex of rhyolitic domes includes the Indio Muerto Dome (host rock for the Upper Eocene copper porphyry system of El Salvador) and the flow-banded Potrerillos Dome (60 Ma), formed by glassy rhyolites with sanidine, plagioclase, and scarce biotite.

GEOCHEMISTRY

Both groups include rocks of the high potassium calcalkaline series, although, in the Harker diagrams, potassium and sodium show a large scatter, in spite of the fact that precaution was taken to analyze fresh volcanic and intrusive rocks. Nevertheless, the mineral assemblage of biotite and sanidine, found ubiquitously in the trachyandesites and rhyolites, indicates that effectively the rocks are potassium-rich. The two cycles show similar time-composition trends. The Upper Cretaceous-Paleocene event began with a bimodal association of gabbros and monzogabbros (45-53% SiO_2); trachybasalts and trachyandesites (49-59% SiO_2) associated with high silica rhyolitic tuffs (75-77% SiO_2), followed in later stages, by a large volume of pyroxene-biotite trachyandesites and hornblende dacite tuffs (62-66% SiO_2) filling the initial compositional gap. In the Paleocene-Lower Eocene event a similar trend was found, with large initial volumes of trachybasalts and andesites (50-58 % SiO_2) interstratified with high silica rhyolitic ignimbrites, lavas and domes (70-78 %SiO_2) and late-stage lavas and intrusives of dacitic composition (60-66% SiO_2). Both suites show relatively high contents of Al_2O_3, but the late stage dacites, are enriched in FeO^* and TiO_2 and impoverished in MgO and alkalis (tholeithic behavior). The early bimodalism could be explained if the basic rocks have a mantle or lower crustal source, while the rhyolites could have a more significative crustal component. The late dacites could be the result of mixing of crustal and mantle magmatic components and low pressure differentiation-fractionation in high level magma chambers.

DISCUSSION

The Upper Cretaceous - Lower Eocene magmatism already described, represents a large volcanic field (80 km wide) stretching more than 500 km from Copiapó (28°S, Rivera y Mpodozis, 1991) to the Central Depression of the Antofagasta region (23° S, Boric et al., 1990) There, large collapse calderas developed synchronously with volcanic centers erupting extremely fluid trachyitic lavas. The Late Cretaceous - Early Tertiary magmatic successions of northern Chile probably represents a synextensional magmatic suite, similar, in some regards, to the Eocene Basin and Range volcanic province of the western U.S. (Gans et al., 1989), although, in the chilean case, large scale extensional structures controlling the location of the centers have not yet been recognized. Like in the Basin and Range, this episode occurred after a major, Late Cretaceous, crustal thickening contractional deformation episode (Jones et al., 1992) although, in northern Chile, the subsequent extension, doesn't seem to have evolved to the extreme that has been documented for the Basin and Range province.

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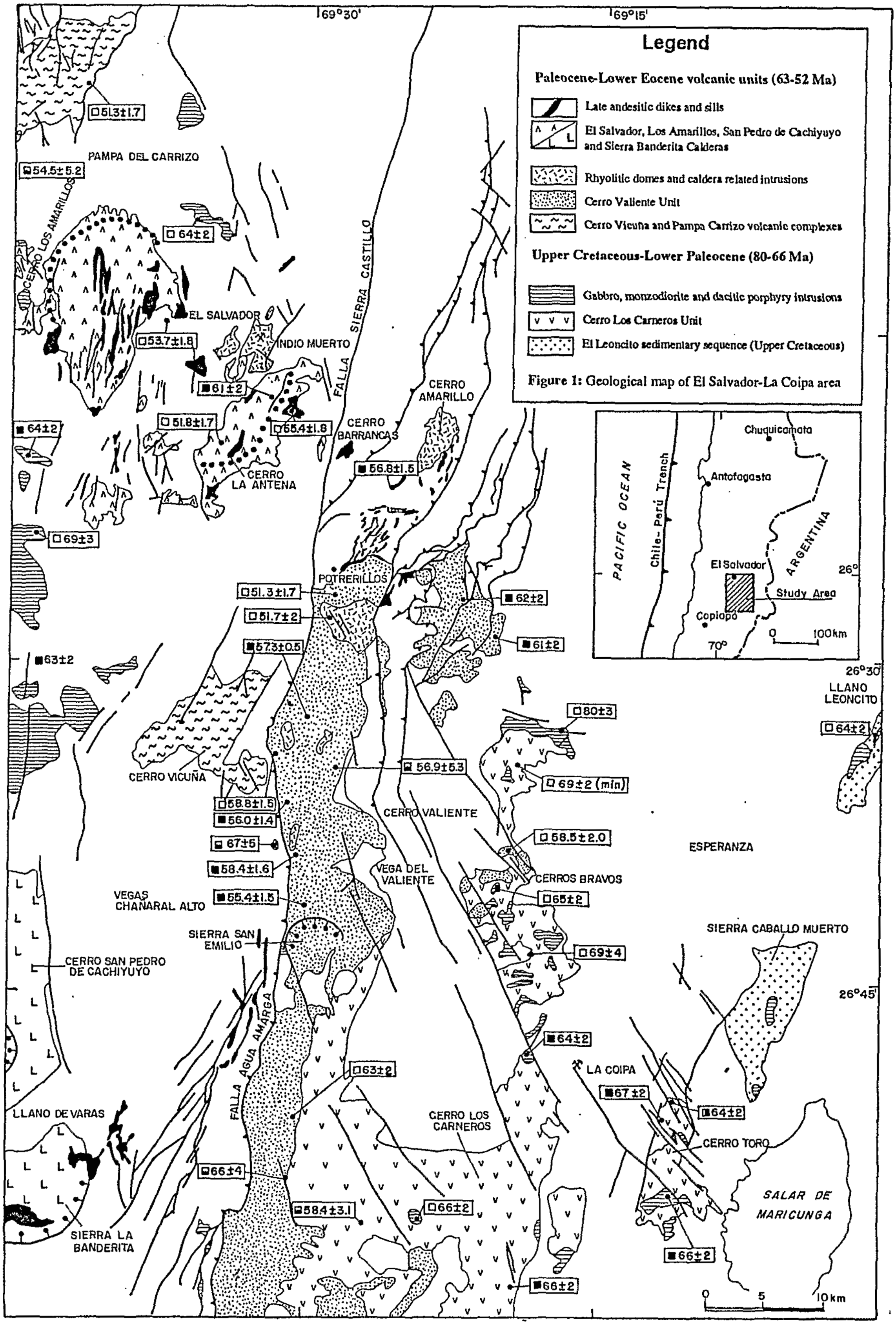

Figure 1: Geological map of El Salvador-La Coipa area

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