THE PLIO-HOLOCENE MAGMATIC ARC BETWEEN 36° - 39° S: CONTROLS OF THE BENIOFF GEOMETRY

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INTRODUCTION

Within the global tectonic frame, the occidental edge of South America is an active continental margin product of the convergence betwen the Nazca and Antartica plates and the south American continental plate (Le Pichon, 1968; Isacks and Oliver, 1968; Janes, 1971; Stauder, 1973; Menjard and Philip, 1976) originating an igneous activity (Volcano-tectonic) that remains at present time. The convergence plane (Benioff Zone) presents angle variations along the active margin (Barazangi and Isacks, 1976; Isacks and Barazangi, 1977; Bevis and Isacks, 1984; Jordan et al., 1983, etc.).

During the past decade, numerous studies have increased the knowledge about the Benioff Zone behaviour and geometry. In function of distribution and features of magmatic sequences which have been developed during the Plio Holocene, this work, with the support of studies and geophysical information localized at the south Andin region, interprets and postulates a geometrical model of the descending plane in the zone included between 36° and 39° S latitude.

Gathering the geological, geophysical and volcanic evidences, complementind with petrogenetic concepts (particularly those related to the Shoshonitic magma generation hypothesis) and together with the analysis of registered seisms between 36° and 39° South Latitude during 1906-1980, a theoretical model of oceanic plate descending evolution from Pliocene up to Holocene is proposed.

The first data group allows us to distinguish three subductin areas in the plate, separated by fractures which are approximately located between parallel 33° and 37° SL; 37° and 38° 30' S; 38° 30' and 45° / 46° S, triple point (Figure 1).

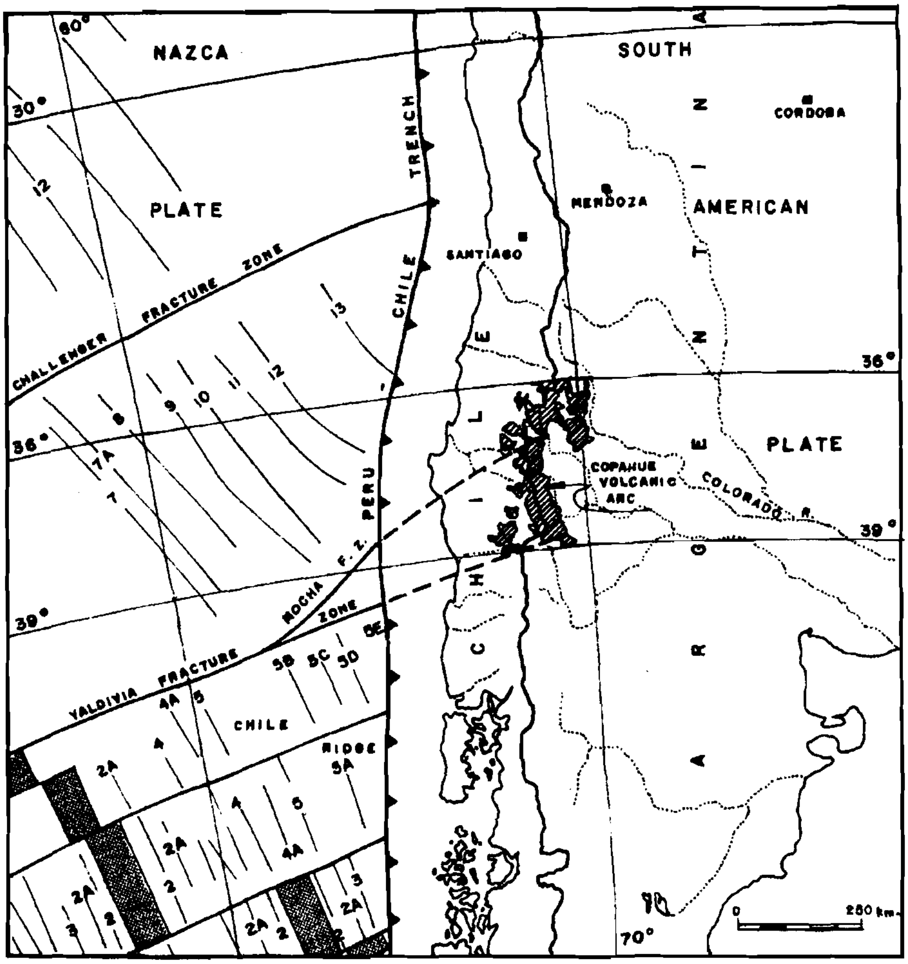

Figure 1: Map showing the fracture zone of the Oceanic Plate and extensions of the Mocha and Valdivia Factura Zones onto the continental margin, reinterpretation of its outlines after Herron (1981). The map also shows the location of Chile Ridge and Perú-Chile Trench and volcanic activity during the Pliocene-Holocene, between 36° and 39° lat. S.

Based on the information exposed in the study, the following conclusions can be extracted from:

a) At 37° and 38° 30' SL the subducted plate is segmented because of the interaction with the South American plate. The fracture area at North is represented by Mocha Fracture (37° SL) and it is defined at the South by Valdivia Fracture 38° 30'. These fracture zones delimit an area that outlines the limits between a crust which, at Trench sector, has different ages and structures (Herron, 1981) and in the continental area reflects in surface unequal volcanic characteristics, related to evolution, distribution and composition aspects.

b) The fracture zones pointed out above, allow us to interpret the existence of a "splinter or microplate". This splinter corresponds to the separationof a minimum portion of Nazca plate, at SE, in the contact area with Chile Ridge. This small fraction with a N 80° E pushing direction (Stauder, 1973) different than the one at the North of 37° SL (N 85° E, Stauder, op. cit.) has a penetration front with a N 10° W general direction. This disposition is probably due to the unequal penetration speed since the edges have different contact surfaces (the contact area is greater at North whilst at the South it is reduced by interaction with Chile Ridge). At the same time, its reduced size decreases the pushing force, being this a probable cause for major inflexion of penetration angle.

c) The efusive centers, which are the origin of the Plio-Holocene calcoalkaline and shoshonitic magmatic sequences, have an unequal distribution.

At North of 37° the calcoalkaline front extends up to 69° 45' and to the South up to 70° 30' and the distribution surface of the shoshonitic (?) magmatic sequences hase an extension of 60 km. to the North of 37° SL in EW direction, and this area is restricted to a narrow fringe of 10 km. to the South. At the same time, there is a concordance betwen the volcanic distribution areas in surface, the data information about the seismic profiles and the magma generation zones, which is approximately 80 to 100 km. depth for calcoalkaline magmas (Hanus and Veneck, 1978) and 150 km. for shoshonitic magmas (Deruell, 1982).

CONCLUSIONS

This set of data allows the postulation of a theoretical model of the subduction plane geometry since the Pliocene to the Holocene (Figure 2). The most remarkable characteristics of the theoretical model are:

I) At North of 37° SL, the subduction (?) plane gets deeper through a 28° to 30° plane (Swift and Carr, 1974) and penetrates slowly to 150 to 160 km. depth. Its influence in surface should have been extended up to 69° 45' WL minimum.

II) Between 37° and 38° 30' in the area close to the Trench, the "splinter or microplate" gets deeper with a small angle of 20° approximately (Plafker, 1972). From 72° 30' / 72° 15' the oceanic microplate penetration angle increases. This change of angle and higher depth is corroborated with the location of active calcoalkaline volcanism at 71°, 71° 30' WL. Furthermore the Andean Andesitic primary magmas generation areas can be found at these latitudes in coincidence with seismic profile data. It is interpretated that this penetration angle remains up to a depth of 130 to 150 km. approximately (Shoshonitic magmas generation area) since the extension of efusive centers of this sequence at surface is limited by a narrow fringe of 10 km. approximately.

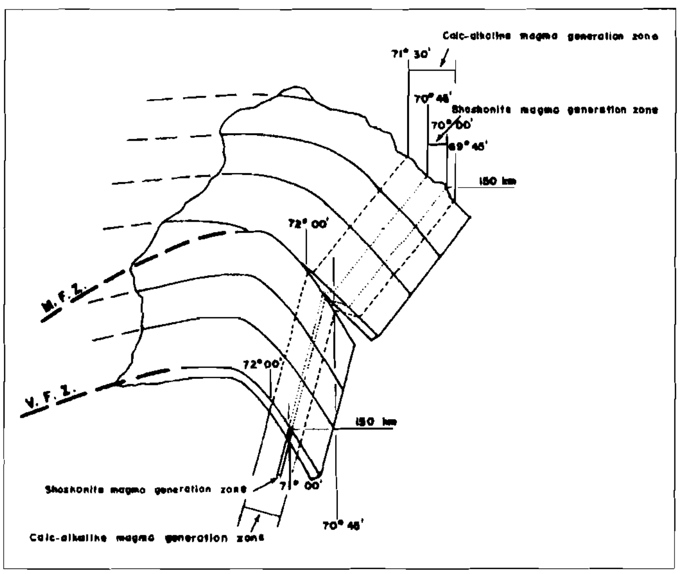

Figure 2: Interpretation of the oceanic plate geometry in the continental area between 36° - 39° last. S. During Pliolocene - Holocene, in function to volcanic evidence.

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