THE ANDEAN ELEVATION AT 39º SOUTH LATITUDE FROM GRAVITY DATA

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RESUMEN: Se presenta aquí una sección gravimétrica transcontinental E-W en 39º de latitud Sur analizándose, además de los clásicos modelos corticales, posibles mecanismos de compensación isostática y evaluando el acortamiento compresivo que habría contribuído decisivamente al levantamiento Andino.

KEY WORDS: gravity - geodinamics - isostasy - shortenings

INTRODUCTION

The analyzed section is refered to a previous study at these latitudes (Diez Rodriguez and Introcaso, 1986), incorporating gravity anomalies both in the Pacific and Atlantic ocean sectors and altimetric satellital data(Fig.1)

It was prepared with data from the Instituto Geográfico Militar Argentino and the Universidad de Chile, in the continental sector, while at sea, batimetric data from the satellital file of the Instituto Antártico Argentino and Free Air anomalies from Bowin et al (1981) were used. With these data Bouguer anomalies were also calculated by replacing the sea water ($\sigma a = 1.03$ g/cm^3) by materials of density $\sigma = 2.9$ g/cm^3, (the assumed continental crustal density according to Pacino and Introcaso, 1988; Introcaso and Pacino, 1989; ...).

The profile, which exceeds 2000 Km. length, shows minimum Bouguer anomalies of about -90 mGal in coincidence with the largest Andean altitudes, while maximum values of +230 mGal are located offshore, in the Pacific Ocean (Fig.1).

GEOLOGICAL SETTING

This section crosses, in its continental itinerary, important geological provinces in Chile and Argentina: Cordillera de la Costa, Valle Central Chileno, Cordillera de los Andes, Cuenca Neuquina, northwestern section of the

cuenca de Colorado, Cuenca Interserrana Bonaerense and Southern border of Tandilia.

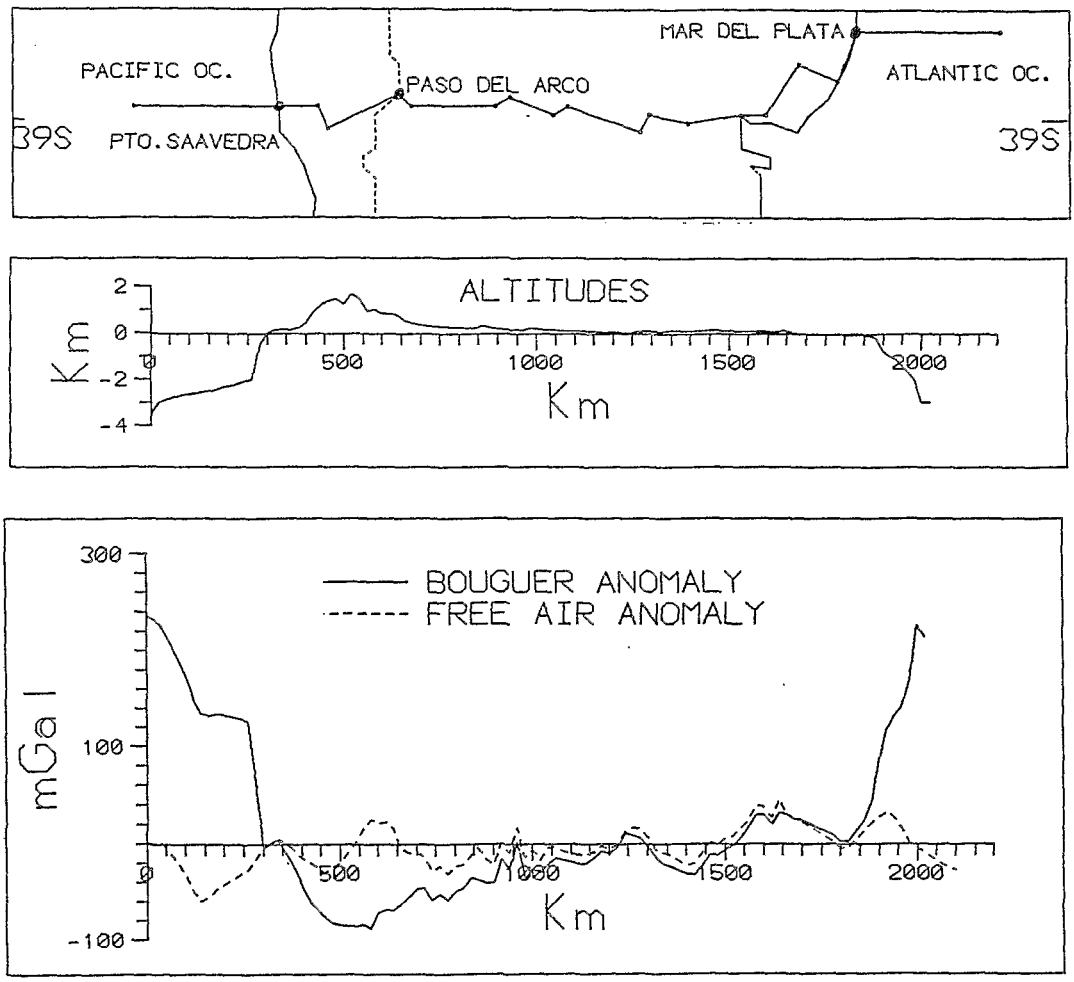

Fig.1: Location of the section. Altitudes, Free Air and Bouguer anomalies profile.

ISOSTATIC BEHAVIOUR

The isostatic balance for the section was analyzed in two ways: (a) by means of a thickened crust in the Airy concept and (b), by means of both, a thickened crust and a thermal root in the upper mantle, according to Pratt's hypothesis.

The results indicate that the studied section essentialy responds to an Airy's isostatic model, with little possitive and negative anomalies which, in a great part, could be justified locally taking into account inhomogeneities in the upper crust in the different crossed geological provinces. The model with a lithospheric thermal root gives no more than 20 mGal in its maximum and it has a short longitudinal extention, but it must be taken into account attending to the important manifestations of active volcanism southwards 33º South latitude and the heat flow expressions detected (Muñoz et al, 1990).

GRAVITY MODELS

It has been analyzed the possible gravimetric influence from the subducted plate, a wedge of asthenospheric materials between the Nazca and Southamerican plates, two "roots" in the intermediate and lower crust in the continental sector and "antiroots" in the lower crust in both oceans. In this way, a simple one layer crustal model shows maximum depth for the continental crust of about 43Km. This value could vary in no more than 10% incorporating the other gravity effects refered. For that, and as a simplification, a one layer crustal model is shown in Fig. 2 together with its gravity response and the observed gravity data. Once again, and according to the results obtained in previous studies for different Andean sections (Introcaso and Pacino, 1988; Pacino and Introcaso, 1989), it was proved that the observed Bouguer anomaly is mainly controlled by the M discontinuity and the subcrustal gravimetric effects are either rather smaller than was supposed or they cancel each other out.

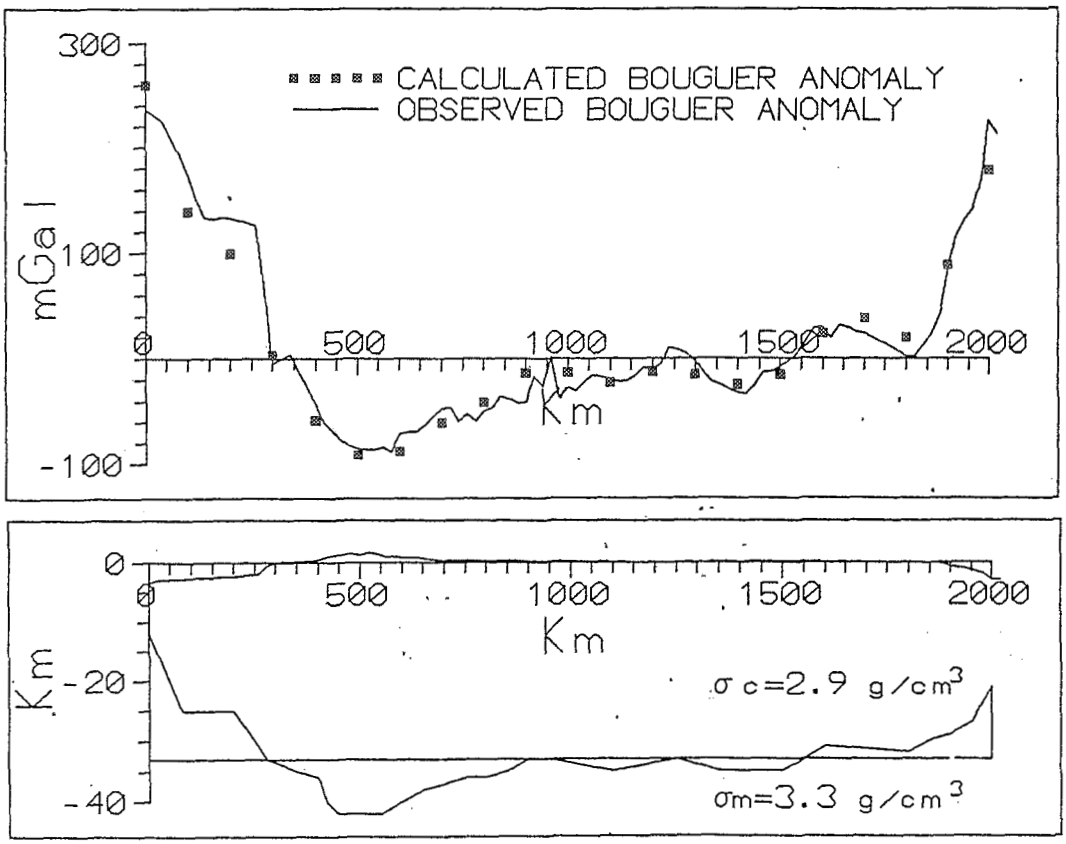

Fig.2: One layer crustal model and its gravity response.

SHORTENINGS

Values of compressive shortening were also calculated from the topographic areas above the sea level, and the areas of crustal roots beneath the assumed "normal" crustal thickness

obtained from the different models.

Following Isacks (1988) and assumming isostatic equilibrium, the shortening value found is 66 Km. By the other side, considering the "roots" from the inversion of gravity data and according to Introcaso et al (1992), the shortening value reaches 72 Km.

CONCLUSIONS

From gravity data, the maximum thickness for the continental crust at 39º South latitude was located beneath the Andean axes, at 43 Km. depth, while the minimum thickness for the ocean crust at that latitude, with 12 Km. depth, would be located 300 Km. offshore, in the Pacific Ocean.

A preliminar isostatic analysis would indicate that the section essentially responds to an Airy's isostatic model showing, as a whole, a reasonable isostatic equilibrium.

The calculated shortening values for all the crustal models are in the order of 70 Km.

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