

SURFACE AND SUB-SURFACE THRUST STRUCTURES

Subandean zone

The northern branch of the Subandean Zone is characterised by important thrust sheets (10-20 km) and broad synclines filled by Neogene sediments - piggy back basins with 6,000 m of syn-tectonic sediments [Baby et al., 1995]. Surface mapping, reflection seismic data, and drilling information provided by the Bolivian State Oil Company (YPFB) show that the main detachments are located in the Ordovician shales, in the Silurian shales, in the Devonian shales and in the Permian shales. The foredeep has a bottom that slopes at 4°. In our cross-section (cf. Fig.), the amount of shortening taken from tectonic balancing is 74 km, i.e. 50%.

In the southern branch, an important east verging thrust (Mandiyuti Thrust) divides the southern Bolivian Subandean Zone into two fold and thrust belts that differ according to their thrust system geometry. The western belt is characterised mainly by fault propagation folds and fault bend folds, whereas the eastern belt is characterised by fault propagation folds and passive roof duplexes [Baby et al., 1992a]. The main detachments are located in the Silurian dark shales, in the early Devonian shales, and in the base and top of the Middle to Late Devonian dark shales. The Silurian-Devonian succession is covered by more than 2000 m of late Paleozoic and Mesozoic sandstones with no potential detachments; in some places it is also covered by several thousand meters of syn-orogenic Neogene sedimentary rocks. The foredeep has a bottom that slopes at 2°. Total shortening decreases from 20° S (140 km, i. e. 50%) toward the south (70 km, i. e. 35%, at 22° S).

Interandean zone and Cordillera Oriental

They are deformed by involved basement east-vergent thrusts and associated back-thrusts. Near the surface, shortening is concentrated in the west-vergent thrust system at the western part of the Cordillera Oriental and - in the southern branch - in the Interandean zone (cf. Fig.). The Cordillera Oriental is characterised by presence of small Neogene piggyback basins which have recorded the deformation history [Hérail et al., 1996]. Surface data allowed to construct some balanced cross-sections. An amount of shortening between 80 and 100 km is estimated.

Altiplano

The combined study of field and seismic reflection data shows that the Altiplano is structured by Oligocene extensional basin partially inverted during the Neogene, and by the west-vergent thrust system of the Cordillera Oriental [Rochat et al., 1996].

The northern Altiplano (cf. Fig.) is characterised by a very thick series of Cenozoic continental sediments (more than 10 000 m) which come from the Oligocene extensional tectonics and from the Neogene uplift of the Cordillera Oriental. The southern Altiplano shows the maximum amount of shortening. It is deformed by an important east-vergent thrust system [Baby et al., 1992b]. Construction of balanced cross sections has been made possible due to surface mapping, reflection seismic data, and drilling information provided by the Bolivian State Oil Company (YPFB).

DEEP DATA AND CRUSTAL BALANCING

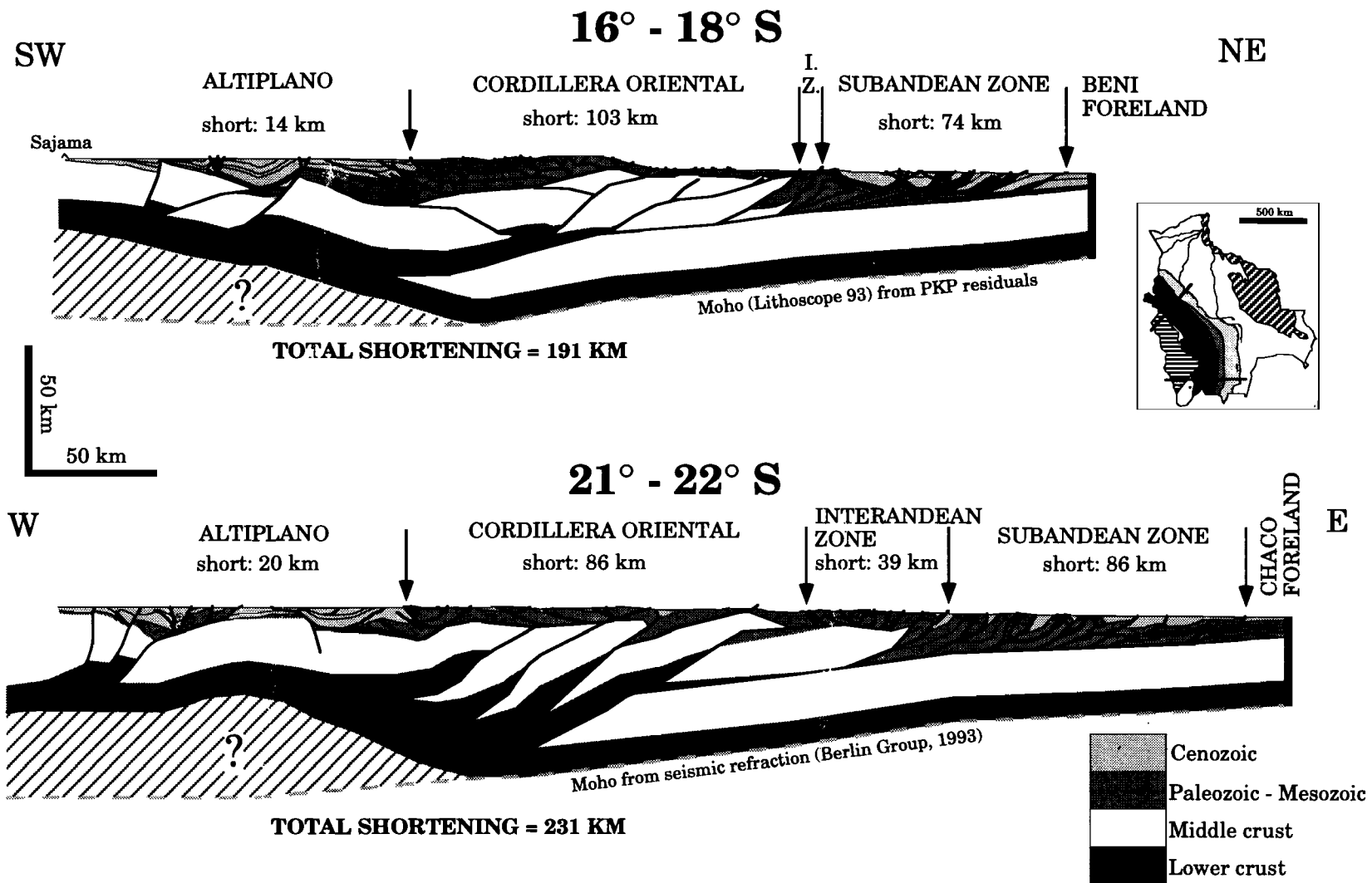
From surface and geophysical data obtained in the last decade, we have constructed two crustal balanced cross-sections (Fig.).

In the northern branch of the orocline, some results of the French Lithoscope experiment - a teleseismic field experiment [Dorbath et al., 1993] - have been used to construct the deep structures. The Moho shape was established from PKP residuals. In the southern branch, the results of the Berlin Group - seismic refraction data [Wigger et al., 1994] - give a Moho shape and show that high velocity zones under the Cordillera Oriental can be interpreted as high positions of lower crustal material.

In the two crustal balanced cross-sections, the total amount of shortening in the Paleozoic, Mesozoic and Cenozoic cover, calculated from our regional studies, is accommodated by the development of a duplex of middle and lower crust. This duplex can explain the crustal thickening under the Cordillera Oriental, but not under the Altiplano. These results are in accordance with the balanced model of Schmitz (1994) in the southern Central Andes.

CONCLUSIONS

From north to south, our balanced cross-sections show that, in the back arc system of the Bolivian orocline, the total amount of shortening varies from 191 km to 231 km. These values are in



Crustal balanced cross-sections
in the northern and southern branches of the Bolivian Orocline

