THE EASTERN CORDILLERA OF SOUTHERN BOLIVIA: A KEY REGION TO THE ANDEAN BACKARC UPLIFT AND DEFORMATION HISTORY

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INTRODUCTION

The back-arc region of Southern Bolivia comprises three major units (fig. 1): The Altiplano, forming a high plateau at about 4000m, is an intramontaneous basin with Cenozoic infill. The Eastern Cordillera (EC), reaching more than 5000m altitude, is built up mainly of a very thick pile of Ordovician anchimetamorphic sediments. In places, it is covered by Cretaceous and Paleogene or Neogene sediments, respectively, among which continental ones prevail. To the W the EC is overthrust upon the Altiplano. The Subandean ranges with Late Paleozoic to Neogene rocks, form part of an E-verging fold-and-thrust belt, together with the eastern part of the EC (Interandean). As the Altiplano and the Subandean units have been subject of oil prospection, geological exploration was much more intensive, there, than in the EC. Looking, however, for a geodynamic model of the back-arc evolution in Meso- and Cenozoic times, the EC plays a key role. In this view we present new results from extensive field work in the western part of the southern EC (Tupiza Region) combined with K/Ar and apatite fission track dating. The onset of major deformation phases, deformation style and progress can be well outlined herein through Cenozoic times.

GEOLOGICAL FRAMEWORK

The EC is bound to the adjacent physiographic provinces by a pair of divergent thrust systems. To the west the Paleogene-Neogene sediment infill of the Altiplano basin is overthrust at the San Vicente thrust system by turbiditic rocks of Llanvirn-Caradoc age (Erdtmann et al., 1995) whereas at the eastern border of the EC, accomodated thin-skinned folding and thrusting in Cambrian to Triassic strata of the Interandean zone refer to a basement involved thrust (Kley, in press).

The oldest Mesozoic rocks of the Southern EC are swarms of mafic dikes and sills intruding Ordovician strata. These rocks are exposed in the area of Cornaca, 50 km N of Tupiza. A sample of a dike N of Cornaca yielded an Early Jurassic age of 184.0±4.9 Ma (K/Ar, whole rock). The emplacement of these magmatic rocks is due to extensional processes that culminated east of South America in the opening of the South Atlantic.

Predominantly continental Cretaceous sediments of the Puca Group are completely recorded for the timespan ?Kimmeridgian to Paleocene in a back-arc rift setting. In the southern part of the high fragmentated Potosi basin discontinuous Cretaceous successions from the N-trending synclines of Tupiza and Camargo reflect active rifting processes accompanied by normal faults and alkaline basaltic volcanism. In the syncline of Tupiza Coniacian basanitic lava-flows of the Aroifilla Fm. (Sempere, 1994) are the youngest Cretaceous strata. However, Tertiary conglomeratic rocks of the Tupiza region include Pucalithus limestone fragments of the El Molino Fm. (Maestrichtian) which does not crop out in the area, at present.

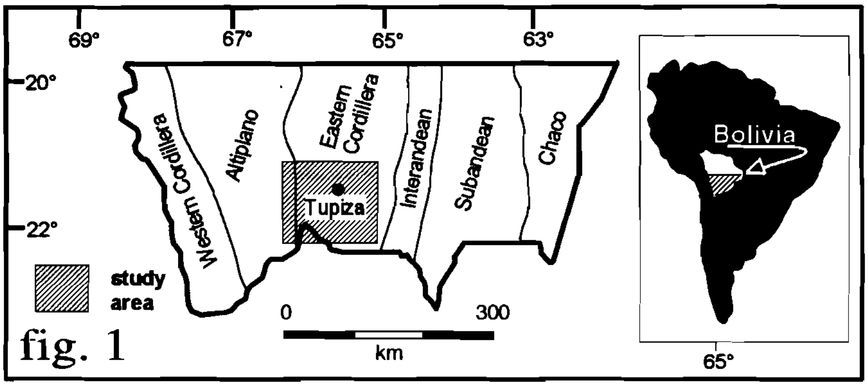

fig. 1

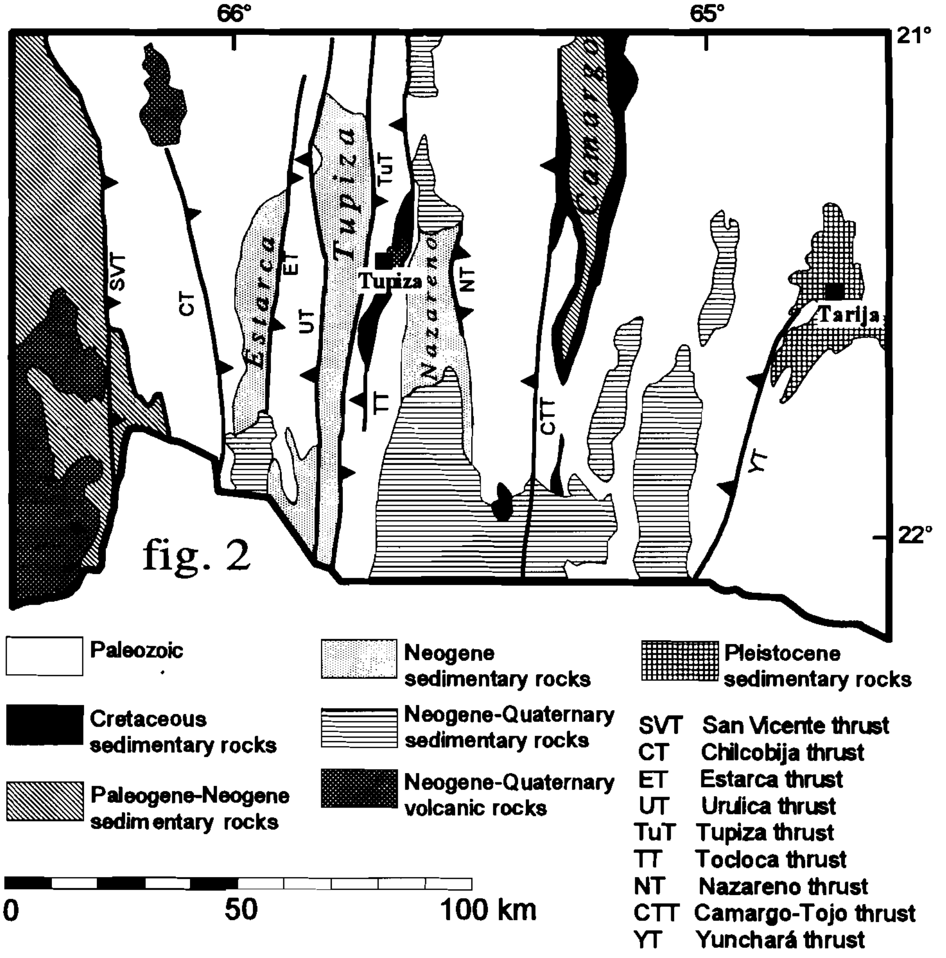

fig. 2

Fig. 1: Major physiographic and structural provinces of the Southern Bolivian Andes.
Fig. 2: Generalized geological map of the Tupiza-Tarija region, Southern Bolivia.

12.79±0.12 Ma (Ar/Ar) by Gubbels et al. (1993). This upper section consists of fluvial and pediment deposits which are connected with the origin of the San Juan del Oro peneplain. The southern prolongation of this surface at the Argentinian boarder covers also the Tupiza and the Estarca basins. Lava-flows from the Tupiza Fm. m2 locally enter the basin at its western edge (Rancho Chuchuli) in a basal position. Biotites from a trachyandesitic sample from this locality yielded a biotite K/Ar age of 21.3±0.4 Ma. Here ongoing conglomeratic sedimentation is recorded by progressive angular unconformities which demonstrate synsedimentary folding. The eastern limit of the basin is marked by the westvergent Nazareno thrust.

APATITE FISSION TRACK DATA

Two Oligocene ages have been obtained from apatites of magmatic rock samples of pre-Cenozoic origin. Coniacian basanitic lava-flows from the top of the Aroifilla Fm. exposed near Tupiza yielded an age of 32.1±4.9 Ma. Apatites from an Early Jurassic dike intruded into the Ordovician rocks in the area of Cornaca have been dated with 29.7±2.7 Ma. These data testifie to an early Tertiary uplift of the EC.

CONCLUSIONS

The fission track data point to an Early Oligocene uplift of the EC, which may have caused erosion of the Cretaceous-Paleocene cover. This event was followed by the deposition of the probably Late Oligocene Catati and Tupiza m1 Fms..

Neogene basin development started with a major tectonic pulse at 24-22 Ma which effected an angular unconformity at their bottom. The basins are mainly controled by W-verging overthrusts, which probably pass into a deep-seated detachment plane near the brittle/ductile transition zone. Within the single basins compressive deformation is heterogenous. In the Nazareno basin, continuous deformation is recorded from 22 to 12 Ma, whereas in the Tupiza and Estarca basins thrust activity happened later than 17 Ma.

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