Crustal Shortening Rates in Correlation to Structural Geology in the Sub-Andean Zone of Bolivia

I. Abstract

The fold and thrust belt of the Bolivian Sub-Andes has been a topic of much discussion and debate for the past twenty years. Various ideas regarding the Sub-Andean zone (SAZ) structural geometry have been published, documenting conflicting ideas on the evolution of this complex region. Variations in balanced cross-sections result in a wide range of shortening estimates, thus highlighting the need for accuracy and precision when constructing balanced cross-sections.

II. Introduction

The structural geology of the SAZ of Bolivia is thought to vary from north to south, and the debate as to why is a geologic hot topic. Various geologists have proposed a wide range of crustal scale models, including lithospheric delamination, lower crust flow, crustal scale anticlines, and lithospheric extension, to explain the geology of the Central Andes. This paper focuses on the structural and palaeogeographical aspects by presenting different balanced cross-sections of the SAZ created by different groups and shows cross-sections from different authors, grouping them by latitude. Comparing cross-sections from the same location illustrates that predetermined ideology can impact our interpretation of structural responses to the Paleozoic Basin which is more expansive in the north than the south. This group of authors has compiled the cross-sections with the goal of comparing structural interpretations of the SAZ and hence better understanding the role of structural processes in the central Andes at a regional scale.

III. Geologic Background

The Bolivian Andes are located between 14 and 23 degrees South, and are generally divided into five sections: the Western Cordillera (WC), the Altiplano (AP), the Eastern Cordillera (EC), the Intermountain Zone (IZ), and the Subandean Zone (SAZ) (Figs. 1). These regions are grouped by topographic elevation (Fig 2) and, recently, basement structure (Figs. 3 and 4) (McQuarrie 2005, 2006, 2008, Kley, 1997). The SAZ of Bolivia is a thin-skinned fold and thrust belt, meaning that all deformation takes place above a main detachment surface. The Salta anticline is a large, east-west trending, fold and thrust belt known as the Subandean Zone. It is the largest and most active of the subduction zone, responsible for a substantial amount of the deformations that are observed in the SAZ. This change in topographic elevation is responsible for a substantial amount of the deformations that are observed in the SAZ. It is the largest and most active of the subduction zone, responsible for a substantial amount of the deformations that are observed in the SAZ.

IV. Discussion

Northern Bolivian Latitudes

- **Kley, 1999**
  - **Amount of Shortening:** 74 km
  - **Structure:** Large individual thrust sheets of nearly equal thickness.
  - **Notes:** Slices of the Beni basin are thrust above the IAZ and SAZ.

Central Bolivian Latitudes

- **Kley, 1999**
  - **Amount of Shortening:** 90 km, shorter cross-section length.
  - **Structure:** The IAZ is comprised of Palaeozoic through Mesozoic strata, segmented by large thrusts and fault propagation antiforms. The SAZ consists of Palaeozoic through Cretaceous strata, with fault propagation folding among 5 thrusts.
  - **Notes:** Large stressed basement is present.

Southern Bolivian Latitudes

- **Kley, 1999**
  - **Amount of Shortening:** 79 km
  - **Structure:** Several small, tightly packed thrusts and backthrusts in the IAZ and western SAZ and three large thrusts segregating strata in the eastern SAZ (highlighted).
  - **Notes:** Generalization of strata dating.

V. Conclusion

Although the amounts of crustal shortening vary by section, the differences are small. This indicates that small discrepancies in structural interpretations will slightly impact shortening estimates. Although McQuarrie’s estimates are smaller than Kley and Baby, his data is well substantiated in his extended format. Some of the trends in shortening that are expected are indeed present, with highest amounts seen in the central portion of the orocline. However, one would expect to see higher amounts in the northern part of the orocline, which is what is observed. McQuarrie’s estimates are smaller than Kley and Baby, his data is well substantiated in his extended format. Some of the trends in shortening that are expected are indeed present, with highest amounts seen in the central portion of the orocline. However, one would expect to see higher amounts in the northern part of the orocline, which is what is observed.