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Erosion in the Andes and sedimentation in the foreland basin of eastern Bolivia

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The Chaco basin is located in Eastern Bolivia, to the east of the front of the Southern Bolivian Subandine fold and thrust belt. The Chaco basin represents the flexural foreland basin related to the eastward thrusting of the Andes. A detailed study of numerous seismic profiles, drilling logs, and field observations, that are available from hydrocarbon exploration in the Chaco basin, allowed for evaluation for the sedimentary infilling of the basin (Zubieta-Rossetti, 2002). The sedimentary succession of the Chaco basin is a continental clastic sequence with a marine intercalation at its very beginning. The succession ranges from Late Oligocene (27 My) to present day. The clastic material is related to the erosion of the Andes, and more precisely to the catchment area of Rio Grande and Rio Parapeti rivers. The subsidence history is characterized by a strong acceleration in Late Miocene (12 My). The actual sedimentary volume is evaluated to 150,000 km^3, of which 85,000 km^3 represents the Guandacay formation (6 to 0 My), 55,000 km^3 the Tariquia formation (12 to 6 My) and 10,000 km^3 the Petaca formation (27 to 12 My). The infilling rates are of the order of 590 km^3/My (Petaca), 13,500 km^3/My (Tariquia) and 14,200 km^3/My (Guandacay). Related to the catchment area of the Rio Grande and Rio Parapeti, and taking into account the variation in density related to a progressive compaction of the oldest sediments, the eroded/deposited mass are respectively of the order of 17 t/y/ km^2 (Petaca), 352 t/y/ km^2 (Tariquia) and 350 t/y/ km^2 (Guandacay). These results clearly demonstrate that the erosion/deposition became important in the area only during Late Miocene, in correspondence with the tectonic evolution of the Subandine range.

The actual rate of erosion of the area is evaluated from the sedimentary volume exported by the rivers (Guyot, 1993). According to the measured suspended matter, and taking into account that 10 % more represent bottom transported sediments (Guyot, 1993) and 35 % more dissolved material (Milliman and Meade, 1983), the actual annual rate of exportation is of the order of 2400 t/y/ km^2, about 10 times higher than the Miocene-Pliocene rates.

Different interpretations could be proposed to explain such a discrepancy.

1. The surface of the catchment area has been recently modified. However, the crest line between Altiplano and eastern Andes (Rochat, 2000) and the drainage network (Horton and De Celles, 2001) have been established since Oligocene. No recent modification has been documented.

2. The relief of the Andes became greater in recent times; however the strong mountain uplift of the Andes occurred about 10 to 12 My ago (Sempere *& al.*, 1994; Rochat *& al.*, 1999), not in very recent times.

3. The efficiency of the erosion agents strongly increased in recent times, possibly in correlation with climatic change and resulted with higher erosion rates. A similar evolution has been documented in different mountain ranges (Hay *& al.*, 1992; Peizhen *& al.*, 2001), strengthening this hypothesis.

4. The whole package of sediments is not trapped in the foreland basin, but approximatively about 10% of them. Such a solution is in contradiction with the evaluation of Guyot (1993), who estimates that almost 75% of the material eroded in the Andes, remains entrapped in the Amazonian foreland. However dating recent sediments in the Mamore and Beni basins has demonstrated that, for the last 100 years, the sediment accumulation has been episodic, with a frequency of about 8 years (Aalto *& al.*, 2003), corresponding to exceptional rainfalls associated to La Nina events. If this phenomenon characterized the whole sedimentary infilling of Chaco basin, only about 10% of the time will be registered in the sediments; the remaining sediments should have been exported out of the Chaco basin as far as to the Amazon deep sea fan.

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