Organisation des Nations Unies pour l'education, la science et la culture

Géoparcs mondiaux UNESCO

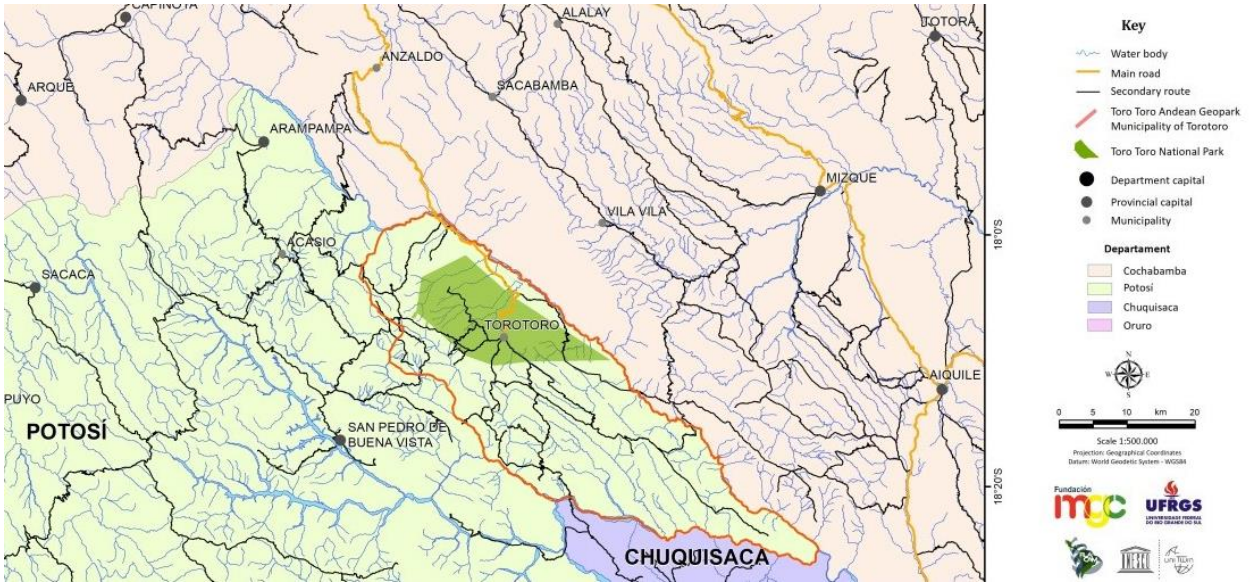
Applicant UNESCO Global Geopark

Torotoro, Bolivia

Geographical and geological summary

Location of the Torotoro Andean Geopark, Aspiring Unesco, in Central Bolivia, South America.

Location of the Torotoro Andean Geopark, Aspiring Unesco, in Potosí Department, Bolivia.



1. Physical and human geography

Aspiring Torotoro Andean Geopark, located in the Province Charcas, North of Potosí Department, Bolivia, has the same limits of the Municipality of Torotoro. The most used access occurs through the city of Cochabamba, whose distance is 134 km. From Potosí city, the distance is 552 km. The Torotoro's coordinates are 18°08'01"S and 65°45'47"W, and the area is 118,218 km². Part of the area constitutes the Torotoro National Park, one of the most important in Bolivia, with 16,570 ha, which represents 14% of 116,020 ha, the total area of the Municipality. The territory comprises seven districts and 75 communities. The Torotoro-Caine synclinorium structures the geomorphology with a significant diversification of geoforms resulted from the dissection of karstic and clastic

sequences. Torotoro presents itself as a geological, biological, and anthropological singularity, whose evolution in geological and civilizing times brings one of the most integrated and complete records in these mountains of the Earth. The temperature varies in inverse relation to the altitude. The annual average is 16.9°C (62.4°F), with average rainfall of 733 mm. The driest month is July, and the rainiest month, January. The temperature variation throughout the year is 6.5°C (43.7°F). Torotoro has 10,870 inhabitants, and the majority is of Charca origin. Circa 90% of the Torotoro population speaks Quechua, and two percent (2%) speak Aymara. However, increasingly, Spanish becomes fluent in a higher number of people. Approximately 57% of the population speaks Quechua and Spanish. The majority of the population of Torotoro (88.7%) lives in their rural areas in a traditional way. The 2012 Census revealed that 90.5% of homes, in a total of 3,511, are privately owned. There is an essential conservation of traditional architecture. The Autonomous Government of Torotoro (GAMT), National Board of Protected Areas (SERNAP), and the Management Committee of the Torotoro National Park are essential members for management and understand that this protected area is the heart of the Geopark. At the community level, there is a diversity of social organizations composed of unions, associations, community enterprises, committees, and social actors such as non-governmental organizations.

2. Geological characteristics and geology of international importance

The magnificent Torotoro-Caine synclinorium structures Torotoro landscape. It is a Pliocene, and Pleistocene structure remaining of the thrust and fold belt type shrinkage generated by the Andean orogeny. The deformation encompass thick sedimentary package of several geochronological Periods of the Paleozoic, Mesozoic, and the Cenozoic. The Upper Cretaceous limestone sequence encompasses the main visible surface in the landscape that defines the large fold geometry. In the whole of the Bolivian Eastern Andes Belt, this synclinal is the best preserved in structural and morphological terms. Besides, only in this syncline, the carbonate package of the Cretaceous Andean Sea was well preserved. At least three major structural geomorphological assemblies of a kilometric scale should be highlighted. The first is the Torotoro suspended syncline. The carbonate beds topped the syncline's southern hinge, which is projected into the valley with negative slopes by the differential erosion of the underlying beds. This allows observing in the field a typical syncline ridge, typical of older folded terrains, just in tectonic terrain that still are building, such as the Eastern Andes. The second is the geomorphology of the western limb of the southern domain of the Torotoro syncline, where the dissection by transversal gorges to the axis and the dissolution of the carbonate beds led to the formation of 16 hogback hills with a triangular shape, aligned as in a tooth, which it is locally called k'asas. Some of the k'asas is considered sacred in the local culture. The third geomorphological set takes place in the central domain, where the west limb of the Torotoro syncline becomes almost a monocline. There, the erosion of carbonate and siliciclastic beds led to the formation of a labyrinth canyons web that run to the Caine trough. The walls of the canyons show stratigraphic sections of the entire geological history and evolution of life in the region. In carbonatic beds tend to have upwelling and caves.Thus, the Torotoro syncline, by a geomorphological, stratigraphic and tectonic singularity, exposed the thick sedimentary package from the Paleozoic Peru-Bolivia basin located at the border of the Western Gondwana, to the transarc basin installed with the individualization of Southern America. During the Upper Cretaceous, the elevation of the sea level led to the marine transgression of this basin, forming the Andean Cretaceous Sea. This epicontinental shallow sea, with several carbonate environments and a diversity of marine trophic chain species, from microbial, mollusks, even fish and turtles, was registered by abundant fossil and fifth and sixth order stratigraphic sequences, recorded by El Molino Formation. On the shore of this sea, different groups of dinosaurs wandered, and the tracks and footprints were preserved. Due to these worldwide known ichnites, Torotoro was registered as a Global Geological Site by UNESCO under the number 189 in the year of 1986. More than 2,500 tracks of five groups of dinosaurs in various combinations of footprints estimated. The Torotoro dinosaur footprints led to understand the behavior of Titanosaurus better and were the first convincing evidence of Late Cretaceous sauropods grazing. They also provide evidence on the morphology of Titanosaurus, such as caliber legs, and their threshing. On the other hand, the high diversity of tracks shows that there was no gradual decrease in the dinosaurs at the end of the Cretaceous, which favors the thesis that there was a catastrophic event in the Cretaceous / Paleogene boundary. Torotoro dinosaur tracks have already been considered as a very diverse set, not recorded anywhere in the world, and is registered in more than seven successive stratigraphic levels.