Geophysical Research Abstracts, Vol. 8, 03971, 2006
SRef-ID: 1607-7962/gra/EGU06-A-03971

Evidences of Cenozoic intraplate strike slip deformation in interior of the East Antarctic craton

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Since the recent discovery of the subglacial lakes beneath the East Antarctic ice cap, extensive geophysical investigations have been performed from the international scientific community in order to highlight the poorly known bedrock physiography of the East Antarctic craton. Radio echo sounding (RES) data collected in the Vostok-Dome C region revealed the existence of regional, elongated subglacial valleys characterised by asymmetric slopes, namely the Aurora and Concordia Trenches. Localised physical conditions at the base of the ice sheet favour the formation of huge water bodies near and within these depressions (Lake Concordia, Lake Vincennes, Lake Aurora).

According to classical plate tectonic theory, cratons are stable tectonic zones not affected by contemporaneous plate boundary activity. However, to date numerous examples of Cenozoic intracratonic deformation are documented such as the lake Baikal, related to the existence of an intraplate strike slip deformation belt within the Asian plate, and the East African rift system which is responsible for the splitting of the eastern part of the African plate from the rest of the continent.

Some evidences from the East Antarctica craton have been considered the result of intraplate tectonics by numerous authors. Proposed tectonic scenarios to explain the occurrence of the intra-continental depressions, some of which host the subglacial Antarctic lakes, range from continental rift system to normal reactivation of regional thrust sheet. Even the time constraints of these inferred tectonic episodes is still a matter of debate. Some authors proposed a Paleozoic or even older age. However these depressions could hardly survive the long lasting, surface processes preceding the ice cap formation in Eocene-Oligocene times. The actual observed asymmetry that characterise the Aurora and Concordia Trenches, as well as the Vostok Lake depression, contrasts with the expected morphology resulting from glacial erosional processes. These considerations point to Cenozoic age of these tectonic subglacial features. The aim of this work is to investigate on the tectonic origin of the Aurora and Concordia Trenches and to frame these structures, together with the Vostok Lake depression, into a structural-tectonic regional framework related to the existence of a fault corridor in the East Antarctic craton. A twofold approach was followed, namely HCA numerical modelling of the bedrock, as obtained by RES data, and lineament domain analysis of the ice cap surface imaged by the Radarsat mosaic of the Antarctic continent. The Aurora and Concordia Trenches can be simulated by two regional, west-dipping listric normal faults characterised by a length of over 100 km and trending respectively NNW-SSE and N-S. This interpretation may be extended to the Vostok depression, about 500km West of the Aurora Trench. The three faults confirm the existence of a NNE-SSW trending fault corridor that runs at least from the Lake Vostok to the Aurora and Concordia Trenches with an average width of about 200 km and a length of over 800 km. It indicates the presence of an Upper Cenozoic deformation episode in the East-Antarctica craton. This corridor can result from local variations in the crustal rheology, or from localised crustal extension, or else from a regional strike slip deformation belt within the East Antarctic craton. The characteristic en-echelon geometry with a left step component of the Concordia, Aurora and Vostok fault system, frame well within a regional NE-SW trending, left lateral, strike slip deformation belt. Lineament analysis showed that the regionally sized lineaments detected on the ice cap surface strongly relate to the structural architecture of the subglacial basement and support the reliability of the proposed tectonic scenario.