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The Vostok-Adventure tectonic corridor in the East Antarctic Craton

Paola Cianfarra and Francesco Salvini
Roma Tre University, Geology Dept., Roma ITALY

The East Antarctic craton (EAC) is a fragment of the Gondwanaland Precambrian shield as confirmed from the sea floor geophysical reconstruction. Despite the progress achieved in the last decades for the understanding of the tectonic evolution of the EAC, our knowledge of the subglacial geology mainly derives from geophysical data because the ice sheet (3500m average thickness) prevents from direct investigations. Since the onset of the East Antarctic Ice Sheet (EAIS) (34 Ma), the tectonic activity represents the major modelling agent of the subglacial landscape, due to the dry ice cap-bedrock contact preventing any erosional or sedimentary episodes.

Radio echo-sounding (RES) data evidence the existence of an articulated bedrock physiography characterised by elongated valleys. From W to E there are: the Vostok Subglacial Depression, the Aurora Trench, the Concordia Trench and the Adventure Trench. All these valleys have asymmetric shape with the eastern steeper side and the western gentler slope characterised by rounded shape that resemble the morphology observed in the East African rift valleys with half graben geometry.

To explore the tectonic origin of the Aurora, Concordia and Adventure depressions a forward modelling approach was followed (Hybrid Cellular Automata technique), in order to best fit the present day bedrock morphology with the topographic expression of normal faults with a given geometry and displacement.

The modelling consisted in simulating the development of the present day morphology by the relative movement between the footwall and the hangingwall of faults with normal component. These faults produce the observed asymmetry in their topographic expression.

Tuning of fault geometry and displacement allowed to minimise the misfit between the model and the morphology derived from RES data.

The Adventure and Aurora Trenches were replicated by the activity of two W dipping, listric faults, both fading into a detachment surface at the depth of 34 km. A vertical displacement of 2000m and 420 m was computed for the Adventure and Aurora Fault, respectively.

A steeper geometry characterises the west dipping Concordia Fault. The modelled displacement of 750 m allowed to simulate the observed bedrock morphology.

The length of the studied trenches let to estimate an over 100 km horizontal length for the modelled faults. This is compatible with the computed vertical dimensions of the order of the tens of kilometres and the predicted displacements giving to these faults a crustal importance. The sharp, asymmetric morphology across the studied troughs suggests a Cenozoic age for their formation.

The same analysis may well fit also the Lake Vostok origin. The asymmetrical morphology of the top of the magnetic basement in the Vostok area highlighted by Stundiger et al. (2003), as well as the wedge shaped morphology of the basin (Filina et al., 2008), open the possibility of a similar tectonic environment (i.e. listric normal fault) responsible for the origin of the depression. If this is true we speculate that the Vostok, Aurora, Concordia and Adventure faults might represent the effect of a transtensional corridor related to a left-lateral, strike-slip deformation belt within the EAC.