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New type of brittle deformations: two-axial turn structure of fractures in the Kovdor carbonatite intrusion (NW Russia)

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The Earth's crust is known for a few types of structural fissuring and faults organization. First of all, this is an orthogonal or some kind of non-orthogonal fissuring network with a various number of systems. The hierarchic model is also popular since it stipulates a regular arrangement and collateral subordination of several ranks of elements relative to each other, and a general fault and/or shear zone. An axis-symmetric fissuring structure is developed in the central (ring)-type massifs and some other geological bodies. It is formed due to the progressive turn of adjoining fissure planes around the massif symmetry axis (mostly vertical) at a discrete angle (within 5-15º on the average depending on the scale and internal structural features). The investigation of the fault tectonics in the Kovdor carbonatite intrusion (NW Russia) has resulted in the identification of a new brittle deformations type. It is formed due to the simultaneous turn of fissure planes at discrete angles around two orthogonal guiding lines (axes), where one is represented by a vertical massif symmetry axis (L1), and the other axis (L2) lies horizontally in the fracture plane. Nonetheless, the rotation along the both axes is codirectional, i.e. when moving counterclockwise around the L1 axis, the L2 rotation is also counterclockwise. If we very tentatively consider a fissure as an ellipse, and take into account the whole assemblage of long and short axes, the overall picture of their spatial distribution generates a screw conoid or ordinary helicoid type structure. It will be shown as an S-shaped plane poles chain in the stereogram. A sequence of large scale fissures (longer than 100 meters), which are 25 to 100 meters apart from each other and regularly vary in strike and dip angle, is mapped in the open pit of the Kovdor apatite-magnetite deposit. The accuracy of positioning for each fissure is a few centimeters in measurement spots, with a deviation from its actual surface due to the undulation induced by the generalized plane estimated at ± 1 meter. The poles of the mapped planes are plotted in the stereogram and compared with model calculations while the planes themselves are visualized in a 3D model. The behavior of the fissure selection in the stereogram and in the 3D model fully corresponds to the laws of two-axial codirectional turn of fractures. This is a new type of brittle deformations, which is of significance for the interpretation of evolutional features and modern state of the stress field in the Kovdor central-type carbonatite intrusion.