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Extreme values of fold-related shortening in the hinterland structure of the Shilbilisaj section in the Talas Ridge (Tien Shan)

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Talas Ridge forms the western part of the Tien Shan Caledonian structure. The sedimentary cover shows a thickness of about 10 km and consists of carbonate flysch and para-platform deposits metamorphosed under greenschist and lesser grade. This structure relates to the "hinterland" tectonic type, characterized by the abundance of many small and moderate-sized folds of the "similar" morphological type. Conventional cross-section balancing techniques developed for "foreland" structures, with large "parallel" folds cannot be applied correctly to such complicated structures. Thus, a special method based on the "geometry of folded domains" was developed for balancing of "hinterland" structures. To test the proposed method, we choose the westernmost Shilbilisaj profile of the Talas Ridge that consists of a large number of folds.

The proposed approach is based on the hierarchical system of hinterland fold structures, and on the accordance of the “folded domain” deformation to the strain ellipsoid, as described in detail in F. Yakovlev [2017]. On the first step the detailed structural profile is divided into a number of domains, 0.5-1 km wide; each domain consists of several folds of almost the same morphology. Consequently, a number of morphological parameters are measured, together with the axial surface dip angle and the interlimb angle that allow the construction of a strain ellipsoid for each domain. The core of the reconstruction method consists of three consecutive kinematic operations: 1) rotation, 2) horizontal simple shearing, and 3) horizontal stretching. As a result, a pre-folded form of a domain is produced, characterized by length and tilting of a domain segment that differ from the current profile parameter values. Sequential aggregation of all pre-folded domains leads to a complete pre-folded profile that allows the calculation of its shortening value. In the next step a few "structural cells" with a length approximately equal to the sedimentary cover thickness, are selected that combine several pre-folded domains. Taking into account the pre-folded and current lengths of such cells, their shortening values are determined. In the system of hierarchy of folded structures, folded domains and structural cells (and its strain parameters) belong to the third and fourth levels, respectively.

The first three project participants restored the structure of the section independently, starting with the domain selection procedure. The preliminary estimates of the shortening of the entire

profile obtained by participants were close to each other and very high (K=L0/L1, where K – shortening value, L0, and L1 – pre-folded and current length in km, respectively): 4.49=118.5/26.4; 4.29=114.0/26.6; 4.67=119.1/25.5. The first participant allocated 63 domains and 12 structural cells, based on the thickness of the sedimentary cover. The shortening values for these cells varied along the profile from high in the southern cells to relatively small in the center and again to high in the northern parts (K=5.20, 4.47, 4.27, 3.79, 3.86, 3.93, 4.24, 4.91, 4.74, 5.53, 4.84, 4.9).

Yakovlev F.L. 2017. Reconstruction of folded and faulted structures in zones of the linear folding using structural cross-sections. Moscow, Published in IPE RAS, 60 p.