Comparison results of geodetic and seismic assessment of the Earth's crust deformation process (by example of the Tien Shan)

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Presence of significant heterogeneities in deformation field of the Tien Shan emphasizes nonuniformity of crust movements. Applying of different methods allows more accurate estimation of the deformation state in the region. At the same time, using few data sources can be very helpful in the results verification. Features of geophysical methods not always allow assessment of crust condition in some zones of the studied areas, but use of complex approach can help to expand an information set.

In the present paper, we have attempted to estimate the deformation state of the Tien Shan with the help of two different methods and the obtained results comparison. Both seismological data [Kostuk, 2008] and GPS observations results [Zubovich et al., 2007; Kostuk et al., 2010] were involved as data sources. In the process of the seismotectonic deformation (seismic strain release) research, three deformation regimes — trust, transpression, and trust-vertical regime — were determined for the Northern Tien Shan territory. The Lode-Nadai coefficient analysis indicates compression and shear strain in the most part of the studied territory and tension state only in minor parts of the crust, while the seismotectonic deformation rate intensity is $2{\cdot}10^{-9}$ $year^{-1}$.

Calculation of the contraction\extension axes direction based on GPS data showed that crust contraction in the region in general occurs in north-north-western direction, with small changes from zone to zone. It was defined that deformation field is quite heterogeneous; areas of high contraction rate and maximum shear strain rate were marked out. Some small areas of dilatation were localized. Deformation rate intensity was estimated according to GPS data and was $2{\cdot}10^{-8}$ $year^{-1}$.

Comparison of results of seismotectonic analysis and GPS data indicated that there is coincidence in the axes directions and deformation regimes. At the same time, despite the similarity of tendencies of deformation regimes, the deformation rate intensity by GPS is by a factor of ten larger than the siesmotectonic deformation rate intensity that conforms to the results of other researches dedicated to the other regions [Zobin, 1987; Radziminovitch et al., 2006].

In so doing, comparison of the contraction axes azimuths by GPS and seismological data showed significant concordance. In particular cases, there was determined almost complete concordance of directions, while in other cases marked difference took place. Azimuth according to GPS made 356° (rms=14.5°), and by the earthquake moment tensor solution data was 353° (rms=14.5°). Considering the root mean square deviation we could state that different methods provided the same estimation of the contraction direction azimuth. At the same time, average deviation between contraction axes by two different methods in each point was 14.5°. Thus, a considerable predomination of the north-north-western direction was noticed. Obtained results were confirmed by neotectonic structural grain, near-latitudinal trends of ranges and basins, reverse and thrust faults of the same orientation.

Additional estimation of the contraction axes directions the territory of California (USA) and island Honshu (Japan) showed similar results. Thus, the azimuth for California by GPS made up 40° (rms=29°), and by seismological data — 46° (rms=31°) and the average deviation between contraction axes directions in each point was 16°. In island Honshu these values equaled: 110° (rms=38°), 104° (rms=39°) and 20°, respectively that also proved the results obtained.

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Electric Conductivity of the Earth Crust in the North-Eastern Part of the Alpine-Himalayan Orogenic Belt

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Regional anomalies of high electric conductivity in the depth of the Earth crust characterize alpine tectonic structures. This is also true of the Alpine-Himalayan orogenic belt (AHOB), the mountain formation that encompasses western part of South-Eastern Asia, north-east of Africa and south of Europe. It separates Eastern-European (EEP), Siberian, Chino-Korean and Southern-Chinese platforms from the Afro-Arabian and Indian platforms, it stretches from Gibraltar in the west and covers part of the western and southern Europe, Mediterranean See, northern Africa and Indonesian archipelago.

This belt splits into several branches. The main one stretches from Pyrenees through Alps and Carpathians to Balcanides and northern Anatolia, Caucasus, Kopet Dag and Himalayas. It was suggested that there is one more northern Dobrudzha-Crimean-Caucasian branch [Kulik, 2009].

Carpathian and adjacent regions from the geological standpoint include south-western part of EEP and alpine folding region of Carpathians together with frontline and inner Miocene depressions as well as pre-alpine epyrogenic zones (Scythian, Misian and Dobrudzha).

Tarkhankut conductivity anomaly (CA) was identified in the western Crimea [Kulik, Burakhovich, 1999] and has comlex configuration at the depth of 10 km. Its cumulative longitudinal conductivity (S) is 5000 Sm. Its most conducting parts are located in the Black See basin, Karkinit-North-Crimean depression and Almian-Cimmerian trench.

In the sub-latitudinal direction from Tarkhankut peninsula to Novoselov uplift stretches CA 20—30 km wide and with S = 500 Sm. It is located at the depth of 5 km. Further on it changes the direction to north-western and can be partially traced along narrow fin like slope of the crust foundation. In the mountainous Crimea there is an anomalous zone with S = 1000 Sm located in the region of converging isolines on the map of density of quake epicenters. Conductivity zone at the depth of 2 and 5 km with corresponding S equal to 2500 and 5000 Sm can be identified in the eastern part of Crimea. This zone geographically coincides with location of mud volcanoes of Kerch — Tamansk region that can be possibly controlled by tectonic fractures with roots lying at the depth of 5—7 km.

Northern Dobrudzha fold-shift structure 50 km wide stretches in the north-west direction for 200 km. It can be traced inside Black See basin at the distance of 50 km but it's not connected with mountainous Crimea. It is quite likely that struc-