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3-D lithosphere model and earthquakes mechanisms of the Tien-Shan

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Some results of the joint analysis of the data about the earthquakes mechanisms and about the 3-D model of the Tien-Shan lithosphere, aimed at finding-out of conditions of strong earthquakes sources formation are considered in this report.

The new 3-D model of the Tien-Shan lithosphere is designed up to depths of 225 kms [1]. Calculations have been executed on the basis of the experimental data of first arrivals times of the seismic waves, both of regional, and distant (teleseismic) events, including nuclear explosions. The analysis of the model has shown the following. The earth's crust within the limits of southern mountain frame of the Fergana hollow on the depth 10-15 km is strongly heterogeneous – there is alternation of zones of the raised and lowered -waves velocities, including waveguides. Any significant heterogeneity of the mantle is absent. The velocities are gradually increasing with depth in it. High-velocity anomalies in the mantle are shown northern – under the northeast frame of the Fergana hollow and further towards the northern Tien-Shan. The mantle is characterized here with strongly pronounced heterogeneity on depths up to 200 kms – there are extended sub vertical objects of abnormal low velocities of -waves (Vp=7.6-8.0 km /sec), adjoining with high-velocity inclusions. There is no heterogeneous velocity structure in the crust of the Chu basin territory. Low velocities are shown here up to depths of 30-40 kms and more. The situation becomes more complicate to the east.

It was chosen a plunge angle of compression axis to study stress field of the Tien-Shan as informative parameter, because it has been determined by various scale researches (geological, geodetic, seismological) a revealed prevalence of near horizontal compressing efforts in the limits of the Tien-Shan. The earthquakes mechanisms catalogues created by Institute of seismology (for 1970-1993) and by Seismological Expedition (for 1994-2005) for events with $\geq$3 had been used. The analysis has shown that position of compression axis periodically fluctuates. Moderate force earthquake occur when position of compression axis comes nearer to horizontal. But the strongest destructive earthquakes occur in conditions when horizontal compression in the earth's crust starts to weaken, i.e. the compression axis starts to deviate from horizontal position [2].

Features of spatial distribution of the earthquakes occurred by different plunge angles of a compression axis are interesting. More than half of all earthquakes occur under near horizontal orientation of a compression axis (<20 º) and they are evenly distributed over all territory of the Tien-Shan. When a plunge angle of compression axis increases (= 20 º - 40 º) the density of earthquakes epicenters to the West of Talaso-Fergana fault appreciably increases too. The insignificant quantity of earthquakes (about 10 %) occurs under steep plunge angles of compression axis, more than 60º. They are located along two strips which spatially coincide with zones of occurrence of known strong earthquakes with > 6.5.

Because of low resolvability of 3-D models of Southern Tien-Shan areas, position of the strong earthquakes hypocenters of this area was not analyzed. The hypocenters of crustal strong earthquakes (> 6.5) of Northern Tien-Shan settle down above vertical borders of the unit of high and low velocity in the mantle. As it was mentioned above, there are not numerous weak earthquakes, motions in which sources occurred under steep plunge angles of compression axis. The lower velocity zone in width approximately 100 km and extending on sub longitudinal direction between 42º - 43º degrees, precisely appears on a horizontal section, on the level of 130 kms. Epicenters of all strongest earthquakes of the last 2 thousand years have settled down on northern border of this zone. 1992 =7.4 Suusamyr earthquake is the first strong event which had taken place on southern border of the mentioned zone. It especially alerts that it is one of categories of events with lack of an extensive surface rupture

i.e. blinding faulting [3]. Kochkor earthquake 2006, W=5.8 also had taken place on southern suburb of this zone near to known Karakunjur pale seismic dislocation.
It is also visible on the mentioned horizontal section, that northern border of a non-homogeneous mantle spatially coincides with the zone of a joint of the Kazakh shield and the Tien-Shan orogen. The southwestern one is discordant to extendance of surface structures. It is established by seism tomography methods, that depth of these structures is not less than 30 kms [1]. It is possible to assume with equal probability two (?) various mechanisms of discordant relations between deep and subsurface elements of Central Tien-Shan lithosphere. It can be consequence of a plume magmatizm, having here place 70-45 million years ago [4] or it is result of deep detachment due to shortening of the Tien-Shan during newest stage [5].

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