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Models of fluid saturated zones according magnetotellurics and seismics data on Tien-Shan crust and mantle along transect MANAS

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Recognized as one of the highest, youngest, and most active orogenic systems on the Earth the Tien Shan is situated internal to the Eurasian continent. New deep seismic data acquired from 2004 to 2007 constitute an -400 km lithospheric transect located from the northwestern Tarim Basin in China to the northern Tien Shan in Kyrgyzstan. This seismic profile consists of 40 seismic stations “Quanterra” containing STS-2 (Streckeisen, Switzerland) and CMG – 3T (Güralp Systems Ltd) broadband seismic receivers. Registration of the seismic data in each station was conducted with sampling frequency of 40 Hz.
Time service based on GPS clock was applied on each station. Average distance between the seismic stations along the profile is 10-15 km. Observations were held on 30 stations in Kyrgyzstan and on 10 of them in China. As a result of seismic investigations wave speeds cross-section was calculated.
A 450 km long north-south magnetotelluric profile spanning the Tien Shan from Kazakhstan to western China reveals lateral variations in the resistivity of the Earth crust and mantle lithosphere to depths of 140 km. MT profile consisting of 19 long period MT soundings (20-20,000 s periods) were combined with 30 broadband stations (0.1-1600 s periods). Broadband measurements (0.001-100 s periods) were also acquired at the 14 long period sites in Kazakhstan and Kyrgyzstan. [Bielinski, et al 2003] Conductivity changes of up to one order of magnitude are a result from variations in temperature or composition, or both. Previous magneto telluric (MT) studies [Trapeznikov et al., 1997] partly show that some low velocity layers also have low resistivity, lending support to the fluid hypothesis. Studies of wave speeds reveal sections of the crust that have pronounced low velocity zones in the thicker portions of the crust which are attributed to crustal metasomatism [Ghose et al., 1998] or fluid filled fractures in pervasively deformed rocks [Vinnik et al., 2002].
Comparing an obtained conductivity model with a wave speeds model we have found several objects that have anomalous features on both cross-sections. These objects are located in the depth interval of 20-30 km; resistivity of the objects is decreased to 5-10 Om*m relatively to outer rocks with resistivity of 500-1000 Om*m. Seismic velocities of the obtained anomalies decrease to 5-6 km/s relatively to 6-6.5 km/s in the outer rocks. Temperatures in the deepest part of the anomalies come up to 600-650 °. It indicates the possibility of amphibolites dehydration and filling of weaken crumbling rock massifs with released water following the resistivity and seismic velocity decrease.
There was held the comparison of the data of laboratory resistivity measurement of eclogite sample with vertical resistivity profiles of the sampling point. On the graphics of vertical resistivity profiles one can see extremum on the depth of about 20 km corresponding to crustal conductive layer. On the depth of about 110 km there is an asthenospheric layer. The part of the vertical resistivity profile graphic that lies from the crustal conductor to the asthenospheric layer accurately correlates with laboratory dry samples resistivity measurements. At the same time the part vertical resistivity profile graphic correlating to the crustal layer differs sharply from the laboratory dry samples resistivity measurements by reason of the presence of water.
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