DIFFERENCE IN THE PHYSICAL MECHANISMS OF EARTHQUAKES AT DIFFERENT DEPTH AND CHANGE IN THEIR IONOSPHERIC RESPONSE

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As it is known, the brittle fracture cannot occur at depths greater several dozens kilometers [Rodkin, 1995; 1996; Sornette, 1999; Houston, 2015; and etc.]. However, earthquakes occur at depths of up to 700 km or more. This is usually explained by the presence of the deep fluid, which reduces the effective friction in rocks, and/or by metamorphic/phase transformations that take place in the downgoing lithospheric plates.

However, no significant differences between the characteristics of the shallow, medium-depth, and the deep earthquakes were known. A few these differences have been founded only recently in [Rodkin, 2021; Rodkin, 2021; 2022]. Firstly, It was shown that the existence of fast slips along the fault zones (and the corresponding stresses) is insufficient for the occurrence of earthquakes deeper than 30-50 km in these zones despite the evident shear displacements. Moreover, the tendency of an increase in the maximum depth of earthquakes with an increase in the displacement velocity along the fault zone was found. The existence of deeper earthquakes requires is associated with metamorphic transformations, in particular, with dehydration reactions. It was shown that the typical values of a few earthquake characteristics (the normalized duration of the seismic process, apparent stress, etc.) differ significantly in different depth ranges. The differences correspond to the expected changes in earthquake mechanisms. The increased median values of apparent stresses and the duration of the seismic radiation process are confined to the depth intervals corresponding to the boundaries of different mechanisms for the implementation of earthquakes.

Thus, from theoretical considerations supported by seismological data, we conclude that "normal"earthquakes can occur only in the upper 30-50 km of the lithosphere. Earthquakes of medium depth appear to be connected with a dehydration embrittlement; the deep earthquakes are presumably associated with solid state (phase) transformations.

In the light of the foregoing, it is natural to assume that the nature of the precursor effects of earthquakes of different depths should also differ. According to the data of the Tokyo vertical ionospheric sounding station (1957-2020), the hourly variations of the critical frequency foF2 arising in connection with earthquakes have been studied. The tendency of increase in foF2 values during 1-2 days before the earthquake was found for the earthquakes shallower 35 km. For M6.2+ earthquakes with a depth of $35 \leq h < 70$ km, at distances up to 500 km from the station from (-1) day to (+2) day, a statistically significant decrease in foF2 values takes place. The amplitude of this anomaly tends to increase by the time of the earthquake. The difference in the nature of the precursors testifies in favor of the difference in the corresponding processes of earthquake preparation. Possible physical mechanisms of the observed difference are discussed.