Low velocity zones in the Earth's crust

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Institute of Geophysics, National Academy of Sciences of Ukraine, Kiev, Ukraine
korchin@igph.kiev.ua

In the resent years fragmentary crustal low velocity zones were revealed by DSS profiles at depths of 5—22 km around the Earth. However, their nature remains not quite clear.

Interdisciplinary interpretation of DSS data including petrophysical thermobaric modelling the ithospheric composition brings more insight into the nature of these anomalous zones. In most cases they are considered as thermodynamical phenomena rather than a result of changing composition when mineral material is transformed by pressure and temperature at the depth of their occurrence.

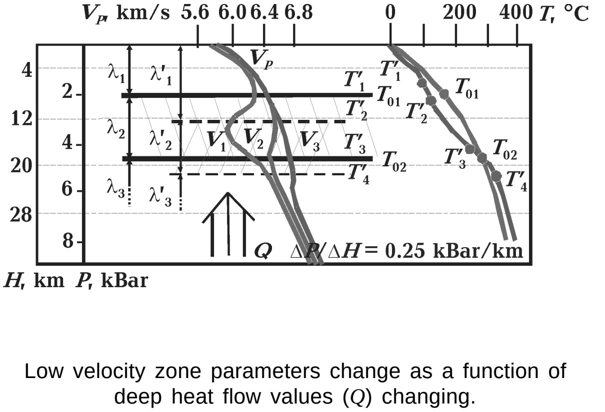
Multimethod laboratory studies of sample show that under *PT*-conditions at 5—15 km depths rocks are subjected to cataclastic and dilatational changes. Amajor mechanism responsible for this behaviour is a resultant effect of irregular and differently oriented tensions in the sample. In contacts between grains they reach values which exceed the strength limit of individual minerals that destructs integrity medium at a microlevel.

Here the rocks are characterized by low Young and shear modules, high brittleness (low Poissons's ratio), high discompaction (high dilatancy), low thermal conductivity (λ). The discompacted state of rocks at 5—20 km depths is a fundamental characteristic of the Earth's crust. It results from the counteraction of pressure and temperature at these depths. The inversion zones established by laboratory experiments in most cases well coincide with low velocity zones in the Earth's crust from DSS profiles.

As low velocity zones result from temperature destruction of rocks uncompensated by pressure at 5—18 km depths, changes in T at these depths can lead to change in intensity of the thickness of these zones and rate of decrease in V_P within them. Crustal thermobaric zones are shown to increase, decrease and disappear depending on $\partial T/\partial H$, $\partial P/\partial H$, λ, T. Instability of the crustal thermobaric zones of low velocity result in their episodic occurrence in the crust and their vertical and horizontal migration depending on temperature fluctuations in the crust.

The low velocity zone in the earth's crust is characterized by the lowered values of λ ($\lambda_1<\lambda_2<\lambda_3$) (Figure). It is the reflecting horizon for a heat flow with the thermal activity processes at large depths as a source. Presence of layer with the lowered heat conductivity on the way of the thermal energy distribution results in the temperature increasing at the lower part of layer and its decreasing at the upper one. That is why the equilibrium *PT*-conditions of the low velocity zone existence are disturbed.

The state of the upper layer of zone is equalized with the rock's state of the upper horizons with a temperature drop in the upper part of this zone. The upper edge of zone goes downward. The border with T_{01} values goes down to T_{02} values position. Simultaneously, there is the zone's foot overheat that is proportionally to the difference of heat conductivity of zone's mineral environment in the lower part of the bedding rocks. The lower foot of zone with T_{02} values goes down to the level of T_{04} values position. The higher pressure stops the growth of a zone due to compensation of thermal structural violations of rocks. Thus the zone area changes the configuration — its power can be increased (with the increase of intensity of deep heat flow) or this zone will disappear (with the sufficient heat lowering from a depth).



Low velocity zone parameters change as a function of deep heat flow values (Q) changing.