Lithosphere structure of Vietnam and adjacent territories based on seismic *P*-waves tomography and gravity

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In the framework of this research work, the structural model of lithosphere of Vietnam territory and its adjacent areas is presented, based on the results of seismic *P*-waves tomography in combination with of Bouguer Gravity Anomaly. The combined processing and analysis of these two types of data will greatly contribute to a clarification of structural characteristics of lithosphere of Vietnam territory and its adjacent areas.

3D *P*-velocity model of the mantle under South-East Asia was received as the solution of the seismic tomography problem by Taylor approximation method, which was supposed by V. S. Geyko [Geyko, 2004]. The solution don't depends from the referent model selection and can be imagine in Cartesian and spherical coordinate system. The used tomography method permits recovering the mantle model being optimal in the given metric in respect with the whole totality of *P*-wave first arrival traveltime data within the frame of selected basic model of interpretation. It includes the apriory assumptions, theory and algorithms of numerical inversion, parameterization of velocity function, the smoothing method and other regularizing factors. The results are imagine in horizontal, longitude and latitude sections of the model.

Density model of lithosphere and mantle of Vietnam territory and its adjacent areas. The establishment of lithosphere density model of Vietnam territory and its adjacent areas is made, based on the following principles:

1. Density of sedimentary rocks is determined based on the study of density distribution of mineral and rock in a territory of Vietnam.

2. For the crystalline cover and upper mantle, the Pudiurov's correlated formula on density value and velocity of longitudinal *P*-waves propagation $V_P = 6\rho - 11$ is used, where V_P (km/s), and ρ (g/cm^3).

3. Synthesis of final result for construction of density model is the solution of 3D Gravity inverse problem.

Combined analysis of gravity data and seismic *P*-waves velocity for study the lithosphere structure of Vietnam territory and its' adjacent areas. The structural features of lithosphere of Viet Nam territory was set up, based on data of seismic waves tomography and gravity data in combination with other available material of exploration seismic and electrical and telluric surveys etc [Cao Dình Trieu, 2005].

Underneath lithosphere boundary is established, based on the followings:

• Anomaly cross-sections of seismic *P*-wave tomography. This boundary reflects a lager change of velocity propagation in the underneath part of lithosphere (seismic lithosphere is characterized by high velocities).

• To solve 3D Inverse Gravity Model with an average density values of the top mantle layer is 3,4 g/cm^3, of the asthenosphere is 3,20 g/cm^3, and the earth crust is 2,90 g/cm^3 [Cao Dình Trieu, 2002].

3D P-velocity model of the mantle under South-East Asia was received as the solution of the seismic tomography problem by Taylor approximation method, which was supposed by V. S. Geyko [Geyko, 2004]. The solution don't depends from the referent model selection and can be imagine in Cartesian and spherical coordinate system. The used tomography method permits recovering the mantle model being optimal in the given metric in respect to the whole totality of *P*-wave first arrival travel time data within the frame of selected basic model of interpretation. It includes the a priory assumptions, theory and algorithms of numerical inversion, parameterization of velocity function, the smoothing method and other regularizing factors. The results are imagine in horizontal, longitude and latitude sections of the model.

The thickness of the Earth crust of Vietnam territory and its adjacent is varying in limits of values lesser 12 up to 38 km. Oceanic cover has value of thickness less than 14 km; continental cover has thickness varying from 24 km up to more than 38 km; and cover of transitional zones has thickness value from 14 to 24 km.

The Vietnam territory and its adjacent areas seismic lithosphere does not pick out for all territory. On the whole, thickness of the lithosphere of Vietnam territory and its adjacent areas is varying from 50 km to larger 110 km. The seismic lithosphere picks up under central part of North Calimantan block up to 50 km, under South China block up to 75 km, under Indochina block up to 50 km. The maximum lithosphere depth is under blocks Central East Sea and East East Sea — 110÷120 km.

References

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Autowave solutions of a nonlocal model for geophysical media taking into account the hysteretic character of their deformation

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Geophysical media as open thermodynamic systems actively display synergetic properties, ability to creation of localized dissipative structures, and an order. Experimental investigations show that dynamics of physical processes in nonequilibrium media is determined substantially by hierarchy and discreteness of a media structure, the set of internal relaxing processes, the nonlocality of interaction between structure elements, the directed exchange of energy between the degrees of freedom. In the papers [Danylenko, Skurativsky, 2007; Danylenko et al., 2008] it is proposed to take into account these features of internal media structure in the dynamical equation of state. This leads to the nonlocal nonlinear mathematical model for structured media:

$$\frac{d\rho}{dt}+\rho\frac{\partial u}{\partial u}=0\,,\quad \rho\frac{du}{dt}+\frac{\partial p}{\partial u}=\gamma\rho^{m}\,,$$

$$\tau(\dot p-\chi\dot\rho)=\ae\rho^{n}-p+\Phi_1+\sigma\left\{p_{xx}+\rho^{-1}p_x\rho_x-\eta\left(\rho_{xx}-\rho^{-1}\rho_x^2\right)\right\}-$$

$$-h\left(\ddot p+\eta\left\{2\rho^{-1}\dot\rho^2-\ddot\rho\right\}\right)+\frac{h^2}{\tau}\dddot p+\frac{h\chi}{\tau}\left\{\frac{6}{\rho}\dot\rho\ddot\rho-\frac{6}{\rho^2}\dot\rho^3-\dddot\rho\right\},\qquad (1)$$

where ρ is the density of a medium, u is the velocity, p is the pressure, $\gamma\rho^m$ is the external mass force, τ is the relaxing time, σ and h are parameters of spatial and temporal nonlocalities, the parameters $\ae$ and χ are proportional to the squares of equilibrium and frozen speeds of the sound. The function $\Phi_1=\varepsilon\Phi_1(\rho,p,\dot\rho,\dot p)$ describes hysteretic reaction of a medium under the deformation, ε is the scale parameter.

Previous investigations of the wave solutions of model (1) in the form [Danylenko, Skurativsky, 2009]

$$\rho=R(\omega),\quad p=P(\omega),\quad u=2\xi t+U(\omega),\quad \omega=x-\xi t^2\qquad (2)$$

shown that accounting the spatial and temporal nonlocal effects in the dynamical equation of state ex-