upper crust boundary and the Moho), and to rock density changes resulting from variations of the stress field (dilatation/compression). At large scales, the density variation effect dominates that of the vertical displacement. Part of the gravity low has been attributed to non-uniform coseismic subsidence of the Andaman Sea overriding plate [Panet et al., 2007].

Comparison of Grace data with the sparse GPS available information allowed us to construct a relaxation model and to discuss the amount of afterslip. In our post-seismic model the observed GPS displacements and gravity variations are well explained by of visco-elastic relaxation plus small amount of afterslip at the downdip extension of the co-seismically ruptured fault planes. Our model comprises 60 km thick elastic layer above a visco-elastic asthenosphere with Burgers body rheology. The mantle below depth 220 km has Maxwell rheology. Assuming a low transient viscosity in the 60—220 km depth range, the GRACE data are best explained by constant steady-state viscosity throughout the ductile portion of the upper mantle (e.g. 60—660 km). This suggests that the localization of relatively low viscosity in the asthenosphere is chiefly in the transient viscosity rather than the steady-state viscosity. The data indicate that mantle viscosity is as low as $8{,}10^{18}$ Pa s in the 220—660 km depth range, maybe indicating a transient behaviour of the upper mantle in response to the exceptionally high amount of stress released by the earthquakes. The remaining misfit to the GRACE data, larger at the smaller spatial scales, was explained by a cumulative afterslip of about 75 cm at depth continuation of the co-seismic rupture, over 30— months period spanned by the GRACE models. It produces small crustal displacements at the level of GPS errors.

Our results confirm that satellite gravity is an essential complement to the ground geodetic and geophysical networks, for understanding the seismic cycle and the Earth inner structure.

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Numerical study of dynamic phenomena in the coal seam with taking into the account the influence of gas filtration and diffusion

© ***A. Dimaki[1], E. Shilko[1], A. Dmitriev[1], S. Zavsek[2], S. Psakhie[1], 2010***

[1]Institute of Strength Physics and Materials Sciences, SO RAS, Tomsk, Russia
dav@ispms.tsc.ru
[2]Velenje Coal Mine, Velenje, Slovenia
simon.zavsek@rlv.si

Coal beds are media with hierarchically organized structure, in which the processes of gas transfer in solid framework produce the significant influence on the mechanical response. Numerical simulation of such media requires special methods to describe as the motion of a solid frame as the transfer of gas in the pores and channels, taking into account the interconnection between these processes. In the paper the symbiotic cellular automata (SCA) method is proposed, which is the combination of conventional [Wolfram, 1986] and movable cellular automaton [Psakhie et al., 2001] methods (CCA and MCA, consequently). In the framework of SCA method the investigated medium is considered as a superposition of two interrelated media. One of them is described by a set of MCA and another — by a mesh of CCA [Zavsek et al., 2005]. The step of calculation consists of two main substeps. First of them is the step of the MCA model, called "mechanical step". At this substep motion equations of movable automata are solved. In other words, the process of mass transfer of solid due to mechanical loading is simulated at the first substep. Next for the mechanical — "net" substep is performed on a mesh of CCA. At this substep the process of mass transfer of gas in the pores and channels is considered, as well as the values of the forces acting on the movable cellular automata from gas phase are calculated. The configuration of pores and channels through which gas propagates, is projected to the mesh of classical cellular automata from the MCA layer. This symbiotic approach combines solutions of mechanical and gas dynamic problems and allows description of multiphase heterogeneous media.

During simulation of coal we used the following main assumptions.

1. Isothermal approximation (T=const) is used for considered system "porous solid — gas/liquid".

2. Description of fluid transfer in filtration volume is done on the basis of linear model of stabilized flow of liquid and gas (Darcy law) [Alekseev et al., 2007].

3. Description of diffusion mechanism of gas transfer (transfer of gas molecules in solid-phase framework) is done using Fick law.

4. Calculation of fluid pressure is done using Van der Waals equation. Possibility of phase transition "gas↔liquid" is taken into account. When considering phase transformation, it is assumed that in two-phase state the pressure is constant. In corresponding interval of fluid specific volumes the Van der Waals dependence of pressure (p) on specific volume (V_{spec}) is replaced by the segment of isobar horizontal line (p=const).

5. Simulation of processes of adsorption and desorption on the outer surface of porous solid is carried out using the equation, which is written on the basis of Darcy law.

6. The influence of pressure of contained gases/liquids on solid-phase framework is calculated within linear approximation of porosity dependence on material mean stress [Borisenko, 1985]. Within the framework of present approach the gas-liquid fluid is considered as homogeneous multicomponent two-phase mixture. Phase composition for each component (fluid) is calculated independently of other components. Influence of absorbed gas molecules (molecules located in crystal lattice) on increase of elastic energy of solid-phase framework is not taken into account.

Verification of proposed approach was carried out by means of comparison of the results of modeling of the samples of fine detritus in the CO_2 atmosphere with the results of experimental studies performed by researchers of Velenje coal mine (Faculty of natural sciences and engineering, University of Ljubljana, Slovenia) [Pezdic et al., 1999]. These results demonstrate a qualitative agreement between model and experimental data. The effect of the CO_2 on the mechanical response and the failure of the samples of fine detritus was studied. Mechanical properties of fine detritus and xylite inclusions were used as given in [Zavsek et al., 2005]. The response and failure of fine detritus under uniaxial compression in the CO_2 atmosphere and in vacuum have been simulated. Results of simulation have shown that the presence of external gas pressure resulted in an increase of strength and ultimate strain of specimens without a noticeable change in Young's modulus. Also, the fracture pattern of specimens has undergone some changes.

It is clear that the proposed approach does not cover the entire spectrum of processes in a multiphase heterogeneous medium. Nevertheless, proper selection of model parameters allows obtaining good agreement with the results of natural experiments. This demonstrates the correct formulation of the problem and qualitatively correct description of the basic processes occurring in the system.

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Geodynamic and geotectonic position of the geoisostatic stress fields of seismic active segments of Ukraine

© *M. Dovbnich, S. Demianets, 2010*

National Mining University, Dniepropetrovsk, Ukraine
dovbnichm@mail.ru

The majority of Ukrainian territory is situated in the Eastern European platform. Meanwhile the most seismic active is the young tectonic structures of its south and south-west framing. First of all it's a zone of articulation of the Eastern and the Southern Carpathians — Vrancea zone and Crimean seismically active segment. In the historical past the earthquakes repeatedly leaded to the catastrophic consequences.

The main geodynamic factor, defined the regions seismicity, is a moving and interaction of separate tectonosphere fragments — tectonic blocks. Studying the nature of tectonic forces, caused different scale geodynamic processes behavior, is an actual question in solving the fundamental and applied problems. The analysis of geological environment stress-deformed state is the key section in chain of the nature and the prognosis of seismic events investigation.

The aim of the work — using the satellite and ground gravity data to make an analysis of the geological environment stress-deformed state, occurred as a result of the disturbances of the tectonosphere equilibrium state and it further usage in the investigation of the nature and the prognosis of seismic events.

Authors investigate the disturbances of the Earth equilibrium state and connected with them tectonosphere stress fields — effects, caused by the deviation of factual Earth Figure — geoid from theoretical equilibrium Figure — ellipsoid. These investigations based on the phenomena called geoisostasy. The model of the equilibrium state of the rotating Earth, offered by K. F. Tyapkin, geoisostasy is well described in geological and geophysical literature [Tyapkin, 1984]. The minimization energy principle, in accordance with which every natural dynamic system is aspired to minimize its interior energy, is the physically mathematics basis of this conception. The equilibrium Figure of our planet is the rotating ellipsoid. In accordance with this principle, the planet will reach the hydrostatic equilibrium in the moment, when the deviation between geoid and ellipsoid in whole Earth will be equivalent to zero. Therefore, evolving Earth aspire to minimize the height of geoid anomalies. Otherwise, the Earth tried to reach the hydrostatic equilibrium, in which its equilibrium form will take the ellipsoid form. Meanwhile, the geoid deviations from ellipsoid, caused by the heterogeneities of tectonic nature inside the planet can be used as an equilibrium criterion. As far as there is the geoid deviations from ellipsoid, so in accordance with the mentioned above principle there must be forces aspired to smooth those deviations, to make it equivalent with the equilibrium Figure. Therefore the mechanic stresses will occur in the tectonosphere of the planet. The law of the stress distribution will be defined as a function of the geoid deviation from the ellipsoid appropriated to it. The value that was taken as a deviation measure from the equilibrium state is suitable because it can be calculated using the results of the Earth gravity field studying based on satellite and ground data. The tectonosphere stresses connect with these disturbances can be estimated using the data of the equilibrium state disturbances in time and in space [Dovbnich, 2008].

Taking into account that tectonosphere has difficult fault-block building it becomes clear that the