Computer simulation related to salt tectonics in the Dnieper-Donets basin

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In this work we investigate thoroughly the mechanisms that generate salt diapirs in brittle rocks [Poliakov et al., 1996] using the fully dynamic model of natural materials with internal structure. The over-

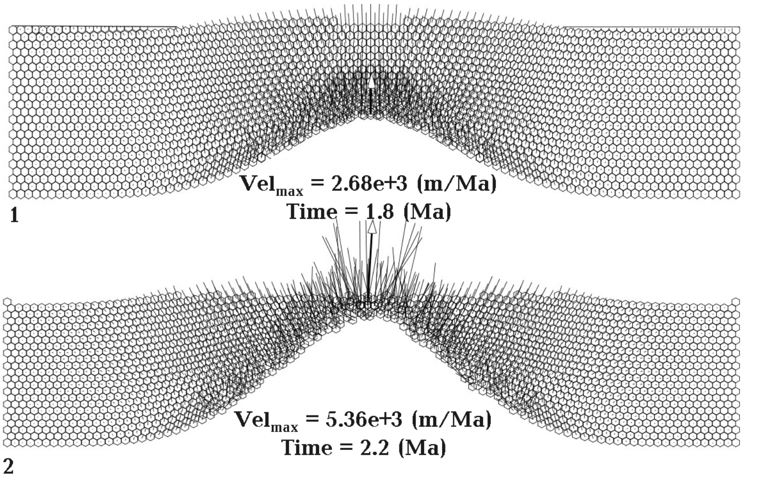

Fig. 1. Positions and velocities (arrows) of blocked sediments during salt diapir growing (model with taking into account erosion).

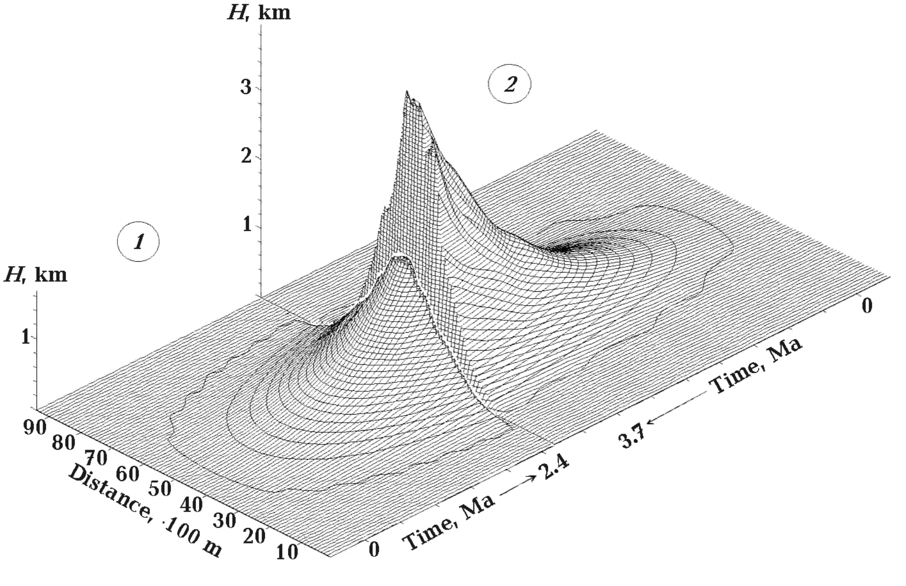

Fig. 2. Salt diapir growing in case of different thickness of sediment overburden: *1* — initial thickness is equal to 1.8 km, *2* — initial thickness is equal to 3.6 km.

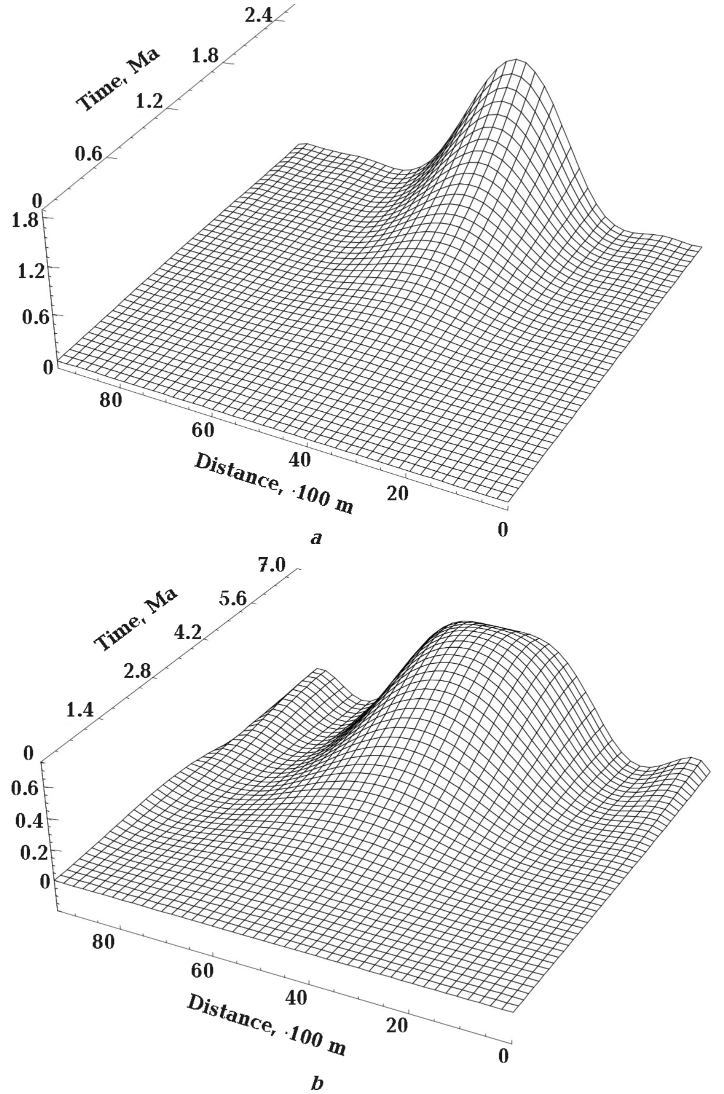

Fig. 3. Salt diapir growing in case of momentary erosion (*a*); diapir growing in case of simultaneously sedimentation 0.5 km/Myr (*b*).

burden and salt are represented by sandstone and salt blocks, capable to be separated or crushed under exterior load. In the 2D model we equate the dynamics of block media [Starostenko et al., 1999]:

$$m_k \frac{d^2\mathbf{x}_k}{dt^2} = \sum_j \mathbf{F}_{\mathrm{jk}}\ ,\ \ I_k \frac{d\varpi_k}{dt} = \sum_j \mathbf{M}_{kj}\ ,$$

where m_k is mass of block k; I_k is moment of inertia of block k; $\mathbf{x},\omega$ are co-ordinate and angular velocity; forces are presented as summarized frictional force, forces owning to energy dissipation, elastic interaction force and gravity force [Poliakov et al., 1996]:

$$F_{ij} = F\mathbf{n}_{ij} = R\left(\varepsilon_{ij}\right)\mathbf{n}_{ij}$$

$$\varepsilon_{ij}^{\substack{compresion \\ tension}} = \pm 2r - \left(\sum_{k=1,2}\left(x_i^k - x_j^k\right)^2\right)^{1/2} .$$

Thus set are a brittle-elastic medium, which one frequently use at physical simulation in this field. In such model density contrast between salt and brittle overburden leads to the salt diapir generation. By additional causes can serve small regional sediments tensions, their erosion, local basement subsidence along fault. As a result of computer 2D-simulation and comparison with geologic datas on salt tectonic of the Dnieper-Donets Rift basin (Ukraine) is established, that buoyancy forces are capable to drive diapirs of salt into brittle overburdens.

Fig. 1 shows the result of computer 2D-simulation of salt diapir growing. Fig. 2. shows the comparison of salt diapir growing in case of different thickness of sediment overburden. Fig. 3. shows the comparison of salt diapir growing with and without erosion.

References

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Digital modeling of the rift processes in the Dniepr-Donets Basin, Ukraine

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A model of the lithosphere, incorporating both dynamic and thermal processes, has been developed by solving a coupled system of differential equations governing stress and temperature in a 2D block-structured geophysical medium [Starostenko et al., 1999; 2001]. Using the kinetic energy of block k in functional form:

Fig. 1. Locations of seismic reflection profile Zachepilovka — Belsk (*1*) and Mikhailovka — Prokopenki (*2*) in the central part of the Dnieper-Donets Basin (DDB).

$$T_k = \frac{m_k}{2}\left\{\upsilon_{k-1}^2 + 2\beta\left(r_{ok-1} - r_{k-1}\right)\upsilon_{k-1}\frac{\partial \upsilon_{k-1}}{\partial \vec{r}_{ok-1}} + \right.$$

$$\left. + \beta^2\left(r_{ok} - r_{k-1}\right)^2\left(\frac{\partial \upsilon_{k-1}}{\partial r_{ok-1}}\right)^2\right\} +$$

$$+ \frac{1}{2}\left(1 + b_k\right)^2\left(\omega_{k-1}\times\omega_{k-1}\right)I_{k-1}^{l,j} +$$

$$+ I_{k-1}^{l,j}\left\{\frac{\beta^2}{2}\left(div\,\upsilon_{k-1}\right)^2 + \beta^2\frac{\partial \upsilon_{k-1}}{\partial r_{ok-1}}div\,\upsilon_{k-1}\right\} +$$