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# NEW TYPE OF OIL AND GAS TRAPS CONNECTED WITH GRAVITATIONAL DISLOCATIONS OF SARMATIAN DEPOSITS IN BIL'CHE-VOLYTS'KA ZONE OF PRECARPATHIAN DEEP OF UKRAINE

In sedimentary layers of many world oil-and-gas-bearing basins gravitational disjunctive dislocations and connected with them plicated structures were formed [1, 2]. Such structures are the objects of oil and gas geological prospecting.

The formation of gravitational faults is similar to shifts formation on the slopes of earth surface under gravitation force. The cut off block is displaced, sliding along arched surface, that's why broken by a shift initially horizontal bed turns out to be inclined at different angles from both sides of dislocation surface. Gravitational faults are shift's variety, which are formed in sedimentation basins in the layers of watered low lithificated sandy-clay se-diments on the boundaries of contrasting tectonic movements of the substratum under high rates of terrigenous material accumulation.

The slopes steadfast is determined by binding forces of sedimentary layers particles. For sandy rocks these forces are equal to frictional resistance on grains surface, and for clay deposits the main meaning get water-colloid connections between mineral particles. Shift resistance in clay deposits depends on the character and thickness of diffuse covers and also on the direction of applied force towards the layered sediments – to shift the rock along the bedding is much more easier than across sedimentation surfaces. This is explained by horizontal orientation of clay particles during their sedimentation [3].

Sediments steadfast on the slopes is determined by an angle of natural slope – that is the maximum angle, by which sediments still remain in equilibrium state. The angle value depends on material properties, which make up the sediment. The steadfast of under-watered slopes is also effected by the free water quantity. The moisture of silts reaches 70–80% [4], and their

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density at no more than 100 meters depth usually doesn't exceed 1,7–2,0 g/cm$^3$. The mineral particles are highly hydrated, and the bonds that appear between them under coagulation, are significantly weakened. The steadfast of watered clay sediments is so small, that natural slope angle in them exists within 5–10° on air and about zero under water. That's why, even under slight attempts, the sediments on the bottom of a basin start moving. For example, the shifts on the bottom of Mexican bay in the area of Mississippi submarine delta are formed at the bottom slope 0,7–1,5°, the most often up to 0,5°. Using methods of seismic surveys and echolocation the systems of gravitational dislocations were set up on almost horizontal areas on the bottom of the basin, and they are named shifting circuses.

One of the shift formation factors is high speed of sedimentation, which causes porous pressure increase and sediments mechanical steadfast decrease – the value of shift resistance in submarine deltas, as a rule, doesn't exceed 0,05 kg/cm$^2$. Under positive pressure absence, clay slopes under water are steadfast even when slope angle is 20°, but slide under bottom slopes less than 1° having positive pressure [5]. Moreover, in the process of compaction from sediments porous waters are driven, in the strata appears filtration flow, which is directed upwards, and migrated water as if hangs the upper sediments strata. In addition, this water accumulated under clays on the boundary of sandy and clay layers, not only hangs the upper part of sediments, but also creates a peculiar lubrication for their sliding.

There are other reasons of gravitational dislocations formation in sedimentation basins such as: geochemical (high organic content, methane and carbonic acid gas generation and at great depths – gas hydrates formation), hydrodynamic (strong waves, especially during hurricanes and tsunami), tectonic (earth quakes and local shocks). But not all researches consider to be obligatory the presence of outer factor for beginning of sediments sliding process – shifts are wide spread not only in tectonically active areas but also within seismic passive and calm continental borderlands, for example on the territory of Norway and Iceland [6, 7]. This proves that shifts are auto kinetic formations, frequency of which is regulated by seasonal character of sediments supplying by rivers (floods).

Mostly, not one but several factors effect simultaneously, which explains mass spreading of shifts on sub water slopes.

Due to discussed material we can imagine the mechanism of gravitational faults formation in the following ways.

When the bottom reaches the sedimentation basin slope, which coincides with sediments natural slope angle, the integrity of strata is broken and its part under the effect of its own weight slides in the direction of sea bottom slope and falling of rocks bed. This is caused by the fact that gradual layer slope increase causes the increase of side pressure of certain sediments mass on the rocks of the same age which are bedded according to layers fall. In consequence of the effect of this pressure, watered friable sediments compact, decreasing in their volume. This causes the loss of resistance for sediments mass, which is located gypsum metrically higher than beds can rise up. Clean clays beds during blocks sliding lubricate the slide surface.

Gravitational faults gradually become flat with depth and they decrease the amplitude simultaneously; at last, they transfer into so-called inter surface disruptions (flats), which are parallel to sedimentation surfaces, and disappear in side-compacted sediments zones. So, faults are rootless and don't have direct connection to basement fractions.

In plan faults have the shape of arches, concaved for layers immersion and deposits strata increase. The amplitude of gravitational faults ranges from 50 to 150 m, and their length ranges from several to 20 kilometers, at width 1–3 km. Separate faults are united in shift fronts, at 100 and more kilometers of length, which are located as parallel systems.

As a result of beds tucking in lowered walls of gravitational faults, structural noses or low-amplitude narrow asymmetric anticlines are formed. Gravitational tectonic dislocations are formed considementationally as due to accumulation of new portions of sediments, the movements along fractures periodically renew.

Gravitational faults are formed at the areas of avalanche sedimentation of the first global level. According to investigation results of delta constructions of the Niger, Mississippi, Amazon, Nile and other rivers it was established that gravitational tectogenesis was shown the most actively at the areas with gradual immersion of consolidated substratum. For these areas the contrastive sedimentation rate in raised and lowered parts of terrace-steps is typical, which caused the formation of high gradients of sedimentary mantle thickness. The terrigenous material is accumulated in frontal parts of underwater deltas with high speed-over 100 m/mln years.

Gravitational dislocations are in various world parts nowadays: in basins of Gulf Cost, Niger, Sun-Jorge , Kutei, the Northern Sea, Dnipro-Donets depression and others.

Despite of significant spreading of delta deposits in sedimentary sections of platforms, regional foredeeps and a number of other mobile geostructures, powerful terrigenous compensated shelfs (delta structures) were connected only to boundaries of adjacent geostructures, which immersion rates differed significantly.

To such boundaries we refer, foreland and deep-water trough boundaries with destructive type of the ocean crust (Paleogene deposits of Gulf Cost); foreland and deep-water depression with relict ocean crust (Paleogene construction of Apsheron); foreland and contemporary ocean depression (Paleogene Niger delta); inner platform trough and regional syneclise (Verei-Melekes strata of north-west cover of Precaspian depression).

According to geological-geophysical investigations such dislocations are prognosed in Bilche-Volytsa Sarmatian deposits in Precarpathian foredeep. They were accumulated at high speed-up to 800 m/mln years. In Sarmatian time Horodok, Sudova-Vyshnia, Krakovets regional fractures caused significant differentiation of substratum immersion rates. Amplitude of vertical blocks displacement of Mesozoic rocks reaches 140–350 m. All these factors promoted the gravitational tectonic dislocations formation in low-lithificated sandy-clay strata of Sarmatian deposits. As an example, on Figures 1 and 2 you can observe structural constructions for North-Yavoriv area on the part of Horodok fracture, which borders in the North-West with Poland. For these structural constructions we'he used materials of wells which were drilled with an aim of oil, gas and sulphur fields searching. The figures demonstrate gravitational arched faults in Sarmatian deposits, which begin over the blocks boundaries of Mesozoic rocks. Sediments sliding along the curvilinear surface after layers falling caused beds tucking in and formation in lowered blocks faults of narrow asymmetric anticlinal (hemianticlinal) folds. Objectivity of the geological construction interpretation of the chosen area, which we'have offered is proved by gas showings in Sarmatian deposits during the drilling of the wells 7, 11, 13 Hrushiv-Horodok.

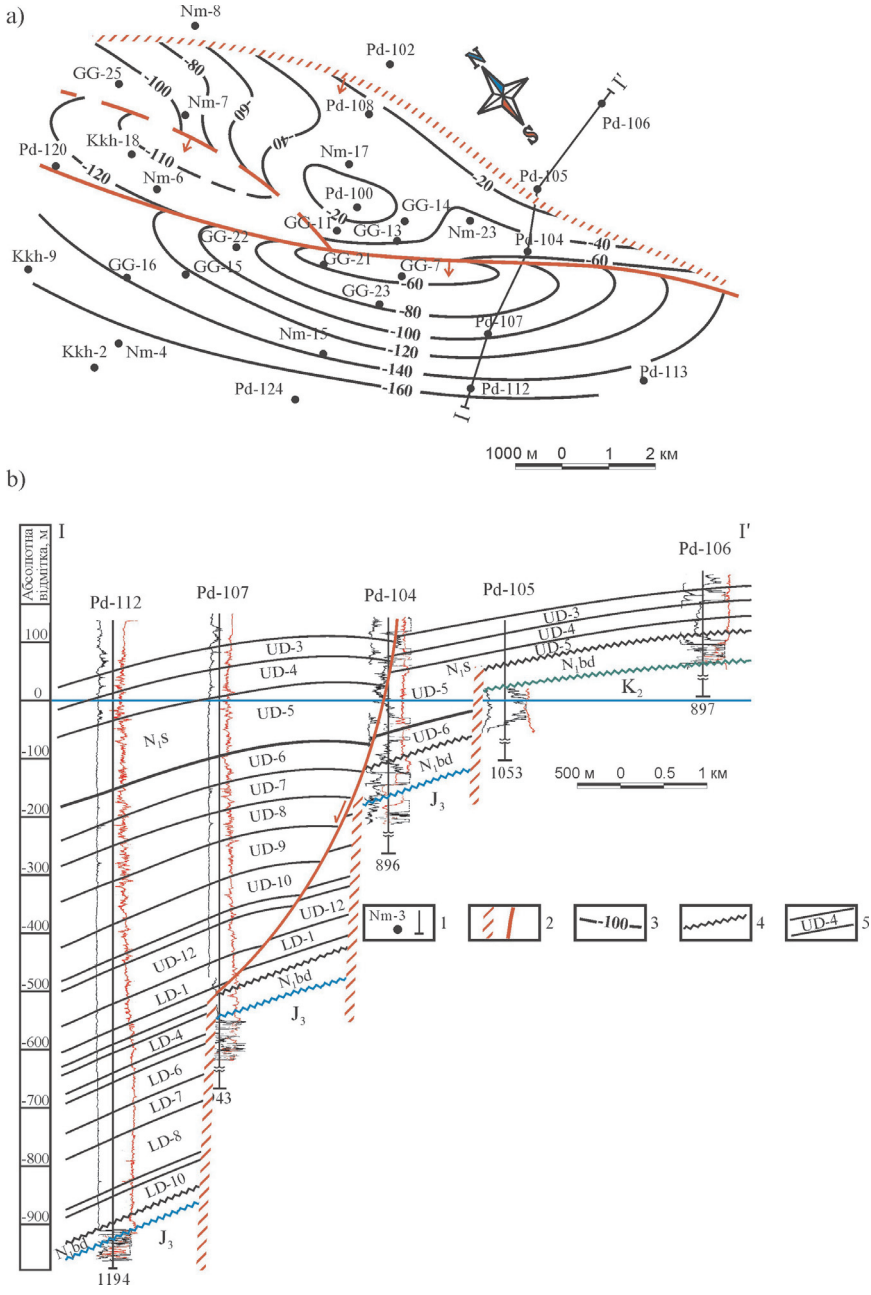


**Fig. 1.** Structural map of horizon cover VD-6 (a) and geological cross-section by line I-I'(b) in Horodok break zone (North-Yavoriv surface). 1 – wells: Kkh – Kokhanivka, Nm – Nemyriv, Pd – Pidlubska, GG – Hrushiv-Horodok; 2 – fractured faults; 3 – isohypses of horizon cover VD-6, m; 4 – stratigraphic unconformity; 5 – horizons

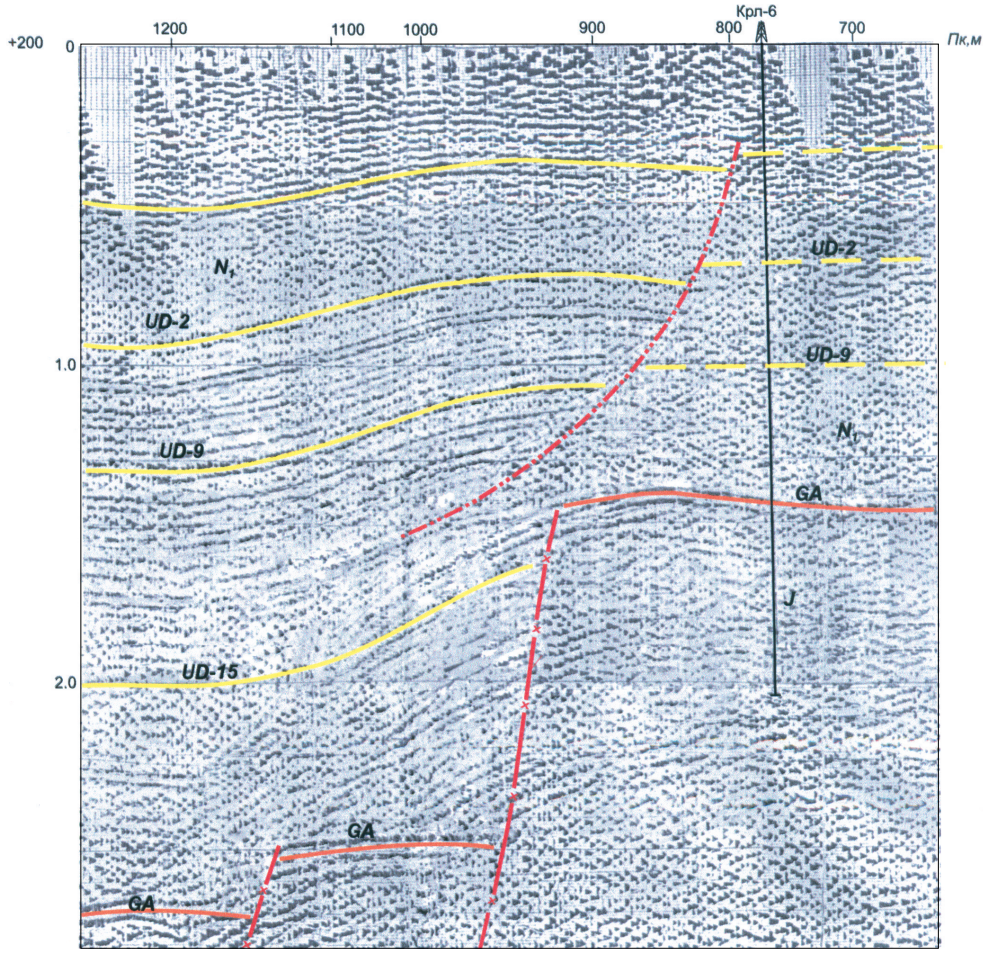


**Fig. 2.** Karolin surface in Krakovets fracture zone. Fragment of time section WUGEE 20 6677. Geologic interpretation Kh. B. Zayats, 2008

Probably, that gas pools of Horodok field are also connected with tectonically-screened traps of gravitational dislocations. The presence of such structures is also proved by seismic surveys results (Fig. 2). Searching of hydrocarbon pools, connected with gravitational dislocations, – is very prospective and promising trend of work in Sarmatian deposits of Bilche-Volytsa zone in Ukraine and adjacent Polish territories.

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