Practical value. Conducted investigations are conductive to the knowledge of processes of the peat accumulation and coal formation. Cited material is of great importance for ascertaining the peculiarities of morphology, formation conditions and comparative analysis of coal-bearing formations of the Lviv-Volyn and other similar coal basins.

Keywords: *coal seam, the Khoriv, Kulychkiv and Oleske suites, Tournaisian and Visean stages, lower boundary of coal-bearing formation, geological map*

Рекомендовано до публікації докт. геол. наук М.Б. Яковенком. Дата надходження рукопису 25.01.15.

УДК 553.94.551.735

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EFFECT OF TIME-TRANSGRESSIVE FAULTS UPON METHANE DISTRIBUTION WITHIN COAL SEAMS

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ВПЛИВ НА ПЕРЕРОЗПОДІЛ МЕТАНУ У ВУГІЛЬНИХ ПЛАСТАХ РОЗРИВІВ РІЗНОГО ВІКУ ФОРМУВАННЯ

Problem solution of efficient methane extraction in coal deposits depends on analysis of their distribution conditions within coal-bearing thickness. Tectonic structure is the most important factor of methane redistribution and retaining within coal-bearing thickness in terms of Western Donbas.

Purpose. To determine the effect of tectonic faults of various types and occurrence period upon methane redistribution for the purpose of its efficient extraction.

Methodology. Collection, analysis, and generalization of the measuring results of coal seam gas bearing capacity in geological prospecting wells using KA-61core extractor as well as mapping of gas bearing capacity and its derivatives using approximation polynom of three initial stages within the walls of tectonic faults of various types with their following analysis were the methodological basis for the study.

Findings. Methane-bearing characteristics of coal seams within the walls of high-amplitude, consedimental, medium-amplitude postsedimental and low-amplitude fault have been analyzed. Maps of local gas-bearing capacity deviations have been developed to demonstrate the effect of these tectonic faults upon localization of methane accumulations.

Originality. Effect of various faults as well as methane redistribution within coal seams of Western Donbas has been analyzed for the first time.

Practical value. The data of core extractor measuring can be used to analyze the effect of tectonic fault upon coal seam methane-bearing characteristics. The analysis of the developed maps in terms of undetermined fault type allows assuming the time of fault formation as well as the character of its effect upon methane redistribution.

Keywords*: methane-bearing characteristics, consedimental and postsedimental faults*

Introduction. It is known that tectonic faults have considerable effect upon coal seam gas-bearing characteristics. This effect is stipulated by various parameters of faults and coal-bearing thickness. Thus, it has been established that a fault type effects gas redistribution. It is conventional to consider that faults factor into degassing while overlaps result in gas accumulation. It is noted that faults, being crisscrossed relative to seam extension, support degassing and vice versa. Such observations are true both for relative low and high-amplitude faults. Faults also have different formation periods, consedimental faults formed during sedimentation under conditions of general stretching of coal formation rock should be characterized by increased gas permeability while postsedimental faults formed after sedimentation during displacement inversion in terms of general contraction of rocks should be characterized by decreased gas permeability.

Unsolved aspects of the problem. The article is devoted to the observations of the effect of time-transgressive faults upon gas redistribution in terms of Pavlograd-Petropavlivka region of Western Donbas.

Under conditions of Western Donbas where parameters of occurrence depth of coal-bearing thickness as well as sedimentary cover thickness are quite low, the tectonic structure depends completely upon the structure of crystalline basement; thus, the effect of deep faults upon sedimentation processes as well as upon postsedimental transformations is quite considerable.

As for its geostructural characteristics, Pavlograd-Petropavlivka region covers central and eastern parts of the Samara massif. In general coal formations follow the occurrence mode of crystalline basement rocks; they are character-

ized by western and north-western strike with a gentle dip towards the north, northern east at the angle of 3–5°. Rock occurrence is complicated by the disturbances of fault nature with the amplitude from several meters up to 30 m and 45–80° incidence angles.

According to the conclusions of previous studies by Yershov V.Z., Nagorny Yu.M., and Glazova A.M. [1], Prykhodchenko V.F., Nagorny Yu.M., Khomenko N.V., Prykhodchenko S. Yu. [2], faults of Pavlograd-Petropavlivka region are divided into three types. The first being consedimental ones, include concordant faults with south-eastern inclination displacers (high-amplitude Northern-Eastern, Bogdanivsky and Bulakhivsky, medium-amplitude Central, Southern-Ternivsky, A fault, and Kapitanivsky). The second type of faults formed during inversion of vertical displacements involves associated and discordant with south-western inclination of displacers (high-amplitude Povzdovzhny fault and low-amplitude faults). The third type covers mixed faults.

Problem formulation. To determine the effect of the period of faulting formation upon gas-bearing characteristics of coal thickness, change of this parameter within hanging and lying walls of the largest consedimental (Bogdanivsky) and postsedimental faults (Povzdovzhny and low-amplitude Blagodatnensky) were analysed.

Main research. Within this region, Bogdanivsky fault covers the territory from the north-west to the south-east with 265–340 m shift amplitude and 50° incidence angle with 10° up to 45° in azimuth; it is characterized by amplitude increase towards the eastern, south-eastern direction. There are fields of "Geroiv Kosmosu" and "Zakhidnodonbaska" mines in the hanging north-eastern wall and those of "Blagodatna", "Ternivska", and "Samarska" mines in the south-western wall.

A number of medium-amplitude faults have been determined in the hanging wall within "Geroiv Kosmosu" mine; the faults are apophyses of large fault with orientation at various angles relative to its displacers. Gas-bearing characteristics of $c_{10}^{в}$ seam are from 4 to 12 m^3/t of methane. 7–9 m^3/t of methane values prevail. Gas-bearing characteristics of more than 9 m^3/t of methane are recorded in the centre of the mine field and within its south-western area near the fault. Minimum gas-bearing characteristics of the coal seam (2–4 m^3/t of methane) are recorded within the boundary western area of the field near Bogdanivsky fault. As for regional features, gas-bearing characteristics increase in the south-western direction. Local deviations of gas-baring characteristics from the regional background are recorded within three sites (Fig.1). The negative, south-eastern one coincides with the positions of local anticlinal fold and a number of faults which are partings of Bogdanivsky fault. Positive gas anomaly is located in the south of the mine field extending in parallel to the displacer of Bogdanivsky fault.

Gas-bearing features of the north-western site of $c_8^{в}$ "Zakhidnodonbaska" mine field is characterized by high values (6–17 m^3/t of methane) and average values are 8–14 m^3/t of methane. Maximum values are recorded within the southern-western part near Bogdanivsky fault. A number of small anomalies of increased gas-bearing values (from 6 up to 12 m^3/t of methane) are recorded along the fault. As for the regional features, gas-bearing characteristics of c_8 coal seam increase north-west. The map of local gas-bearing deviations from the regional background clearly indicates two positive anomalies along Bogdanivsky fault: the major south-western one with 6 m^3/t of methane and the minor central one with 2 m^3/t of methane. While comparing the maps of gas-bearing local deviations and local structures of the coal seam, we can see that these anomalies coincide in their area with local anticlinal folds.

The south-eastern site of "Zakhidnodonbaska" mine field is characterized by average gas-bearing (4–14 m^3/t of methane). While approaching Bogdanivsky fault increased gas-bearing characteristics can be noted.

The regional component of gas-bearing characteristics within c_8 seam grows north-west. The map of local deviations from the regional background records positive anomaly of 6 m^3/t of methane at the point of Bogdanivsky fault cleaving. This area of the mine field does not have any negative anomalies.

Gas-bearing characteristics of c_7 coal seam within a lying wall of Bogdanivsky fault within "Blagodatna" mine is 5–8 m^3/t of methane increasing towards north-south-east; it coincides with the increase of coal seam occurrence depth.

General gas-bearing characteristics as for "Ternivska" mine c_6 coal seam are within 1–6 m^3/t of methane; average values are 1–2.5 m^3/t of methane. Medium-amplitude Ternivsky fault divides the mine field area into two parts: southern and northern ones. It is accompanied by the net of branching low-amplitude apophyses. The northern hanging fault wall is characterized by low gas-bearing values (1–2.5 m^3/t of methane); the values increase both in the southern direction while approaching Ternivsky fault and in the north-eastern direction while approaching Bogdanivsky fault. Minimum gas-bearing value of 0.86 m^3/t of methane is recorded in the central part of the wall. As for regional features gas-bearing increase within a hanging wall of Ternivsky fault occurs in the south-western direction.

Gas-bearing of "Samarska" mine c_4 coal seam is characterized by low values of 1–5 m^3/t of methane. The maximum values (5 m^3/t of methane and 4 m^3/t of methane) are recorded within the north-eastern area near the fault. Regional increase of gas-bearing value occurs in the north-eastern direction. The map of local gas-bearing deviations clearly indicates two positive and negative anomalies along the north-eastern border. The largest negative anomaly with 3 m^3/t of methane is recorded within the area of low-amplitude fault. Positions of positive anomalies (the western one with 1.5 m^3/t of methane gas and the eastern one with 2 m^3/t of methane gas) coincide with the local rising gradient.

Thus, coal seams of Bogdanivsky fault hanging wall ("Geroiv Kosmosu" and "Zakhidnodonbaska" mines) are characterized by higher gas-bearing characteristics compared to the seams of a lying wall ("Ternivska", "Blagodatna", and "Samarska" mines). It is stipulated by the depth of coal seams. Coal seams of a lying wall occur at minor depth; they are often watered and disturbed considerably by low- and medium-amplitude failures as a result being more degassed. The local gas-bearing anomalies are located along Bogdanivsky fault. The positive anomalies are replaced by the negative ones at minor distances. Consequently, consedimental

Bogdanivsky fault has considerable effect upon gas redistribution. However, this effect is ambiguous. The areas with both high and low gas-bearing values are concentrated along the fault at relatively short distances.

Povzdovzhny fault experienced its formation within the period of geotectonic mode inversion. It stretches towards the south-east with irregular inclination of a displacer area. Shift amplitude is 50–165 m; displacer inclination is south-western at the angle of 60–70°. A number of medium-amplitude and low-amplitude faults are recorded within both walls.

"Stashkov" mine field is located within a hanging wall of Povzdovzhny fault; "Dniprovska" mine field is located within a lying wall of this fault (Fig.2).

Gas-bearing features of c_{10} seam in a lying wall are within 1.5–7.6 m^3/t of methane. Maximum values are recorded within the north-western (7.6 m^3/t of methane) and north-eastern (4.5 m^3/t of methane) parts. Regional gas-bearing characteristics of c_{10} coal seam increase in the western direction while approaching the zone of two joints: Bogdanivsky and Povzdovzhny. The map of local gas-bearing deviations indicates minor anomalies near Povzdovzhny fault.

The negative anomaly (1.5 m^3/t of methane) is within the zone of failures degassing the thickness; the central negative one (1.5 m^3/t of methane) is connected with the crest of anticlinal curve and area of low-amplitude fault. The minor positive anomaly (1 m^3/t of methane) is located within the north-western field area coinciding with the local synclinal fold continuing within "Zakhidnodonbaska" mine field. The second positive anomaly (1.5 m^3/t of methane) is located towards the east from the negative one coinciding with the wall of local curve.

The gas-bearing values within Stachkova mine field along c_8 seam are 0.8–5.5 m^3/t of methane (on average –1.5 m^3/t of methane). The minimum values are recorded within the eastern and south-eastern parts of the mine field. While approaching to Povzdovzhny fault, the gas-bearing parameter increases up to 5.5 m^3/t of methane. The regional gas-bearing constituent grows in the northern direction along with the thickness depth. The map of the local gas-bearing deviations indicates one large anomaly being negative as for its area (1.5 m^3/t of methane) in the central part of the mine field and two positive within the eastern (1.5 m^3/t of methane gas) and northern (3 m^3/t of methane) parts. The analysis of the map of the local structures shows that the negative anomaly is within the south-eastern wall of the local anticlinal fold formed near Povzdovzhny fault. The eastern positive anomaly is in the structural low between local folds. The northern positive anomaly is in the wall of anticlinal fold.

Thus, the anomalies of the local gas-bearing deviations within the walls of Povzdovzhny fault are insignificant having no wide distribution. The negative anomaly within a lying wall covering the central part of "Dniprovska" mine continues within "Stashkov" mine field as well despite the fact that they are divided by Povzdovzhny fault. Such situation is characteristic for the positive anomalies as well. Consequently, Povzdovzhny postsedimental fault does not affect considerably gas redistribution and formation of anomalies of the local gas-bearing deviation.

Correspondingly, low-amplitude Blagodatnensky fault occurs relative to the inclination of coal-bearing rock thickness (Fig. 3). The fault is characterized by north-western strike; the inclination of the displacer area is north-eastern at the angel of 70°. The displacement amplitude within the mine field varies from 15 down to 3 m.

Svidovska site is within a hanging wall of Blagodatnensky fault; the north-eastern part of "Zakhidnodonbaska" mine and the south-eastern part of "Geroiv Kosmosu" mine are within its lying wall.

Gas-bearing features of $c_8^{в}$ coal mine of Svidovska site added to "Zahidnodonbaska" and "Geroiv Kosmosu" mines are within of 2–14 m^3/t of methane. Gas-bearing increases in the south-eastern direction. The maximum value of more than 14 m^3/t of methane is recorded within the south-eastern part of the mine field; the minimum value of 2 m^3/t of methane is observed near the south-western boundary of the mine field. As for the regional features, gas-bearing characteristics of $c_8^{н}$ coal seam within the field site vary south-east.

The local gas-bearing deviations of $c_8^{н}$ coal seam from the regional background of Svidovska site are recorded within four areas, among them there are two positive and two negative ones. The largest negative anomaly (6 m^3/t of methane) is within the western part of the site near Blagodatnensky fault; the second negative anomaly with deviations from the regional background (3.5 m^3/t of methane) is within the north-eastern part of the site. The positive gas anomalies are within the north-western and south-eastern parts of the area. The north-western anomaly has a two-dome structure; the value of a gas-bearing deviation of a coal seam from the regional background is 3–4 m^3/t of methane. It strikes in parallel to Blagodatnensky fault. The south-eastern positive anomaly has a complex multi-dome structure as well with deviations from the regional background being from 4 up to 6 m^3/t of methane. It is large and elongated in the south-eastern direction; its location in the map of the local deviations of $c_8^{н}$ coal seam hypsometry coincides with the anticlinal curve.

Two anomalies are recorded within a lying wall of Blagodatnensky fault along the north-eastern boundary of "Geroiv Kosmosu" mine in the map of the local deviations. The large positive one (3 m^3/t of methane) strikes along the fault and the large negative one (4 m^3/t of methane) continues within the field of "Zakhidnodonbaska" mine with considerable values up to 9 m^3/t of methane gas. In the map of the local deviations of coal seam hypsometry it coincides with the local anticlinal curve. A number of minor anomalies of negative and positive nature are observed along the south-eastern boundary of "Zakhidnodonbaska" mine field apart from the large negative anomaly; these minor anomalies continue within the field of Svidovska site. Thus, low-amplitude Blagodatnensky fault does not break the general distribution pattern of the local gas-bearing deviations.

Conclusions. The regional faults of Western Donbas, consedimental Bogdanivsky and postsedimental Povzdovzhny, affect gas redistribution within the coal seams in different ways. The consedimental fault influences gas redistribution considerably. However, this effect is ambiguous. Both zones

with relatively high gas-bearing features and zones with relatively low ones are concentrated along the fault at short distances. Postsedimental Povzdovzhny fault and low-amplitude Blagodatnensky one do not affect gas redistribution considerably. The anomalous gas-bearing values are not connected with it.

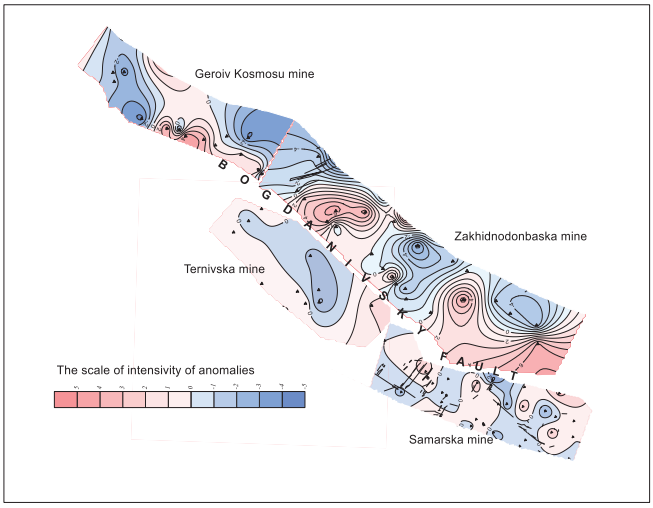

Fig. 1. Map of local gas-bearing deviations along consedimental Bogdanivsky fault Legend: ▲ – borehole; ⬭ – isolines of local gas-bearing deviations; ⟋ – low-amplitude faulting

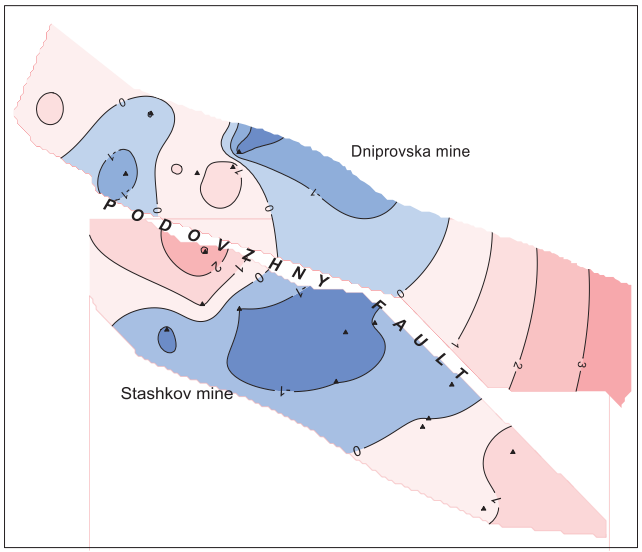

Fig. 2. Map of local gas-bearing deviations along postsedimental Povzdovzhny fault See Fig. 1 for the legend

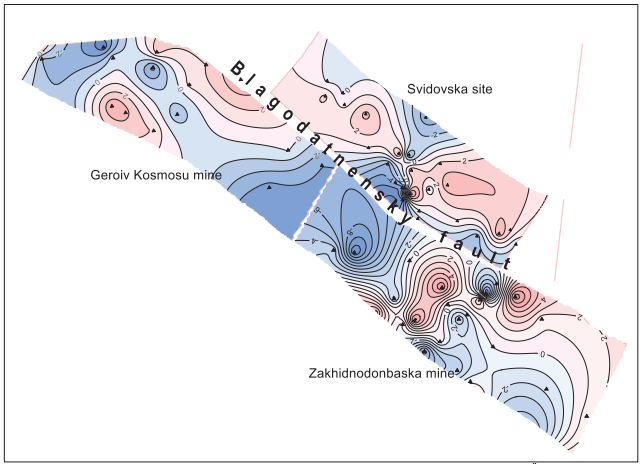

Fig. 3. Map of the local gas-bearing deviations along low-amplitude Blagodatnensky fault See Fig. 1 for legend

ISSN 2071-2227, Науковий вісник НГУ, 2016, № 1

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Вирішення проблеми ефективного видобутку метану на вугільних родовищах залежить від вивчення умов його поширення у вугленосній товщі. Тектонічна будова − найбільш впливовий чинник перерозподілу та збереження метану у вугленосній товщі в умовах Західного Донбасу.

Мета. Визначити характер впливу тектонічних розривів різного типу та віку закладення на перерозподіл метану у вугільних пластах з метою ефективного його видобутку.

Методика. Методичною основою був збір, аналіз та узагальнення результатів замірів газоносності вугільних пластів у геологорозвідувальних свердловинах за допомогою кернозабірника КА-61, побудова карт газоносності та її похідних з використанням апроксимаційного поліному трьох перших ступенів у крилах тектонічних розривів різних типів і їх аналіз.

Результати. Виконаний аналіз метаноносності вугільних пластів у крилах великоамплітудного конседиментаційного, середньоамплітудного постседиментаційного та малоамплітудного розривів. Побудовані карти локальних відхилень газоносності, що демонструють характер впливу цих тектонічних порушень на локалізацію скупчень метану.

Наукова новизна. Уперше проведено аналіз впливу розривів різних типів на перерозподіл метану у вугільних пластах Західного Донбасу.

Практична значимість. Використовуючи дані замірів кернозабірників, можна провести аналіз впливу тектонічного порушення на метаноносність вугільного пласта. Аналіз побудованих карт, за невизначеності типу розриву, дає можливість припустити час формування розриву та характер його впливу на перерозподіл метану.

Ключові слова: *метаноносність, конседиментаційні та постседиментаційні розриви*

Решение проблемы эффективной добычи метана на угольных месторождениях зависит от изучения условий его распространения в угленосной толще. Тектоническое строение − наиболее весомым фактором перераспределения и сохранения метана в угленосной толще в условиях Западного Донбасса.

Цель. Определить характер влияния тектонических разрывов разного типа и возраста на перераспределение метана в угольных пластах с целью его эффективной добычи.

Методика. Методической основой был сбор, анализ и обобщение результатов замеров газоносности угольных пластов при бурении в геологоразведочных скважинах с помощью кернозаборника КА-61, построение карт газоносности и их производных с использованием апроксимационного полинома трех первых степеней в крыльях тектонических разрывов разных типов и их анализ.

Результаты. Выполнен анализ метаноносности угольных пластов в крыльях крупноамплитудного конседиментационного, среднеамплитудного постседиментационного и малоамплитудного разрыва. Построены карты локальных отклонений газоносности, которые демонстрируют характер влияния этих тектонических нарушений на локализацию скоплений метана.

Научная новизна. Впервые проведен анализ влияния разрывов разных типов на перераспределение метана в угольных пластах Западного Донбасса.

Практическая значимость. Используя результаты замеров керносборника, можно провести анализ влияния тектонических нарушений на метаноносность угольных пластов. Анализ построенных карт, при неустановленном типе разрыва, дает возможность предположить время формирования разрыва и характер его влияния на перераспределение метана.

Ключевые слова: *метаноносность, конседиментационный и постседиментационный разрыв*

Рекомендовано до публікації докт. геол. наук В.С. Савчуком. Дата надходження рукопису 09.02.15.