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СЛАНЦЮВАТІ ПОРОДИ СПАСЬКОЇ СВІТИ НИЖНЬОЇ КРЕЙДИ ЯК ПЕРСПЕКТИВНІ ОБ'ЄКТИ ОТРИМАННЯ ВУГЛЕВОДНІВ

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У зв'язку з виникненням можливості видобування вуглеводнів з ущільнених сланцюватих порід, з'являється необхідність їх детального дослідження, особливо на території України. Раніше дані товщі вважались лише нафто-материнськими. На даний час у світі доведено, що збагачені на органічну речовину відклади можуть бути одночасно як материнськими породами так і породами-колекторами. У Західному регіоні України найбільш збагаченими органічною речовиною є чорного кольору сланцюваті породи менілітової світи олігоцену та спаської світи нижньої крейди. Вказані відклади найбільш поширені в межах Внутрішньої зони Передкарпатського прогину (менілітова світа), Скибової зони Карпат (менілітова та спаська світи) та зони Кросно (спаська світа). Саме на спаській світі нижньої крейди, яка знаходиться в межах Кросненської зони, акцентована основна увага у даній праці, її детальне місцезнаходження, літологічні та петрографічні особливості. Надається грунтовна характеристика мінерального складу гірських порід у виготовлених шліфах. Детально описана присутня вуглефікована органічна речовина у чорних сланцюватих породах спаської світи. Також надається характеристика всіх інших важливих мінеральних включень перспективних порід, які траплялись у шліфах виготовлених з порід в межах досліджуваних регіонів. Матеріал поданий у статті є вихідним для продовження грунтовних геологічних та геофізичних досліджень в межах виділених перспективних територій, а також в подальшому можливого отримання промислових припливів вуглеводнів газового ряду.

Ключові слова: мінеральний склад, органічна речовина, сланці.

In connection with arising of possibility of hydrocarbons extraction from compactioned shale rocks, appears necessity for detailed research, especially on territory of Ukraine. Layers are before given were considered only as source-rocks. At nowadays it is well-proven in the world, that this deposits are enriched on organic matter can be simultaneously not only source-rocks but also reservoir-rocks. In the Western region of Ukraine most enriched on organic material are black shales of menilite suite of Oligocene and spass suite of Low Cretaceous. Deposits are indicated most widespread within the limits of Interior zone of Precarpathian foredeep (menilite suite), Skybova zone of Carpathians (menilite and spass suites) and Krosno area (spass suite). Exactly on spass suite of Low Cretaceous which is within the limits of Krosno area, basic attention is accented in this work, detailed on it's location, lithologic and petrographic features. There is also given description of mineral composition of the mountain rocks in the microsections. And there is also in detail described present of coaled organic material in the black shale rocks of spass suite. Description is also about all other important mineral including of perspective rocks, which happened in microsections made from rocks within the limits of the investigated regions. Material that are given in the article are the basement materials for continuation of further geological and geophysical researches within the limits of the distinguished perspective territories, and also in future possible receiption of industrial gas yields.

Key words: mineral composition, organic material, shales

THE APPLICABILITY RANGE OF NET MODEL FOR PORE SPACE OF UNCONVENTIONAL ROCKS

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Net model is relatively simple and efficient tool for flow description through pore space of conventional reservoir rocks. Its concept is based on dividing of pores space volume into two part: one

created by pore bodies, the second created by pore channels. It is possible with the use of fractal analysis of cumulative pore size distribution curves. Additionally, microscopic analyses give so called connectivity factor (number of pore channels joining single pore body with other ones). Such data, can be applied directly to Hagen - Pouisele formula.

Such procedure can be applied also for unconventional reservoir rocks like tight sandstone reservoir rocks. Even microporous sandstones have regular pore space which can be described using net model. Some problems may occur for carbonate tight rocks, because of space heterogeneity but generally it is still possible to apply this kind of model.

Situation change when we take into consideration shale reservoir rocks or coal rocks. These kind of rocks have nanoporous pore space. For pores lower than 100 nm model of fluids flow changes. Moreover, adsorption, capillary condensation and diffusion phenomena occurs. It is possible to perform fractal analyses for these rocks but its results show that range of pore radiuses 5 – 100 nm is characterized by two or three fractal numbers. This fact make impossible to applicate net model for such kind of pore space. Proof of application fractal analyses for part of pore space of such kind of rocks build by pores greater than 100 nm also fail because of inability to obtain unequivocal value of fractal number. Additionally, these rocks show great space heterogeneity so even for small number of samples for which we estimate fractal number connectivity factor change in very great range, not quite physical (for example 0.03).

Performed analyses showed that net model of pore space can be applied only to tight, regularly created rocks and more heterogeneous tight rocks has to be described using other flow models based on Knudsen diffusion and Darcy law.

ANALYSIS OF PORE SPACE OF SHALE ROCK USING MICROSCOPIC METHODS

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The paper presents comprehensive study of the Polish shale rock formation samples microstructure combined with mineralogy. Recently FIB/SEM technique, for pore space morphology and its 3D reconstruction, appeared as a method more and more frequently used by leading companies providing geological services. This work shows SEM and FIB/SEM data as a powerful tools for pore space extensive examination.

The permeability in shale rock depends on the existing pores and their mutual relationship and distribution of organic matter. Where mineral pores (interP) dominates pore network will be well connected. Continuous migrated organic matter with OM pores create well connected pore network.

For the description the pore space SEM (Qemscan) analyzes, FIBSEM and reconstruction the pore space (3D) were performed. The workflow applied in this study contain thin section (classic petrology) and mineralogical composition (Quemscan) analyzes. On the basis of these two analyzes regions to high resolution images (HRI) were selected. Based on HRI, FIB SEM 3D imaging was conducted. For each sample 2-4 HRI and 2-3 FIBSEM analyzes were performed.

In all samples a mixed pore network (Loucks et al., 2009) is dominant with the presence of interparticle pores (interP), intraparticle pores (intraP) and pores in organic matter (OM) (Loucks et al. 2009, 2012).

Intraparticle pores are located in clay agregates, in pyrite framboids between crystals of pyrite, dissolution-rim pores. Interparticle pores are located between grains and between clay platelets. Organic-Matter pore are located in organic matter. OM in shale rock are present as organic matter (depositional) and bitumen (migrates in mineral pores).The pores in the organic matter are formed in both in-place organic matter and in migrated organic matter. In OM pores distinguished sponge OM pore texture, bulb OM pore texture, fracture in bitumen and solid bitumen without pores. Migrated bitumen cemented mineral pores.