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# DECOMPRESSION OF ROCKS AS A RESULT OF FLUIDS OPERATING UNDER HIGH PRESSURE IN THE EARTH'S CRUST

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The problem of terrigene sediments consolidation in the Earth's crust and expression fluids from them under the operating of static pressure is sufficiently investigated and is reviewed in the literature. The opportunity in the nature of passing the inverse processes - decompression of rocks and forming in this connection in sedimentary associations the zones with heightened permeability to the given time is not purely investigated. It's logical to think, that in rocks in requirements of considerable geostatic pressure and high temperature, that is on large depths of earth crust, the permeability of rocks should be moderated. However, the results of exploring and prospect drilling of deep and super-deep bore wells in miscellaneous locales of a world testify that in sedimentary rock mass of Earth crust in the high depths very often there are meeting the rocks, which in certain conditions become the natural reservoirs, saturated by fluids, and in which there are the deposits of oil and gas.

This fact is interlinked that in rocks in the large depths, not only processes of rocks sealing flow, but the processes of their decompression under the operating of high-head fluids, which are implanted in these sediments. This process improvements the reservoir properties of deposits, and sometimes even influences on their formation in those rocks, which did not possess by these properties earlier.

It is known, that from super-deep bore wells on the Kola peninsula SG-2, which one was bored almost completely in crystalline rocks, were obtained the water inflows from the depth of 7 - 8 thousand meters and more.

It is very interesting to give in connection with an considering problem, the results of drilling the super-deep bore wells Lugy-1 and Shevchenkovo-1 in Western Ukrainian oil-and-gas-bearing province.

The results of drilling these bore wells testify, that in their sections there are high values of coefficients anomaly (**C*a***) of formation pressures. It's the evidence of abnormal pore pressure. They characterize the presence of abnormal interstitial pressure zones with decompression spacing of clay and sand rocks. Converts on itself attention one important part. As a rule, in these rocks there is marked the regular magnification of drilling rate of well (fig. 1-a and 1-b). It is necessary to say, that the similar coincidence of abnormal pressure zones with the intervals of magnification of drilling rate is fixed in Carpathians in other bore wells, for example in bore wells: 28-Kosmatch, 27-Slivki, 14- Kosmatch Pokutski, 814-Pasechna, 3-Roznatov etc. The magnification of drilling rate is always watched in rocks with smaller thickness, or in decompression rocks. This phenomena testifies, that there is a feedforward between the magnification abnormal pore pressure of fluids, which saturate the rocks, and degree of compaction or decompression of rocks, which are drilled out.

There are miscellaneous thoughts and concepts about the processes of decompression of rocks in Earth's crust.

Esteeming a problem of decompression the rocks and forming due to this process in them the natural reservoirs with field resources of hydrocarbons, it is necessary to recollect an existence of hydrocarbon upbuilding in Jura Bazenov strata of Western Siberia, where the clays and argillites are the rock reservoirs. On the separate leases of these clays and argillites the reservoirs of hydrocarbons were formed, which are characterized by the anomalously high formation pressures. It is possible with confidence to consider, that the Bazenov strata reservoirs of hydrocarbons are placed in rocks

of secondary decompression. Volumetric mass of clay materials of Bazenov strata in leases of presence the hydrocarbons reservoirs is moderated by magnitudes 200 — 300 kg/м$^3$.

According to our concept [A. Orlov, 1980], the forming of decompression zones can be genetically bound up with the expression of fluids from reservoirs in accommodating them clay rocks through the originating of fractures in folding processes. It is known, that tectonic stress, which results to the formation plicated and disjunctive dislocations in sedimentary strata, can considerably exceed the values of static pressure. Therefore, at the tectonic moves the rock skeleton of reservoirs can be deformed even in the event when their gravitational sealing already greater practically is impossible.

With the purpose of endorsement of an opportunity of existence in sedimentary strata not only sealing of depositions, but also inverse process – the decompression of rocks under operating of fluids, which one invade in them under the pressure, in Ivano-Frankivsk University were held the experimental researches in different periods.

These experiments were encompass with following: in the cylinder were positioned the cores of sand argillites between the samples of medium-grained sandstone's cores with permeability 83,6 – 84 md, length 368 and 384 $\cdot$ $10^{-3}$ m, and diameter 2,7 $\cdot$ $10^{-3}$ m. The sandstones were saturated with pore water (salinity of water 0,1 kg/l - NaCl). After hydro-wring (40 $\cdot$ $10^6$ Pa) at the temperature of 20 $^0$C in the middle of system pressure was hoisted up to 37 $\cdot$ $10^6$ Pa. There were made five experiments by endurance from 4 up to 21 days. In three cases after four days in argillites under the operating of pressure by fluid, which was squeezed out from sandstones, the fractures were reshaped, and the free filtering started in system. In two cases there were obtained effects, which testify about decompression of argillites without effect of a fluid fracturing (see the table). In argillite the apparent porosity was augmented from 0,40 up to 1,60 %, and volumetric mass was diminished from 2590 up to 2550 kg/м$^3$. The experiment lasted 14 day. At conducting similar experiment with argillites during 21 day the apparent porosity was augmented from 2,20 up to 8,50 %, and the volumetric mass was diminished from 2610 up to 2440 kg/м$^3$. Thus, the experiments affirmed an opportunity of decompression of rocks under pressure of fluids, which are implanted in them.

We conducted also similar experiments with marl shale [Орлов А.А., Ляху М.В, Чорный М.И., Омельченко В.Г. Изучение экранирующих свойств карбонатных пород верхнего мела Керченского полуострова на установке УП-3000//Повышение достоверности определения параметров сложных коллекторов и флюидоупоров: Материалы VI Всесоюзного совещания. - Львов, 1988, с.188]. It is interesting, that after the trial of marl shales during 30 day they practically have not yielded to variations, not looking that the pressure in system was augmented up to 85 $\cdot$ $10^6$ Pa , at hydro-wring of a specimen in 100 $\cdot$ $10^6$ Pa. It has shown, that the marl shales yield to decompression very gentle or practically do not yield in the depths, accessible for well drilling for today. Therefore they can remain as the covers in sedimentary rocks of Earth's crust.

**Table.** Parameters of the tested argillites before and after the experiments

| Length of a sample, cm | Diameter of a sample, cm | Pressure of hydro-wring, $10^6$ Pa | Pressure inside system, $10^6$ Pa | Endurance of experiment, days | Apparent porosity, % | | Volumetric mass, kg/m$^3$ | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Before the experim. | After the experim. | Before the experim. | After the experim. |
| 1,1 | 2,7 | 40,0 | 36,0 | 14 | 0,4 | 1,6 | 2590 | 2550 |
| 3,6 | 2,7 | 40,0 | 36,0 | 21 | 2,2 | 8,5 | 2610 | 2440 |

The availability of alternation of stratas, which are decompressioned, with the stratas, which are decompressioned very gentle or not decompressioned, can cause formation of natural reservoirs in Earth's crust.

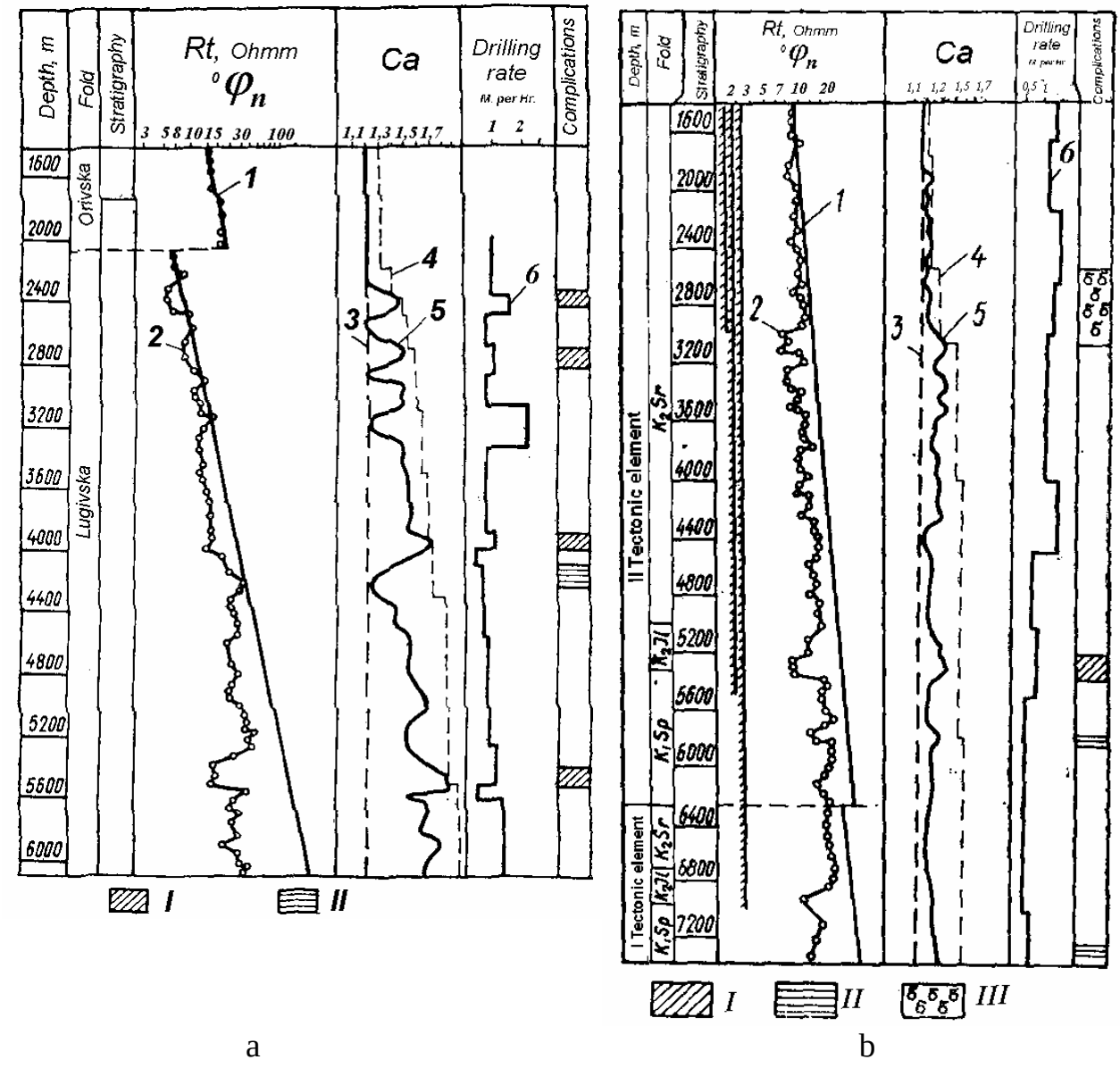


**Figure 1.** Allocation of zones with heightened values ***Ca*** in a section of wells:
Lugi-1 (a) and Shevchenkovo-1 (b) (O. Orlov, M. Chorni, V. Vasilechko).
I - slide-rocks and downfalls of walls in bore well; II - differential sticking of a drilling tool; III - gas show at boring.
1 - variation of apparent resistivity (Rt) of clay rocks in condition of their normal compression; 2 - real compression; 3 - normal hydrostatic pressure in deposits; 4 – abnormality of pressure in depositions, which are determined by the density of washer fluid; 5 - abnormality of pore pressure; 6 - curve of drilling rate.