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THE IDENTIFICATION TECHNIQUE OF OIL WELL WATER INVASION WAYS

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Abstract. *The questions about the reasons of oil well extracted product water encroachment are discussed in this article. They are classified on three classes. The more significant characteristics are pointed for every class. The possible ways of water invasion into a borehole have been discussed when some distinctive reasons of this process have been determined. Peculiar interconnections and effect transit have been indicated according to block diagrams. The more convincing and awkward ways are particularly pointed. The nature of water, getting down the hole, served as the following differentiation category of water encroachment. Both groups are discussed in detail and some of them have the examples.*

Keywords: *water encroachment, reasons, ways, the nature of water, entry, leak-proofness, cone*

The distinctive feature of time consuming oil field development at the completion stage is consistently increasing water invasion of well production. It is a matter of common observation that plenty of Volga-Ural region and Western Siberia fields are at or just passing belated exploitation stage. In this connection the limitation problem of its inflow is becoming the primary. On the ground of lithologic and reservoir facies non-uniformity, the process of development well water encroachment becomes the inescapable consequence of this factor. Moreover, it often happens at the first months or after two years. The essential oil selections from reservoir happens because of increased associated water selection.

The real time length of water-free production is so varied in form on duration, that plenty of different circumstances can be the reasons, which explain this event. The first group of reasons is geological, to which refer: geological structure of development object, lithological factor, stratum reservoir characteristics, interchange and arrangement character of highly and low-permeable sub layers. The next group of reasons is defined by the nature of liquids, which take part in process of filtration, defined by physical and chemical properties of fossil water, reological oil characteristics and water quality, used in formation-pressure maintenance system. The last category of reasons affect technological aspects, which defines uncontrolled water entries, relating to locating scheme of development wells in relation to discharge ranges, long-distance and close arrangement of oil water contact (OWC), well construction technology and operation conditions (see Fig. 1).

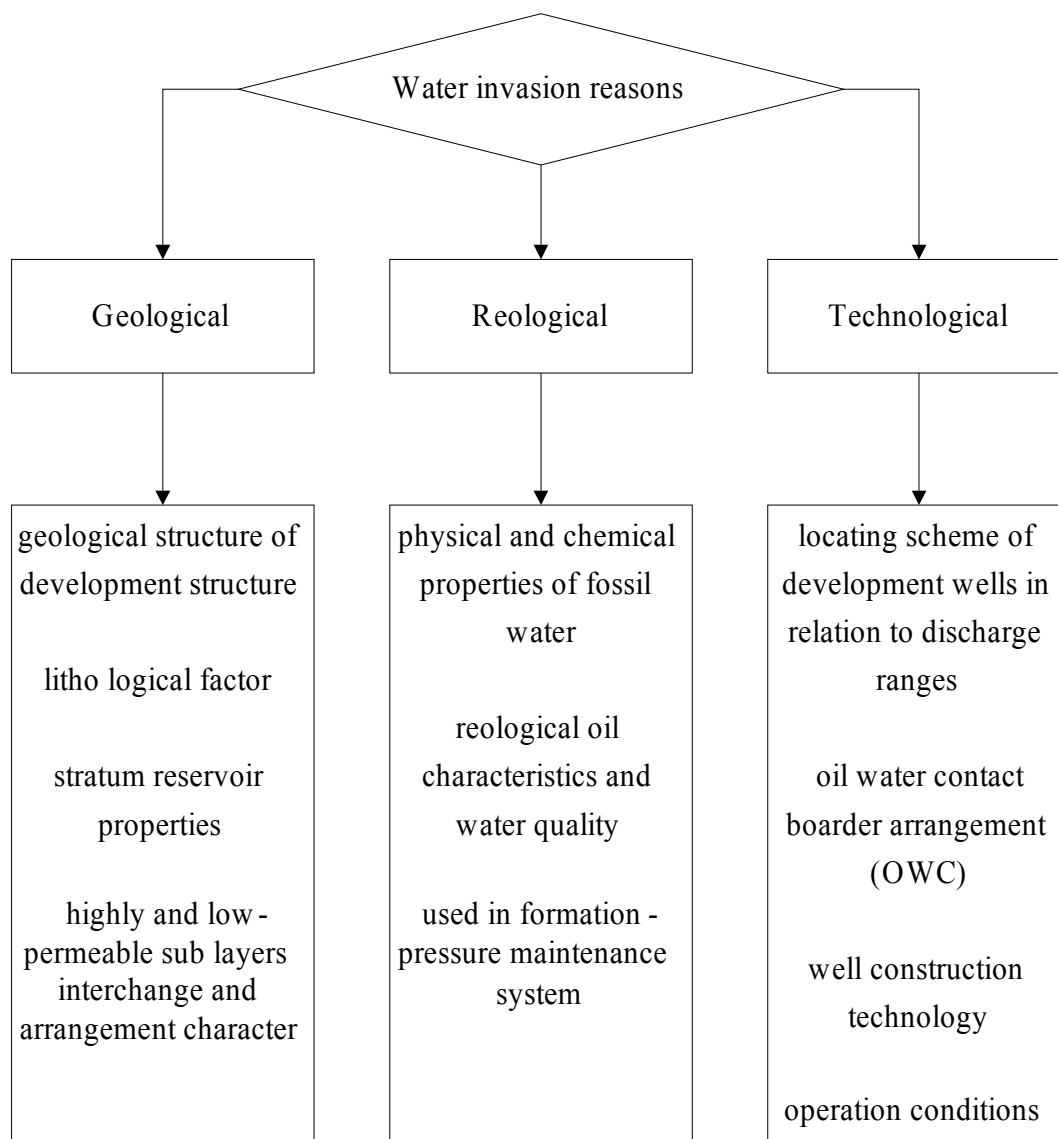


Fig.1. The reasons, which explain water invasion of development wells.

The next step, when the reason of water entry into boreholes have been determined, is allocation of it's migration ways. In the result of performed investigations on identification of well production water encroachment character as exemplified by Romashkino field [2] it was established that the ways of water entry to the bottom of development wells can be classified in the following way:

- According to the space between rocks and production casing;
- during OWC dislocation in exploitation filter zone;
 - during injected and edge water approach to exploitation filter zone on homogeneous stratum foot part or on the more permeable sub layers;
 - during well exploitation with the bottom, which is higher than OWC in homogeneous stratum with invasion cone formation;
 - through deformations in production casing by the waters of higher horizons.

Let's try to compare and identify the sequence of water filtration ways into a borehole. Block diagram, which shows definite interconnections between varieties of water entry ways is given in Fig. 2. As a rule, cone formation of water encroachment appears in highly productive reservoirs by the presence of vertical directed permeability in near wellbore part. You should take into account the fact that the presence of channels, deficient strength and isolating characteristics of cement stone part in annular space between exploitation well and rocks prevent cone formation in significant number of boreholes. The entry of extraneous water happens in the discussed case, even by not essential pressure drop. Therefore, the biggest number of boreholes is watered because of extraneous water filtration by faulty sealing of annular space.

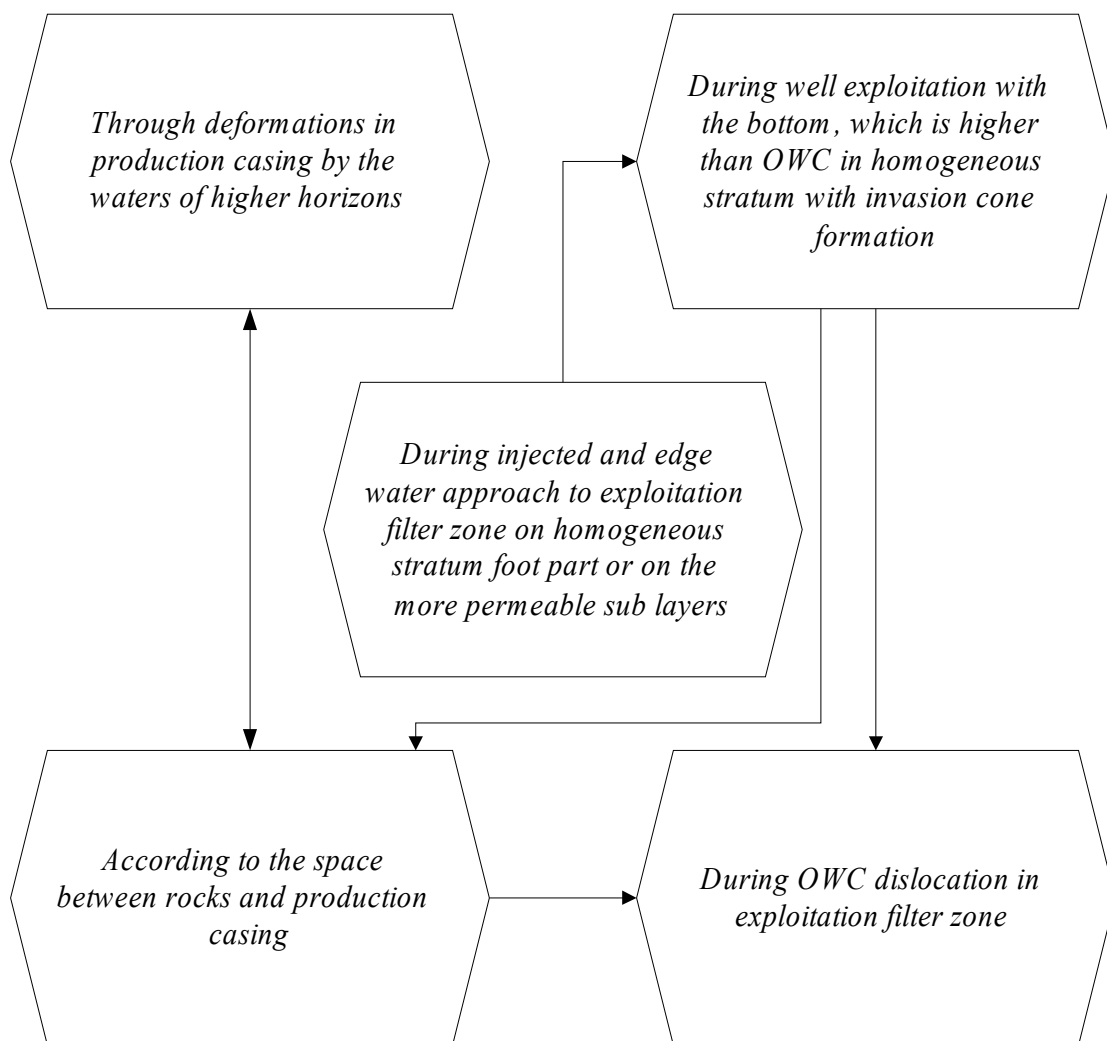


Fig.2 The classification of water entry ways to development well bottoms.

In its turn, tightening of formation-pressure maintenance system and edge waters by the bottom part or by the most permeable stratum sub layers under the influence of fluid horizontal movement is the main way of water entry. It stands to mention the fact that progressive water cut increase, pointed only in 20 % of boreholes from a whole analyzed stock, which is usually has anomalous water invasion mode.

The questions about waters, which take part in encroachment of oil production, is not less important. One big group is that, which contribute to oil displacement from reservoir, the other does not play any important role in this process (see Fig. 3). The first group have the following composition: stratum water, which were in the bed in the beginning. Edge water, which bestirred due to elastic deformations of rocks and fluids, which saturate them in the result of formation pressure decrease (this brings rock volume in-crease, which leads to porous channel constriction, and also increase of saturating them waters) can be related to this group. The water, delivered by formation-pressure maintenance system can also be related to this group. It's properties is especially specific, so far as fresh water, which is taken from a basin with low temperature and minimal density, viscosity meanings, that leads to stratum thermal background decrease, is often used for injection.

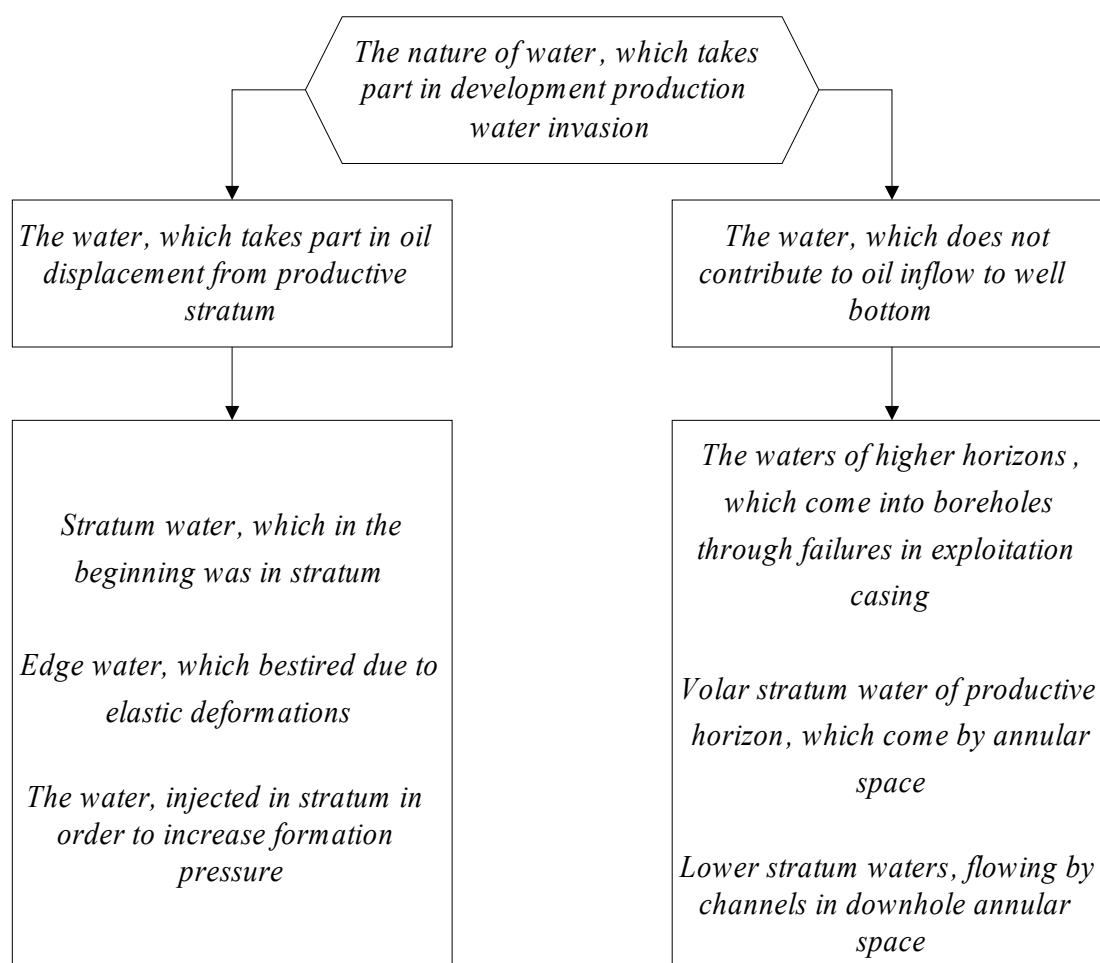


Fig.3. The waters, which take part in development production water invasion.

The second water category includes variants, which do not take part in injection and oil displacement and represents the waters of higher horizons, coming into boreholes through failures of exploitation casing. The mixture of stratum water with the water of the given groups at times give undesirable effect in form of salt settling out and their sedimentation on exploitation facility (the reason of it can be inconsistency of Bobrikovskian horizon water and Tournaisian stage dissolved salts. The following two types of water influx are volar stratum water of productive horizon, which come by annular space and lower stratum waters, flowing by channels in down hole annular space. The indicated types are the most difficult objects of isolation. First, they do not take part in oil displacement from reservoir and come into the borehole by the channels of bottom-hole area and annular space between exploitation casing and rock, bringing to depression decrease on stratum oil-bearing part and relative permeability decrease by oil.

In the result of realized investigation and generalization we can make the following conclusions:

- we compared and classified the reasons of development boreholes water invasion;
- we offered the classification of water encroachment according to the three groups, every of which is united by properties combination for the first time ever. All classes got common title;
- we made classification of water entry ways on development well bottoms and we offered block diagram with the indication of connection and transition inside it;
- the parameter, as the nature of water, which waters development production, is united in block diagram.

References

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