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Integrated Reservoir Geology, Seismic Facies, and Production Studies to Determine the Potential of Well Development Area

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Summary

Dynamic models of the seismic, geological, and flow characteristics of a reservoir are the main tool used to evaluate the potential of drilling new infill wells. Static geological models are mainly based on borehole data combined with dynamic analyses of production dynamics. They are used to determine the redevelopment of and adjustments to new drilling locations; however, such models rarely incorporate seismic data. Consequently, it is difficult to control the changes in geological models between wells, which results in the configuration of well positions and predicted results being less than ideal. To improve the development of adjusted areas in terms of their remaining oil contents, we developed a new integrated analysis that combines static sediment modelling, including microfacies analysis (among other reservoir and seismic properties), with production behaviours.

Theory / Method / Workflow

Here, we illustrate this new process by (1) establishing favourable areas for static geological analysis; (2) studying well recompletion potential and the condition of non-producing wells; (3) conducting interwell analyses with seismic and sedimentary data; (4) identifying potential sites constrained by seismic and geological studies, as well as initial oilfield production; 5) providing suggestions in a new well development plan. The first step that we recommend for recovering the remaining oil in the South Mangyshlak Sub-basin is to fully use the old well stock to recomplete wells for production from overlying horizons, which will provide quick and cost-effective potential sites. Our analysis of all shut-in and idle wells led to the selection of many wells suitable for recompletion from overlying horizons. As a result of analysing well dynamics, and in combination with potential sections, wells on horizon J-III were selected to recomplete from overlying horizons. According to the final proposal for horizon J-III, three wells are suitable for recompletion from overlying horizons and eight new wells are suitable for drilling in the southern part of the sub-basin suitable for recompletion to overlying horizons and new wells for drilling in the southern part on the distribution plane of proved-undeveloped reserves. The next aspects are crucial for drilling new wells, the reserves of potential objects, the productivity of neighboring wells, the thickness of oil reservoirs, and the presence of anomalies in the field of seismic attributes. On that basis, the new wells defined in areas where the high rate of existing production wells and the high thickness of oil reservoirs. The wells in the edge areas of oil deposits, the reserves of which previously not produced. After putting new into operation, it is necessary to continue drilling work because of the new actual conditions. Using the map of the distribution of the proven undeveloped reserves, new wells were proposed for each reservoir interval. Then, shut-in deeper wells were recommended for secondary utilization to produce from the overlying horizons. This approach of generating a development plan is iterative and was based on the map of undeveloped reserves. To increase

the chance for the future redevelopment of closely spaced wells, we recommend drilling as many horizons as possible during the development of new wells.

Results, Observations, Conclusions

Seismic data were used to constrain a structural and geological model of the study area, which provided the basis for adjusting the developmental approach of the oil reservoir and for assessing the exploration potential of the area. A comprehensive study using seismic inversion attributes and sedimentary (micro)facies revealed that reservoirs in the South Mangyshlak Sub-basin are mainly composed of deltaic deposits. Deposition in the reservoir included deltaic and branched channel sand bodies; the thickness of the sandstones varies markedly in the study area, and the lateral connectivity of the reservoir is complex. The main target horizon, J-III, contains four 4-branched deltas and channel sand bodies that are spread in a wide, perpendicular strip, with the distribution and productivity of hydrocarbons being determined by the facies characteristics. There is potential for redevelopment of the field; specifically, the low-seismic-amplitude traps at the edges of the study area appear to have potential. Resources in the southern and central part of the area amount to 29.5 MMbbl. Therefore, it is necessary to drill new wells to rapidly develop these field reserves.

Novel/Additive Information

The new, integrated workflow proposed here should enable the operating company to efficiently review production enhancement opportunities within the bypassed zones of reservoir layers, whether targeting structural or stratigraphic oil zones. Moreover, new drilling and workover opportunities to access remaining oil along the edges of the main sand bodies and in discontinuous areas have been identified from their seismic attributes. We ranked these targets based on their expected flow rates, ultimate recoveries, and associated reservoir and operational risks. This approach also provides a means of developing an in-depth understanding and for conducting a detailed exploration of the known best-producing areas that have historically been successfully drilled within the field.

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