Effectiveness of Seismic Surveying in the Perm Kama Area

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Systematic investigation of the deep structure of the Perm Kama area by the seismic method was begun in 1951 by Permneftegeofizika. These studies were initially reconnaissance in nature.

Areal exploration of structures in the sedimentary section and their preparation for deep prospecting drilling have been accomplished in considerable volume since 1955. From 1955 to 1963, the following 17 uplift in the Perm Region were prepared for deep exploration drilling by seismic surveying: Kozubayev, Grigor'yev area (including Nikol, Dolganov, and Grigor'yev uplifts), Byrmin, Mazunin, Startsev, Ashap, Kalinin, Tarakanov, Sosnov, Polom, Vereshchagin, Chernov, Myl'nikov, Nezhdanov, Zyu kov, Beloyev, and Kochev. Up until the beginning of 1964, deep exploration drilling had been carried out on the Kozubayev, Startsev, Vereshchagin, Tarakanov, and Mazunin uplifts and in the Grigor'yev area.

Marker reflecting horizons in the Perm Kama area are identified with the following geologic boundaries: reflection K - with the top of the carbonate sediments of the Iren horizon, which is the first marker surface on which structural diagrams are made; reflection I - with the top of the clastic part of the Verey horizon; reflection II - with the top of the clastic sediments of the Yasnopolyan supra-horizon; reflection III - with the top of the clastic sediments of the Kynov horizon.

Comparison of structural maps based on seismic data with deep drilling data is accomplished for reflecting horizons II and III in connection with oil exploration in Lower Carboniferous and Devonian sediments.

The Kozubayev uplift occurs on the Loban swell within the area of the Permsko-Bashkir dome. Exploration drilling was begun here in 1955; the reflection method was used. Observations were along a system of transverse profiles with a distance of 500 m between shot points and 25 m geophone spacing. Refraction work was carried out to trace the first rigid interface and to determine velocities in the unit above the Kungur.

As a result of work on reflecting horizon II, which corresponds to the top of the clastic sediments of the Yasnopolyan horizon, a gentle brachyanticline with an amplitude of 100 m was found. The structure map based on drilling is very similar to the seismic map. See Fig. 1.

The maximum difference in position is 15-20 m.

The Grigor’yev area is located in the southwest part of the Ghermoz saddle. Exploration drilling was begun here in 1959 on the basis of seismic surveying. The total length of the reflection profiles was 500 km with a density of the net of profiles from 1.5 to 0.9 km per sq km. The reflection method was used to study interfaces in the Carboniferous and Devonian and the refraction method to determine the top of the halogen-carbonate rocks of the Iren horizon. The distance between shot points using the reflection method was 725-625 m; for the refraction method, 3125-2500 m. The distance between receivers was 20-25 m.

Seismic investigations in the Grigor’yev area have revealed the Dolganov, Nikol, and Grigor’yev areas on reflecting horizons of the Carboniferous and Devonian. Nine deep exploration wells were drilled in the Grigor’yev area for oil exploration in the Devonian sediments. Comparison of the structure map for reflecting horizon III with results of deep exploration drilling shows that in this structure the seismic data do not reflect the deep structure. The error was due to the low level of the seismic method in 1959. See Fig. 2.

The Mazunin uplift, which is located on the southeast border of the Kamsko-Kinel depression, was found and prepared for exploration drilling in 1959. A distinguishing feature of the region is the shallow depth of occurrence of the halogen-carbonate complex. The upper clastic complex is replaced toward the east by dense carbonate rocks. The parameters of this complex have been studied by structural-parametric drilling in conjunction with seismic logging. The work bears the character of areal reconnaissance with subsequent detailization along a system of profiles.

Observations by the method of reflected waves was carried out with shot intervals of 280-350 m with grouping of five geophones per channel on a 40-m base.

The dimensions of this uplift on horizon II within the 1475 m structure contour is 9 by 3 km; amplitude is 50 m.

The structure based on drilling coincides in general with that from the seismic surveying. On the top of the clastic sediments of