Stratigraphic Model of Vendian Terrigenous Deposits of Nepa Arch (Nepa-Botouba Anteclise), Eastern Siberia*

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Abstract

Nepa Arch is located in the central part of Nepa-Botuoba Anteclise, in the southeast part of Eastern Siberia (Figure 1). Nepa Arch is the most studied oil and gas area of Eastern Siberia and includes the oil and gas fields Vakunay, Verhne-Chona, Timpuchikan, Talakan and others (Figure 1). Presence of these oil and gas fields demonstrates the high petroleum potential of this area. Despite this fact there are still some unsolved questions. One of them is the stratification of productive horizon V_{10} in the conjunction zone of Nepa-Botuoba Anteclise and the Pre-Patoma regional trough. Here horizon V_{10} differs from horizon V_{10} of inside areas of Nepa-Botuoba Anteclise in its structural and textural features. Therefore, two types of horizon V_{10} were distinguished in the Nepa Arch on these grounds. The first type of horizon V_{10} is identified inside the area of Anteclise (Verhne-Chona, Timpuchikan, Chaianda fields). Thickness of this type of horizon V_{10} reaches 10-12 m. It consists of quartz-feldspathic sandstones with mudstone and siltstone interbeds of 1-2 m thickness.

Correlations

Three parts can be selected in the first type of horizon V_{10} (Figure 2a). The lower section consists of alternation of anisomerous sandstones (mainly gritstones) and thin, lenticular mudstone and siltstone interbeds. The midsection consists of fine-grained (rare medium-grained) argillaceous sandstones. This part of horizon V_{10} is characterized by higher radioactivity because of high content of clay minerals. The upper section consists of alternation of anisomerous sandstones (mainly fine- and medium-grained sandstones) with lenticular and horizontal mudstone and siltstone interbeds. Porosity of the first type of horizon V_{10} ranges from 2-5% to 22%, the permeability reaches $500*10^{-15}$ m^2. The second type of horizon V_{10} was revealed in the southeast and the east slopes of Anteclise (Talakan Field and others). The second type of horizon V_{10} embodies heterogeneous alternation of sandstone and clay rocks. However, a number of beds can be indicated. Each bed has a clear marked bottom, where coarse-grained, gravel sandstones gradually moved onto mudstones (Figure 2b). Sandstones are characterized by massive structure, rare lenticular, inclined bedding. Mudstones are characterized by horizontal bedding. Porosity of the second type of horizon V_{10} is 10-15%, the permeability reaches $200*10^{-15}$ m^2.

Taking into consideration the difference of structure between the first and the second types of horizon V_{10} it was decided to name horizon V_{10} of the second type horizon V_{11}, as it is older (Figure 3). A unit of high radioactivity near the top of Vendian terrigenous deposits (between horizon V_5 and V_{11}) is helpful in creating a good correlation. In the upper part of this member a sandstone-siltstone unit is distinguished, which corresponded to horizon V_{10} of the first type in the Vakunay Field. Sorting of this sandstone-siltstone unit allows us to make a conclusion about an absence of the pre-Tira depositional break, because thickness of the member between the bottom of horizon V_5 and top of horizon V_{10} is maintained and reaches 20 m. Further analysis of this profile provides a conclusion about the limited distribution of the intra-Nepa depositional break, made on the grounds of change of thickness of the member between the bottom of horizon V_{10} and top of horizon V_{13}. Thickness of this member changes from 50 m to 70 m in the wells, located to the south of Verhne-Nyuya-780 well, but is 0 m in the wells located to the north of Verhne-Nyuya-780 well. Such observation gives an opportunity to suggest that the intra-nepa depositional break is developed only in the central part of Nepa-Botuoba Anteclise.

The siltstone and shale member between the bottom of horizon V_{11} and top of horizon V_{13} is replaced by sandstones and siltstones near the paleo-coastline. It was decided to name this horizon V_{12}.

Conclusions

In 2000 the regional seismic profile Batolit was acquired and allows for the first time consideration of the stratigraphic model of Nepa Arch described above from seismic data. On the grounds of complex analysis of seismic data and log and core data, the following conclusions were made:

1) Using log and seismic data reflections, connection of different productive horizons can be indicated.

2) Reflections presumably connected with horizons V_{10} and V_{13} join in the area of Verhne-Chona-69 well, forming a united reservoir (Figure 4, location I).

3) Reflection presumably connected with horizon $V_{11\text{-}2}$ (it corresponded to horizon V_{11} on Figure 3) shims to horizon V_{10} (Figure 4, location II).

4) In deep pressure sinks on the basement surface one reflection can be indicated (under reflection presumably connected with horizon V_{13}). Admittedly this reflection can be associated with horizon V_{14}.

5) In Talakan-812 well area horizon $V_{11\text{-}1}$ shims to horizon V_{10} (Figure 4, location III). Horizon $V_{11\text{-}1}$ was not penetrated by drilling before.

6) On the grounds of displacement of reflections, fractures are marked out.

Analysis of correlation of reflections on the regional seismic profile Batolit confirmed the stratigraphic model of Nepa Arch, originally based on log and core data. Conclusions made in the presented research are very important for prediction of oil-and-gas content of the Nepa Arch.

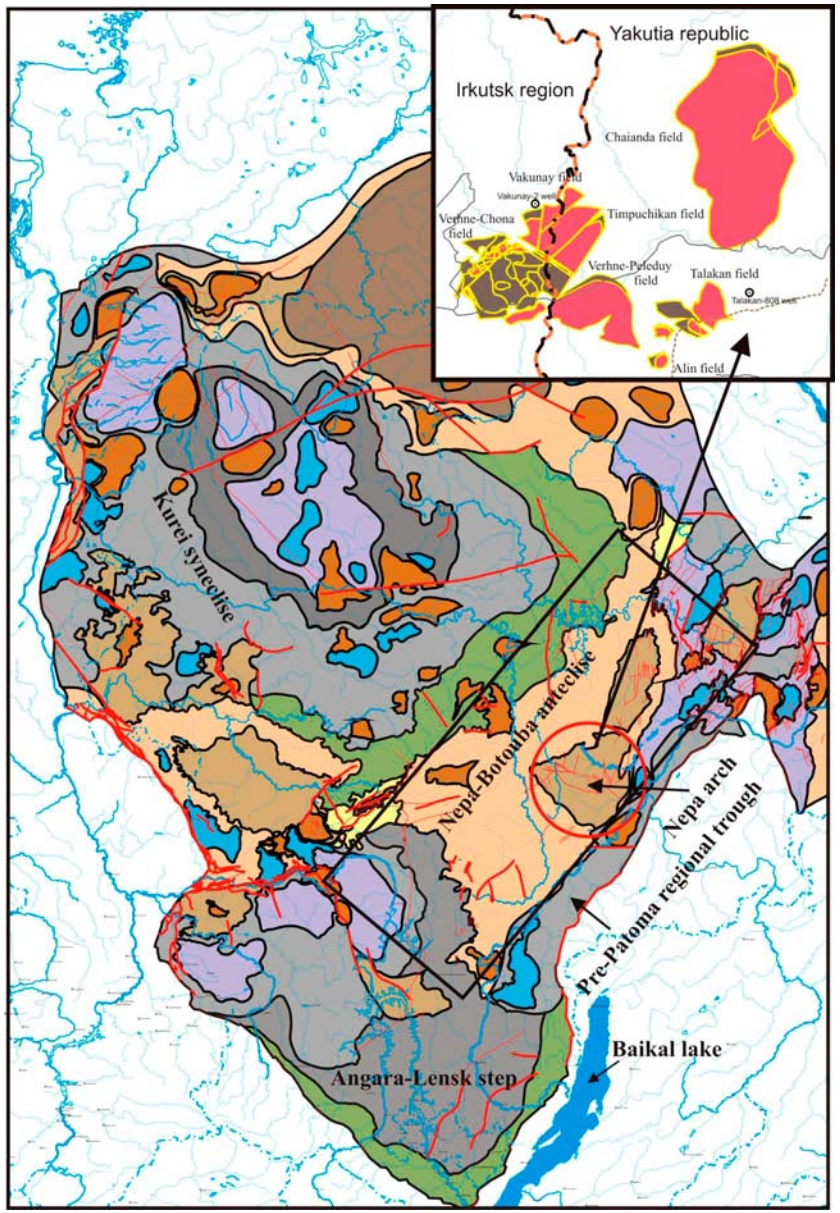


Figure 1. Location map of research area (Nepa Arch).

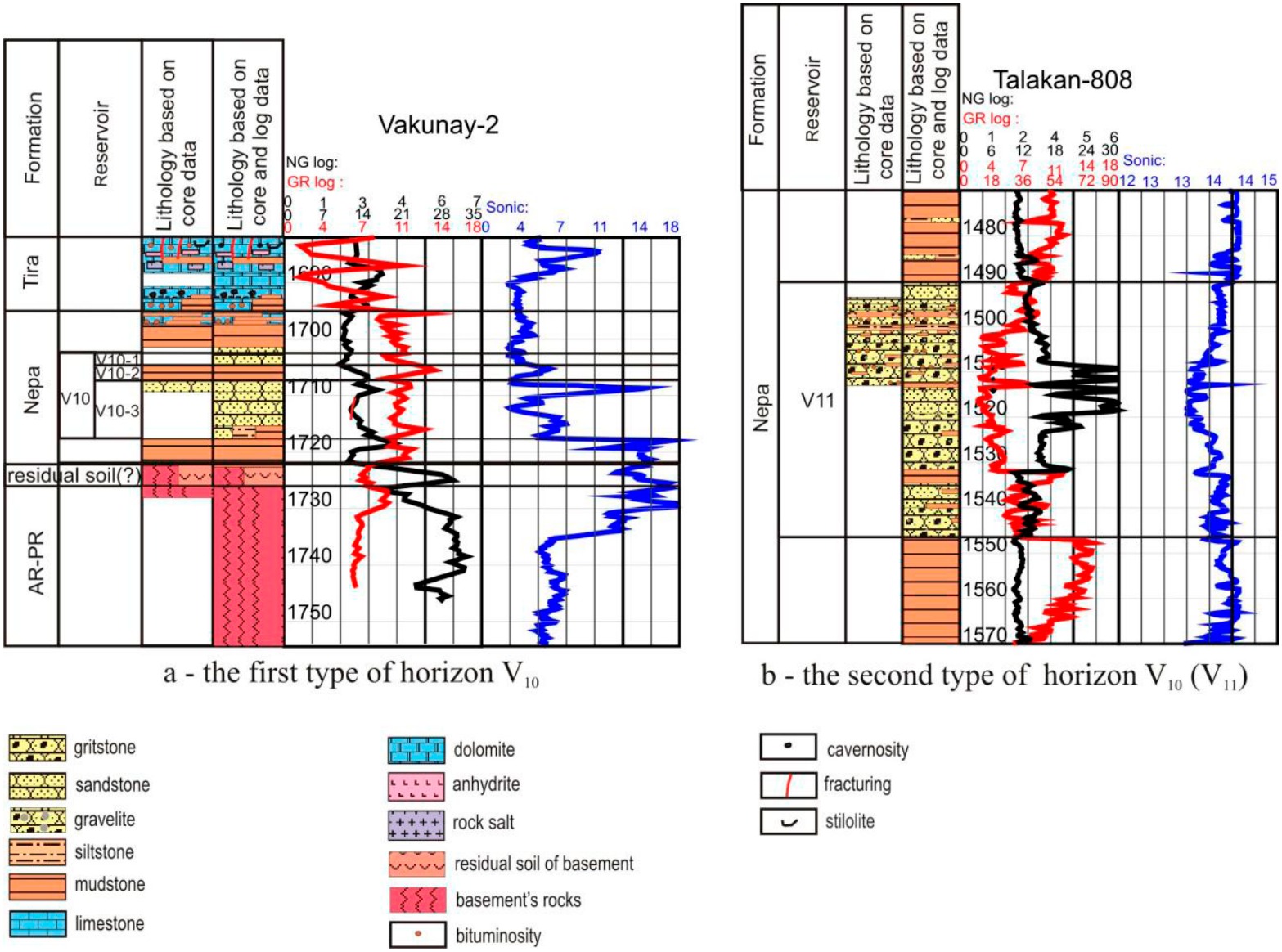


Figure 2. Typical sections of horizon V10 (a) and horizon V11 (b).

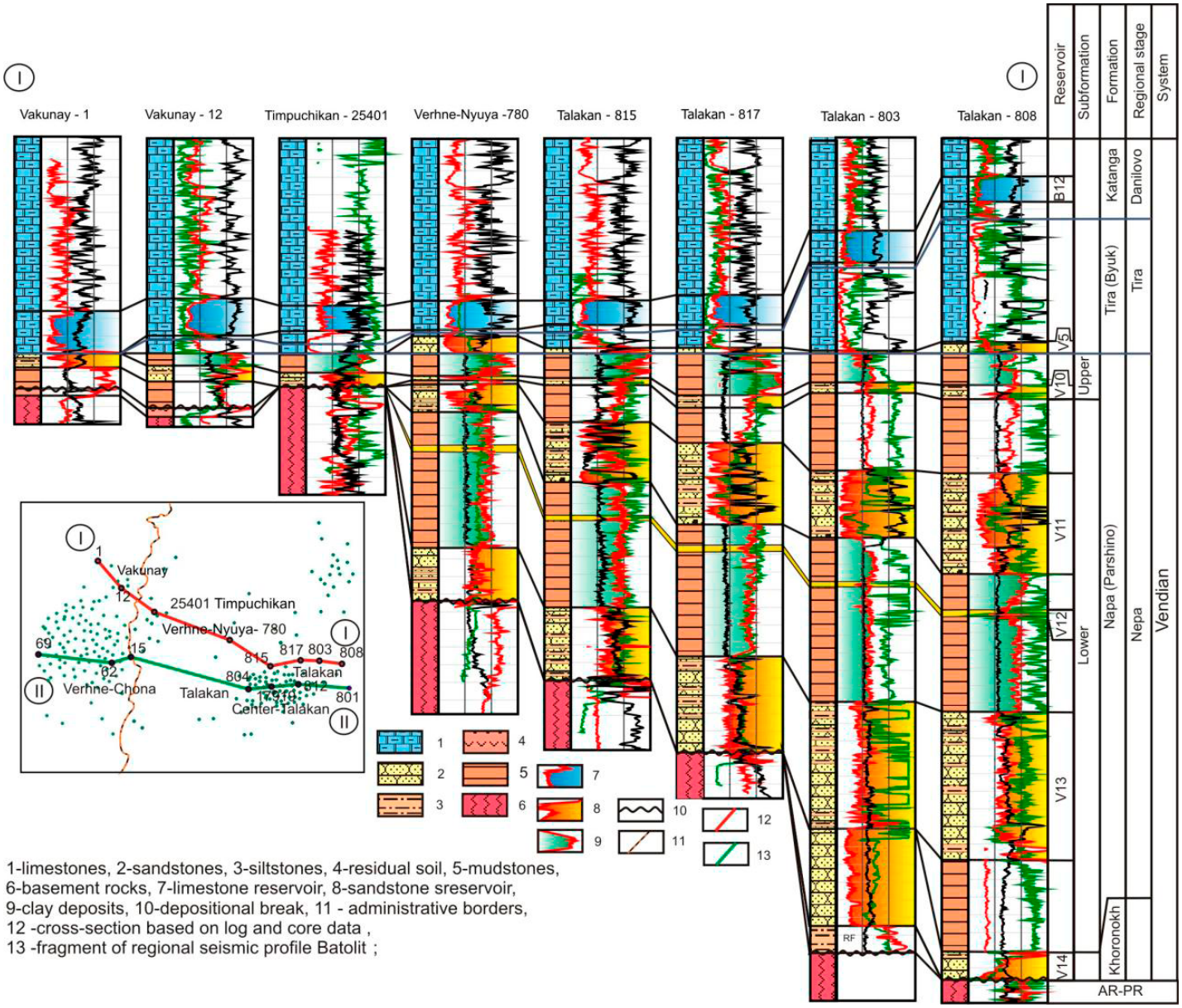
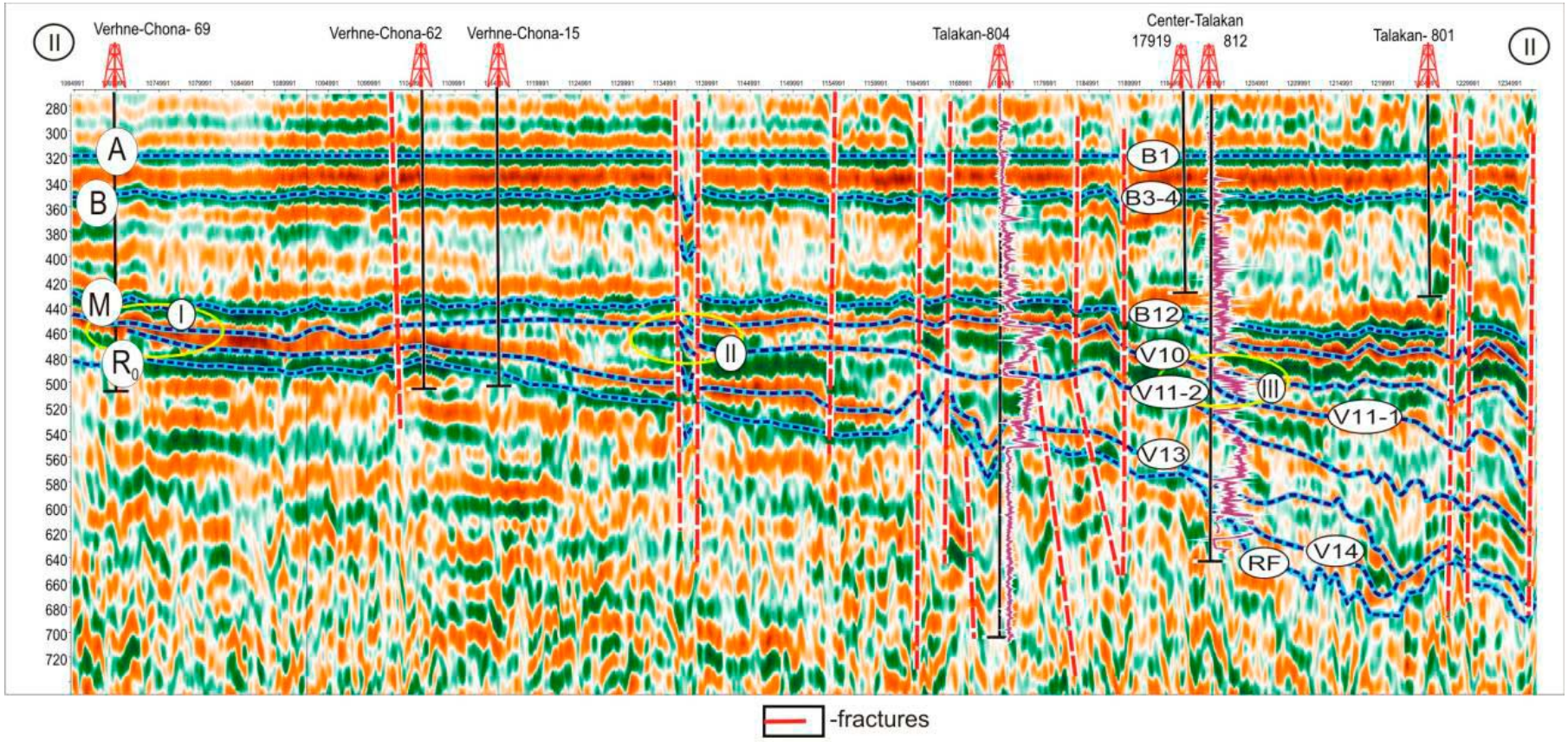


Figure 3. Cross-section based on log and core data (Vakunay-1 – Talakan-808).



A - osinsk horizon; Б - top of tetere formation; M - top of tira formation; R_0 - surface of Ar-PR_1 basement

Figure 4. Section of regional seismic profile Batolit osinsk horizon leveled.