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Seismogeological Criteria for the Gas Potential of Aptian–Cenomanian Sediments in the North of West Siberia (by the Example of the Yubileinoe Field)[1]

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Abstract—Seismogeological criteria for the gas potential of the Aptian–Cenomanian sediments of West Siberia are substantiated. The research was carried out by the method of integrated interpretation of seismic materials, well logs, well test results, and petrophysical studies. As a reference object we used the Yubileinoe oil and gas condensate field located in the Nadym–Pur interfluve, in which a unique gas deposit is concentrated in the Cenomanian reservoir PK_1 and the Albian sand bed PK_{18}. Based on the research results, seismogeologic criteria for gas prediction have been formulated. Massive Cenomanian gas pools are displayed in wave seismic fields by: (1) the presence of reflectors formed at the gas–water contacts in time sections and a decrease in the amplitude parameters of the reflector G confined to the roof of Cenomanian sequence; (2) an increase in the time thickness (ΔT), a decrease in the interval velocities (V_{int}), and a decrease in the amplitude–energy parameters of the seismic record in the Aptian–Cenomanian sequence. Aptian–Albian sheet gas pools are displayed in the wave fields by a sharp increase in the amplitudes of the seismic record, forming "bright spot" anomalies in the time sections.

Keywords: seismic exploration, petroleum prediction, gas pool, "bright spot", dynamic parameters of seismic record, West Siberia

INTRODUCTION

The northern and arctic areas of West Siberia are among the world's largest gas-bearing region. The main gas reserves in the north of the West Siberian oil and gas province are concentrated in the Aptian–Albian–Cenomanian sequence (Kazarinov, 1963; Nesterov, 1971; Kontorovich et al., 1975; Ermilov, 2004).

The Yubileinoe oil and gas condensate field, unique in terms of gas reserves, is located in the Gubkinskii oil and gas region (NGR) of the Nadym–Pur oil and gas area (NGA), within which such giant gas fields as the Medvezh'e, Urengoiskoe, Yamburgskoe and Yamsoveiskoe fields have been discovered (Fig. 1).

In this region, the principal gas pools are concentrated in the Cenomanian sand body PK1. It underlies thick clay Turonian seal rocks (Kuznetsov Formation), to which one of the most reliable seismic reflector in West Siberia is confined. The Cenomanian pools are massive and controlled by anticline structures. Smaller gas, condensate and oil pools are localized in the Aptian–Albian, Neocomian and Middle–Upper Jurassic sandy layers. This is the situation that takes place on the Yubileinoe field, which is the target of the research.

The unique Yubileinoe oil and gas condensate field was discovered in 1969 by prospecting well No. 1, in which a gas gusher with a discharge of 1182.5 thousand m^3/day was obtained from the Cenomanian sand bed PK1. At present, 7 hydrocarbon pools have been discovered at the field: 1 pool in Cenomanian sand body PK1; 3 pools in Aptian–Albian sand beds PK18, PK20, and PK21; 2 pools in Neocomian layers AU11, BU8/0; 1 pool in the Middle Jurassic layer J2 (Fig. 2). The main gas reserves of 92% of the total initial reserves are concentrated in bed PK1; the reserve of Middle Jurassic–Albian sediments is 8% of the total reserves (Nesterov et al., 1971; Ermilov et al., 2004; Kontorovich et al., 2016).

The pool in the body PK1 on the Yubileinoe field is confined by a relatively large anticlinal structure, the area of which in the Cenomanian roof topography is 523 km^2, the amplitude is 153 m (Fig. 1). As of 2015, cumulative gas production at the field amounted to more than 300 billion m^3, residual gas reserves exceed 200 billion m^3.

The Yubileinoe field has been well studied by modern seismic exploration and deep drilling and can be considered as a reference field for the identification of seismogeologic criteria for identifying gas pools in the Aptian–Albian–Cenomanian sequence in the north of West Siberia.

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SEISMOGEOLOGIC CRITERIA OF THE GAS CONTENT IN CENOMANIAN SEDIMENTS

The reflectors M and G in time cross-sections limit the Aptian–Cenomanian sequence, with which the majority of gas reservoirs are associated in the north of West Siberia. Reflector M is confined to the roof of the Neito unit (Neocomian roof), reflector G—to the bottom of the Kuznetsov Formation (Cenomanian roof) (Kontorovich, 2009; Kontorovich et al., 2016, 2017).

In this region, on large uplifts controlling the unique Cenomanian pools, gas-water contacts (GWC) are often outlined in time sections—an intense reflected wave is formed at the contact of gas and water-saturated sandstones of the PK1 bed. In such objects, under the anticlinal structures in the G reflector topography there are locally occurring reflectors, which become one with the reflector G in the uplift slopes direction. Reflectors associated with GWC are usually quasi-horizontal or downward convex in shape. It is this wave pattern that is displayed at the Yubileinoe field (Fig. 2, 3).

The physical nature of the reflector GWC. Reflected seismic waves are formed at the boundaries of geologic beds with various physical properties. For seismic investigations, such characteristics of rocks as density and p-waves velocity in them are the most important. The product of these parameters is the acoustic impedance of the medium, and the differences in acoustic impedances at the geologic boundaries determine the reflection coefficients and, as a result, the energy level of the reflectors formed on them.

The Cenomanian sequence and its active reservoir PK1 is composed of interlayering siltstone, mudstone and sandstone, with the sand predominating (Fig. 4). On the one hand, the mudstone-clay units separating sand beds are characterized by bad reservoir properties; on the other hand, they are not good seal rocks. Reservoir properties of sand beds that are part of an integrated Cenomanian reservoir are also heterogeneous: good reservoirs with 30% porosity very often are replaced laterally by the mudstones. These circumstances predetermined the fact that the Cenomanian gas pools are massive in type and above the water. At the Yubileinoe field, the average porosity of the gas-saturated sandstones of bed PK1 is 32%. The GWC of the Cenomanian pool is identical with the uplift enveloping isohypse in the topography of G reflector. GWC is on the absolute depth mark of –1080 m. The Cenomanian pool height is 153 m (Fig. 1).

The presence of reflector GWC indicates a boundary of rocks with difference in acoustic impedance. At the same time, the reflector, which is being formed at the GWC, is not isochronous and "cuts" the uneven-aged strata within the structure, which are part of an integrated productive sand PK1.

The analysis of sonic logging data showed that the Cenomanian section is poorly differentiated acoustically. It means the p-waves velocity differences at the boundaries between different lithological units, as a rule, do not exceed 100–150 m/s. Since the lithological composition of rocks lying above and below GWC is identical, it is obvious that in this case the difference in acoustic impedance on GWC can only

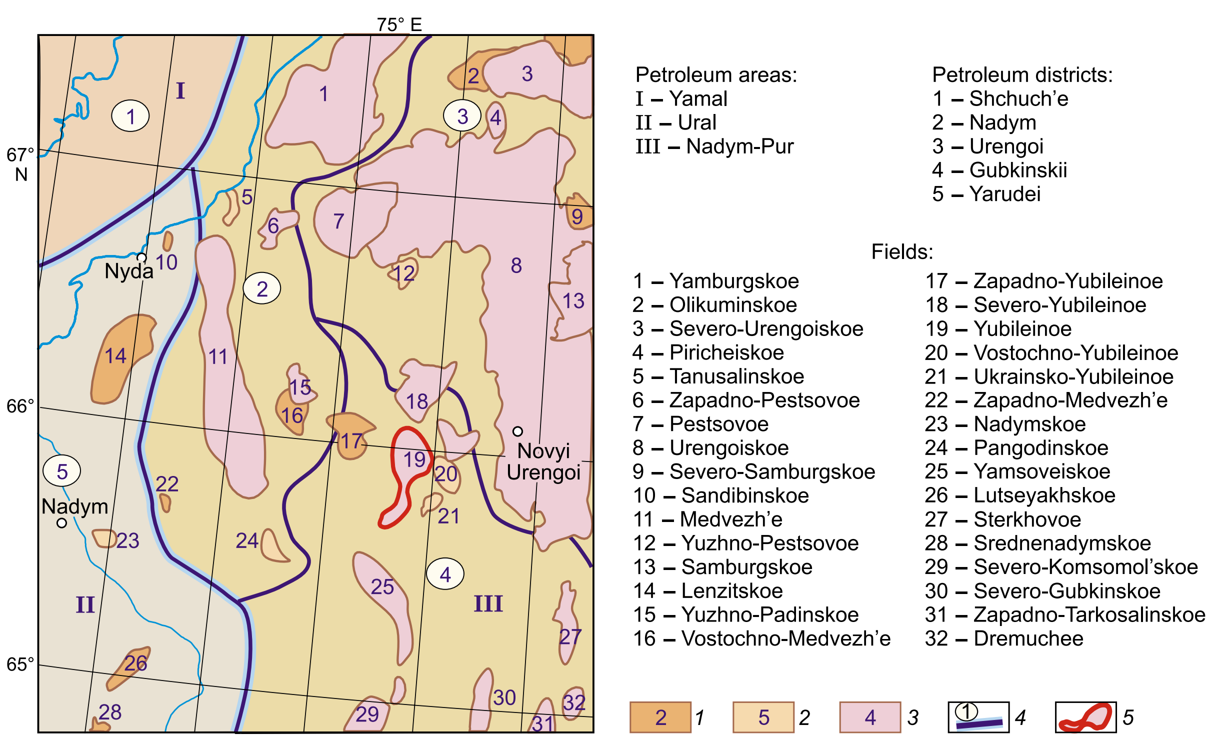

Fig. 1. Fragment of the scheme of oil and gas geologic zoning of the West Siberian oil and gas province (Nadym–Pur interfluve). *1–3*, fields: *1*, oil, *2*, gas and gas condensate, *3*, oil and gas condensate; *4*, oil and gas areas and regions; *5*, Yubileinoe field.

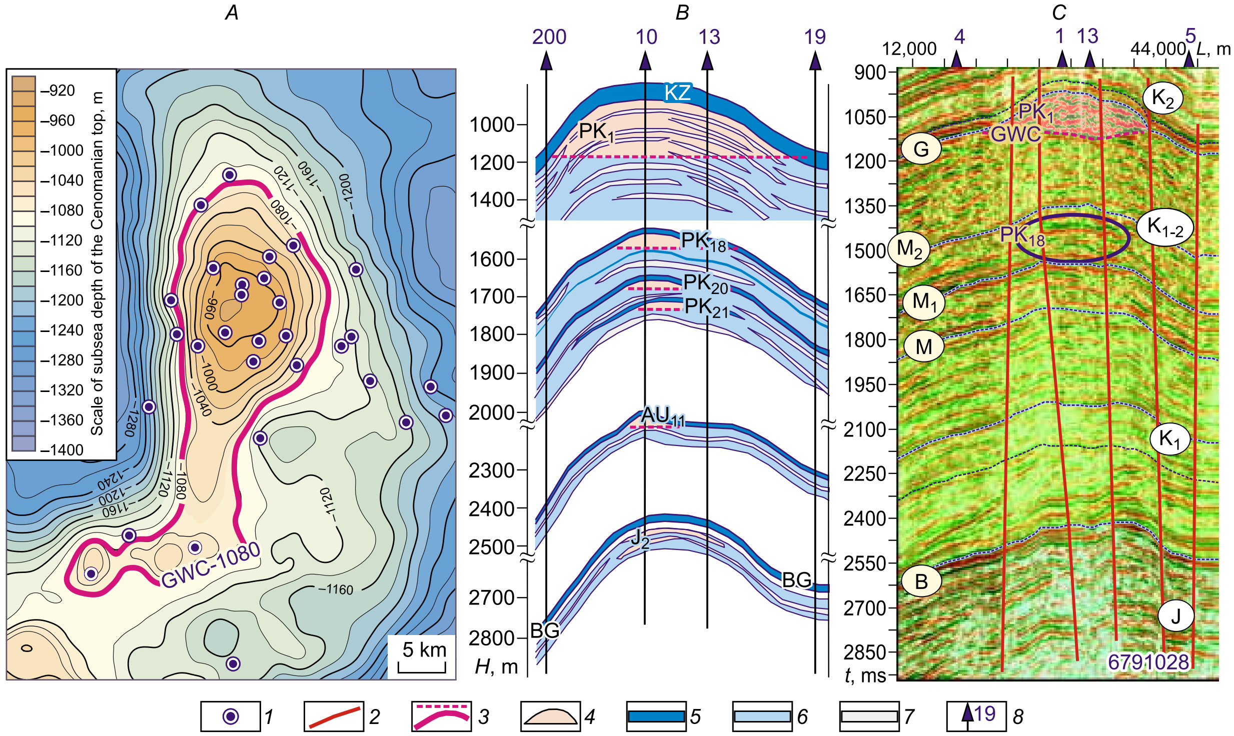

Fig. 2. Structural map for the Cenomanian (*A*) top, geologic (*B*) and seismic (*C*) sections (Yubileinoe field). *1*, wells; *2*, faults; *3*, gas-water contacts; *4*, hydrocarbon pools; *5*, seal rock; *6*, water sands; *7*, impermeable rocks; *8*, well and its number.

be associated with the reservoir saturation—with the Cenomanian gas pool.

Reservoir velocity and density. It is known from published materials that in terrigenous rocks at 1–1.5 km depths the velocity of p-waves in water and gas saturated reservoirs differ by 15–25% (Bondarev, 2007). The analysis of the well logging and well tests data from a number of fields in the north of West Siberia performed at IPGG SB RAS showed that the fluid-saturation of the sand beds of TP, HM and PK groups (Aptian–Albian–Cenomanian sequence) sig-

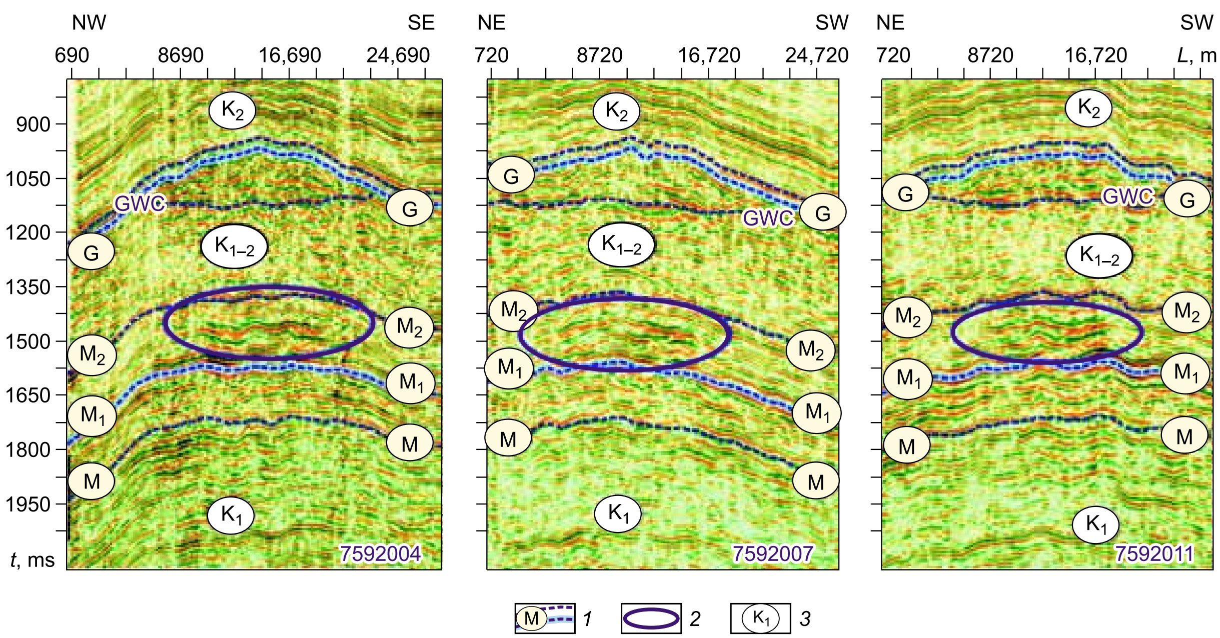

Fig. 3. Seismogeologic characteristics of Aptian–Cenomanian gas pools (Yubileinoe field). *1*, reflectors (M, Neito clay unit; M_1, M_2, clay units in the Aptian–Albian sediments; G, the Kuznetsov Formation bottom); *2*, “bright spot” seismic anomaly; *3*, seismogeologic sequences (K_1, Berriasian–Lower Aptian, K_{1-2}, Aptian–Albian–Cenomanian, K_2, Turonian–Cenozoic).

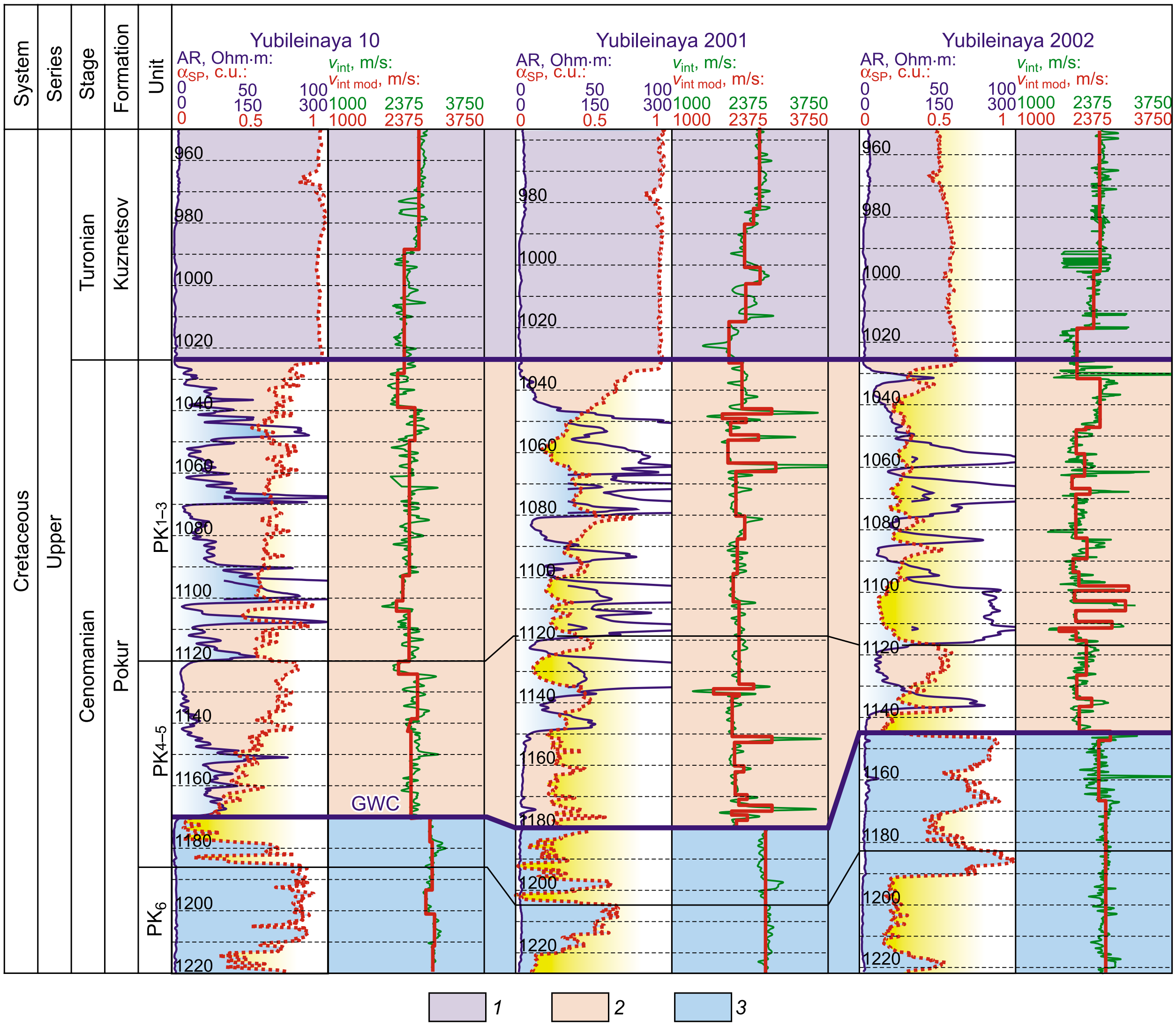

Fig. 4. Well log correlation for the Cenomanian sediments of the Yubileinoe field. *1*, Kuznetsov seal rock; *2*, gas-saturated part of the section; *3*, water-saturated part of the section.

nificantly affects the acoustic characteristics of the rocks. P-waves velocity in gas-saturated sand beds is 2100–3000 m/s, in water-saturated sand beds is 2500–3800 m/s (Gubin, 2015). On average, the velocity differential at the boundary of gas- and water-saturated sandstones is about 500–600 m/s. This is evidenced by the data of sonic well logs in Nadym–Pur interfluve wells.

Analysis of lithologic-sonic sections of productive wells at the Yubileinoe field leads us to conclude that the interval velocity in the gas-saturated part of the section is 2200–2300 m/s, in the water-saturated part—2800–2900 m/s. At the same time, the boundary between gas- and water-saturated sandstones is reliably distinguished in the sonic logs (Fig. 4).

Density changes similarly. The density of methane is 0.00072 g/cm^3, Cenomanian water—1.01–1.03 g/cm^3. That means the density of high-capacity water-saturated sandstones of the PK1 bed is significantly higher than the gas-saturated ones.

The synchronous decrease of velocities and densities of the gas-saturated part of the section leads to a sharp change in acoustic impedance on the GWC and causes an intense reflected wave to form on this physical boundary.

It should be noted that not all Cenomanian gas pools generate reflectors associated with the GWC in time sections. This may be due to both the quality of the seismic material and the limited resolution of the seismic survey. The GWC in time sections will be visible only when the height of the Cenomanian pool is large enough, and the waves reflected from its top and the bottom are not placed over each other. If the thickness of the gas-saturated stratum is insignificant, interference of these signals will occur, which may affect the amplitude-energy characteristics and the shape of the G horizon recording, but will not lead to the formation of a reflector associated with the GWC.

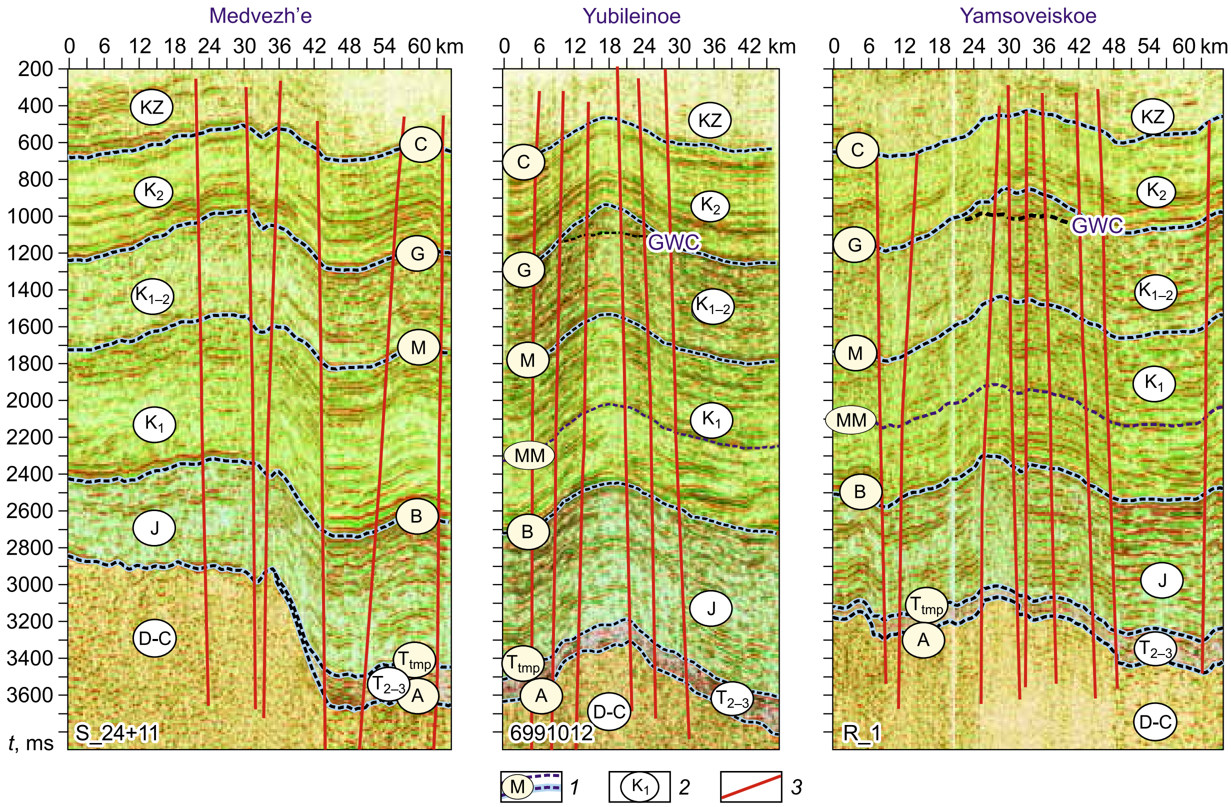

Fig. 5. Seismogeologic sections of profiles s_24 + 11 (Medvezh'e field), 6991012 (Yubileinoe field) and R_1 (Yamsovei field). *1*, reflectors (A, base of the sedimentary cover; T_{tmp}, is the top of the Triassic sediments, B is the top of the Bazhenov Formation, M is the Neito clay unit, G, bottom of the Kuznetsov Formation, C, top of the Gan'kino Formation), *2*, seismogeologic sequences (D–C, Devonian–Carboniferous, T_{2-3}, Triassic, J, Jurassic, K_1, Berriasian–Lower Aptian, K_{1-2}, Aptian–Cenomanian, K_2, Turonian–Cenozoic), *3*, faults.

There is another reason for the absence of a reflector associated with the GWC in time sections. The Yubileinoe field is located in the Nadym–Pur interfluve, near the Medvezh'e and Yamsoveiskoe fields, where unique gas pools are also concentrated in the Cenomanian sands PK1. At the Yamsoveiskoe field, as well as at Yubileinoe, the reflector associated with the GWC is reliably visible in time sections, but it is absent in the largest Medvezh'e field (Fig. 5).

This is explained by the fact that the seismic lines used in the work was worked out mainly in the first half of the 90s. The Yubileinoe and Yamsoveiskoe fields were bring into development in 1992 and 1997, respectively, and the initial, undistorted by the development processes pools are reflected in time cross-sections. The Cenomanian pool of the Medvezh'e field has been developed since 1973, by the time of the seismic exploration work it was heavily watered and distorted during development processes and, therefore, it is not visible in time sections.

The research results allow us to conclude that the presence of quasi-horizontal locally developed reflectors, which in the direction of the uplifts slopes become one with the G reflector and are located in the time sections under the anticlinal structures in the topography of the G reflector, is a reliable predictive criterion for gas pools selection in the Cenomanian sequence. At the same time, the presence of reflectors confined to the top and the bottom of the pool allows estimating its distribution zone and height using only seismic data.

Interval velocities. The gas-saturated intervals of the Cenomanian section are characterized by reduced p-waves velocities. When reservoir height is sufficiently big this factor will lead to a decrease in interval velocities (V_{int}), and consequently, an increase in time thickness (ΔT) of the whole Aptian–Cenomanian seismogeologic sequence bound in time sections by reflector G (the bottom of the Kuznetsov Formation) in the top and M (the Neito clay unit) in its bottom.

Figure 6 shows the dependences of the values of ΔT on ΔH for the Turonian–Cenozoic and Aptian–Cenomanian sequences constructed on the wells of the Nadym–Pur interfluve (the Yubileinoe, Medvezh'e and Yamsoveiskoe fields). There is the normal distribution for West Siberia for the Turonian–Cenozoic sequence located in the upper part of the sedimentary cover—in the direction of the depression zones as the thickness of the sequence increases (depth of the Kuznetsov Formation) the time of the reflector G increases. In the Aptian–Cenomanian there is an inverse distribution due to the drop in velocity in the gas-saturated part of the section.

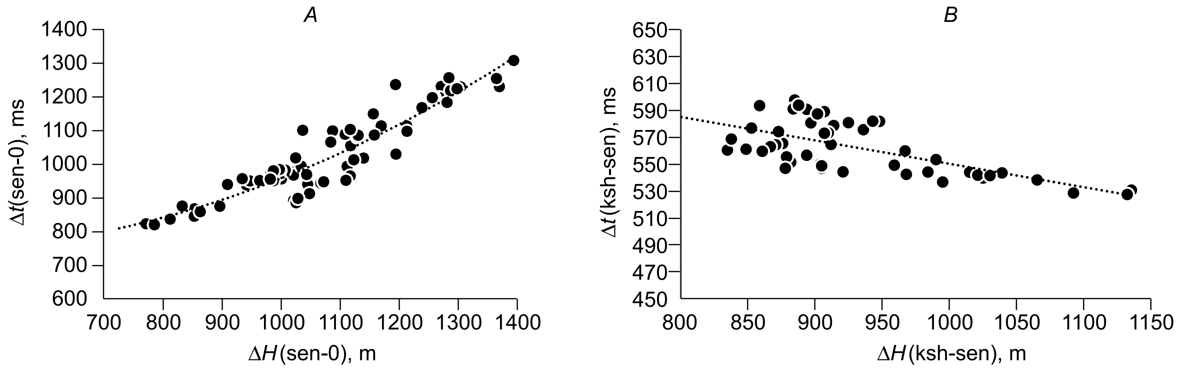

Fig. 6. Dependences of time thickness (ΔT) on their thickness (ΔH) in Turonian–Cenozoic (*A*) and Aptian–Albian–Cenomanian (*B*) sequences (Nadym–Pur interfluve).

The study results showed that the contour of the Cenomanian pool of the Yubileinoe field is characterized by elevated (more than 860–870 ms) ΔT(M–H) values between the reflectors M and G, and lower (less than 2150–2200 m/s) V_{int} values (Fig. 7).

The effect of falling velocities is also reflected in paleoreconstructions. In time paleo-sections, leveled to the reflector G, large anticlinal structures, controlling Cenomanian gas pools in the paleotopography of reflectors M and B, are the local depressions, the formation of which is connected not with the geologic structure of objects, but only with a drop in the p-wave velocities in Cenomanian gas pools (Fig. 7).

Thus, the presence of increased time thickness zones between the reflectors M and G and lower values of the interval velocities of the Aptian–Cenomanian sequence, in plan view overlapping the high-amplitude uplifts identified in the Cenomanian top, is also a reliable predictive criterion for gas pools selection in Cenomanian sequence.

Dynamic characteristics of seismic recording. The decrease in rocks densities and p-waves velocities leads to a decrease in the acoustic impedance of the entire gas-saturated layer and, as a result, to a change in the reflection coefficients not only at its bottom, but also at its top—at the boundary between the Kuznetsov Formation seal rocks and the Cenomanian sand reservoir. The G reflector, which controls the top of the Cenomanian sequence, is formed on the bottom of the Kuznetsov clays, the p-waves velocity in which is about 2000 m/s. Since the acoustic impedance decreases in the gas-saturated part, the reflection coefficient and, as a result, the energy of the reflected wave decreases in the pool zone of the reservoir at the "fluid-reservoir" boundary. Figure 8*A* shows a map of the distribution of seismic records average amplitudes in the interval –5…+10 ms from the reflector G. Map was calculated from seismic data, on which the contour of the Yubileinoe field Cenomanian pool is drawn. The analysis of these materials makes it possible to conclude that the contour of the pool is characterized by lower (less than 8000 USD) amplitudes of reflector G.

It was noted above that Cenomanian reservoirs filled with gas are characterized by lower velocities and densities. At the same time, the gas-saturated bed have a high absorptive capacity. Passing through the gas-saturated part of the section, seismic p-waves significantly lose their amplitude, and, in some cases, a column-shaped zone of low seismic recording energy is formed under the gas pool, and the underlying reflectors are almost not visible. In the Nadym–Pur interfluve, there is such a wave pattern in time sections that intersect the most contrasting Yamsovei uplift, within which the Cenomanian pool height exceeds 200 m. At the Yubileinoe field, the Lower Cretaceous and Jurassic reflectors can be traced quite conditionally, but at the same time, the effect of seismic energy absorption is reflected in the distribution of average values of wave amplitudes inside the entire Aptian–Albian–Cenomanian sequence (Fig. 8*B*).

The results of the dynamic analysis allow us to conclude that in plan view the Cenomanian gas pools coincide with the zones of lower amplitudes values of the reflector G and average amplitudes values of the wave fields within the entire Aptian–Cenomanian sequence controlled by reflectors M and G.

The results of the research allow us to formulate a number of seismogeologic criteria that allow to predict the Cenomanian gas pools:

– the presence of anticlinal structures in the G reflector topography, within which the reflectors confined to gas-water contacts are visible in time sections;

– an increase of time thickness (ΔT) between the reflectors M and G and a decrease of the p-waves interval velocities (V_{int}) within the entire Aptian–Cenomanian sequence in the zones which coincide in plan view to the anticlinal structures identified in the top of the Cenomanian sequence;

– on the uplifts a fall of the amplitude characteristics of the G reflector, which is the top of the Cenomanian reservoir and a decrease of the amplitude and energy characteristics of the seismic record within the entire Aptian–Cenomanian sequence.

As an illustration of the above conclusions, Fig. 9 shows the dependencies of the Cenomanian gas deposits heights on the average amplitude of the G reflector in the interval –5 + 10 ms and on the interval p-waves velocities in the Aptian–Cenomanian sequence constructed from the wells of the Medvezh'e, Yubileinoe and Yamsoveiskoe fields. The anal-

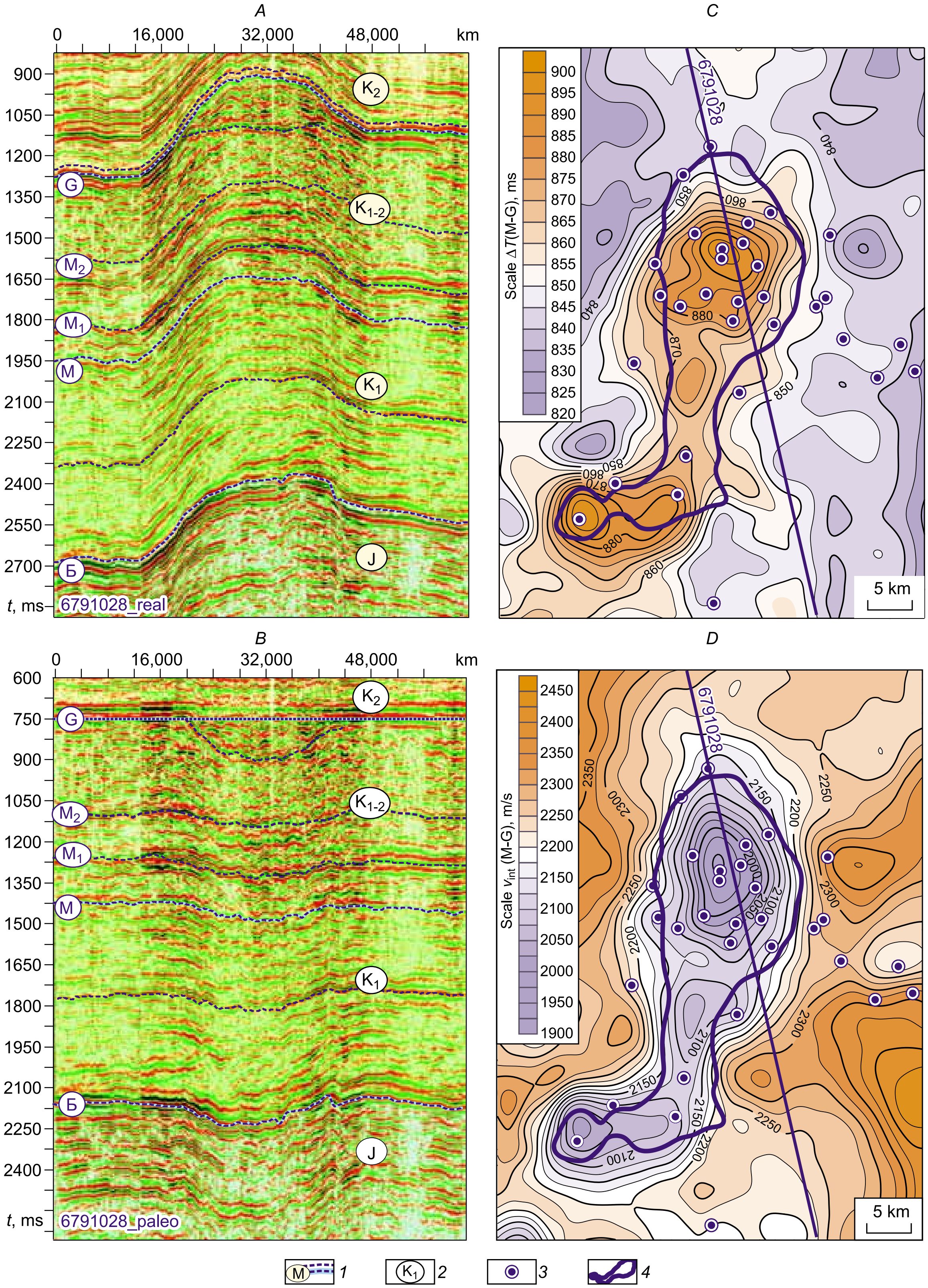

Fig. 7. Modern time section (*A*), paleosection, leveled to the reflector G (B), maps of ΔT values between reflectors M and G (*C*) and the interval velocity map of the Aptian–Cenomanian sequence (*D*) (Yubileinoe field). *1*, reflectors; *2*, seismogeologic sequence; *3*, wells; *4*, outline of the Cenomanian pool.

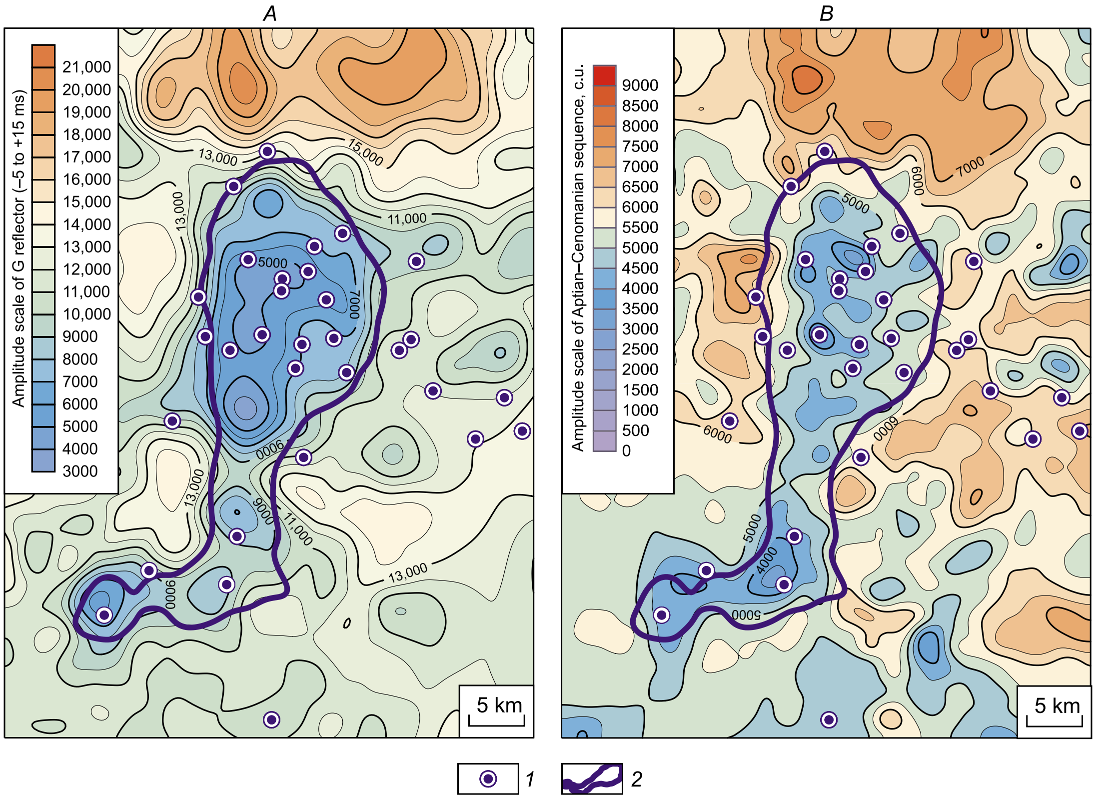

Fig. 8. Amplitude maps of the reflector G (up –5 to +15 ms) (*A*) and medium amplitudes wave field of the Aptian–Cenomanian sequence (*B*). *1*, wells; *2*, outline of the Cenomanian pool.

ysis of these materials allows us to conclude that in the study area an increase of the heights of Cenomanian gas pools (ΔH) is accompanied by a decrease of interval velocities in Aptian–Cenomanian part of the section and the fall of the G reflector amplitudes.

SEISMOGEOLOGIC CRITERIA FOR GAS CONTENT OF THE APTIAN-ALBIAN SEDIMENTS

Gas pools in Aptian–Albian sediments, which are associated with the main gas reserves located to the north of the studied area—Gydan, Yamal and South Kara petroleum regions (Kazanenkov et al., 2014), have a completely different influence on the wave field. In these regions, sandy beds of the XM and TP groups containing significant gas reserves, can be detected in time sections by a sharp increase in the amplitudes of the seismic recording—a “bright spot” anomaly (Kontorovich et al., 2016, 2017). As an example, Fig. 10 shows the time sections crossing the Kruzenshternskoe and Leningradskoe fields, located in the Yamal and South Kara petroleum regions respectively. Locally developed high-amplitude seismic recording anomalies characterizing gas pools are identified in time sections above the reflector M, confined to the Neito clay unit, which lies at the bottom of the Aptian–Cenomanian sequence.

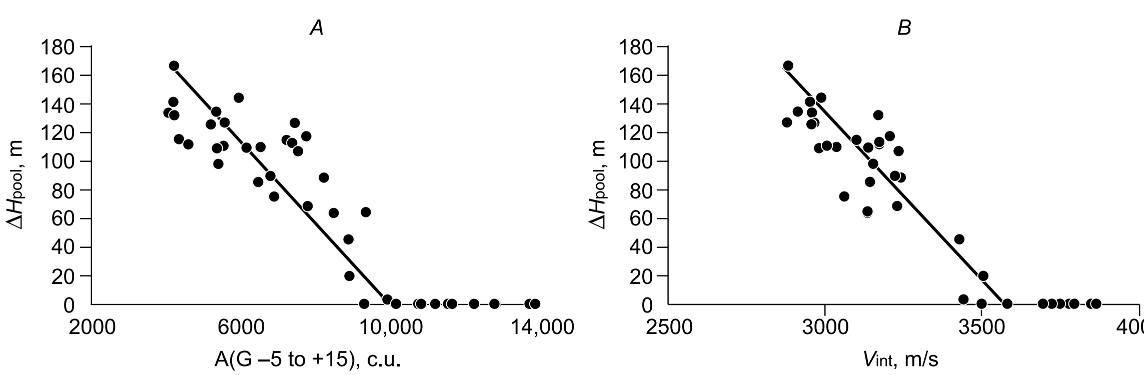

Fig. 9. Dependencies of the Cenomanian gas pools heights on average amplitudes seismic record in the interval of reflector G (up –5 to +10 ms) (*A*) and on interval velocities of the Aptian–Cenomanian sequence (*B*) for the Nadym–Pur interfluve.

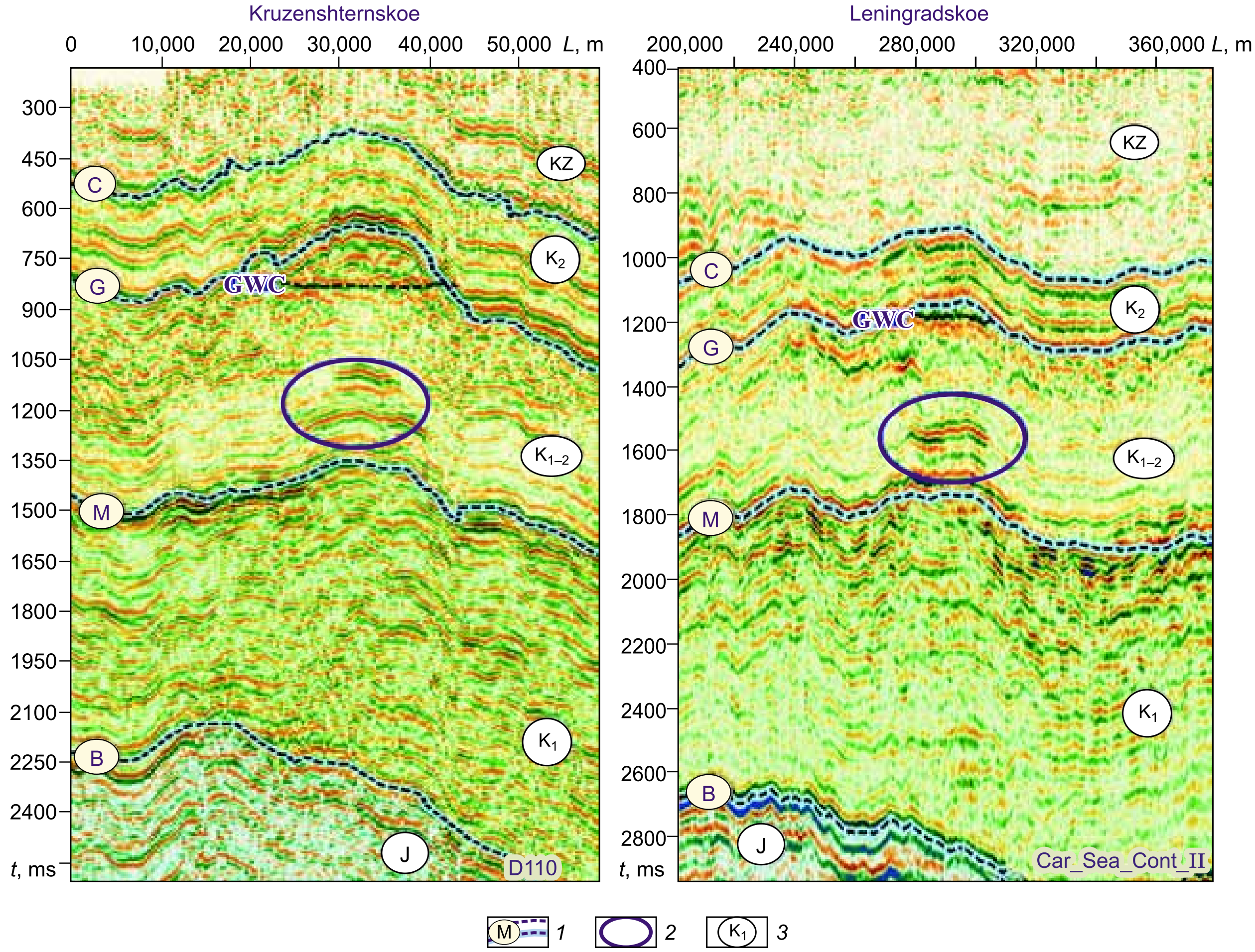

Fig. 10. Fragments of seismogeologic sections D110 and Car_Sea_Cont_II. 1, reflectors (B, top of the Bazhenov Formation; M, Neito clay unit; G, bottom of the Kuznetsov Formation; C, top of the Gan'kino Formation); 2, "bright spot" seismic anomaly; 3, seismogeologic sequences (J, Jurassic; K_1, Berriasian–lower Aptian; $K_{1\text{-}2}$, Aptian–Cenomanian, K_2, Turonian–Maastricht; KZ, Cenozoic).

In the Nadym–Pur interfluve, the absence of regionally occurring seal rocks in the section of Aptian–Cenomanian sediments was the case of significantly smaller hydrocarbon potential for Aptian–Albian sediments. In this region, the Aptian–Albian pools are localized, confined to sandy layers of small thickness and are often not visible in the wave seismic fields.

At the Yubileinoe field, the second largest pool, containing more than 25 billion m^3 of gas (5% of the total initial gas reserves of the entire Yubileinoe field) is concentrated in the PK18 sand bed. The pool of PK18 sand bed is located at an absolute depth of 1560–1650 m and is the largest among the Aptian–Albian pools in Nadym–Pur interfluve area.

It was noted above that in the Nadym petroleum district, the Aptian–Albian–Cenomanian sequence composed of sandstones, siltstone and claystone without seal rocks regionally occurs inside the sequence and is characterized by weak acoustic differentiation. Clay units in this part of the section are reliably correlated on local areas, but they have insignificant thicknesses, rarely exceeding 10–15 m, and they are not always fluid-impermeable. At the Yubileinoe field, the productive sand bed PK18 is covered with a 7–10 m thick clay bed (Fig. 11).

Under conditions of weak acoustic differentiation of Aptian-Albian sediments, only thin calcareous grits characterized by anomaly high p-wave velocities and relatively thick low-velocity gas-saturated sandy layers have abnormal acoustic characteristics in this part of the section. Sonic logs data interpretation of the Yubileinoe field wells makes it possible to note that in wells 2001 and 31, where bed PK18 is gas-saturated, this sand bed is characterized by abnormally low p-wave velocity. In wells 19 and 21, which are located behind the contour of the pool, in water-saturated zone, the bed does not differ in acoustic characteristics from the overlying and underlying sediments (Fig. 11). The thickness of the productive part in the wells 2001 and 31 is 30 and 20 m.

The analysis performed allows us to conclude that on the top and the bottom of the Aptian–Albian gas-saturated sandstones there are jumps in acoustic impedance. The back-

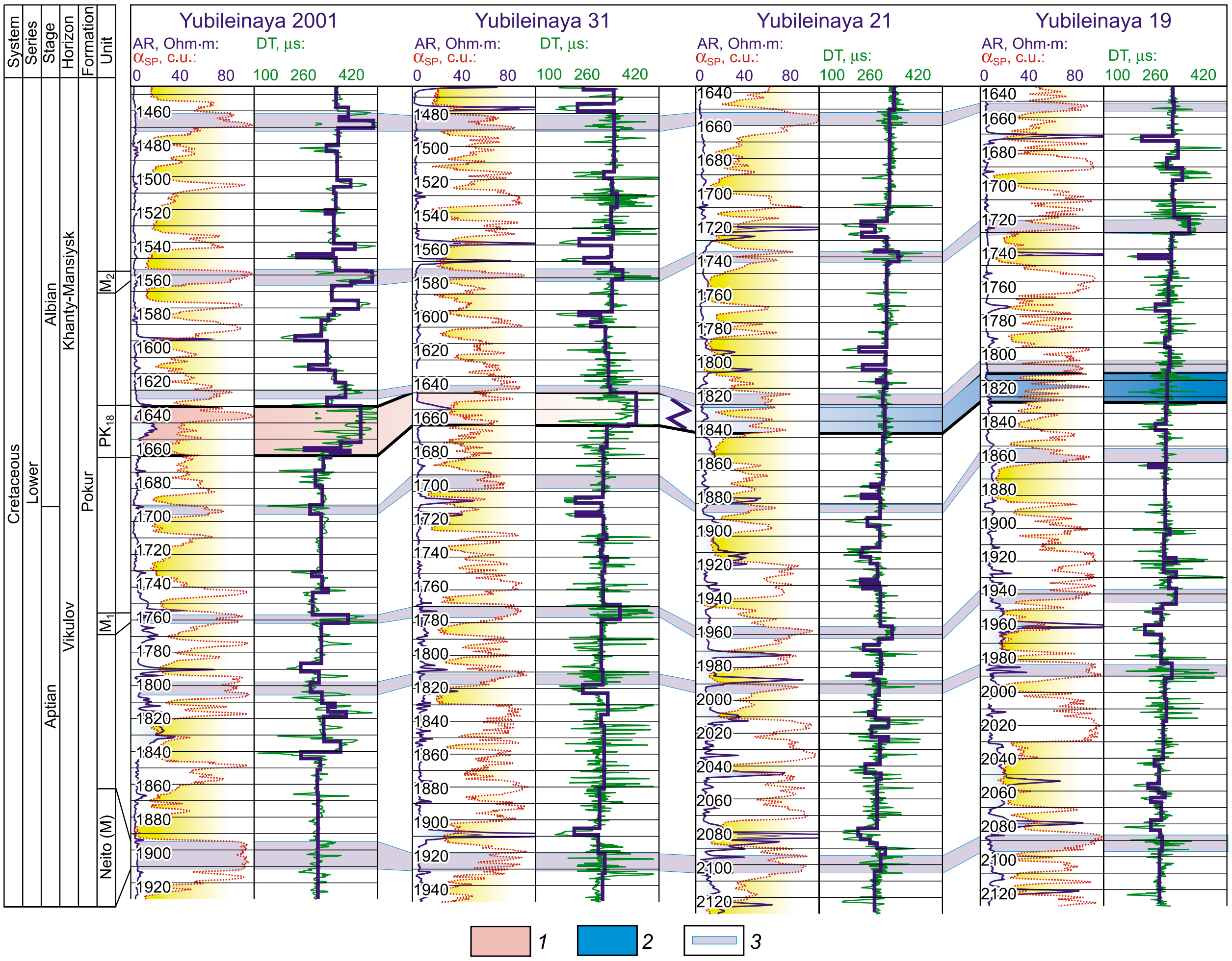

Fig. 11. Correlation diagram of Aptian–Albian sediments in wells of the Yubileinoe field. *1*, gas-saturated sandstone; *2*, water saturated sandstone; *3*, clay beds.

ground velocity values in this part of the section are 2800–3000 m/s, in gas-saturated sandstones 2200–2400 m/s. The results of mathematical modeling of wave fields showed that when the thickness of gas-saturated sandstone with abnormally low acoustic characteristics is 25–30 m, the resonant summation of waves from its top and bottom occurs—the second phase of the wave from the top is in phase combined with the first phase of the wave from the bottom. That leads to an increase in the energy of the interference signal and generates a "bright spot" anomaly in time sections.

The analysis of seismic materials allowed us to identify a local area of increase in the amplitude-energy characteristics of the seismic record, which is reliably traceable over the area (Fig. 3), in the time sections in the interval of occurrence of the PK18 reservoir. Although, in their contrast, these anomalies are certainly not comparable to the anomalies of the Gydan and Yamal petroleum areas, their nature is absolutely the same and is associated with the formation of reflected seismic waves on gas-saturated sandy layers, characterized by abnormally low acoustic properties. It should also be noted that the "bright spot" effect in the Yamal, Gydan and South Kara petroleum regions is also not visible at all fields.

The calculation of the average modulus of the wave amplitudes in the interval of the PK18 reservoir made it possible to outline in the Yubileinoe area a zone of high-energy characteristics of the seismic record and to outline the gas pool. The pool in PK18 bed is developed in the dome of the Yubileinoe uplift, GWC is –1640 m subsea depth, since the results of the wells tests (Fig. 12).

The main conclusions:

1. In the Nadym–Pur interfluve, the Aptian–Albian gas pools are blanket type, significantly smaller than the Cenomanian pools in terms of hydrocarbon reserves and height, and less reliably distinguished by seismic data.

2. Significant in thickness (more than 15 m) gas-saturated Aptian–Albian sandstones are displayed on time sections with positive anomalies of the amplitude characteristics of the seismic record, called the "bright spot" effect.

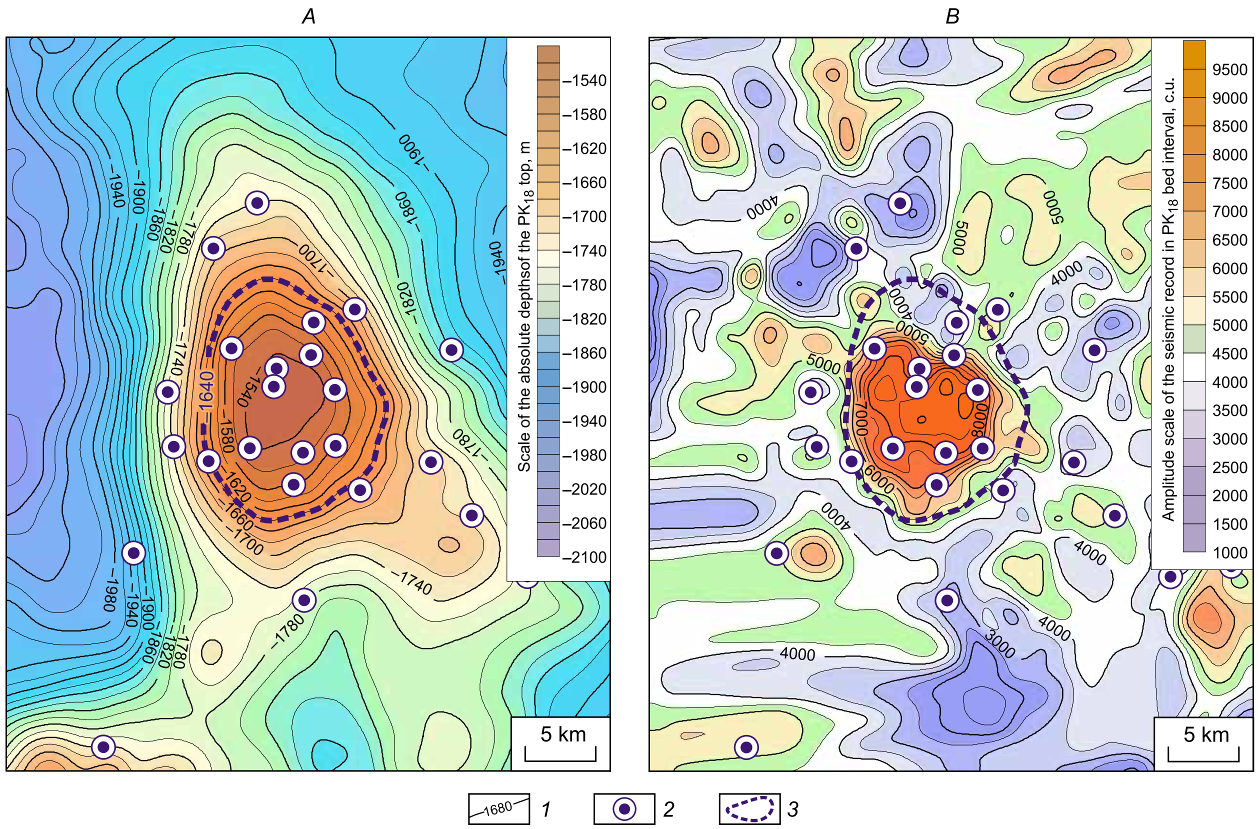

Fig. 12. Structural maps of the PK18 (*A*) sand bed top and seismic record amplitude map in the interval of the reservoir PK18 (*B*). *1*, isohypses of the top of the PK18; *2*, wells; *3*, GWC for the pool in PK18 bed.

The seismogeologic criteria for gas reservoirs prediction in the Aptian–Albian and Cenomanian reservoirs formulated in the work are supported by the results of a two-dimensional mathematical modeling of wave fields.

Figure 13*A* shows the geologic model of the Aptian–Albian–Cenomanian sediments along the cross-line S_13-29, crossing the Yubileinoe field in the north-west direction. The calculation of the synthetic wave field using a lithologic-acoustic model built taking into account the physical properties of gas- and water-saturated sandstones showed that an intense reflected p-wave is formed at the gas-water contact of the massive Cenomanian reservoir, and at the PC18 sand bed in the gas saturation zone a “bright spot” is formed. Similar seismic anomalies are reliably selected in a real time cross-section S_13-29 (Fig. 13*B*).

The choice of the Yubileinoe field as a reference sample was based on the fact that a unique gas pool was discovered in the Cenomanian bed PK1 and the largest gas pool in the sand bed PK18 in Aptian sediments of the Nadym–Pur interfluve. There is modern seismic CDP and deep drilling data for the field.

During the study, materials on the Medvezh’e and Yamsoveiskoe fields located in this region were also analyzed in detail, and time sections were interpreted for the more northern regions of West Siberia and the waters of the Kara Sea.

CONCLUSIONS

This paper is devoted to the development of seismogeologic predictive criteria for the gas pools in Aptian-Albian–Cenomanian sediments in the north of West Siberia. The Yubileinoe field located in the Nadym–Pur interfluve, which can be used as a reference sample, was the target of research.

The research results allowed outlining a number of seismogeologic criteria allowing to predict gas pools in the Aptian–Albian–Cenomanian sequence in the north regions of West Siberia.

Cenomanian gas deposits are displayed in wave seismic fields:

– the presence of anticlinal structures (uplifts) in the G reflector topography, under which the reflectors associated with gas-water contacts are visible in time cross-sections;

– an increase in dT (time thickness) values and a decrease in p-waves interval velocity (V_{int}) inside the Aptian–Albian–Cenomanian sequence;

– a drop in the amplitude characteristics of the G reflector, that is the top of Cenomanian reservoir, and a decrease

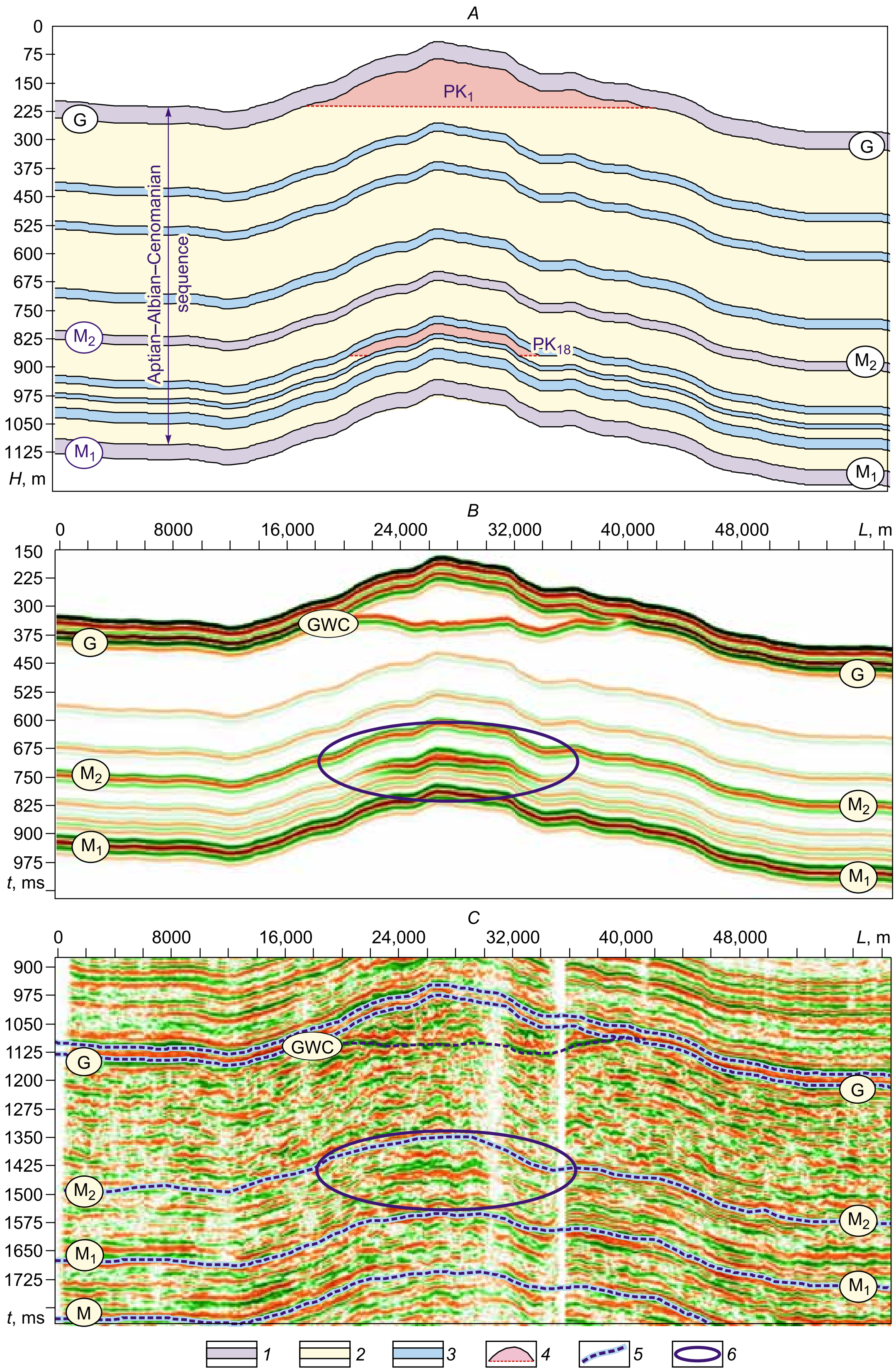

Fig. 13. Mathematical modeling of wave fields (*A*, geologic model; *B*, synthetic time section; *C*, real time section). *1*, units, to which seismic reflectors are confined; *2*, sandy beds; *3*, clay units; *4*, hydrocarbon pools; *5*, reflectors; *6*, seismic anomaly "bright spot".

in the amplitude and energy characteristics of the seismic record within the entire Aptian–Albian–Cenomanian sequence.

Aptian–Albian sheet gas pools are identified in the time sections by a sharp increase in the amplitudes of the seismic record, forming a "bright spot" anomaly.

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