# Annotated list of articles included into collected volume

**Ostrovskaya T.D. Experimental Studies of the Impact of Various Agents on Additional Recovery of Settled Condensate of the Urengoy Oil and Gas Condensate Field / T.D. Ostrovskaya, I.M. Shafiyev, A.S. Rassokhin, A.S. Ershov, A.A. Tomilenko**

The Urengoy OGCF is developed in the depletion mode, which is accompanied by significant losses of condensate in the formation. Therefore, the condensate recovery factor at the final stage is expected to be 0,45. The work provides the results of physical modeling of the impact of various components (methane, carbon dioxide, ethane, propane-butane mixture) on the condensate recovery factor. Physical modeling of the impact on $C_{5+}$ hydrocarbons vaporization process showed that ethane has the major impact followed by carbon dioxide and methane.

**Ostrovskaya T.D. Geochemical Features and Patterns of Hydrocarbon Content Changes of Fluids of the Novoportovskoye Field / T.D. Ostrovskaya, G.S. Fedorova, V.Yu. Artemyev, A.S. Varyagova**

The structural and chromatographic analysis and identified physical and chemical properties of hydrocarbon fluids showed that the content, structure and distribution of hydrocarbons in deposits – complex gas condensate and oil accumulations – are changing in the Jurassic-Valanginian-Aptian-Albia pay section of the Novoportovskoye field. Condensates experience the upwards density reduction, the yield of low-boiling fraction increases, a range of normal alkanes reduces to $C_{15-20}$, the role of naphthenes increases, aromatic hydrocarbons are represented by monocyclic compounds. With maximum content of naphthene hydrocarbons, the content of high-boiling hydrocarbons rapidly decreases and normal hydrocarbons practically disappear. The comparative analysis of geochemical parameters of condensates and low-boiling oil fraction in the same pay beds showed their uniform composition, which proves the common genesis.

**Fedorova G.S. Geochemical Studies of Hydrocarbon Fluids of the Chugoryakhinskoye Field / G.S. Fedorova, L.S. Kosyakova, V.Yu. Artemyev**

Based on geochemical parameters obtained by chromatographic and IR spectrometrical analysis of condensates of the Chugoryakhinskoye Field, condensates were categorized by the enclosing reservoir. It was showed that

$TP_{20}$, $TP_{22}$ and $TP_{23}$ are gas condensate deposits without oil fringe. Fluids of these deposits are close in terms of the composition, belong to the methane-naphthene type and have common genesis. The proposed set of studies will allow to get the information required for prospecting works in the short term.

**Artemyev V.Yu. The Compositional Analysis of Condensates of the $1_{st}$ production zone of the Urengoy Oil and Gas Condensate Field / V.Yu. Artemyev, L.S. Kosyakova, N.M. Parfenova, I.M. Shafiyev, E.T. Stroyny**

The compositional analysis of condensates of the $1_{st}$ production zone of UOGCF performed by gasliquid chromatography and IR spectrometry revealed condensate distinctive features. It was identified that 1A subzone has along with methane-naphthene condensates, the main volume of fluids of the $1_{st}$ production zone, naphthene condensates that are not typical for Valanginian deposits of the Urengoy field. Methanenaphthene condensates of 1A and 1B subzones significantly differ in the composition, which allows to differentiate between these fluids.

**Artemyev V.Yu. Assessment of the Changes in Certain Parameters of Hydrocarbon Systems during Development of Oil and Gas Condensate Deposits using Infrared Spectrometry / V.Yu. Artemyev, E.B. Grogoryev, I.M. Shafiyev**

The performed studies of HC mixtures, condensates and oils confirmed the possibility to use infrared spectrometry with Fourier transform for early detection of changes that take place in the deposit during production, which will increase the efficiency of currently used methods for field development control.

**Semenov E.O. Identification of the Lower Boundary of the Botuobinsky Horizon of the Chayadin Field / E.O. Semenov, A.I. Krikunov, N.Yu. Kanunnikova**

The article provides the results of re-interpretation of field geophysical material, stratification and correlation of sections of a number of wells of the Chayadin field, the Republic of Sakha (Yakutiya). Based on the data on the core taken from wells 321-40 and 321-52, a conclusion is made that the geological model of the field requires further detalization. The performed studies allow to update and substantiate the location of stratigraphic boundaries of the main pay horizons: botuobinsky and khamakinsky.

**KovalevA.L. Modeling the Depletion of Oil Fringe at Gas-Free Production Rate / A.L. Kovalev**

Multi-variant calculations of the depletion of the oil fringe at gas-free production rate have been made on the model of the formation element using Eclipse 300 simulator. The impact of the location of the horizontal wellbore relative to initial gas-oil contact and activity of water drive system on the development parameters has been studied. The studies identified the best wellbore location that ensures the best oil recovery factor.

**Korchazhkina I.Yu. Mathematical Modeling of Treatment of Bottomhole Areas of Gas Condensate Wells by Various Agents / I.Yu. Korchazhkina**

The operation of a gas condensate well drilled in Lower-Cretaceous deposits of the West Siberian field has been subject to mathematical modeling. The simulation experiment studied the phase behavior of the hydrocarbon system at well treatment by dry gas, carbon dioxide, ethane and propane-butane mixture. The dynamics of well production rate after treatment by different agents in different volumes was shown. It was proved that the most efficient agent to increase the production rate of a gas condensate well is a propanebutane mixture with dry gas purging.

**Bratash B.V. Substantiation of the Oil Fringe Model Based on a Simulation Experiment / B.V. Bratash, E.V. Sheberstov**

The article presents simulation experiments performed at the stage of preparation of a full-scale geological and hydrodynamic model of a gas condensate deposit with an oil fringe. The most complicated case is studied: thin oil fringe and underlying aquifer. The article provides case studies proving the need for simulation experiments to identify the dimensions of cells for correct account of gas and water cones near vertical and horizontal wells. Based on experiment results, conclusions have been made on the operation of wells in gas, oil-gas and water-oil zones.

**Kovalev A.L. Simulation Experiments for Analysis of Well Flow Tests / A.L. Kovalev, I.Yu. Korchazhkina, E.V. Sheberstov**

The article specifies the notion of a simulation experiment and points out its similarity with a physical experiment. A commercial software product was used for the experiment. The way to set the filtration block of the program and to account for the wellbore was shown. The problems related to identification of the application limits of the analytical methods for interpretation of studies of gas and gas condensate wells in formations with zonal and stratified inhomogeneity were taken as an example. Experiments on determination of the

dimensions of the condensate formation zone in the pay zone have been carried out. The article provides the example of using the deconvultion procedure for processing the results of well flow tests at wells with various production rate. The possibility of increasing the interpretability of well flow test methods by calculation of the logarithmic derivative of the influence function calculated by deconvultion has been confirmed.

**Krikunov A.I. Stratification and Correlation of Well Sections of the Prirazlomnoye Field using the Cycle-Stratigtraphic Analysis / A.I. Krikunov, N.Yu. Kanunnikova**

The work presents the results of stratification and correlation of well sections of the Prirazlomnoye field using the cycle-stratigraphic analysis. The performed study updated the location of separate stratigraphic boundaries, identified synchronous marker horizons (the latter are argillaceous foundations of sedimentation cycles), identified the location of inter-formation washouts and provided a brief history of the Prirazlomnoye field structure development in the Middle-Coal-Lower Permian time.

**Dakhnov A.B. Increasing the Reliability of Geophysical Data Interpretation using Physical and Reservoir Properties of Samples / A.V. Dakhnov, V.S. Zhukov, O.V. Iselidze, I.B. Kryukova, E.O. Semenov**

In order to generate interpretation models and increase the reliability of calculation of their reservoir properties, Jurassic sandstone and siltstone samples were subject to experimental studies under simulated formation conditions. Crossplots of porosity and permeability and physical parameters of mining rocks (porosity, interval time, P- impedance) were developed and studied. The relationship between the comprehensive parameter and permeability of studied samples can be used for integrated interpretation of acoustic and electric well logging data to estimate the reservoirs permeability. The concurrent account of acoustic and density parameters of reservoir rocks increases the reliability of porosity and permeability calculation based on P-impedance, which allows to recommend the obtained relationship and integrated use of acoustic and density logging methods for porosity calculation. Thus, we have identified reliable interpretation models for Jurassic deposits that can be used to determine reservoir porosity and permeability based on logging data.

**Rizhov A.E. The Impact of Reservoir Pressure and Temperature on Petrophysical Properties of Mining Rocks Samples of the Achim Deposits / A.E. Rizhov, V.S. Zhukov, O.V. Iselidze, E.B. Grigoryev**

The article looks at the results of physical modeling of pressure and temperature changes and studied changes of physical and reservoir properties of

reservoir rocks. The relationship between changes in petrophysical parameters of studied samples and pressure and temperature was calculated and these changes were quantified. It is shown that the increase of efficient pressure to 60 MPa is accompanied by the porosity reduction by 0,83 %. Changes in porosity due to temperature increase by 58 °C do not exceed 0,06 %. The obtained results describe the dynamics of changes in petrophysical parameters of the Achim deposits at modeling changes in formation pressure and temperature.

**Rassokhin S.G. Experimental Studies of Three-Phase Filtration Processes under Pressure and Temperature of the Aptian Deposits / S.G. Rassokhin, V.M. Troitsky, A.V. Mizin, V.P. Vankov**

The article presents results of experimental studies of filtration processes occurring in a multi-phase formation system using physical modeling. The pattern of two- and three-phase filtration in a composite model of pay Aptian deposits with initial water saturation was studied by changes in relative permeability to gas, oil and produced water as saturation functions at different shares of filtered phases in the flow. The analysis of obtained results showed significant reduction of phase permeabilities at joint fluid filtration compared to absolute permeabilities to gas. The work provides the relationship between relative permeability and saturation for a two-phase flow and calculated the area of three-phase flow. The obtained data can be further used for forecasting the production rate and hydrodynamic calculations of the Aptian deposits development at late stages.

**Rassokhin A.S. Studies of the Efficiency of Polyacrylamide Water Solution and Two-Phase Water-Methane Mixture as Agents Displacing the Viscous Oil / A.S. Rassokhin**

Experimental studies revealed the conditions of polyacrylamide water solution viscosity stabilization, substantiated the criterion for quick selecting of the best composition of a two-phase water-gas mixture based on measurements of the mixture hydrodynamic resistances (pressure drop) at filtration under conditions of studied development target. Physical modeling confirmed the high efficiency of used agents for viscous oil displacement.

**Sokolov A.F. Experimental Studies of Distribution of Injected Industrial Waste Waters in the Aquifer-Receiver / A.F. Sokolov, O.M. Monakhova**

The article provides the results of the physical modeling and the full-scale experiment under the conditions of the developed hydrocarbon field – Zapolyarnoye OGCF. The studies identified the mechanism of water-hydrocarbon mixture filtration in the aquifer depending on hydrocarbon

composition. Hydrocarbons that do not make the formation water-repellent filtrate in a water mixture in the form of emulsion. Hydrocarbons that make the formation water-repellent after accumulation of the mixture in the injection zone start to filtrate together with water under constant hydrocarbon saturation of the formation only after reaching the level of hydrodynamic mobility. During the process modeling this level amounted to from 15 to 20 % of the pore volume. It follows from this experimental assessment of phase permeability that the inevitable generation of "plug" from hydrocarbon liquid as an admixture in industrial waste waters can reduce the injection capacity of the well by 5–8 times.

**Kaplan S.A. The Experience of Applying Integrated Geological and Mathematical Modeling of Reservoirs on the Example of Achim deposits of the Urengoy Field Using Seismic and Geophysical Studies Results / S.A. Kaplan, A.E. Ryzhov, E.V. Sheberstov**

The article discusses the following most promising areas of enhancing the modeling efficiency: the application of new methods of detailed interpretation of 3D seismic survey; development of methodical issues of different information integration (sediment accumulation conditions, core analysis results, geophysical studies results and seismic data, hydrodynamic studies, development history, etc.) and the application of stochastic methods on a specific example.

**Grigoryev B.A. Methods of Calculation of Thermal and Physical Properties of Oil, Gas Condensates and their Fractions / B.A. Grigoryev, A.A. Gerasimov**

The article describes the authors' methods of calculation of thermal and physical properties: density and heat absorption capacity of the liquid phase under atmospheric pressure, density, heat absorption capacity, enthalpy and entropy at the initial boiling line, pressure of the boiling and condensation point, vaporization enthalpy and entropy, density, heat absorption capacity, viscosity and thermal conductivity of the liquid phase under $\rho/\rho_{pc} \geq 2$ and $T \leq 600$ K. All methods have been tested and assessed in terms of forecast calculation accuracy.

**Gorodetsky E.E. The Study of Stability and Kinetics of Heavy Fractions Aggregation in Oils of the Urus-Tamakskoye Field / E.E. Gorodetsky, V.A. Deshabo, V.I. Kosov, V.A. Kuryakov, D.I. Yudin, B.A. Grogoryev, L.M. Petrova**

The stability of oils of the Urus-Tamakskoye field (Tatarstan) to heavy fractions sedimentation in case of their hepthane dilution was studied using

the method of dynamic light scattering. It was shown that threshold hepthane concentration that leads to the start of heavy fractions sedimentation and determines the following aggregation pattern is mainly determined by concentration of resins of studied samples.

**Filatov V.M. Multidimensional Analysis of the Content and Properties of Oil and Gas Condensate Fluids Based on NIR Spectroscopy Data / V.M. Filatov, R.Z. Safiyeva, R.Z. Syunyayev, E.B. Grigoryev**

The article demonstrates the possibility of using the multidimensional analysis of the content and properties of oil and gas condensate fluids based on NIR spectroscopy data. Chemometric express-methods developed mainly abroad enhance the quality and reduce the time of analysis. The authors have developed a chemometric express-technique for control of the content and quality of oil and gas condensate fluid using near infrared spectroscopy.

**Rotov A.A. Challenges of Creating an Integrated Engineering Field Model / A.A. Rotov, A.V. Trifonov, V.A. Suleymanov, V.A. Istomin**

The article substantiates the need for creating specialized software systems that would integrate the models of field infrastructure facilities to calculate the engineering parameters of the field. The article considers the challenges of creating the software system on the base of current software products. It formulates new requirements for software systems that increase the accuracy and reliability of calculations.

**Sharafutdinov Z.Z. Management of Disperse Systems Behaviour in Well Construction using Nanotechnologies / Z.Z. Sharafutdinov**

The article is devoted to the management of the properties of disperse systems in the form of drilling muds and cement slurries taking into account supramolecular chemistry provisions, the basis of nanotechnologies. Clay and the cement stone are formed with supramolecular compounds and subject to application of nanotechnologies. It allows to expand the area of application of known reagents and use their higher efficiency for management of properties of clay, drilling mud and cement slurry.

**Bogdanova Yu.M. New Approach to Management of Cement Slurry Properties / Yu.M. Bogdanova**

The work deals with the cement hydration and ways to control cement slurry properties by adding non-electrolytes. The use of this method allows to strengthen the structure of hydrate water of the cement stone by formation of hydrated compounds, which ensures the consolidation of the cement slurry into a strong impermeable stone.

**Buleyko V.M. The Non-Equilibrium Issue in Hard-to-Recover Hydrocarbon Reserves Development / V.M. Buleyko, G.A. Vovchuk**

The article gives the examples of hydrocarbon deposits with hard-to-recover reserves. In the process of field development the hydrocarbons of such deposits are in non-equilibrium state. Therefore, it is proposed to use non-equilibrium thermodynamics methods for modeling the development of hard-to-recover reserves. The article provides the results of modeling the vaporization of a retrograde condensate and their comparison with experimental data. It has been determined that the account of the contribution of thermal diffusion and pressure diffusion along with molecular diffusion itself into the mass transfer allows to qualitatively describe the observed phenomenon.