75th Anniversary of EPR Discovery

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International Conference MAGNETIC RESONANCE: current state and future perspectives (EPR-75)

and satellite XXI INTERNATIONAL YOUTH SCIENTIFIC SCHOOL actual problems of magnetic resonance and its application

PROGRAM, ABSTRACTS

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KAZAN 2019

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ACTUAL PROBLEMS OF MAGNETIC RESONANCE AND ITS APPLICATION
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International Conference "Magnetic Resonance - Current State and Future Perspectives" and satellite XXI International Youth Scientific School "Actual problems of magnetic resonance and its application"

devoted to the 75-th anniversary of the discovery of Electron Paramagnetic Resonance by E.K. Zavoiskii

Book of **ABSTRACTS**

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The Study of Kerogen by NMR

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The kerogen deposits that make up the shale are widely developed in various oil-producing regions of the world. At high temperatures, cracking of kerogen can occur, resulting in the formation of oil components in stages, ranging from the most highly molecular and viscous – asphaltenes to light hydrocarbons and gas.

Using the capabilities of the nuclear magnetic resonance (NMR) method it was found that for a significant part of the rock kerogen molecules, the Gaussian form with the NMR relaxation time characteristic of a solid satisfactorily describes the transverse magnetization decrease. To describe the more mobile elements that make up the organic system of kerogen (formed petroleum) the Lorentz form is used. The ratio between the Gaussian and Lorentz form is 3:1.

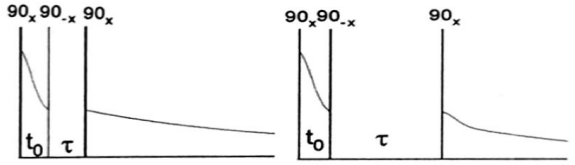

Fig.1. The effect of the Goldman-Schen pulse sequence at two different times of mixing τ.

Since the components of the system that we found for NMR are characterized by different relaxation times, an original study of the interphase exchange was carried out. The data on the morphological features of solid-state (from NMR relaxation) structures of kerogen were obtained using the Goldman-Schen (fig.1) pulse sequence [1].

An analysis of the relaxation attenuation obtained showed that with an increase in the mixing time τ, the fraction of the Lorentz component decreases. When the value of $t_{mix} \geq 5000$ μs is reached, the ratio between the Gaussian and Lorentz components becomes constant and is approximately 3:1 (see fig.2). The obtained experimental results make it possible to unambiguously take the value of the time parameter characterizing the process of interphase redistribution by magnetization, the value $\tau = 600$ μs and determine the spatial scales at which the redistribution of magnetization is carried out [2].

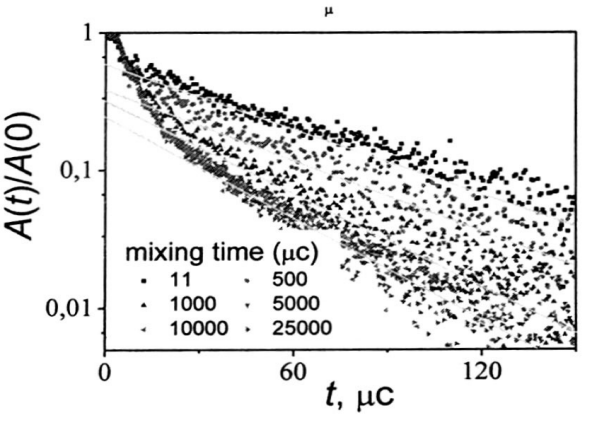

Fig.2. Relaxation attenuation normalized to the initial amplitude for the initial kerogen sample, obtained using the Goldman-Schen pulse sequence. The colors of the diffusion time are coded: black - 11 μs, red –500 μs, blue - 1000 μs, green - 5000 μs, and rose - 10,000 μs, and brown - 25000 μs.

We hope that our results will serve as the basis for creating an express-procedure for analyzing the composition and determining the oil-generating potential of the organic matter of shale rocks.

[1] J. Leisen, Rub.chem. and techn. **72**, 1 (1999).
[2] G. Khutsishvili, JETP **15**, 5 (1962).