Some Systematic Variations in the Composition of Natural Gases in the North of the Volga-Ural Area

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The large zone of oil-gas accumulation of the Volga-Ural oil-gas basin occurs on the Permsko-Bashkir dome and in adjacent parts of the Cis-Ural downwarp. Systematic variations in the oils of these fields have been studied in detail; the natural gases are treated here.

The geochemical characteristics of the gases of the region are a function of the ratio of hydrocarbon and inert components because sulfur and carbon dioxide are not present in significant amounts. The total content of hydrocarbons ranges from fractions of a percent to 96%, increasing from west to east toward the Cis-Ural downwarp. The content of inert gases drops in this direction from 100 to 4%. These variations do not depend on age and depth of occurrence of the host rock but on the relative position of the pool in the section and the distance of the pool from the basement. See Fig. 1. In some cases under similar geologic conditions the ratio of hydrocarbons to inert gases varies with initial reserves: large reserves correspond with higher concentrations of hydrocarbons.

Along with the variation in ratio of hydrocarbon and inert gases, there is also a variation within the hydrocarbons. Homologs of methane increase from 10% in the Cis-Ural downwarp to 70-75% in the nitrogen pools. A decrease in the content of hydrocarbons causes a more significant drop in the concentration of methane in comparison with its homologs. See Fig. 2

The total elasticity of the hydrocarbons and the elasticity of methane and its homologs decreases from the Cis-Ural downwarp toward the central areas of the platform. In the gas pools of the Yurezano-Sylven depression it reaches 200 atm; in the Kylasov zone it decreases to 120-160 atm; on the south of the Permsko-Bashkir dome it is 5-10 atm. Nitrogen is the main non-hydrocarbon component. Its elasticity increases from 5-10 atm in the pools of the Yurezano-Sylven depression to 15-30 atm in the Kylasov zone and 20-50 atm on the south of the Permsko-Bashkir dome and to 100-130 atm in the nitrogen pools.

The concentration of helium increases from the Cis-Ural downwarp toward the Permsko-Bashkir dome. The argon content of the gases is relatively constant.

There is a general correlation between the concentrations of helium and nitrogen. See Fig. 3. The highest values of the ratio between these two components are observed on the Veslyan swell and in several pools of the Cis-Ural downwarp, and the lowest values in pools on the south of the Permsko-Bashkir dome and in the nitrogen pools.

The systematic variations in the gases described here indicate a significant generating capacity in the Cis-Ural downwarp as well as large reserves there at depth.