FORMATION PETROLEUM BIOMARKERS FROM ARCHAEA *THERMOPLASMA* SP. BIOMASS

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Prokaryotes insufficient attention is paid in the formation of petroleum biomarkers. We have previously shown that from the bacteria biomass *Arthrobacter* sp. RV and *Pseudomonas aeruginosa* RM formed petroleum biomarkers (references 1-3). Moreover, only n-alkanes and some oxygenates formation is observed in the soluble portion of these bacteria. Cyclic biomarkers generated in the thermolysis (low temperature pyrolysis) products of the insoluble portion. It is interesting to note that the distribution of steranes C_{27}-C_{29} resembles that in the oils of marine origin.

The present communication is devoted research of the distribution of petroleum biomarkers in soluble portion and the products of thermolysis insoluble portion archaea *Thermoplasma* sp.

Termophilic, acidophilic archaea *Thermoplasma* sp. was grown in a mineral-organic medium of the following composition, g/L: NH_4Cl – 0.33; KCl – 0.33; $MgCl_2 \cdot 6H_2O$ – 0.7; $CaCl_2 \cdot 2H_2O$ – 0.44; KH_2PO_4 – 0.33; microelements, 1 ml; vitamins, 1ml; yeast extract, 0.5; sucrose, 2.0; glycine, 0.7; distilled water; pH 3.0. The strain was cultured under aerobic conditions at 60 ^oC for 48-72h.

The lyophilic biomass *Thermoplasma* sp. under was extracted with chloroform in an ultrasonic bath for 20-25h at room temperature until complete disappearance of the soluble part. The insoluble portion of the archaea was subjected to thermolysis at 340 ^oC for 5h in a sealed glass ampoule. The soluble part of *Thermoplasma* sp. and products of thermolysis were analyzed by gas chromatography-mass spectrometry. Additionally, native biomass of *Thermoplasma* sp. was investigated by pyrolysis Rock-Eval.

Unlike the bacteria biomass *Arthrobacter* sp. RV and *Pseudomonas aeruginosa* RM we identified aliphatic and cyclic high molecular biomarkers - steranes and terpanes in the soluble portion of the biomass of *Thermoplasma* sp. Similarly, their formation is observed in the products of thermolysis insoluble portion of *Thermoplasma* sp. However, the relative content of some hydrocarbons are different from those in the soluble portion. We showed some hydrocarbon ratio in soluble and insoluble products of the thermolysis of *Thermoplasma* sp. (Fig.1). It is easy to notice that in the thermolysis products among alkanes relative concentrations of regular isoprenanes pristane and phytane prevail significantly compared with n-alkanes C_{17} and C_{18}, respectively. Similarly in thermolysis products occurs slight relief of the hydrocarbon composition (the value of n-C_{15}/n-C_{25} in thermolysis products higher than soluble part of *Thermoplasma* sp. 0.02 vs. 0.45). It is interesting to note that the ratio of pristane/phytane vary narrow range 0.64-0.82 (Fig.1a). This value is observed in the oils of marine origin.

The relative distribution of steranes C_{27}-C_{29} is also reminds of the oil of marine origin. But in the thermolysis products is observed higher relative content of cholestane (C_{27}). With regard to maturity coefficients, K_1mat and K_2mat have not reached an equilibrium state, indicating that mature low organic matter. Interestingly, in the thermolysis products values of

K_1mat and K_2mat lower than that in the soluble fraction (0.36 vs. 0.45 and 0.55 vs. 0.69, respectively). The low value of the ratio diasteranes to regular (0.14-0.21) resembles oil generated in carbonate strata (Fig.1b).

Among terpanes value of ratio Ts/(Ts+Tm), M_{30}/G_{30} closer vary within 0.37-0.48 and 0.16-0.17, respectively, indicating a lower degree of maturity of organic matter. However, in thermolysis products significant relatively high content of tetra- (tetra/tri) and pentacyclo (tri/penta) is observed (0.8 vs. 0.37 and 0.46 vs. 0.06, respectively) (Fig.1c).

The above findings are fully consistent with pyrolysis data Rock-Eval. So the maximum pyrolysis temperature Tmax = 410 °C (low degree of maturity), IH = 454 mgHC/gTOC (marine organic matter).

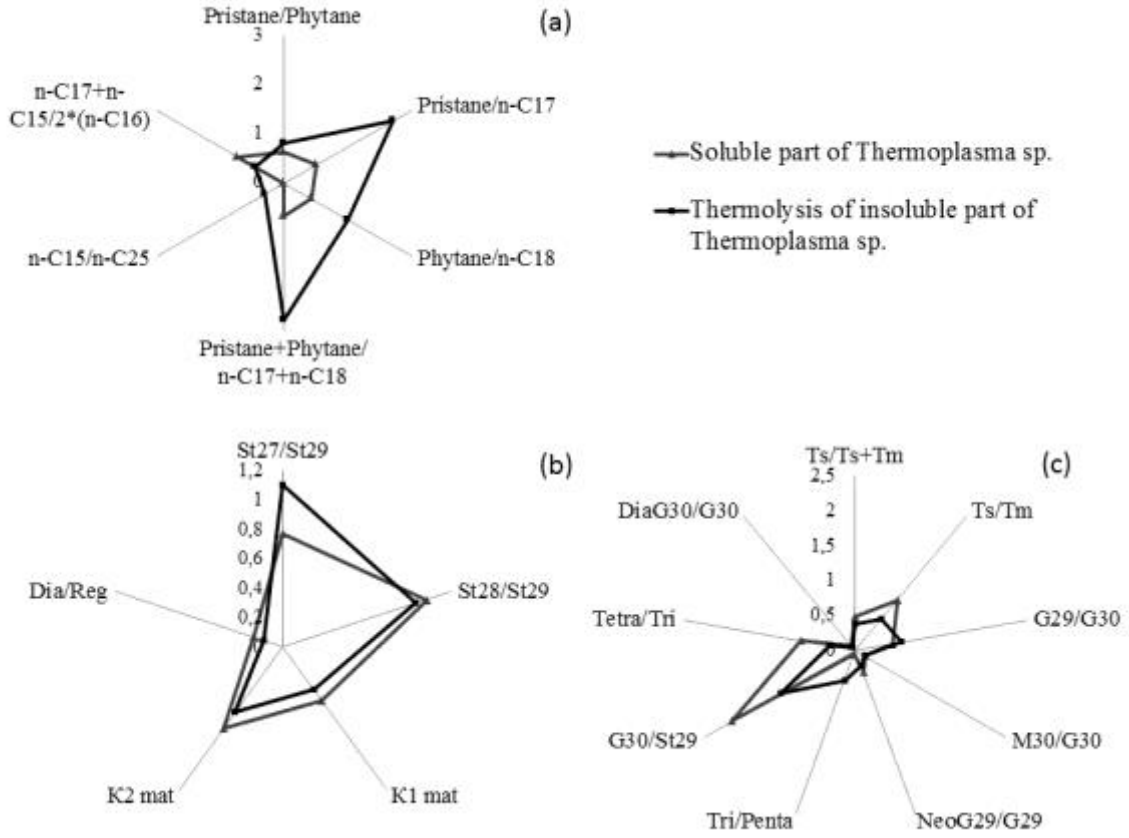

Figure 1 Comparative characteristics of alkanes (a), steranes (b) and terpanes (c) of the soluble part and the products of thermolysis of insoluble part of portion *Thermoplasma* sp. (St – sterane, K_1mat = αS/(αS+αR), K_2mat = αββ/(αββ+αR), Dia/Reg – the ratio diasteranes to regular, G_{29}/G_{30} - the ratio adiantane to hopane, M_{30}/G_{30} - the ratio moretane to hopane).

References

1. Stroeva A.R., Giruts M.V., Koshelev V.N., Gordadze G.N., 2014. Modeling of formation of petroleum biomarker hydrocarbons by thermolysis and thermocatalysis of bacterium biomass. Petroleum Chemistry. Vol. 54. No. 5. P. 347–354.
2. Poshibaeva A.R., Giruts M.V., Koshelev V.N., Gordadze G.N., 2015. Modeling of petroleum biomarkers formation from bacteria biomass. International Meeting on Organic Geochemistry. P. 375-376.
3. Gordadze G.N., 2015. Hydrocarbons in the oil geochemistry. Theory and practice (Gubkin Russian State University of Oil and Gas, Moscow) 559 P. [in Russian]