Geological characteristics and estimation of hydrocarbon potential of Neogene and Triassic source rocks from wells in Croatia and Syria based on the synthesis of the well log, geochemical and seismic data

Ivica Vulama

Abstract: According to their major importance in oil generating process, source rocks evaluation represents one of the main objectives in geological studies of an exploration area. Geochemical analyses of potential source rocks prior to geological modeling rapidly increase exploration results and reduce investigation risk. On the other hand, geophysical rock properties were essential for geological and geochemical interpretation. Characteristic geological-geophysical-geochemical parameters were defined, which represent the source rocks of explored area. Accordingly, they were identified and then defined in quantitative and qualitative sense. Characteristic well log parameters were defined (GR, SL, AC, DEN, CN, R_t and FMI) as well as organic geochemical values (T_max, S_1, S_2, R_o and C_org) enabling their differentiation from other rock formations. Particularly cut-off values of electrical resistivity (R_t) were given for oil-prone and gas-prone source rocks together with results of geochemical analyses.

Net pay of mature source rocks was calculated form the calibration of well log parameters with geochemical data, as well as other associated petrophysical parameters which separate mature from non mature source rocks. Next step represented by matching of evaluated well logging data with 3D seismic, resulted in delineation of source rock formations on seismic sections (example of oil fields Števkovica and Jihar), also enabling the volumetric calculation of hydrocarbons generated in one part of the Jihar field. The possibilities of misinterpretation were analyzed, with necessary precaution measure needed to avoid potential mistakes or the estimates acceptable within statistical margin of error.

The new method of source rocks evaluation on the basis of well logging, geochemical and seismic data synthesis has proven to be practical in order to final target and produce the oil and gas in “E” series of the Števkovica oil field, that were previously considered to be only source rocks intervals. Economical aspects (and effects) are found in better definition of the clay mineral content by interpreting natural gamma ray spectrometry, as given on example of the one part of the Sava depression. This data can significantly reduce the cost of drilling, speed up the drilling operations, and result in safer construction of wells. Calculated net pay and associate petrophysical parameters of the source rocks of the Mura depression were included in a regional geological study which resulted in the new gas discovery.

Significant results were achieved by interpreting immature source rocks of the Irma gas field. The survey resulted in a given source, migration pathway and model of the gas accumulation that might be useful in furthering regional exploration of similar geological systems. In difference to the previous geochemical results, the Triassic source rocks of Kurrachine Dolomite Formation in Syria have significant net pay of mature source rock. The selected representative geochemical analyses, singled out in accordance with the well log interpretation of mature source rock intervals, show that Kurrachine Dolomite Formation is actually a mature source rock in this exploration area. In addition to that it was defined that this fractured source rock represents in situ oil producer, and that no long migration path ways were necessary. Finally, the importance of scientific synergy of all obtained results is highlighted. The multidisciplinary evaluation of source rocks using various scientific and engineering methods leads to discovery of new reserves or increase of reserves that have already been balanced.

Key words: Source Rock, Geology, Well Logging, Geochemical Analyses, Seismic, Triassic, Miocene, Pliocene, Pannonian basin, Middle Adriatic ridge, Drava depression, Sava depression, Mura depression, Palmyrides, Croatia, Syria.

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Mentors:
Ph.D. Josipa Velić, full professor, Faculty of Mining, Geology and Petroleum Engineering in Zagreb
Ph.D. Tihomir Marjanac, associated professor, Faculty of Science in Zagrebu

Reviewers:
Ph.D. Bruno Saftić, associated professor Faculty of Mining, Geology and Pet. Engineering in Zagreb
Ph.D. Josipa Velić, full professor, Faculty of Mining, Geology and Petroleum Engineering in Zagreb
Ph.D. Tihomir Marjanac, associated professor, Faculty of Science in Zagreb
Ph.D. Krešimir Jelić, full professor, Faculty of Mining, Geology and Pet. Engineering in Zagreb

Thesis accepted: