Inference on the Potential of Hydrocarbon Resources in the Gyeongsang Basin, South Korea, Based on Petroleum System Modeling*

Moo-Hee Kang1, Tae-Jin Jeong2, and Ji-Hoon Kim3

Search and Discovery Article #10671 (2014)**
Posted November 24, 2014

*Adapted from poster presentation given at AAPG International Conference & Exhibition, Istanbul, Turkey, September 14-17, 2014
**Datapages © 2014 Serial rights given by author. For all other rights contact author directly.

1Petroleum and Marine Research Division, KIGAM (Korea Institute of Geoscience & Mineral Resources), Daejeon, South Korea (karl@kigam.re.kr)
2Department of Earth and Environmental Sciences, Gyeongsan National University, Jinju, South Korea
3Petroleum and Marine Research Division, KIGAM (Korea Institute of Geoscience & Mineral Resources), Daejeon, South Korea

Abstract

Gyeongsang Basin is the largest Mesozoic terrestrial basin covering about 20,000 km² with sediment thickness up to 8,000 m in South Korea. Many geological and geochemical studies for hydrocarbon exploration have been carried out in this basin since the 1970s, but any conventional oil or gas reserves have not been discovered yet. Some formations such as the Nakdong and Jinju Formations in this basin, however, show relatively high TOC (> 1 wt%) with maturation of late catagenesis, and thus they appear to be a potential source of shale resources as well as conventional hydrocarbon. We performed 1-D petroleum system modeling to constrain the timing of hydrocarbon generation and the amount of generated and expelled hydrocarbon with an integration of geological, geochemical, and petrophysical results. The maturity of the Nakdong Formation, the lowest formation of the basin with an average thickness of 1,100 m composed mainly of sandstones with shales, shows more than 3.0%Ro in the model. This is in good agreement with the results of measured virtinite reflectance (3∼4% Ro) and Tmax (> 590 °C) of outcrop or core samples. Hydrocarbon generation of the Nakdong Formation commenced during Aptian at ∼115 Ma and reached maximum oil generation window at ∼100 Ma. Total amount of generated hydrocarbon in this formation is ∼160 mg/g TOC. Most generated hydrocarbon converted to gas since Cenomanian (∼95 Ma), as a result, about 50% of it was expelled from the formation and about 60 mg/g TOC is charged to the formation. The rest (∼20 mg/g TOC) is residue of organic matters which no longer produce hydrocarbons. The Jinju Formation also represents high thermal maturation (2∼3% Ro), indicated that it has been over-matured. Hydrocarbon generation of the Jinju Formation began at ∼102 Ma (Albian) and reached maximum oil generation window at ∼94 Ma. After Turonian, most generated hydrocarbons converted to gas, thus about 65% (∼105 mg/g TOC) was expelled from the Jinju Formation and ∼35 mg/g TOC of gas with some residue preserved in the formation. Since most sandstones in Gyeongsang Basin have low porosities (1∼4%) and permeabilities (< 1 md), there is a low probability of discovering conventional hydrocarbon reserves. The petroleum system modeling, however, shows some shale gas potential in this basin.
Selected References


Inference on the potential of hydrocarbon resources in the Gyeongsang Basin, South Korea, based on petroleum system modeling

Moo-Hee Kang1 (kang@kigam.re.kr), Tae-Jin Jeong2, Ji-Hoon Kim3
1Petroleum and Marine Research Division, Korea Institute of Geoscience and Mineral Resources (KIGAM), South Korea
2Department of Earth and Environmental Sciences, Gyeongsang National University, South Korea

ABSTRACT

Gyeongsang Basin is the largest Mesozoic terrestrial basin covering about 20,000 km² with sediment thickness of up to 8,000 m in South Korea. Many geological and geochemical studies for hydrocarbon exploration have been carried out in this basin since the 1970s, but any conventional oil or gas reserves have not been discovered yet. Some formations such as Nakdong and Jinju formations in this basin, however, show relatively high TOC (> 1 wt%) with maturation of late catagenesis, and thus they are appeared to be a potential source of shale resources as well as conventional hydrocarbon. We performed 1-D petroleum system modeling to constrain the timing of hydrocarbon generation and the amount of generated and expelled hydrocarbon with an integration of geological, geochemical and petrophysical studies. The maturity of Nakdong Formation, the lowest formation of the basin with an average thickness of 1,100 m mainly composed of sandstones with shales, shows more than 3.0%Ro in the model, which is good agreement with the results of measured vitrinite reflectance (3.4–4.5%Ro) and T_max (~ 580 °C) of outcrop or core samples. Hydrocarbon generation of Nakdong Formation commenced during Aptian at ~115 Ma and reached maximum oil generation window at ~100 Ma. Total amount of generated hydrocarbon in this formation is ~160 mg/gTOC. Most generated hydrocarbons converted to gas since Cenomanian (~95 Ma), as a result, about 50% of it was expelled from the formation and about 60 mg/gTOC is charged to the formation. Hydrocarbon generation of Jinju Formation also represents high thermal maturation (2–3%Ro), and thus about its 65% (~105 mg/gTOC) was expelled from the Jinju Formation window at ~94 Ma. After Turonian, most generated hydrocarbons converted to gas, thus about its 65% (~105 mg/gTOC) was expelled from the Jinju Formation and ~35 mg/gTOC of gas with some residue preserved in the formation. Since most sandstones in the Gyeongsang Basin have low porosities (<1%) and permeabilities (<1 md), there is a low probability of discovering conventional hydrocarbon reserves. The petroleum system modeling, however, shows some shale gas potential in this basin.