An Estimate of Shale-Oil and Shale-Gas Resources of the Phitsanulok Basin, Thailand

Christopher J. Schenk[1]

[1]U.S. Geological Survey: Central Energy Research Science Center, Denver, Colorado, United States (schenk@usgs.gov)

Abstract

As part of a systematic effort to assess unconventional oil and gas resources in priority basins of the world, the U.S. Geological Survey (USGS) quantitatively assessed the potential for unconventional oil and gas resources within the Phitsanulok Basin of Thailand. Unconventional resources for the USGS assessment include shale gas, shale oil, tight gas, tight oil, and coalbed gas. Only undiscovered technically, recoverable shale-oil and shale-gas resources were quantitatively assessed in the Phitsanulok Basin, as there was no evidence for tight gas, tight oil, or coalbed gas systems.

The Phitsanulok Basin has nearly 8 kilometers of nonmarine fill, representing alluvial fan, fluvial, deltaic, marginal lacustrine, and shallow to deepwater lacustrine environments. Organic-rich mudstones of the Chum Saeng Formation are known to be the principal petroleum source rocks in the basin. Petroleum was generated from Type I (and minor Type III) kerogen within Chum Saeng shales, producing a low sulfur and high wax oil. Oil from Chum Saeng Formation shales migrated updip into conventional traps within fluvial-deltaic reservoirs of the Lan Krabu Formation. The hypothesis proposed in this study is that some volume of recoverable oil and gas remains in the source rock to potentially form shale-oil and shale-gas accumulations. Structural inversion in the Miocene may have caused oil to migrate from the deeper part of the basin upward along faults into reservoirs along the basin flanks, and migration might have affected the volumes of recoverable resources. Gas shows from the organic-rich shales suggest the presence of moveable gas and provides some evidence for a potential shale-gas accumulation, but there are no tests of recoverable oil available at this time.

A simple burial history model developed for a well (SPB–A01) in the Sukhothai depression indicates that organic-rich shales of the Chum Saeng Formation reached the thermal maturity thresholds for oil generation in the Miocene and gas generation in the Pliocene, using reasonable geologic input. The model incorporated Type I kinetics, an HI value of 400, and a TOC of 3 weight percent. Heat flow was modeled with highest heat flow associated with rifting followed by thermal decay to present. Assessment results for two unconventional assessment units of the Phitsanulok Basin are summarized. For fully risked unconventional resources, the mean total is 53 MMBO, with a range from 0 to 98 MMBO, and 320 BCFG, with a range from 0 to 622 BCFG; and 5 million barrels of natural gas liquids (MMBNGL) of natural gas liquids, with a range from 0 to 10 MMBNGL. The range of resource estimates is an indication of geologic uncertainty related to retention of oil and gas in the lacustrine shale source rock-reservoir system.