

Unconventional plays in the Etropole Petroleum System, southern Moesian Plate, Bulgaria

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The southern Moesian plate forms a foreland basin in front of the Balkan segment of the Alpine orogen. Sedimentary cover of the plate consists of Paleozoic and Mesozoic-Tertiary rocks up to 10-12 km thick near the Balkan thrust-fold belt.

In spite of several decades of exploration, only about a dozen small to medium-size hydrocarbon fields have been discovered in the Balkan foreland of western North Bulgaria. The main production comes from Middle Triassic Dolni Dabnik dolomites; much smaller reserves are in basal Jurassic sandstones.

During 2007-2008, Direct Petroleum Exploration, Inc. drilled the Deventci R-1 well 8.5 km northeast of the town of Cherven Briag. The well's TD is at 5,902 m within Lower Triassic clastics. Significant gas shows were detected in several intervals of Lower-Middle Jurassic rocks, which previously were not known as potential reservoirs. Twenty-two meters of reservoir section were perforated between 4,141 and 4,180 m in the Lower Jurassic Ozirovo Formation and produced a commercial flow of gas rich in condensate on long-term production test.

The Ozirovo Formation is regionally composed of low-porosity, low-permeability limestones and shales; however, the productive interval in the Deventci R-1 well at least partly consists of porous dolomites. No cores were taken in this interval, but careful studies of cuttings clearly indicate features typical of hydrothermal dolomitization, including large crystals of saddle dolomite, abundant sulfide minerals, partially corroded limestones, and ubiquitous pyrobitumen films covering pore walls.

Apparently dolomitization occurred along the major system of extensional listric faults just south of the well. These faults performed as conduits for hydrothermal fluids. Significant overpressure and the absence of water in production indicate the confined character of the reservoir which is typical of dolomite bodies formed by isolated hydrothermal plumes. Similar reservoirs can be expected along the fault system.

The overlying Etropole Formation, especially its organic-rich lower part (Stefanetz Member), holds great promise for a shale gas play. This formation is the proven source rock for major oil fields in northwestern Bulgaria. Significant gas shows were detected while drilling this section in the Deventci R-1 well. The Stefanetz Member consists of anoxic black calcareous shales with interbeds of marl and limestone. Typically, TOC in shales exceeds 2% and Type II kerogen dominates. The maturity ranges from oil window in more northern areas of the foreland to wet gas window toward the Balkan foldbelt. Estimated log-derived porosity ranges from 7-8%.

Both unconventional plays have a substantial resource potential. Proximity to the market and the available developed infrastructure make them economically attractive.