

Exploration and Production in China of Recently Discovered Giant-Size Oil and Gas Fields in Precambrian (Archean) Basement

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Introduction

Beginning in the early 1970s, abundant oil and gas was discovered in Precambrian basement in the onshore Sichuan Basin in southwestern China. More recently, major to giant-size oil and gas fields have been found in the shallow water Bohai Bay Basin in northern China. These two basins account for a considerable portion of the reserves and production in China (Hao, S., & Liu, 1990). The importance of basement-reservoired oil and gas fields was highlighted on March 1 of this year when CNOOC (China National Offshore Oil Company) issued a press release that the Bozhong 26-6 exploration well had discovered the largest metamorphic buried hill oil field in China.

Renqiu Oil Field

Renqiu is a famous giant-size basement “buried hill” oil field discovered in 1975. Renqiu is located in the onshore part of the Bohai Bay Basin about 120 km directly south of Beijing. This basin one of a series of structural basins that forms the North China basins chain. The buried hill structure has a maximum relief of 1,300 meters and an oil column of 870 meters (Chung-Hsiang P’an, 1982). Dolomitic carbonates of Cambrian and Ordovician age are the best basement reservoirs in this field. By the end of 1976, the field had 19 producing wells with average flows per well of 13,800 barrels of oil per day. The highest producing well reached 32,200 barrels oil per day.

The major producing formation are silicious dolomites of late Precambrian (Sinian) age. The Sinian and also Ordovician basement carbonates formed a prominent structural high. A long period of erosion and karstic weathering including solutions and leeching resulted in an exceptional reservoir. Oil and gas was generated by rich Tertiary source rocks which also sealed the reservoir. The earliest reserves estimates for Renqiu were by Meyerhoff, A.A. & Willums, J.O. who stated that Renqiu had reserves of 200 million tons which is equivalent to 1.5 billion barrels. A later estimated ultimate recovery is 2.3 billion barrels of oil and 0.7 TCF gas (Horn, M.K., 1990). Based on available data, Renqiu as the world’s largest basement oil and gas field. Since Renqiu’s discovery in 1975, more than 40 buried hill oil and gas pools have been discovered, primarily in the North China basins (Horn, M.K., 1990).

Recent Bohai Bay Basement Oil and Gas Discoveries

The Bozhong 19-6 Gas-Condensate Field was discovered by CNOOC (China National Offshore Oil Company) in 2017. This field is located in the Bohai Gulf Basin in 24 meters of water. The discovery well, 19-6-1, intersected 100 meters of pay in an Archean-age buried hill reservoir and 240 meters of pay in the Lower Paleogene Kongdian Formation. A report by Offshore Technology (2022) and the China Daily News (2022) stated that Bozhong 19-6 has reserves of 6.0 TCF gas and 1.1 billion barrels of condensate and was the biggest oil and gas discovery in China in the past 50 years. Thus, the Bozhong 19-6 field is the largest gas-condensate field in basement in Asia. Based on published data, this field is the largest gas field in crystalline basement in the world. The Bozhong 19-6 discovery was followed one year later in 2018 by Bozhong 13-2 which was another basement oil and gas discovery. The water depth is 23 meters. This field was described as a large Archean hill with an 850 meters oil and gas column. The net oil pay is 350 meters. Testing of Bozhong 13-2 provided flow rates of 2,590 barrels of oil per day and 8.8 MMcfg/day (Huiyong, L., et al, 2021). The Bozhong 19-6 field discovered in 2017 and Bozhong 13-2 field found in 2018 fields highlights that the basement oil and gas play remains very much under-explored in China. Very significant is that according to Wang (2021) the gas potential in the Bozhong Depression is estimated at 67 TCF gas.

Most recently and of key importance to the continued exploration for basement reservoirs in China is that on March 1, 2024, CNOOC announced the discovery of the Bozhong 26-6 oil field in the Bohai Sea. The press release stated that this discovery is located in 22 meters of water depth. The main oil-bearing structure is an Archean buried hill and the oil property is light crude. The discovery well BZ26-6-2 was drilled to a total depth of 4,480 meters and encountered 321 meters of oil pay zones. The well was tested at 2,040 barrels of crude oil per day and 11.45 million cubic feet of natural gas per day. The press release concluded stating, “The Bozhong 26-6 oil field is the third oil field discovery with hundred million tons of reserves in southern Bohai Sea after Kenli 6-1 and Kenli 10-2. It is identified as the largest metamorphic buried hill in China. The discovery demonstrates the broad prospect of exploration for subtle buried hills in the Bohai Sea providing importance guidance for exploration in similar basins”. The continued highly successful exploration for oil and gas in basement is very important for China since it decreases the need for China to import expensive oil and gas. Also, this allows China to substitute oil or gas for power generation and decrease the burning of highly polluting coal. The net effect is that the basement oil and gas discoveries are very beneficial for China’s economy and environment.