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National and Global Petroleum Assessment

Assessment of Continuous Oil Resources in the Eastern Great Basin Province of Nevada, Utah, and Idaho, 2018

Using a geology-based assessment methodology, the U.S. Geological Survey estimated undiscovered, technically recoverable mean resources of 534 million barrels of continuous oil and 156 billion cubic feet of gas (associated) in the Eastern Great Basin Province of Nevada, Utah, and Idaho.

Introduction

The U.S. Geological Survey (USGS) quantitatively assessed the potential for undiscovered, technically recoverable continuous oil and gas resources in the Eastern Great Basin Province (Anna and others, 2007) of Nevada, Utah, and Idaho (fig. 1). The assessment focused on the area of the province between the Roberts Mountains and Sevier thrust systems (Peterson, 1994). The major petroleum source rocks within this area are the Upper Devonian–Lower Mississippian Pilot Shale and the Mississippian Chainman Formation (Gutschick and Rodriquez, 1979; Poole and Claypool, 1984; Giles, 1994; Trexler and others, 1995). The geologic model applied to the Pilot Shale and shales in the Chainman Formation is for these shales to have achieved generative maturity for oil by burial to at least 8,700 feet (2,652 meters) within some of the Neogene extensional basins (Grabb, 1994; Anna and others, 2007). Areas that satisfy this depth requirement were defined using modeled gravity data that were calibrated to the petroleum system in Railroad Valley and Pine Valley in Nevada (Barker and Peterson, 1991; Ĭnan and Davis, 1994; Meissner, 1995; Anna and others, 2007).

Total Petroleum Systems and Assessment Units

The USGS defined the Pilot Shale Total Petroleum System (TPS) to contain the Pilot Shale Oil Assessment Unit (AU) and the Chainman Shale TPS with the Chainman Shale Oil AU. Samples from shallower, less thermally mature rocks carried by structurally higher thrust sheets (Ĭnan and Davis, 1994; Meissner, 1995; Poole, 1995) show that Pilot Shales can contain as much as 4 weight percent total organic carbon, have hydrogen indices up to 400 milligrams of hydrocarbon per gram of organic carbon, and are dominated by Type II kerogen (Sandberg and others, 1980; French, 1995). Shales in the Chainman Formation contain up to 8 weight percent total organic carbon, have hydrogen index values as high as 800 milligrams of hydrocarbon per gram of organic carbon, are also dominated by Type II kerogen, and can be overpressured (Sandberg and others, 1980; Grabb, 1994; Anna and others, 2007). The geologic model for the Pilot Shale Oil AU and the Chainman Shale Oil AU is for these shales located within the structurally higher thrust sheets to have been thermally immature to marginally mature for oil generation prior to the Neogene (Grabb, 1994; Ĭnan and Davis, 1994; Meissner, 1995; Poole, 1995). Regional extension in the Neogene resulted in burial of these shales by at least 8,700 feet of sediment, which placed the shales well into the oil-generation window (Meissner, 1995; Anna and others, 2007). Oil was partially retained within the shales following expulsion, potentially forming shale-oil accumulations. Uncertainties in this assessment include the extent of fracturing and its effect on oil retention, the depth to which the shales are thermally mature for oil, and the extent of areas with greater than 8,700 feet of burial. Estimates of shale-oil resources are based on the geologic model presented here and not on other possible scenarios.

The assessment input data are summarized in table 1. Well drainage areas, success ratios, and estimated ultimate recoveries are derived from U.S. shale-oil and shale-gas analogs.

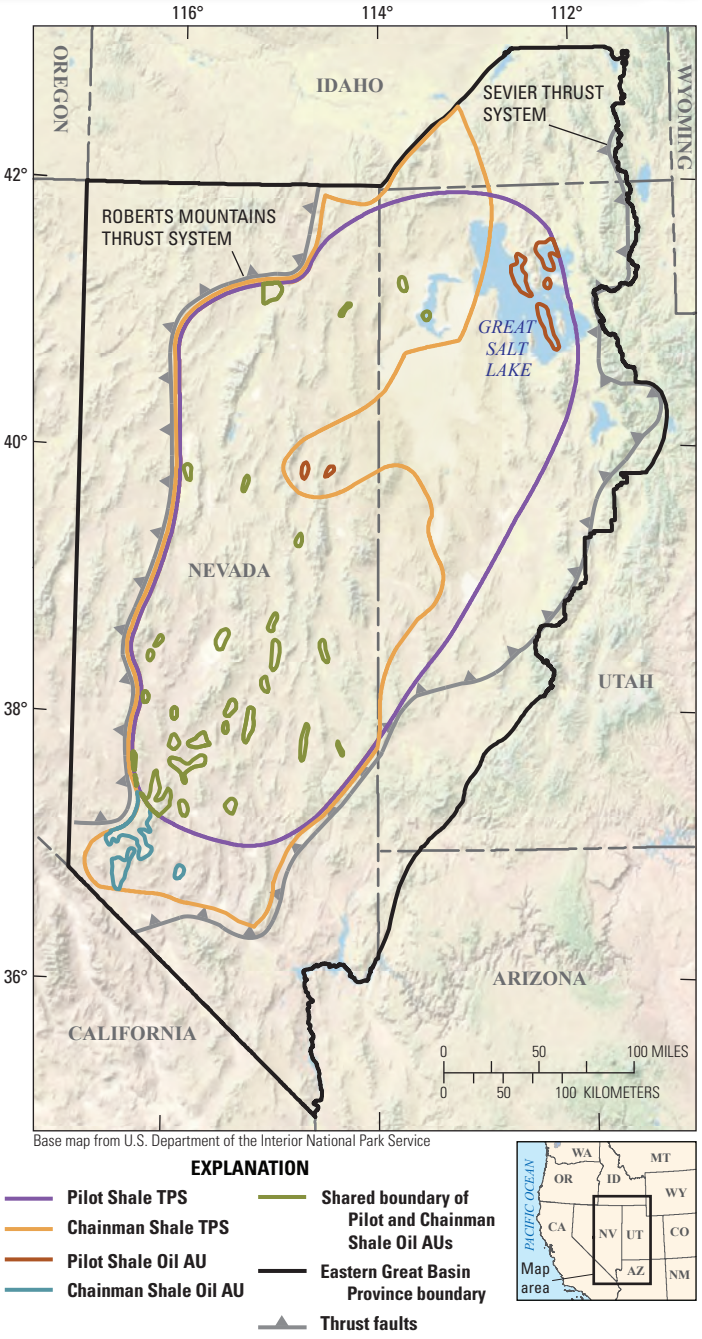

Figure 1. Map showing the location of two continuous assessment units (AUs) and two total petroleum systems (TPSs) in the Eastern Great Basin Province of Nevada, Utah, and Idaho. Adjacent lines illustrate a shared boundary at the outermost line.

Table 1. Key input data for two continuous assessment units in the Eastern Great Basin Province of Nevada, Utah, and Idaho.

[AU, assessment unit; %, percent; EUR, estimated ultimate recovery per well; MMBO, million barrels of oil. Well drainage area, success ratio, and EUR are defined partly using U.S. shale-oil and shale-gas analogs. The average EUR input is the minimum, median, maximum, and calculated mean. Shading indicates not applicable]

Assessment input data—Continuous AUs	Pilot Shale Oil AU				Chainman Shale Oil AU			
	Minimum	Mode	Maximum	Calculated mean	Minimum	Mode	Maximum	Calculated mean
Potential production area of AU (acres)	1,000	870,000	1,740,000	870,333	1,000	904,000	1,808,000	904,333
Average drainage area of wells (acres)	80	120	160	120	80	120	160	120
Success ratio (%)	10	50	90	50	10	50	90	50
Average EUR (MMBO)	0.02	0.08	0.2	0.086	0.02	0.08	0.2	0.086
AU probability	0.8				0.9			

Table 2. Results for two continuous assessment units in the Eastern Great Basin Province of Nevada, Utah, and Idaho.

[MMBO, million barrels of oil; BCFG, billion cubic feet of gas; NGL, natural gas liquids; MMBNGL, million barrels of natural gas liquids. Results shown are fully risked estimates. F95 represents a 95-percent chance of at least the amount tabulated; other fractiles are defined similarly. Fractiles are additive under the assumption of perfect positive correlation. Shading indicates not applicable]

Total petroleum systems and assessment units (AUs)	AU probability	Accumulation type	Total undiscovered resources											
			Oil (MMBO)				Gas (BCFG)				NGL (MMBNGL)			
			F95	F50	F5	Mean	F95	F50	F5	Mean	F95	F50	F5	Mean
Pilot Shale Total Petroleum System														
Pilot Shale Oil AU	0.8	Oil	0	214	649	246	0	83	269	98	0	1	4	1
Chainman Shale Total Petroleum System														
Chainman Shale Oil AU	0.9	Oil	0	254	695	288	0	49	145	58	0	1	2	1
Total undiscovered continuous resources			**0**	**468**	**1,344**	**534**	**0**	**132**	**414**	**156**	**0**	**2**	**6**	**2**

Undiscovered Resources Summary

The USGS quantitatively assessed the potential for continuous oil and gas resources within the Eastern Great Basin Province of Nevada, Utah, and Idaho (table 2). The estimated means for undiscovered resources are 534 million barrels of oil (MMBO) with an F95 to F5 range from 0 to 1,344 MMBO, 156 billion cubic feet of gas (BCFG) with an F95 to F5 range from 0 to 414 BCFG, and 2 million barrels of natural gas liquids (MMBNGL) with an F95 to F5 range from 0 to 6 MMBNGL. For oil and gas accumulations, zeros at F95 reflect the interpretation of geologic risk (AU probability less than 1.0) on the potential occurrence of one well of minimum EUR in the AU. Of the mean total shale-oil resources of 534 MMBO, 246 MMBO, or 46 percent, is in the Pilot Shale Oil AU, and 288 MMBO, or 54 percent, is in the Chainman Shale Oil AU.

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For More Information

Assessment results are also available at the USGS Energy Resources Program website at https://energy.usgs.gov.

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