

# Assessment of Tight-Gas Resources in Canyon Sandstones of the Val Verde Basin, Texas, 2016

*Using a geology-based assessment methodology, the U.S. Geological Survey assessed mean resources of 5 trillion cubic feet of gas and 187 million barrels of natural gas liquids in tight-gas assessment units in the Canyon sandstones of the Val Verde Basin, Texas.*

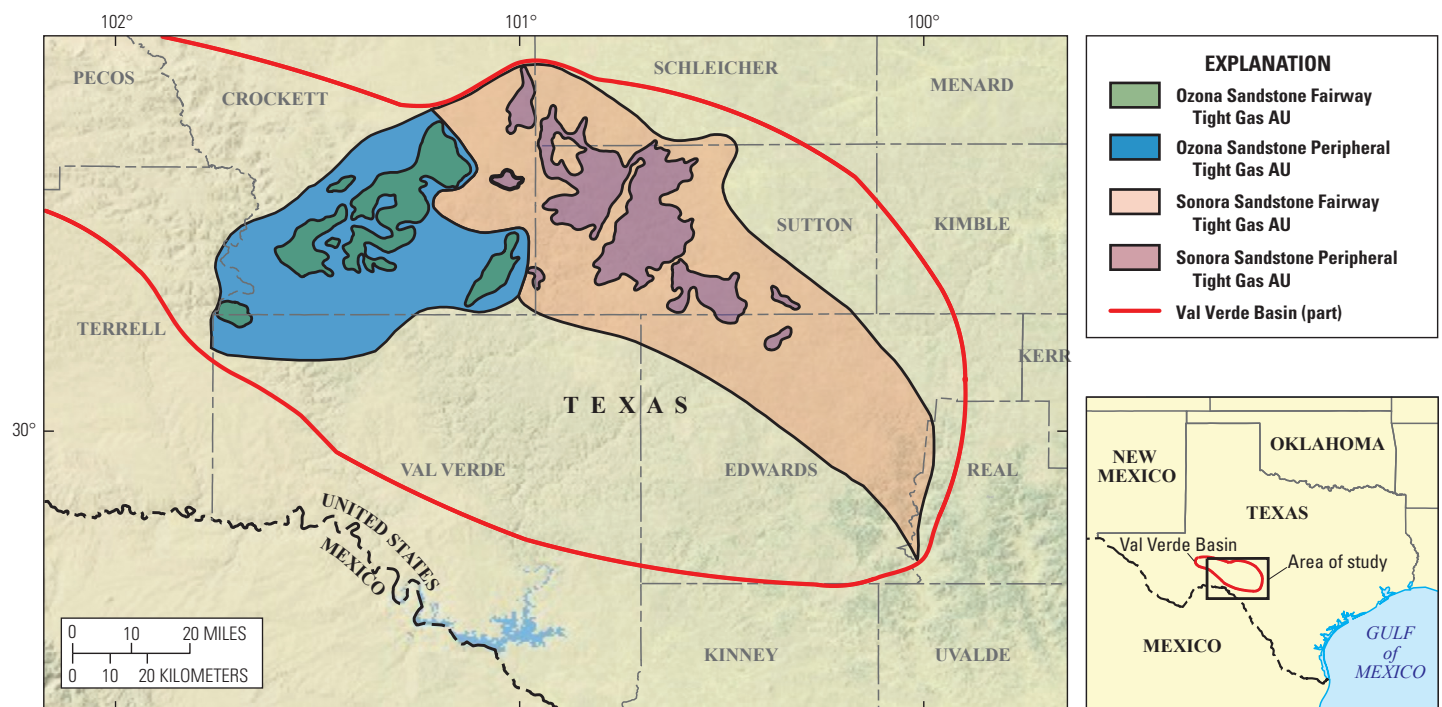
## Introduction

The U.S. Geological Survey (USGS) recently completed a geology-based assessment of technically recoverable tight-gas resources in the Canyon sandstones of the Val Verde Basin in southwest Texas (fig. 1). The Val Verde Basin is the foredeep to the late Paleozoic, north-verging Ouachita-Marathon fold and thrust belt. "Canyon sandstones" is a collective term for several sandstone intervals deposited in deep-water environments in the developing foredeep during the Late Pennsylvanian (Missourian to Virgilian?) and Early Permian (Wolfcampian) (Bebout and Garrett, 1989; Hamlin and others, 1995; Hamlin, 2009). Canyon sandstones include the lower Canyon sandstone, Sonora sandstone, and Ozona sandstone intervals (Hamlin and others, 1995; Hamlin, 2009). The lower

Canyon sandstone was not assessed in this study. The sandstones represent multiple phases of deposition in prograding slope channel and basin-floor submarine fan systems with varying directions of provenance. For example, the Ozona sandstones were sourced from the southwest, whereas the Sonora sandstones were sourced from the northeast (Hamlin, 2009). Maps of sandstone thicknesses (Hamlin and others, 1995; Hamlin, 2009) and production data guided the geologic definition of the assessment units in this study.

Four assessment units (AU) were defined and assessed in the Ozona and Sonora sandstones of the Val Verde Basin. The four assessment units are contained within the Permian Basin Paleozoic Composite Total Petroleum System (TPS). Given that approximately 15,000 wells have been drilled and tested

in the Canyon sandstone, production "fairways" have come into focus through time that are defined by thicker sandstone intervals and thus denser drilling and production. These fairways were also used as a basis for AU definition. The production fairway in the Ozona sandstone is defined as the Ozona Sandstone Fairway Tight Gas AU (fig. 1), and the area surrounding the fairway is the Ozona Sandstone Peripheral Tight Gas AU. Likewise, the production fairway in the Sonora sandstone defined the Sonora Sandstone Fairway Tight Gas AU, and the surrounding area is the Sonora Sandstone Peripheral Tight Gas AU. The outlines of the peripheral AUs generally follow the Ozona and Sonora sandstone boundaries developed by Hamlin and others (1995). Assessment input data for the four AUs are summarized in table 1.



Source: National Park Service

**Figure 1.** Map of the Val Verde Basin, Texas. Assessment unit (AU) boundaries approximate facies maps of the various Canyon sandstones.

## Tight-Gas Resource Summary

The USGS assessed technically recoverable tight-gas resources in four continuous AUs in Canyon sandstones (table 2). Assessed mean resources are 5,004 billion cubic feet of tight gas and 187 million barrels of natural gas liquids. For the Ozona Sandstone Fairway Tight Gas AU, the assessed mean resource is 1,615 billion cubic feet of gas (BCFG), with an F95–F5 range from 730 to 2,683 BCFG. The assessed mean resource for the Ozona Sandstone Peripheral Tight Gas AU is 222 BCFG, with an F95–F5 range from 68 to 425 BCFG. For the Sonora Sandstone Fairway Tight Gas AU, the assessed mean resource is 2,779 BCFG, with an F95–F5 range from 1,223 to 4,677 BCFG. The assessed mean resource for the Sonora Sandstone Peripheral Tight Gas AU is 388 BCFG, with an F95–F5 range from 117 to 735 BCFG. For the four tight-gas AUs, the assessed mean resource for natural gas liquids is 187 million barrels of natural gas liquids (MMBNGL), with an F95–F5 range from 74 to 338 MMBNGL. More than half (56 percent or 2,779 BCFG) of the total assessed mean tight-gas resource is in the Sonora Sandstone Fairway Tight Gas AU.

**Table 1.** Key assessment input data for the four continuous assessment units in the Canyon sandstones of the Val Verde Basin, Texas.

[AU, assessment unit; %, percent; EUR, estimated ultimate recovery per well; BCFG, billion cubic feet of gas. The EUR, well drainage area, and success ratios are taken from U.S. shale-gas analogs. The average EUR input is the minimum, median, and calculated mean. Shading indicates not applicable]

| Assessment input data                   | Ozona Sandstone Fairway Tight Gas AU  |         |         |                 | Ozona Sandstone Peripheral Tight Gas AU  |         |           |                 |
|---|---------------------------------------|---------|---------|-----------------|--|---------|-----------|-----------------|
|   | Minimum                               | Mode    | Maximum | Calculated mean | Minimum                                  | Mode    | Maximum   | Calculated mean |
| Potential production area of AU (acres) | 40,000                                | 180,000 | 270,000 | 163,333         | 10,000                                   | 400,000 | 586,000   | 332,000         |
| Average drainage area of wells (acres)  | 10                                    | 20      | 30      | 20              | 40                                       | 80      | 120       | 80              |
| Percentage of area untested in AU       | 50                                    | 60      | 70      | 60              | 64                                       | 76      | 88        | 76              |
| Success ratios (%)                      | 85                                    | 90      | 95      | 90              | 50                                       | 60      | 70        | 60              |
| Average EUR (BCFG)                      | 0.3                                   | 0.35    | 0.4     | 0.352           | 0.08                                     | 0.1     | 0.4       | 0.116           |
| AU probability                          | 1.0                                   |         |         |                 | 1.0                                      |         |           |                 |
| Assessment input data                   | Sonora Sandstone Fairway Tight Gas AU |         |         |                 | Sonora Sandstone Peripheral Tight Gas AU |         |           |                 |
|   | Minimum                               | Mode    | Maximum | Calculated mean | Minimum                                  | Mode    | Maximum   | Calculated mean |
| Potential production area of AU (acres) | 60,000                                | 287,000 | 431,000 | 259,333         | 10,000                                   | 900,000 | 1,197,000 | 702,333         |
| Average drainage area of wells (acres)  | 10                                    | 20      | 30      | 20              | 40                                       | 80      | 120       | 80              |
| Percentage of area untested in AU       | 50                                    | 65      | 80      | 65              | 68                                       | 72      | 86        | 75              |
| Success ratios (%)                      | 85                                    | 90      | 95      | 95              | 40                                       | 50      | 60        | 50              |
| Average EUR (BCFG)                      | 0.3                                   | 0.35    | 0.4     | 0.352           | 0.08                                     | 0.1     | 0.4       | 0.116           |
| AU probability                          | 1.0                                   |         |         |                 | 1.0                                      |         |           |                 |

**Table 2.** Assessment results for the four continuous assessment units in the Canyon sandstones of the Val Verde Basin, Texas.

[BCFG, billion cubic feet of gas; NGL, natural gas liquids; MMBNGL, million barrels of natural gas liquids. Results shown are fully risked estimates. For gas accumulations, all liquids are included under the NGL category. 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 system (TPS) and assessment unit (AU) | AU probability | Accumulation type | Total undiscovered resources |              |              |              |              |            |            |            |
|---|----------------|-------------------|------------------------------|--------------|--------------|--------------|--------------|------------|------------|------------|
|   |                |                   | Gas (BCFG)                   |              |              |              | NGL (MMBNGL) |            |            |            |
|   |                |                   | F95                          | F50          | F5           | Mean         | F95          | F50        | F5         | Mean       |
| Permian Basin Paleozoic Composite TPS                 |                |                   |                              |              |              |              |              |            |            |            |
| Ozona Sandstone Fairway Tight Gas AU                  | 1.0            | Gas               | 730                          | 1,562        | 2,683        | 1,615        | 8            | 18         | 35         | 19         |
| Ozona Sandstone Peripheral Tight Gas AU               | 1.0            | Gas               | 68                           | 208          | 425          | 222          | 4            | 12         | 27         | 13         |
| Sonora Sandstone Fairway Tight Gas AU                 | 1.0            | Gas               | 1,223                        | 2,681        | 4,677        | 2,779        | 58           | 131        | 245        | 139        |
| Sonora Sandstone Peripheral Tight Gas AU              | 1.0            | Gas               | 117                          | 365          | 735          | 388          | 4            | 14         | 31         | 16         |
| <b>Total undiscovered unconventional resources</b>    |                |                   | <b>2,138</b>                 | <b>4,816</b> | <b>8,520</b> | <b>5,004</b> | <b>74</b>    | <b>175</b> | <b>338</b> | <b>187</b> |

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### Canyon Sandstones Assessment Team

Christopher J. Schenk, Marilyn E. Tennyson, Timothy R. Klett, Tracey J. Mercier, Michael E. Brownfield, Stephanie B. Gaswirth, Sarah J. Hawkins, Heidi M. Leathers-Miller, Kristen R. Marra, Thomas M. Finn, and Janet K. Pitman

### For More Information

Assessment results are available at the USGS Energy Resources Program Web site at <http://energy.usgs.gov>.