

Structure Contour and Isopach Maps of the Wolfcamp Shale and Bone Spring Formation of the Delaware Basin, Permian Basin Province, New Mexico and Texas

Open-File Report 2020–1126

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By Stephanie B. Gaswirth

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Structure Contour and Isopach Maps of the Wolfcamp Shale and Bone Spring Formation of the Delaware Basin, Permian Basin Province, New Mexico and Texas

By Stephanie B. Gaswirth

Abstract

A series of structure contour and isopach maps for the Wolfcamp shale and the Bone Spring Formation of the Delaware Basin, Permian Basin Province, were generated in support of the U.S. Geological Survey 2018 assessment of undiscovered continuous oil and gas resources. The interpreted formation tops used to generate the maps are from the IHS Markit® PRODFit™ database, a commercial proprietary database. The maps in this report are reflective of the stratigraphic units on the IHS Markit type log from southeast Eddy County, New Mexico.

Introduction

A series of structure contour and isopach maps for the Wolfcamp shale and the Bone Spring Formation of the Delaware Basin, Permian Basin Province, were generated from the PRODFit™ database (IHS Markit®, 2018). This is a proprietary database to which the U.S. Geological Survey (USGS) subscribes. These maps were generated in support of the USGS 2018 assessment of undiscovered continuous oil and gas resources in the Wolfcamp shale and Bone Spring Formation (Gaswirth and others, 2018). That study was the first USGS assessment of continuous resources for these units in the Delaware Basin (figs. 1–3; Gaswirth and others, 2018). The structure contour and isopach maps incorporate interpreted formation tops data from PRODFit as of November 1, 2018 (IHS Markit, 2018). Maps published herein are for the intervals that were assessed for oil and gas resources in the Delaware Basin by the USGS.

Geologic Background

The USGS National and Global Assessment of Petroleum Resources Project completed a geology-based resource assessment of undiscovered, technically recoverable continuous oil and gas resources in the Pennsylvanian-Permian Wolfcamp

shale (informal name; age follows Hamlin and Baumgardner, 2012) and the early Permian Bone Spring Formation of the Delaware Basin in the Permian Basin Province of southeast New Mexico and west Texas (Gaswirth and others, 2018). The Delaware Basin is the western subbasin of the Permian Basin Province and is separated from the Midland Basin to the east by the uplifted Central Basin Platform.

PRODFit subdivides both the Wolfcamp shale and the Bone Spring Formation into stratigraphic units based on petrophysical log signatures and landing zones for horizontal wells. The maps in this publication are reflective of the stratigraphic units on the type log from southeast Eddy County, New Mexico, shown in [figure 4](#) (IHS Markit, 2018).

Method Used to Generate Contour Maps

Elevation data for the top of the Wolfcamp and Bone Spring horizons, as defined in [figures 5–34](#), were obtained from PRODFit (IHS Markit, 2018). In the database, records for 15,052 wells in the Delaware Basin contain depth to the top of the Wolfcamp and Bone Spring units; however, the number of data points available varied for each of the surfaces mapped. Data points were put into ArcGIS and contoured using the Kriging contour method for the structure contour maps and the isopach maps. Data points are not shown on the maps because of the proprietary nature of the IHS Markit PRODFit database. Contour maps were clipped to the extent of the data points that were used to create the contour lines. Isopach thickness maps for the units of the Wolfcamp shale and Bone Spring were calculated using elevation data from the tops of units. Fewer data points were available for the isopach maps because data points from two surfaces were necessary to calculate unit thickness.

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Figures

4 Structure Contour and Isopach Maps of the Wolfcamp Shale and Bone Spring Formation

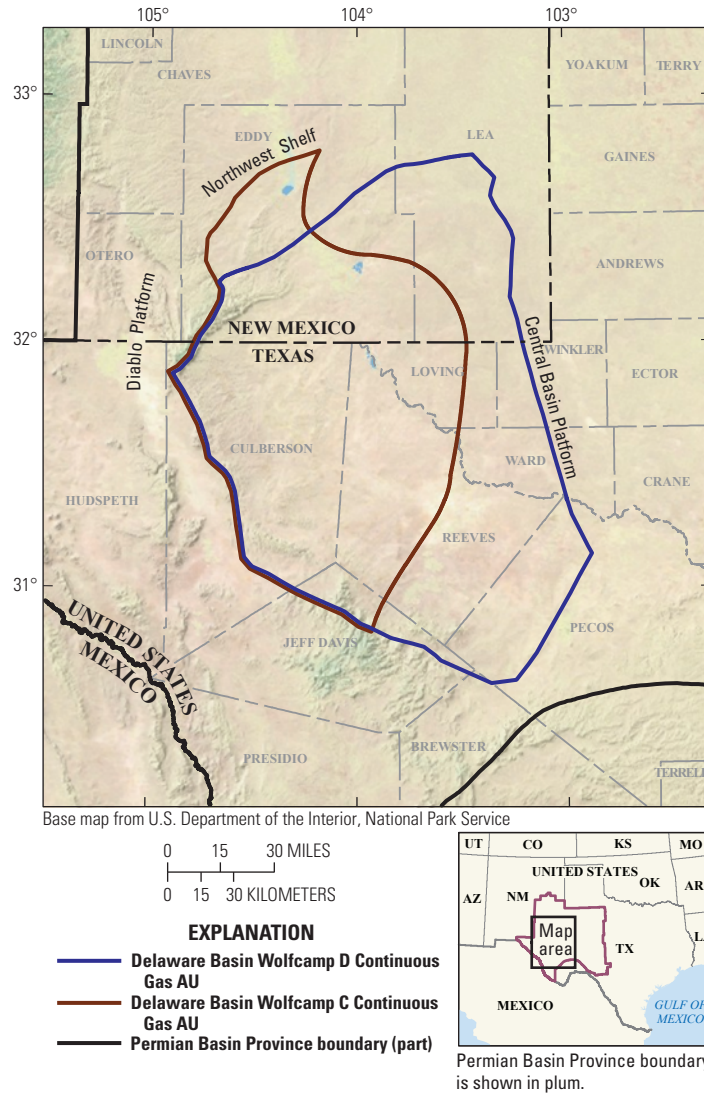


Figure 1. Map showing the Delaware Basin, Permian Basin Province, New Mexico and Texas, and the extent of the two Wolfcamp shale continuous gas assessment units (AUs). Province boundary is from Klett and others, 1997. (From Gaswirth and others, 2018)

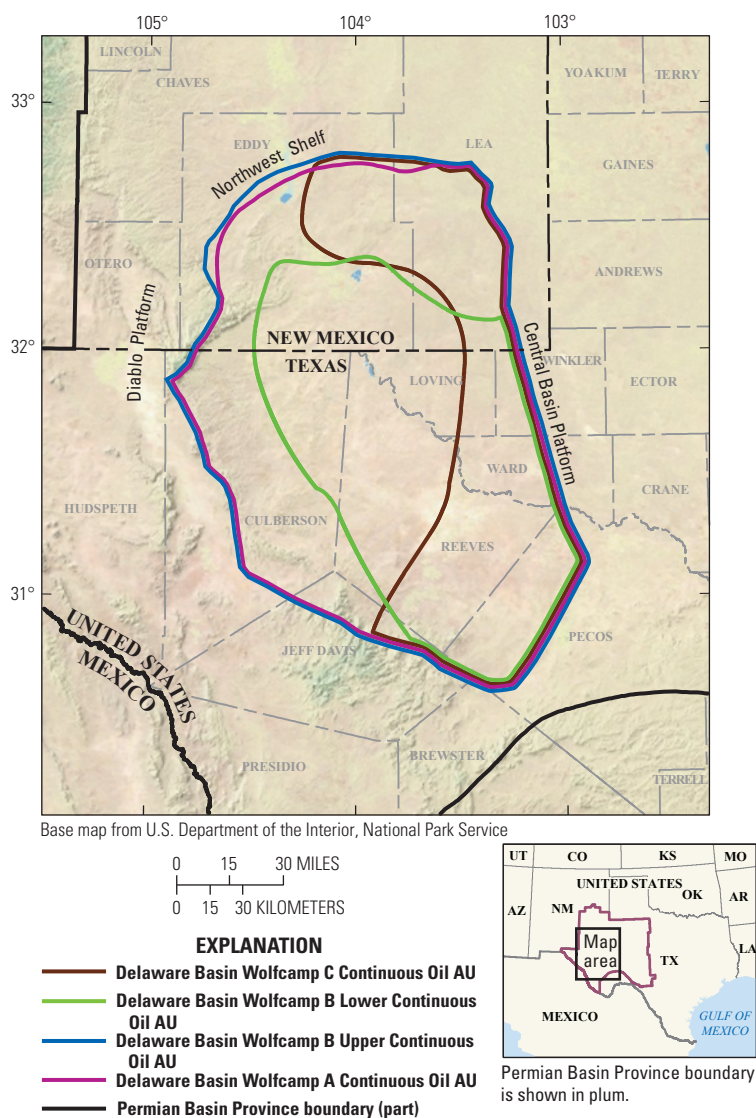


Figure 2. Map showing the Delaware Basin, Permian Basin Province, New Mexico and Texas, and the extent of the four Wolfcamp shale continuous oil assessment units (AUs). Province boundary is from Klett and others, 1997. (From Gaswirth and others, 2018)

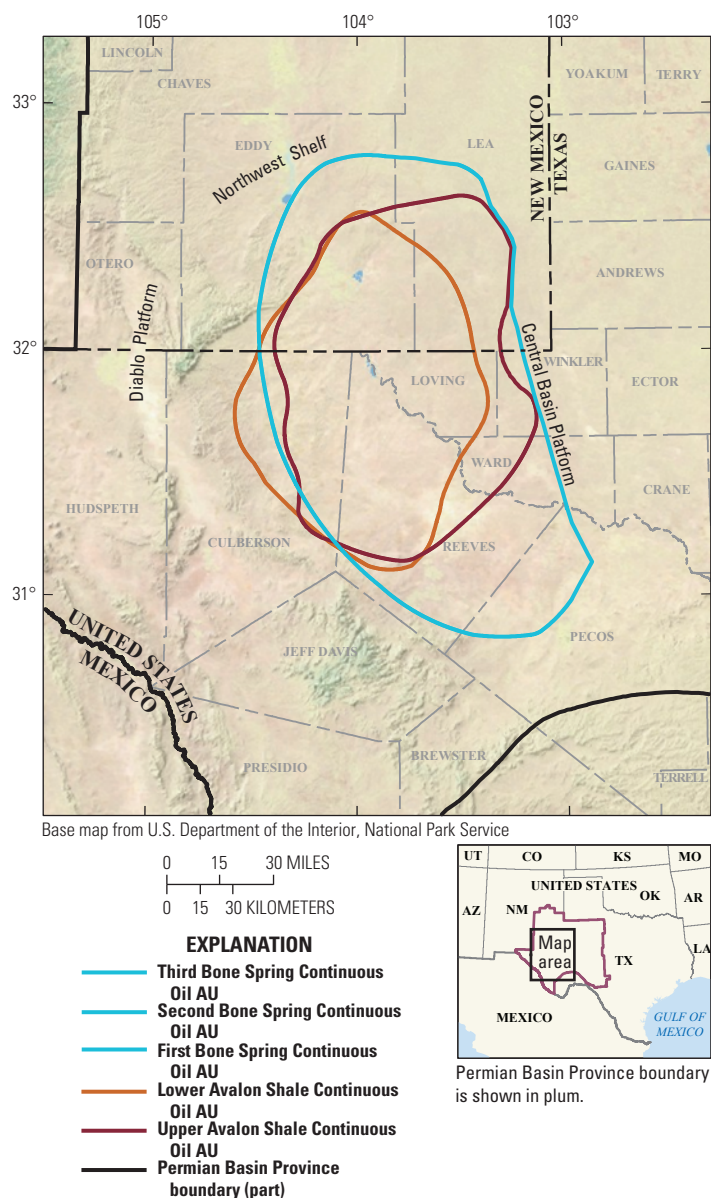


Figure 3. Map showing the Delaware Basin, Permian Basin Province, New Mexico and Texas, and the extent of the five Bone Spring Formation continuous oil assessment units (AUs). The First, Second, and Third Bone Spring continuous oil AUs have the same extent. Province boundary is from Klett and others, 1997. (From Gaswirth and others, 2018)

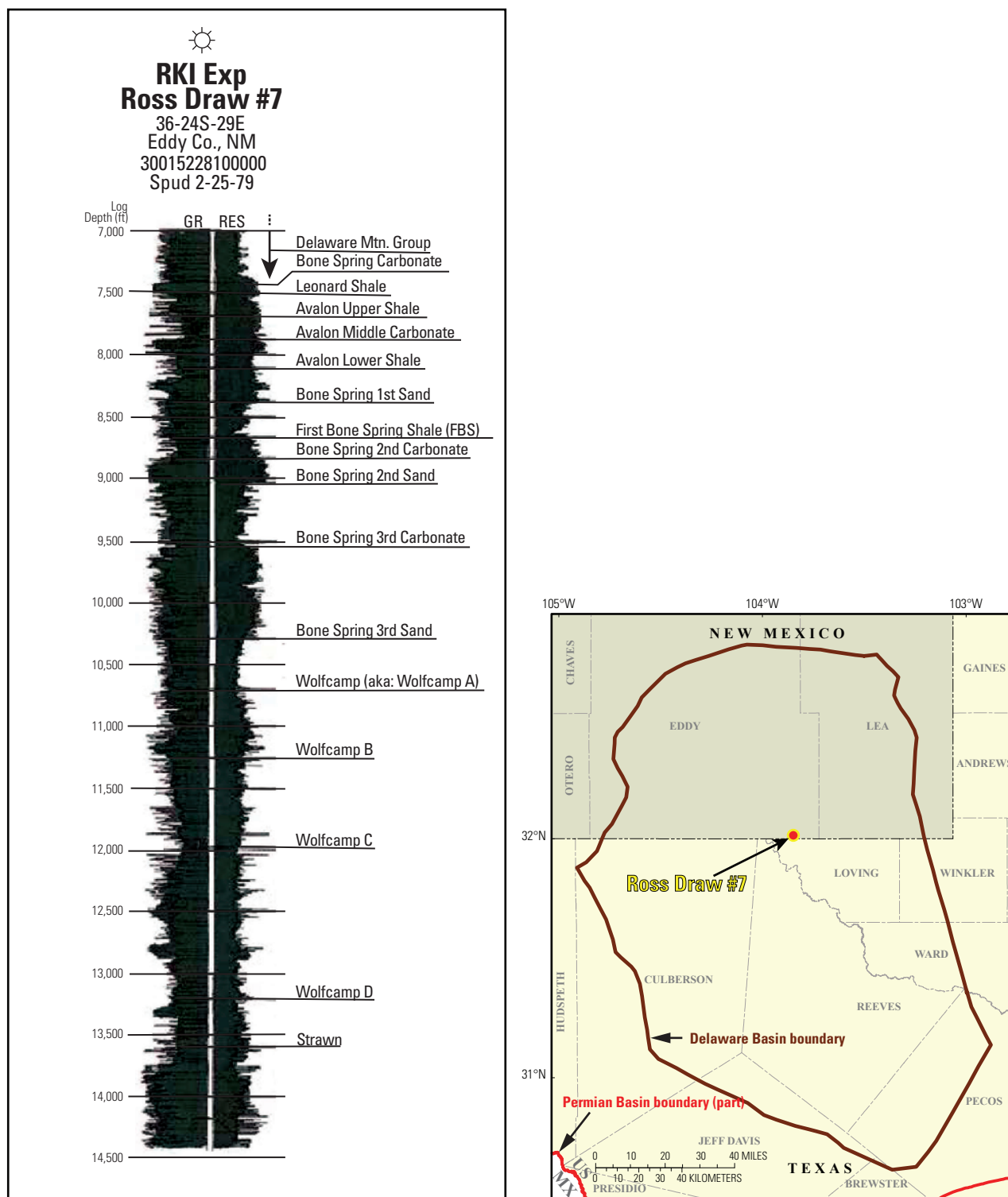


Figure 4. Type log from southeast Eddy County, New Mexico, showing the stratigraphic column of the Wolfcamp shale and Bone Spring Formation of the Delaware Basin (from IHS Markit®, 2018). Formation and unit tops are based on the PRODFit™ database (IHS Markit®, 2018).

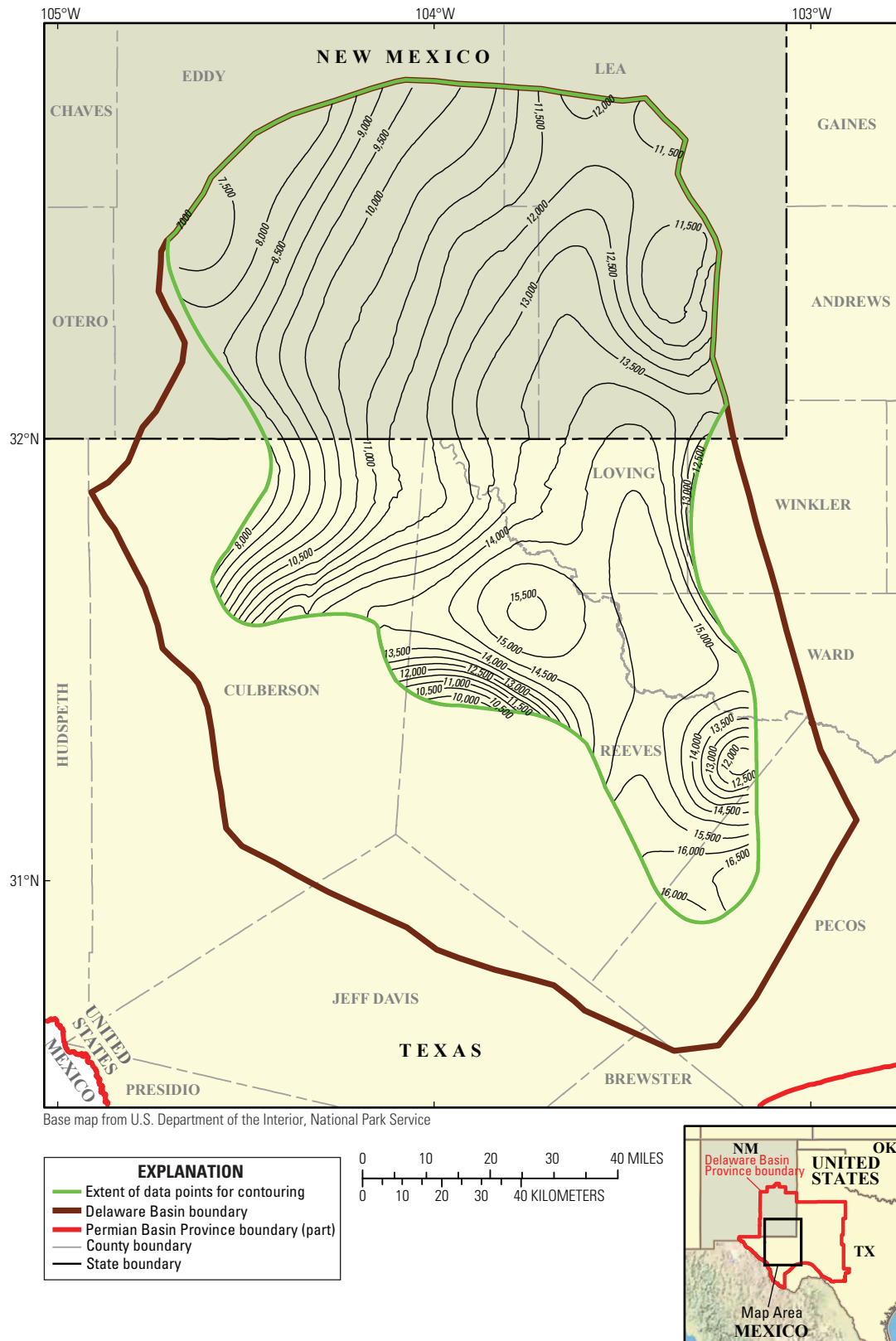


Figure 5. Structure contour map of the top of the Wolfcamp D of the Wolfcamp shale, Delaware Basin, Permian Basin Province, New Mexico and Texas. Contour interval is 500 feet, and 719 data points (wells with Wolfcamp D tops) from PRODFit™ (IHS Markit®, 2018) were used to generate the contour map.

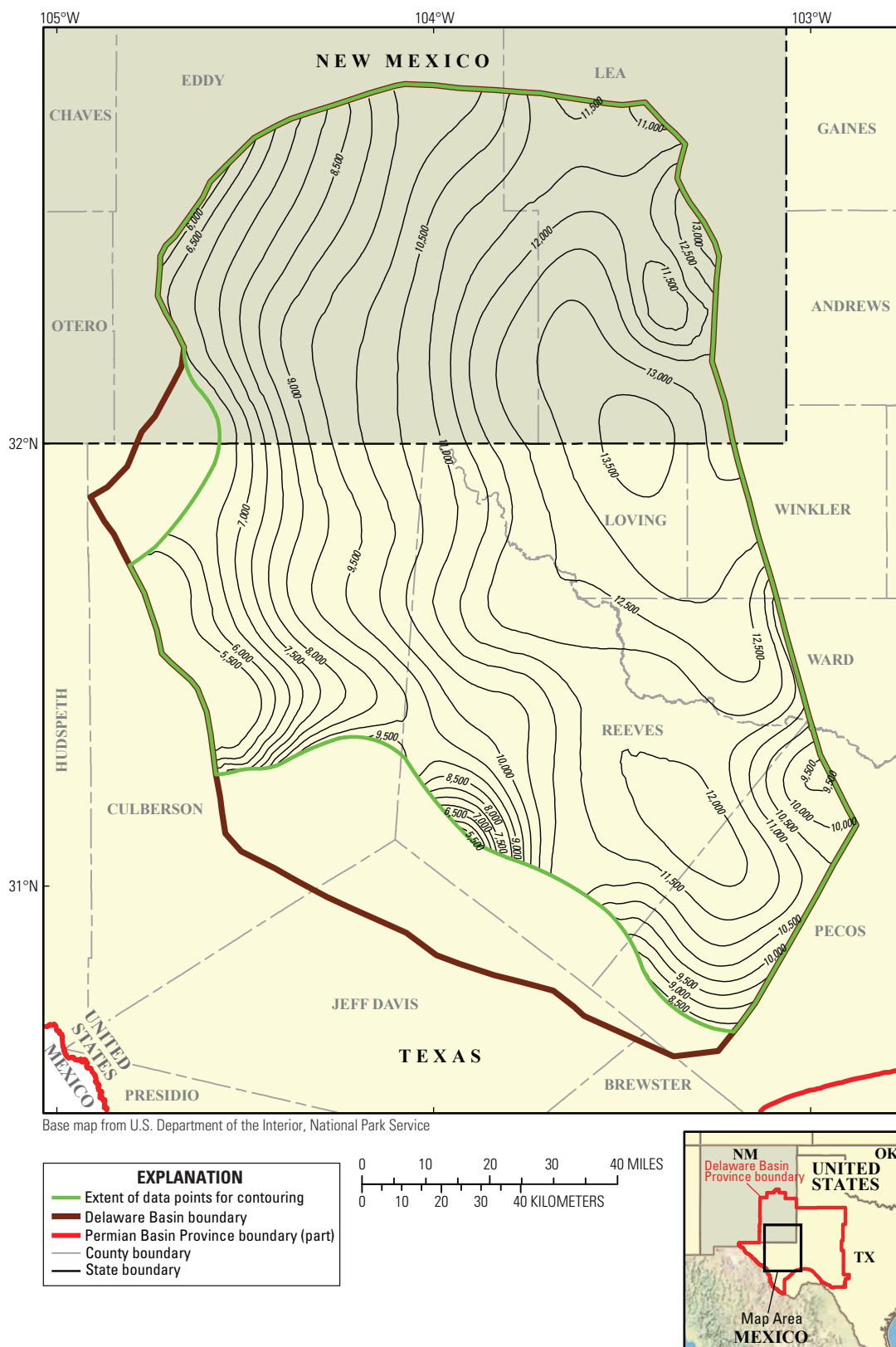


Figure 6. Structure contour map of the top of the Wolfcamp C of the Wolfcamp shale, Delaware Basin, Permian Basin Province, New Mexico and Texas. Contour interval is 500 feet, and 840 data points (wells with Wolfcamp C tops) from PRODFit™ (IHS Markit®, 2018) were used to generate the contour map.

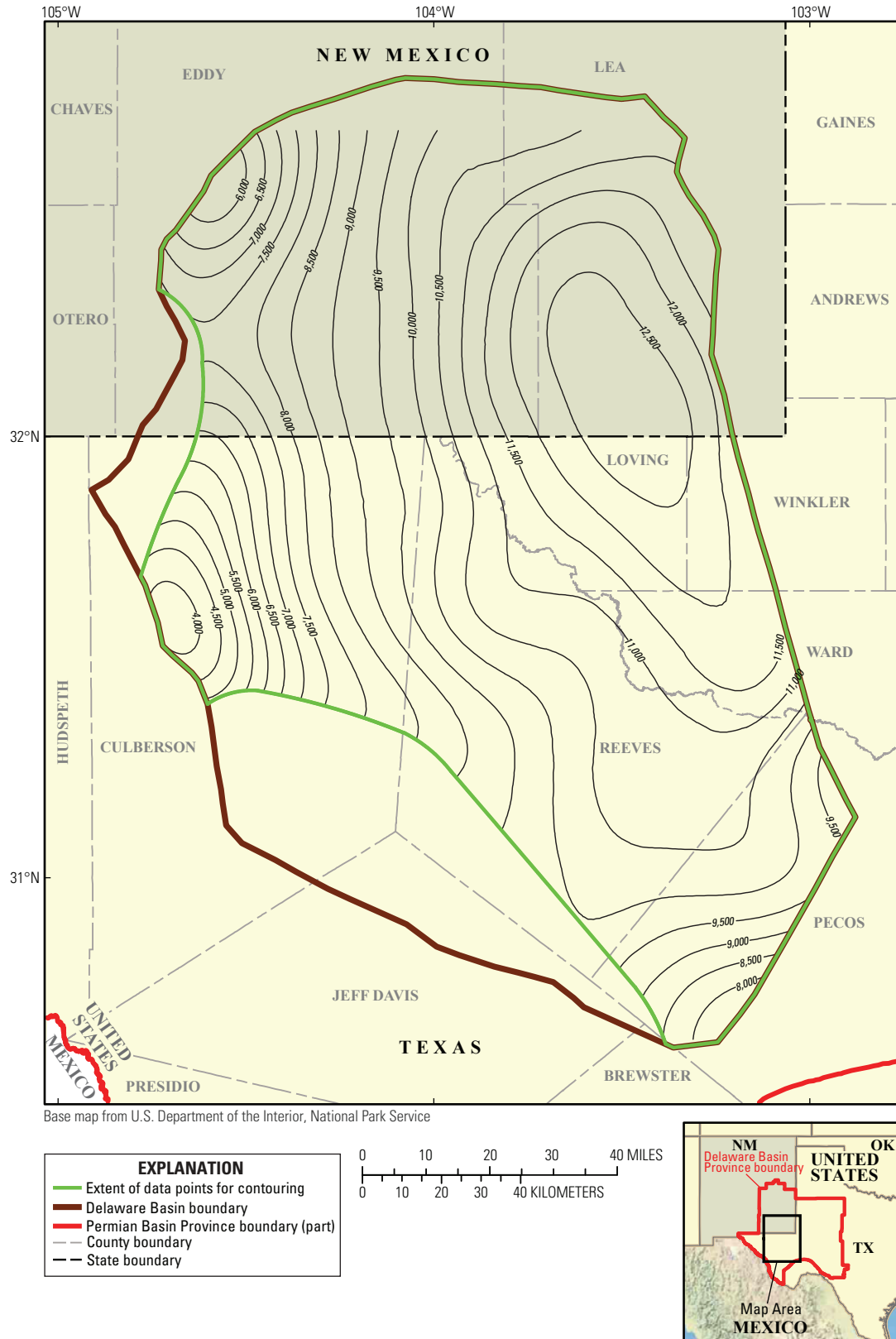


Figure 7. Structure contour map of the top of the Wolfcamp B of the Wolfcamp shale, Delaware Basin, Permian Basin Province, New Mexico and Texas. Contour interval is 500 feet, and 846 data points (wells with Wolfcamp B tops) from PRODFit™ (IHS Markit®, 2018) were used to generate the contour map.

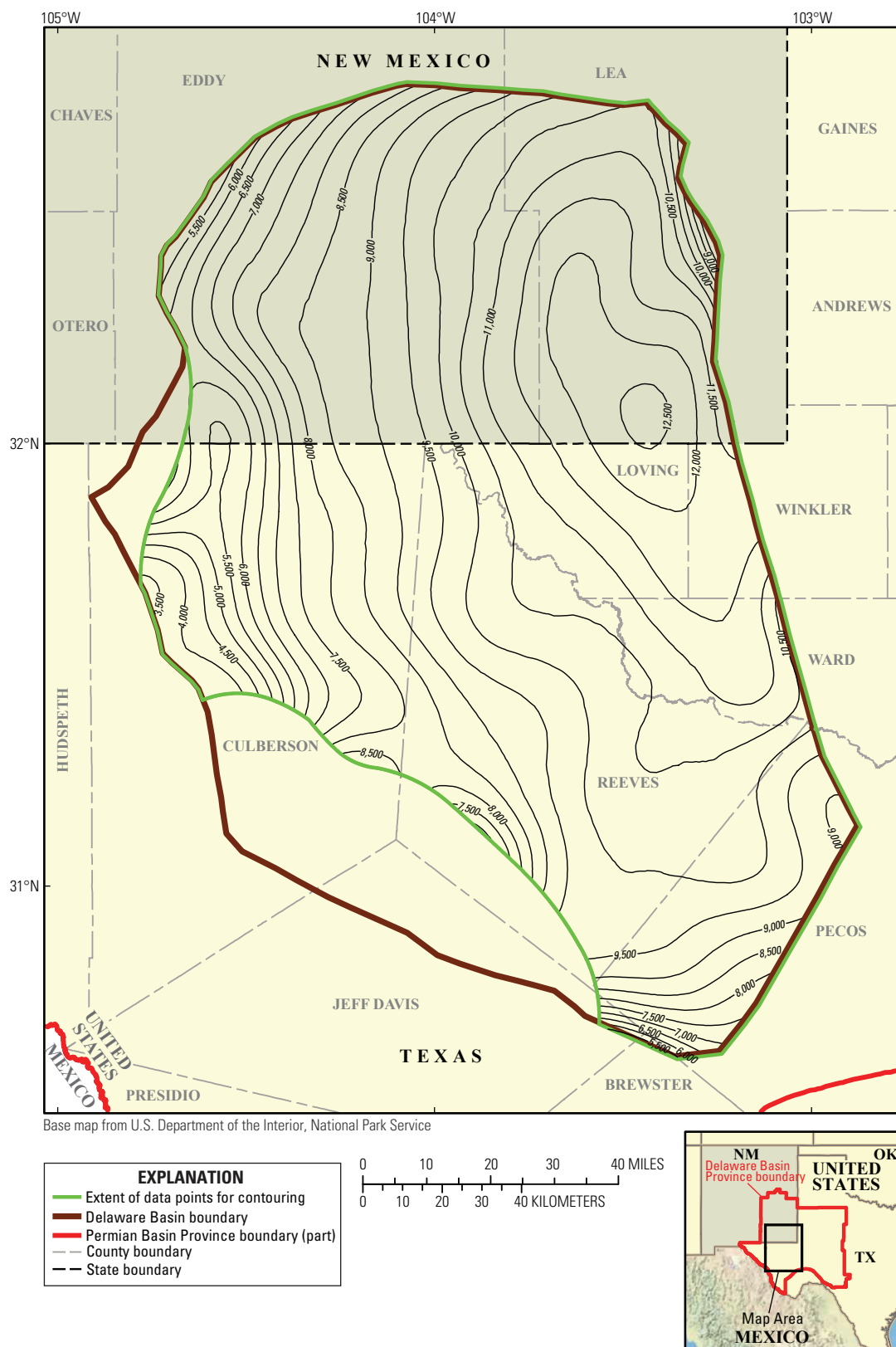


Figure 8. Structure contour map of the top of the Wolfcamp A of the Wolfcamp shale, Delaware Basin, Permian Basin Province, New Mexico and Texas. Contour interval is 500 feet, and 1,213 data points (wells with Wolfcamp A tops) from PRODFit™ (IHS Markit®, 2018) were used to generate the contour map.

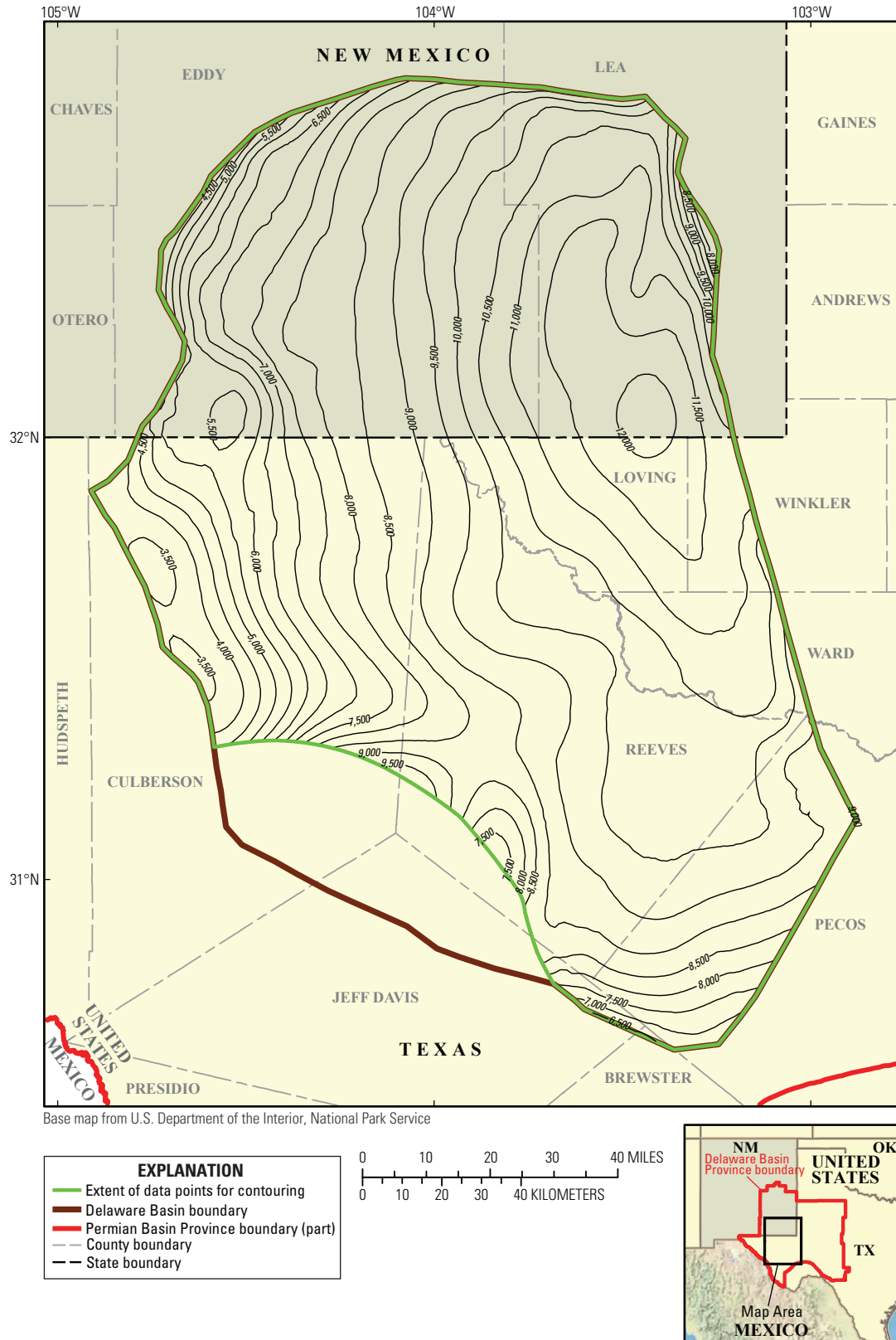


Figure 9. Structure contour map of the top of the Third Bone Spring sand interval (Bone Spring 3rd sand) of the Bone Spring Formation, Delaware Basin, Permian Basin Province, New Mexico and Texas. Contour interval is 500 feet, and 7,917 data points (wells with Third Bone Spring sand interval tops) from PRODFit™ (IHS Markit®, 2018) were used to generate the contour map.

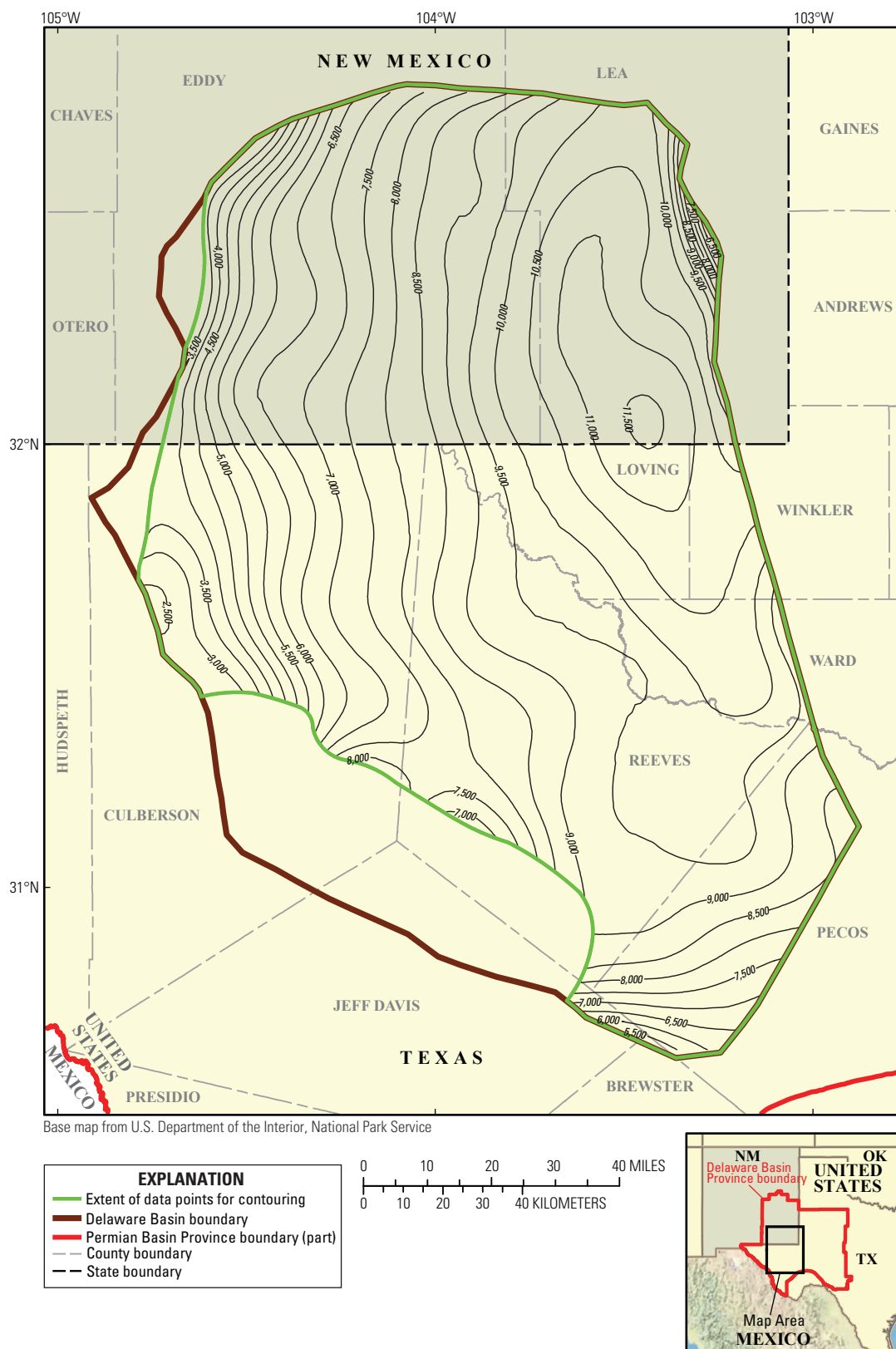


Figure 10. Structure contour map of the top of the Third Bone Spring carbonate interval (Bone Spring 3rd Carbonate) of the Bone Spring Formation, Delaware Basin, Permian Basin Province, New Mexico and Texas. Contour interval is 500 feet, and 1,231 data points (wells with Third Bone Spring carbonate interval tops) from PRODFit™ (IHS Markit®, 2018) were used to generate the contour map.

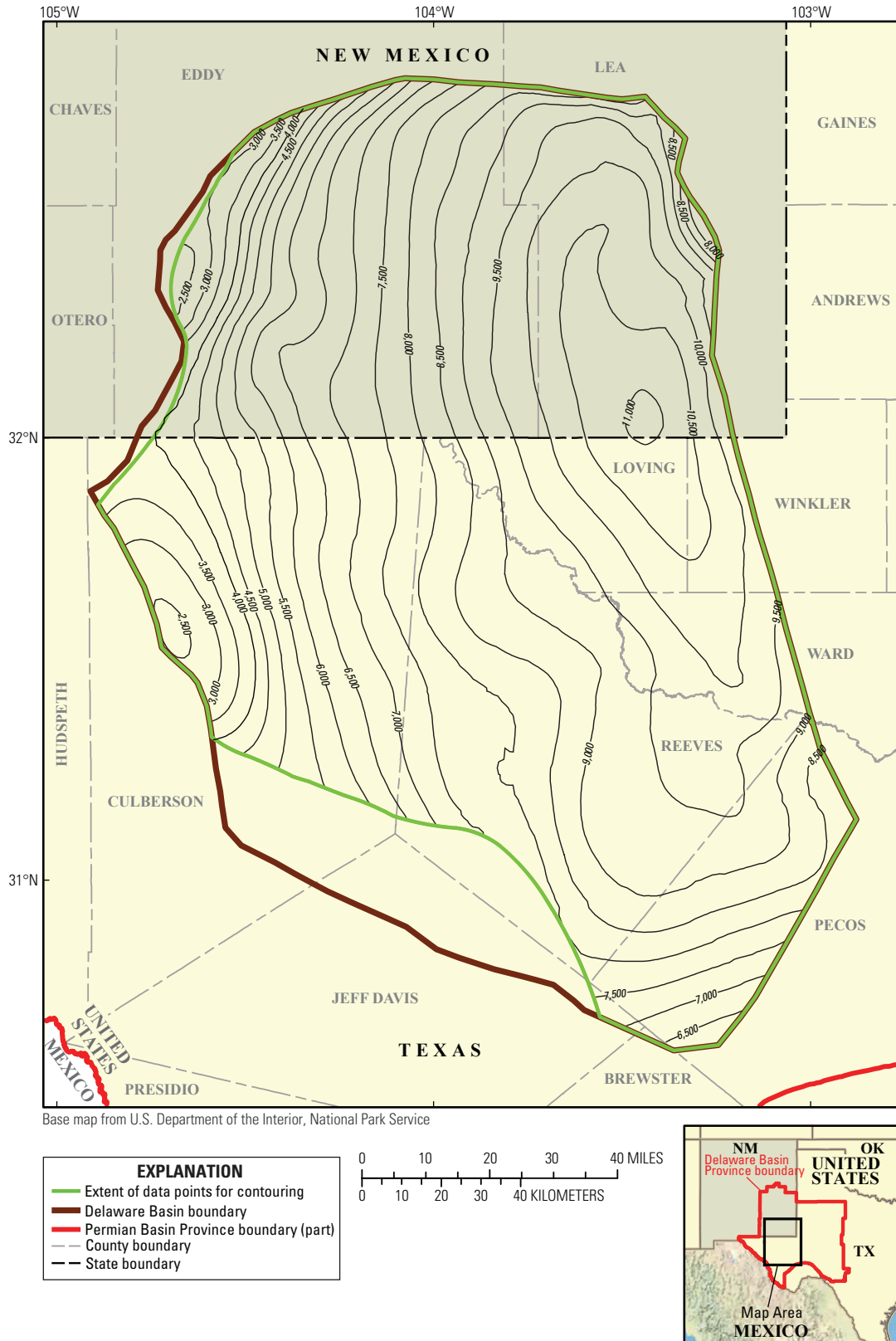


Figure 11. Structure contour map of the top of the Second Bone Spring sand interval (Bone Spring 2nd Sand) of the Bone Spring Formation, Delaware Basin, Permian Basin Province, New Mexico and Texas. Contour interval is 500 feet, and 7,963 data points (wells with Second Bone Spring sand interval tops) from PRODFit™ (IHS Markit®, 2018) were used to generate the contour map.

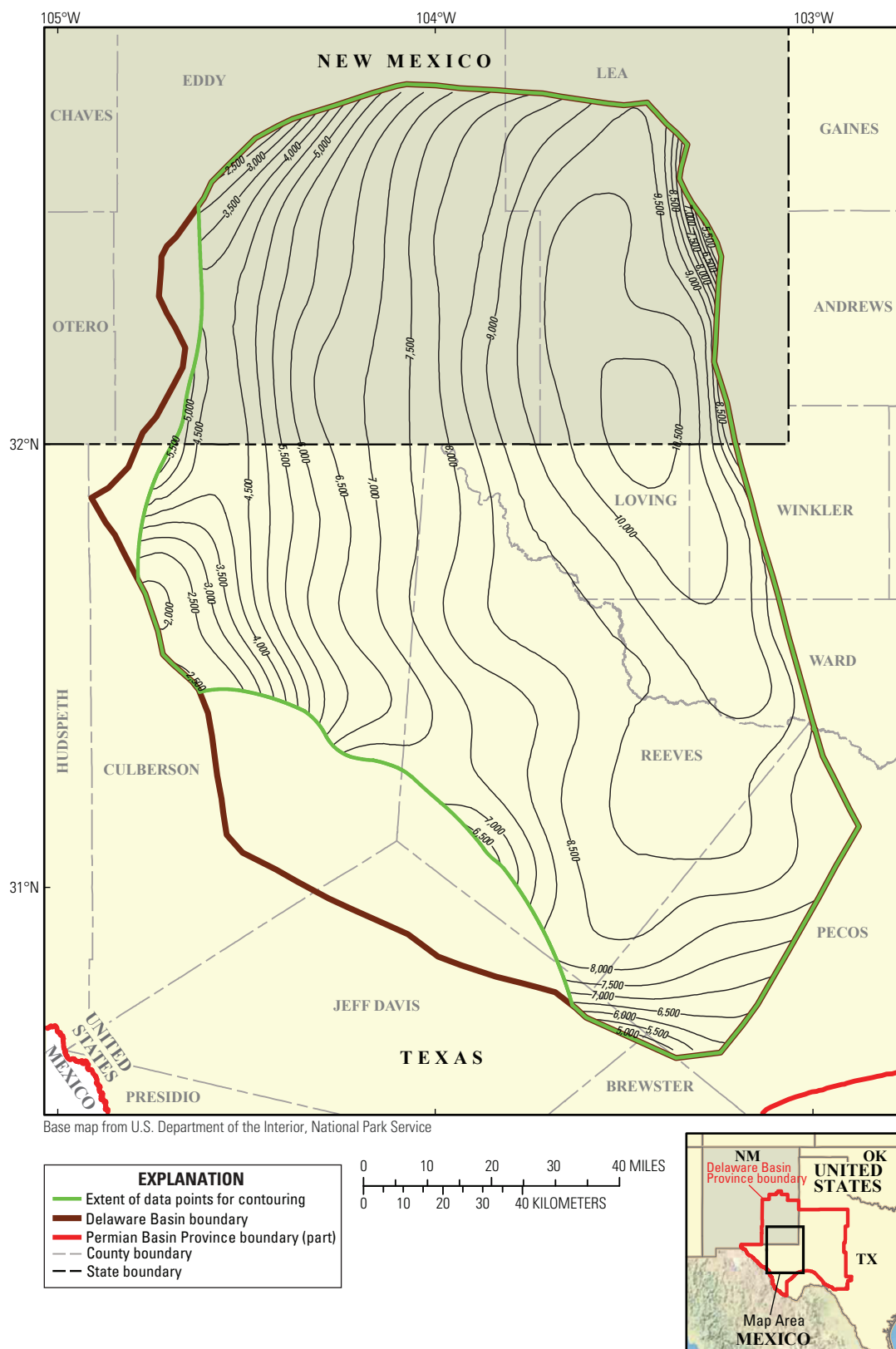


Figure 12. Structure contour map of the top of the Second Bone Spring carbonate interval (Bone Spring 2nd Carbonate) of the Bone Spring Formation, Delaware Basin, Permian Basin Province, New Mexico and Texas. Contour interval is 500 feet, and 1,232 data points (wells with Second Bone Spring carbonate interval tops) from PRODFit™ (IHS Markit®, 2018) were used to generate the contour map.

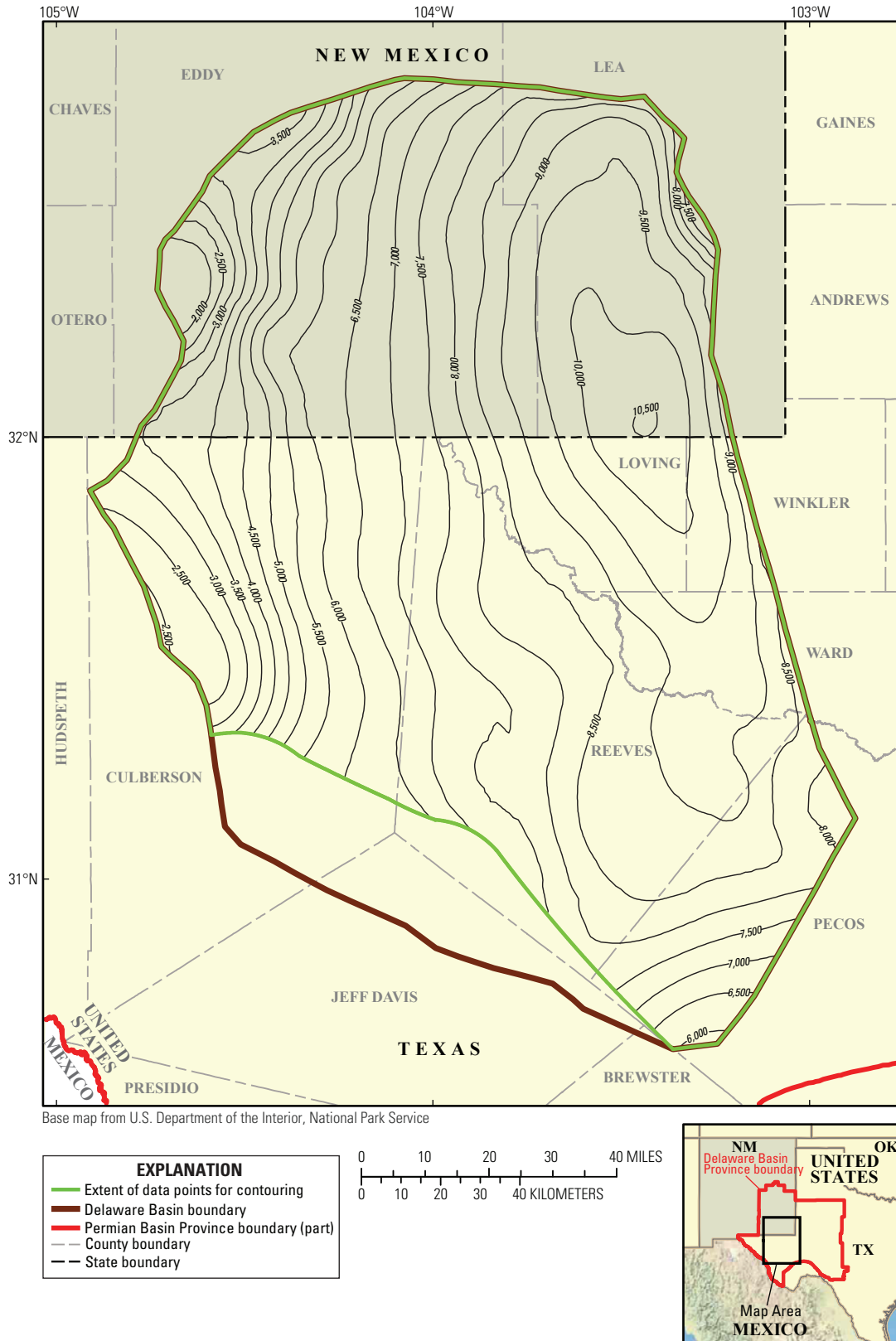


Figure 13. Structure contour map of the top of the First Bone Spring shale interval of the Bone Spring Formation, Delaware Basin, Permian Basin Province, New Mexico and Texas. Contour interval is 500 feet, and 906 data points (wells with First Bone Spring shale interval tops) from PRODFit™ (IHS Markit®, 2018) were used to generate the contour map.

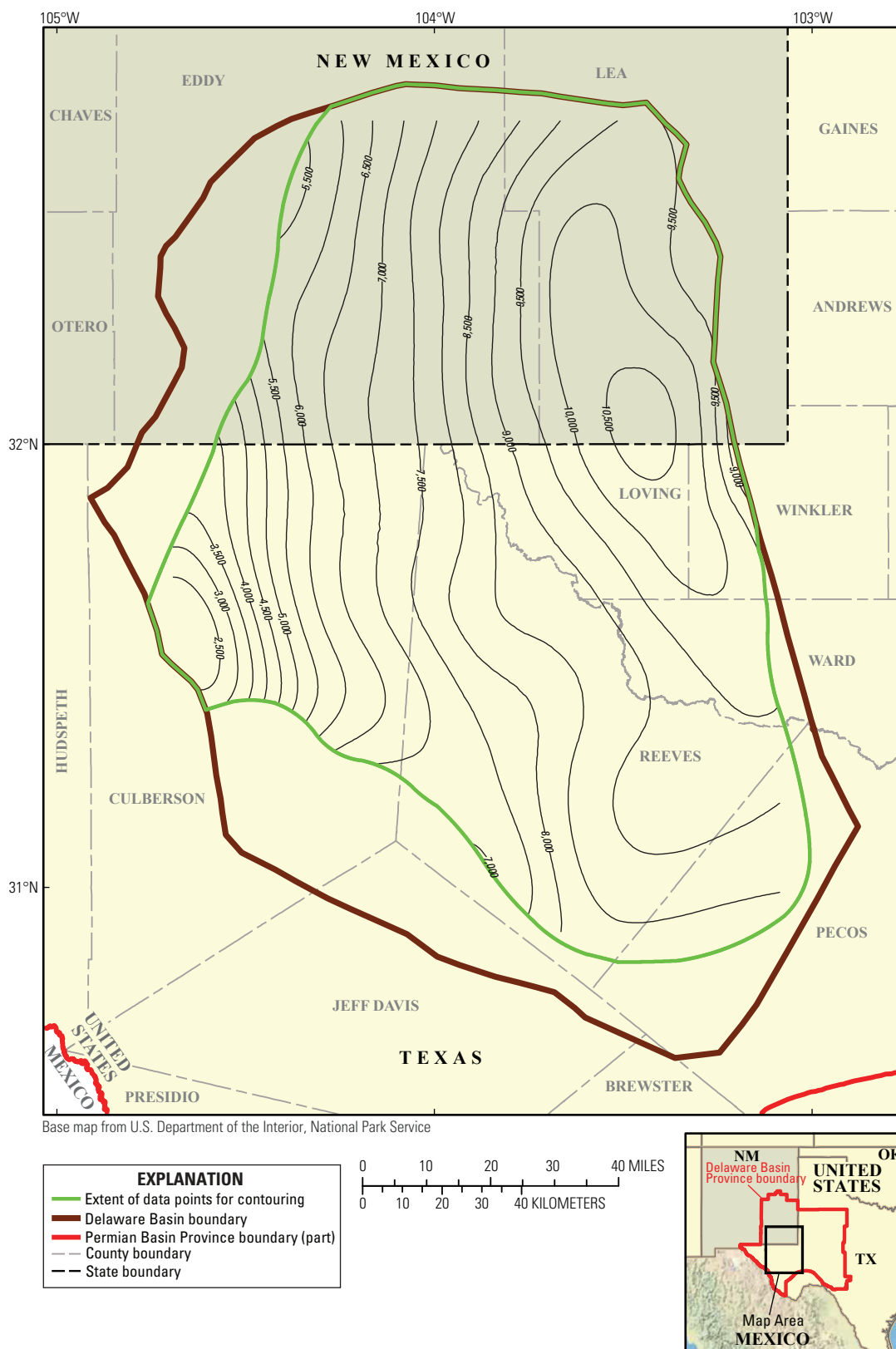


Figure 14. Structure contour map of the top of the First Bone Spring sand interval (Bone Spring 1st sand) of the Bone Spring Formation, Delaware Basin, Permian Basin Province, New Mexico and Texas. Contour interval is 500 feet, and 8,021 data points (wells with First Bone Spring sand interval tops) from PRODFit™ (IHS Markit®, 2018) were used to generate the contour map.

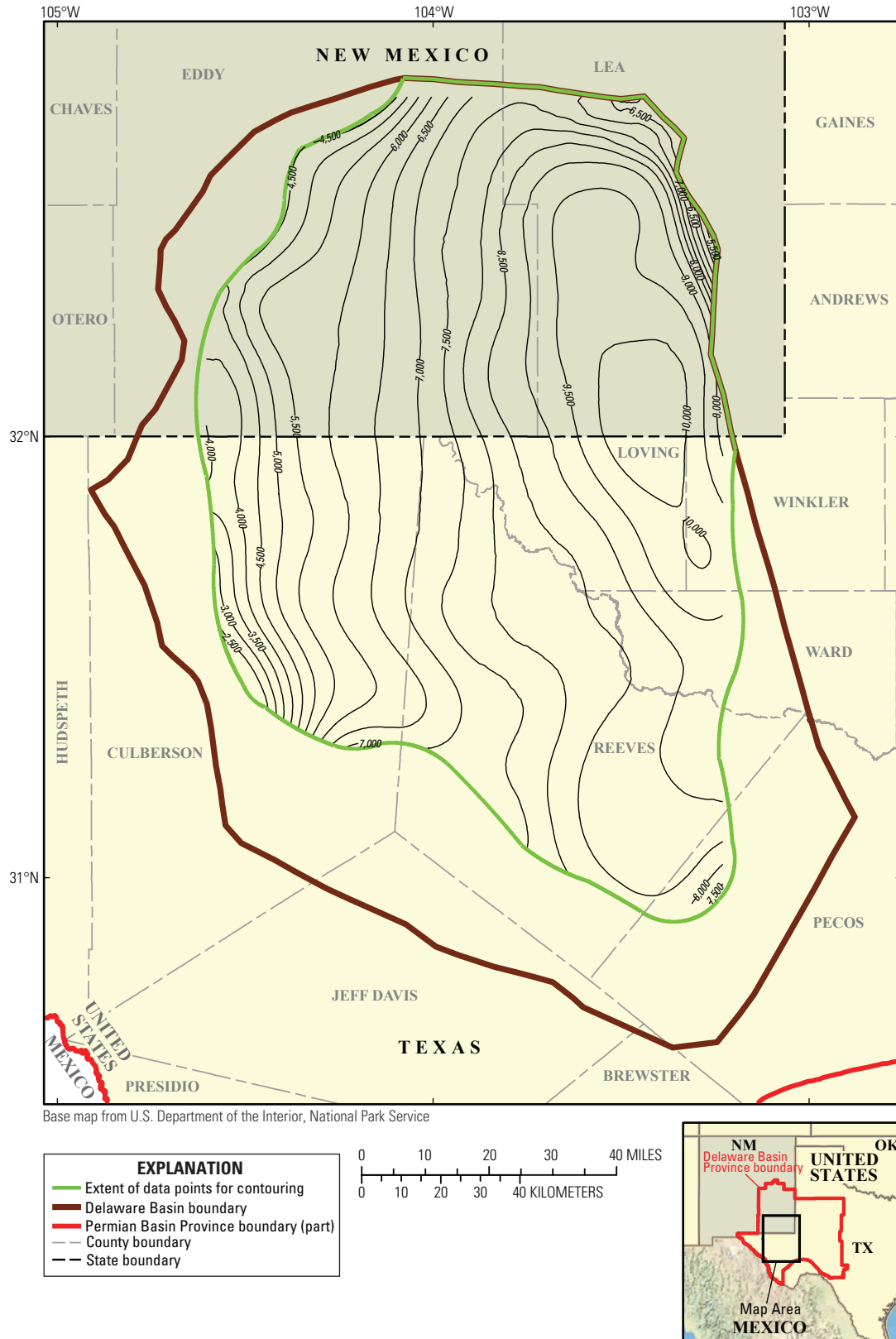


Figure 15. Structure contour map of the top of the Avalon lower shale interval of the Bone Spring Formation, Delaware Basin, Permian Basin Province, New Mexico and Texas. Contour interval is 500 feet, and 780 data points (wells with Avalon lower shale interval tops) from PRODFit™ (IHS Markit®, 2018) were used to generate the contour map.

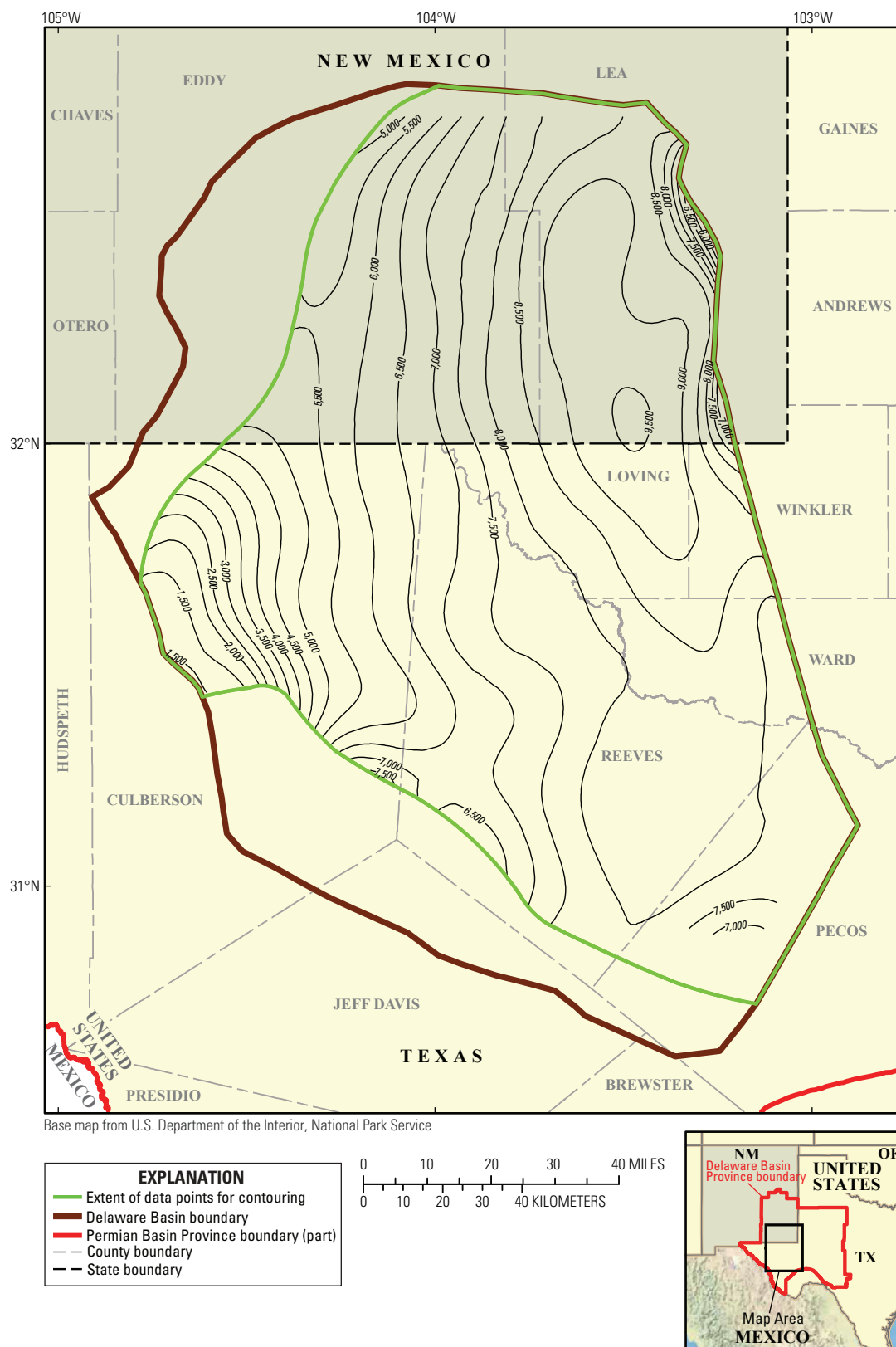


Figure 16. Structure contour map of the top of the Avalon upper shale interval of the Bone Spring Formation, Delaware Basin, Permian Basin Province, New Mexico and Texas. Contour interval is 500 feet, and 877 data points (wells with Avalon upper shale interval tops) from PRODFit™ (IHS Markit®, 2018) were used to generate the contour map.

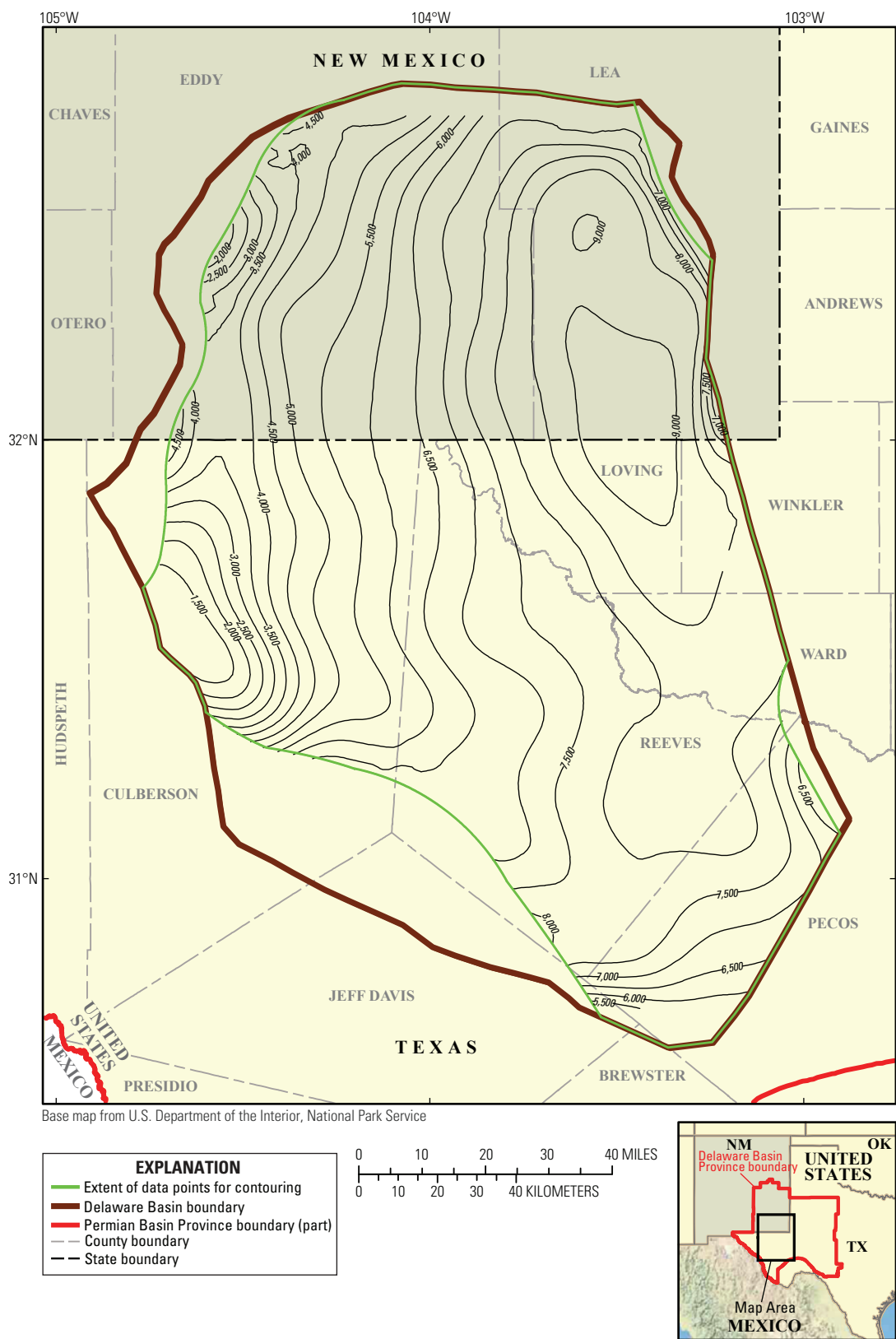


Figure 17. Structure contour map of the top of the Leonard shale interval of the Bone Spring Formation, Delaware Basin, Permian Basin Province, New Mexico and Texas. Contour interval is 500 feet, and 812 data points (wells with Leonard shale interval tops) from PRODFit™ (IHS Markit®, 2018) were used to generate the contour map.

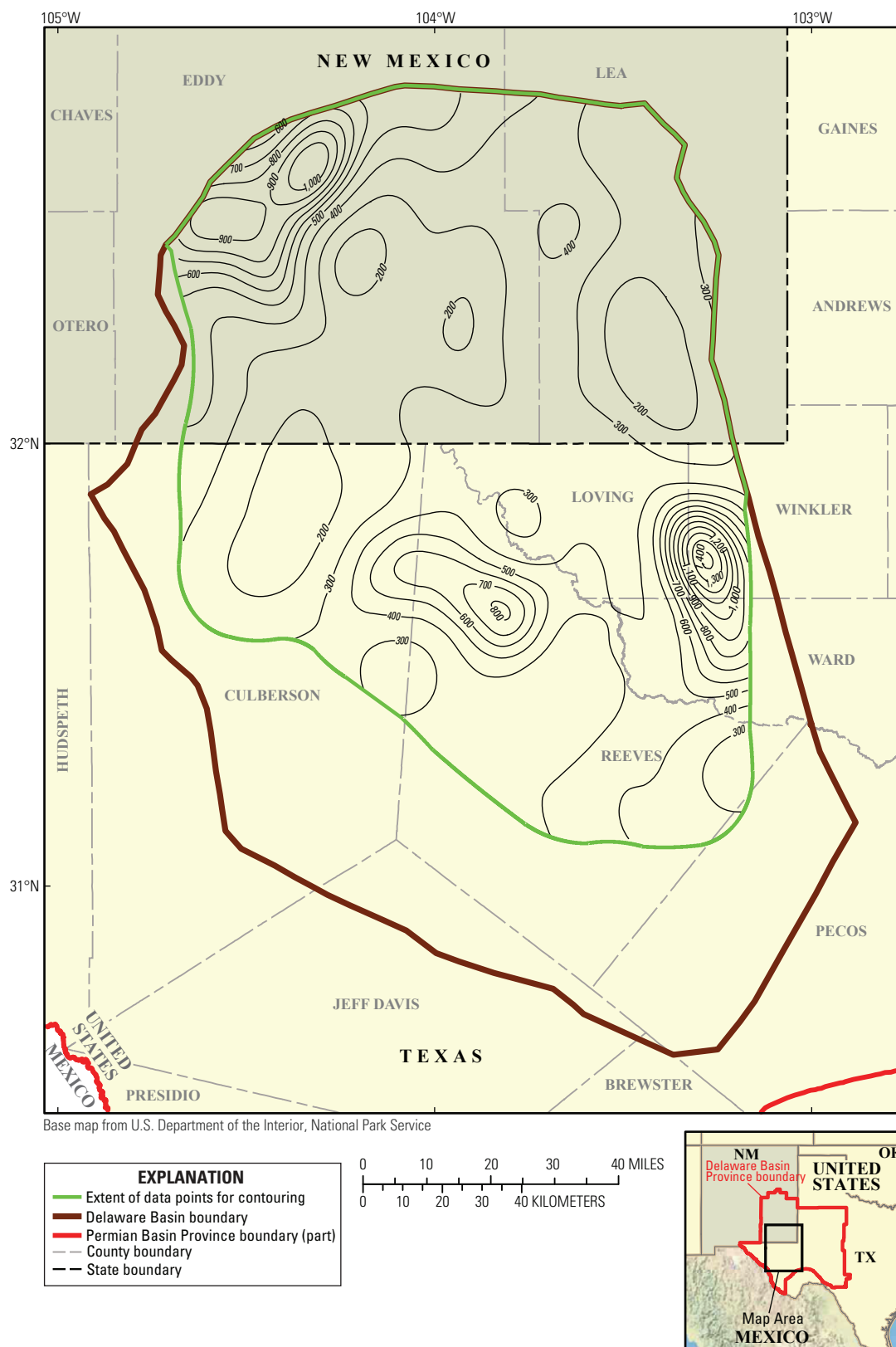


Figure 18. Isopach map of the Wolfcamp D, which is the interval from the top of the Strawn Formation to the top of the Wolfcamp D of the Wolfcamp shale, Delaware Basin, Permian Basin Province, New Mexico and Texas. Contour interval is 100 feet, and 686 data points (wells with Strawn Formation and Wolfcamp D tops) from PRODFit™ (IHS Markit®, 2018) were used to generate the contour map.

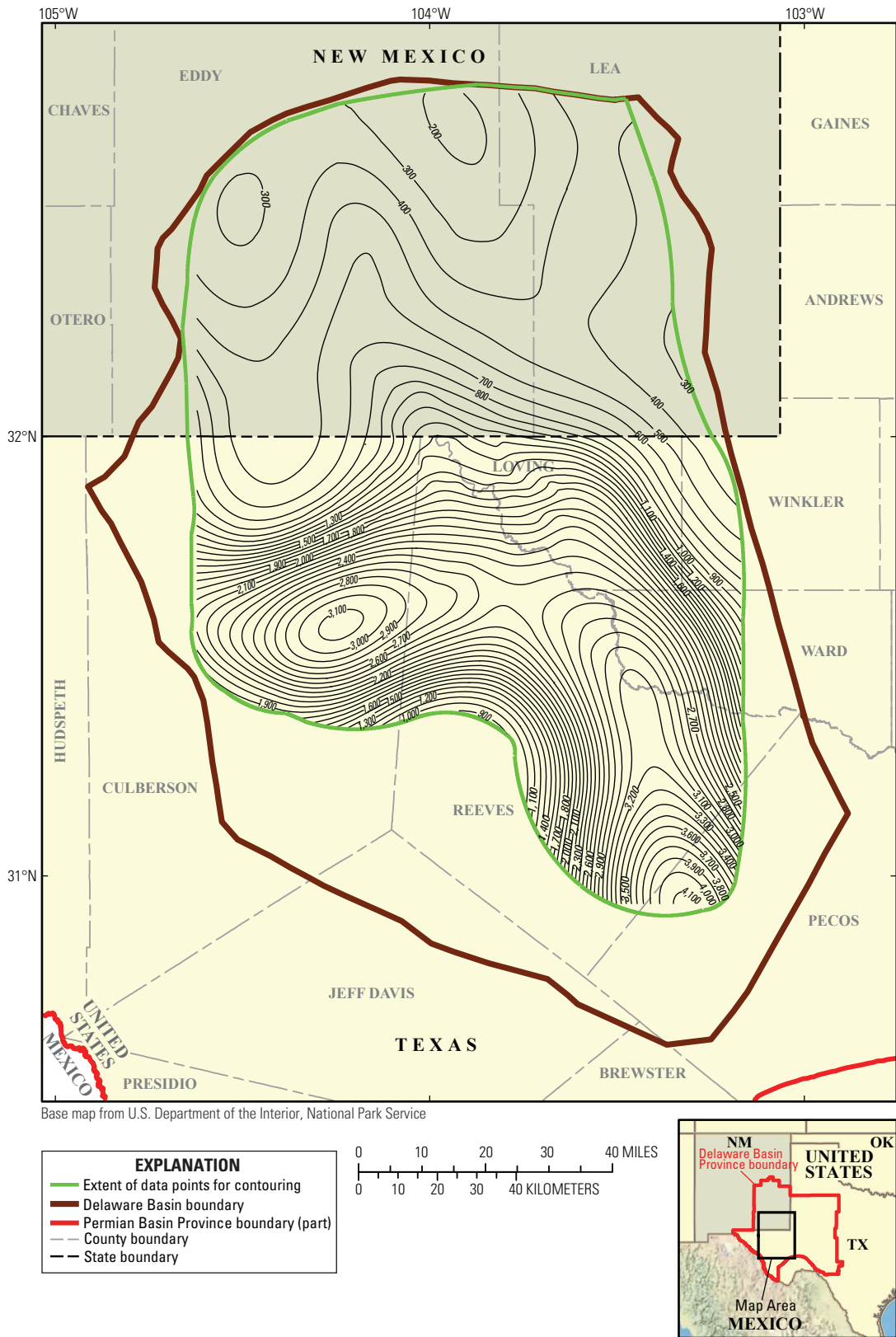


Figure 19. Isopach map of the Wolfcamp C, which is the interval from the top of the Wolfcamp D to the top of the Wolfcamp C of the Wolfcamp shale, Delaware Basin, Permian Basin Province, New Mexico and Texas. Contour interval is 100 feet, and 625 data points (wells with Wolfcamp C and D tops) from PRODFit™ (IHS Markit®, 2018) were used to generate the contour map.

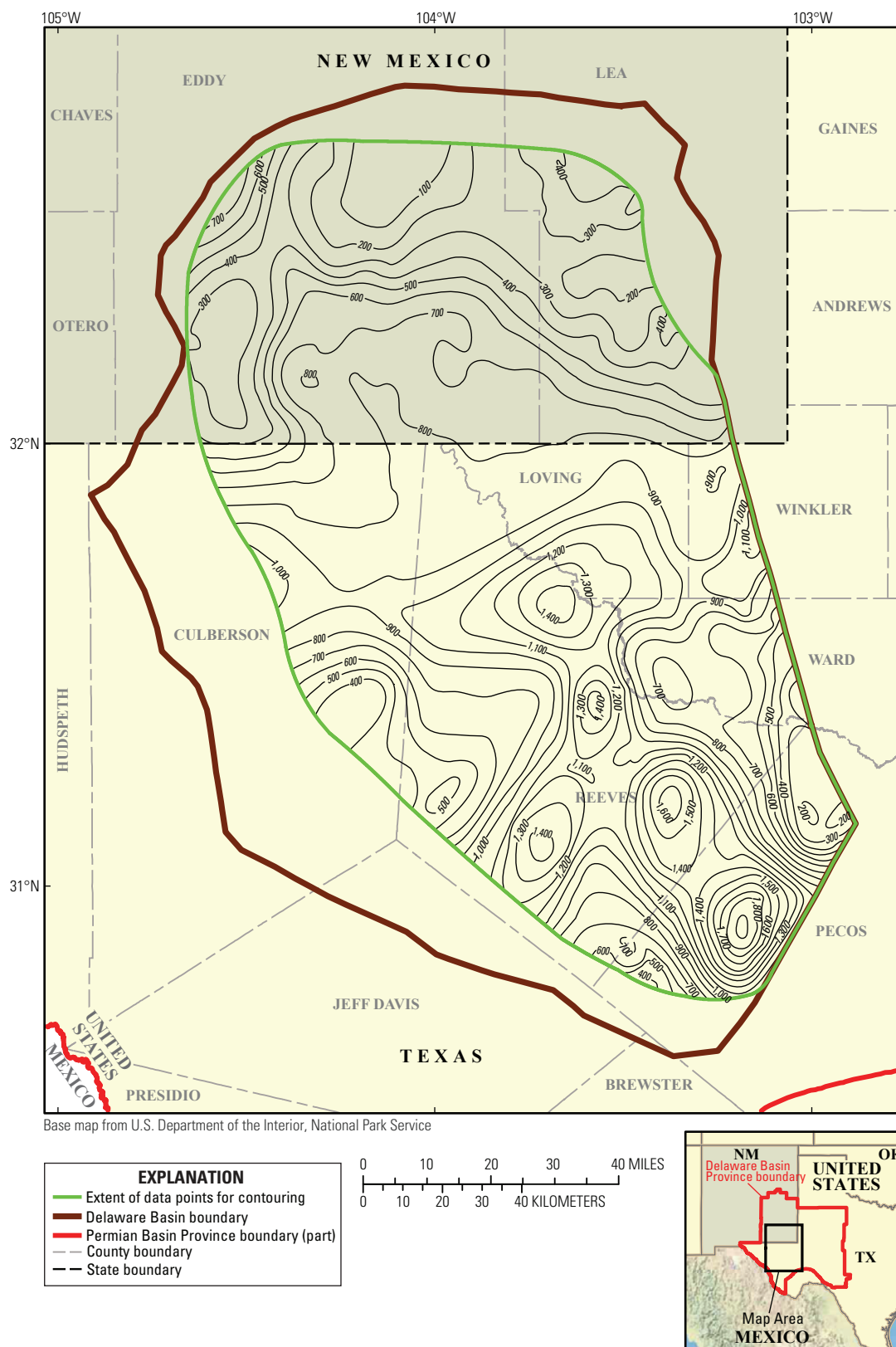


Figure 20. Isopach map of the Wolfcamp B, which is the interval from the top of the Wolfcamp C to the top of the Wolfcamp B of the Wolfcamp shale, Delaware Basin, Permian Basin Province, New Mexico and Texas. Contour interval is 100 feet, and 680 data points (wells with Wolfcamp B and C tops) from PRODFit™ (IHS Markit®, 2018) were used to generate the contour map.

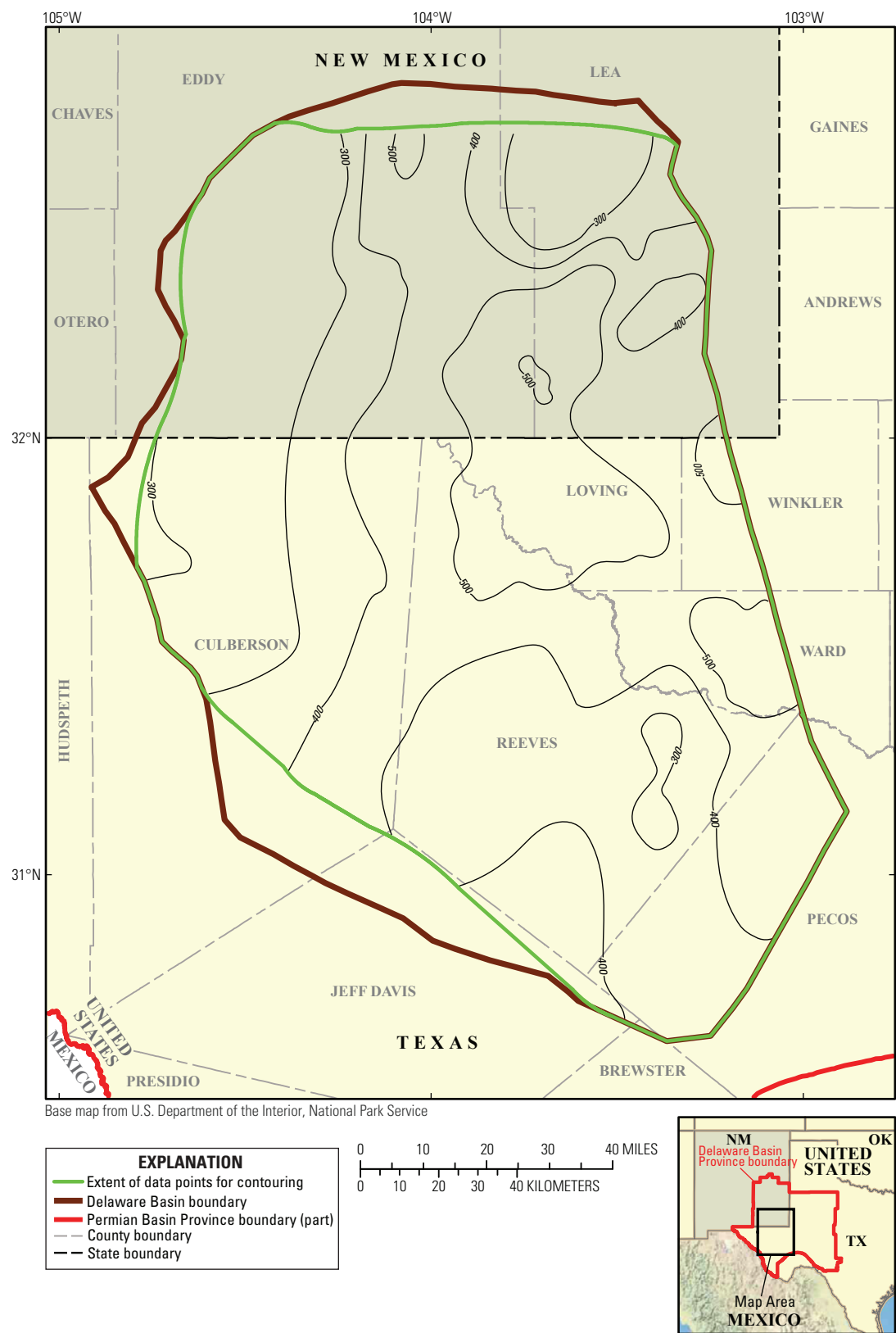


Figure 21. Isopach map of the Wolfcamp A, which is the interval from the top of the Wolfcamp B to the top of the Wolfcamp A of the Wolfcamp shale, Delaware Basin, Permian Basin Province, New Mexico and Texas. Contour interval is 100 feet, and 846 data points (wells with Wolfcamp A and B tops) from PRODFit™ (IHS Markit®, 2018) were used to generate the contour map.

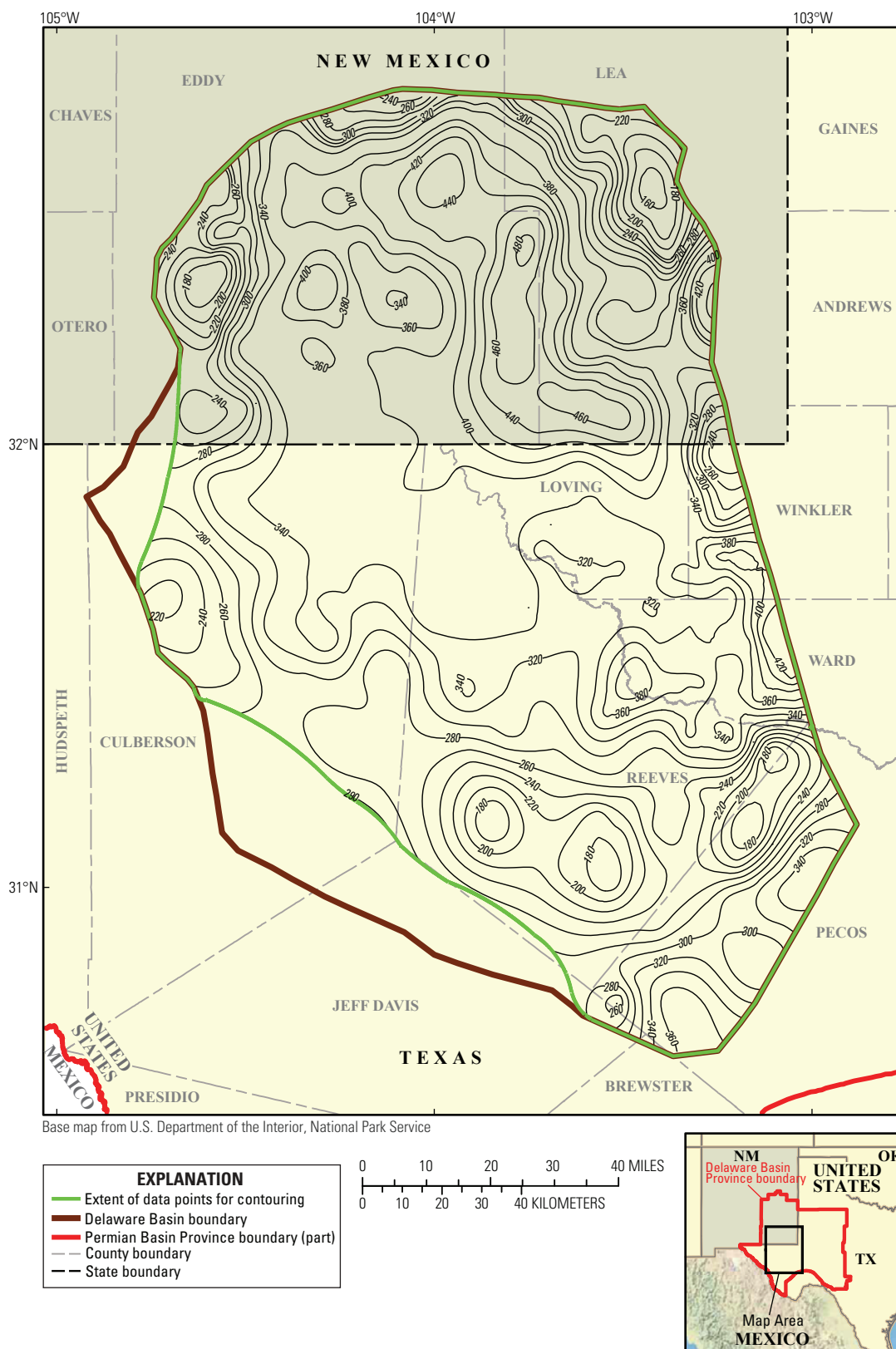


Figure 22. Isopach map of the Third Bone Spring sand interval (Bone Spring 3rd Sand), which is the interval from the top of the Wolfcamp A to the top of the Third Bone Spring sand interval of the Bone Spring Formation, Delaware Basin, Permian Basin Province, New Mexico and Texas. Contour interval is 20 feet, and 1,118 data points (wells with Wolfcamp A and Third Bone Spring sand interval tops) PRODFit™ (IHS Markit®, 2018) were used to generate the contour map.

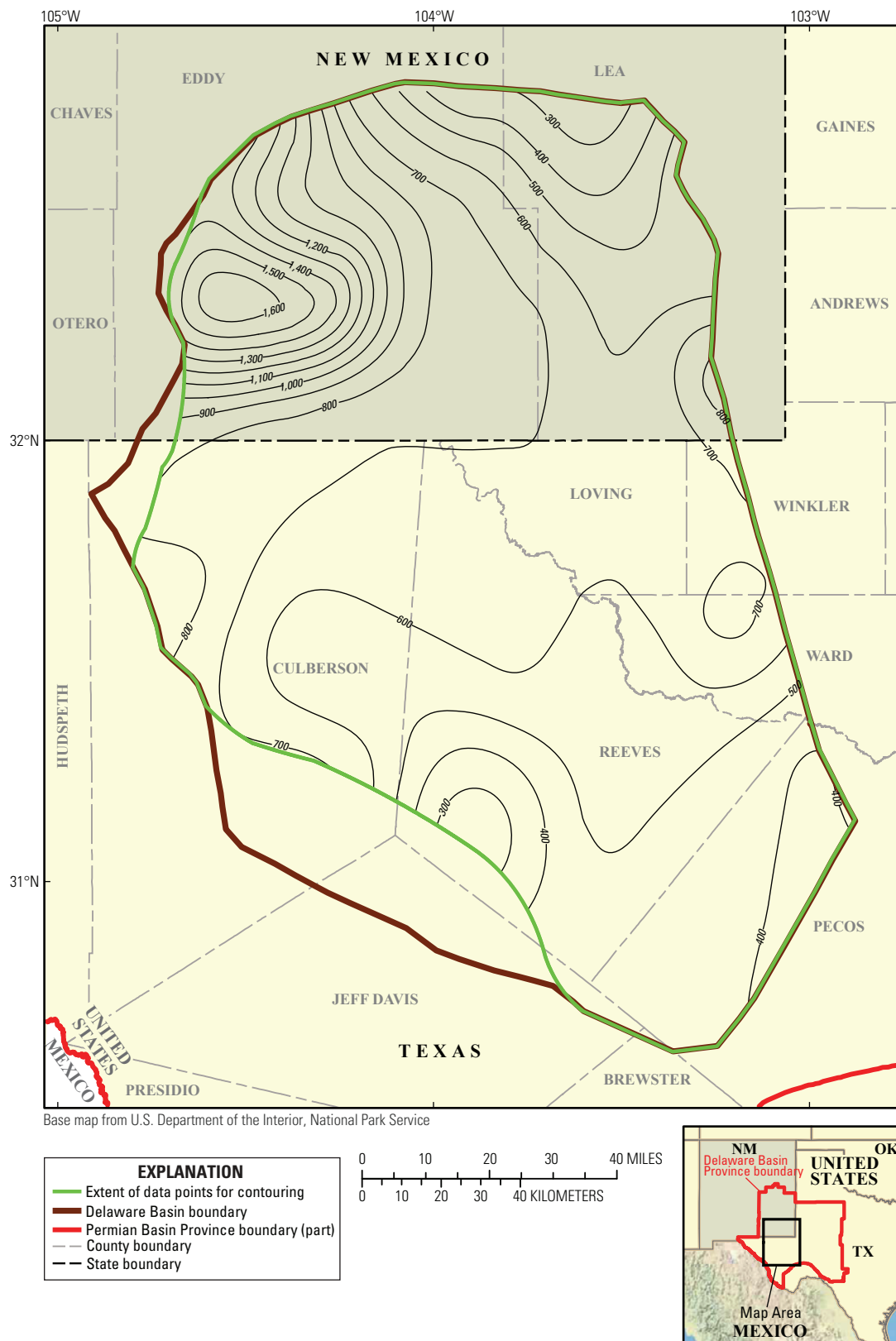


Figure 23. Isopach map of the Third Bone Spring carbonate interval (Bone Spring 3rd Carbonate), which is the interval from the top of the Third Bone Spring sand interval to the top of the Third Bone Spring carbonate interval of the Bone Spring Formation, Delaware Basin, Permian Basin Province, New Mexico and Texas. Contour interval is 100 feet, and 1,181 data points (wells with Third Bone Spring sand and Third Bone Spring carbonate tops) from PRODFit™ (IHS Markit®, 2018) were used to generate the contour map.

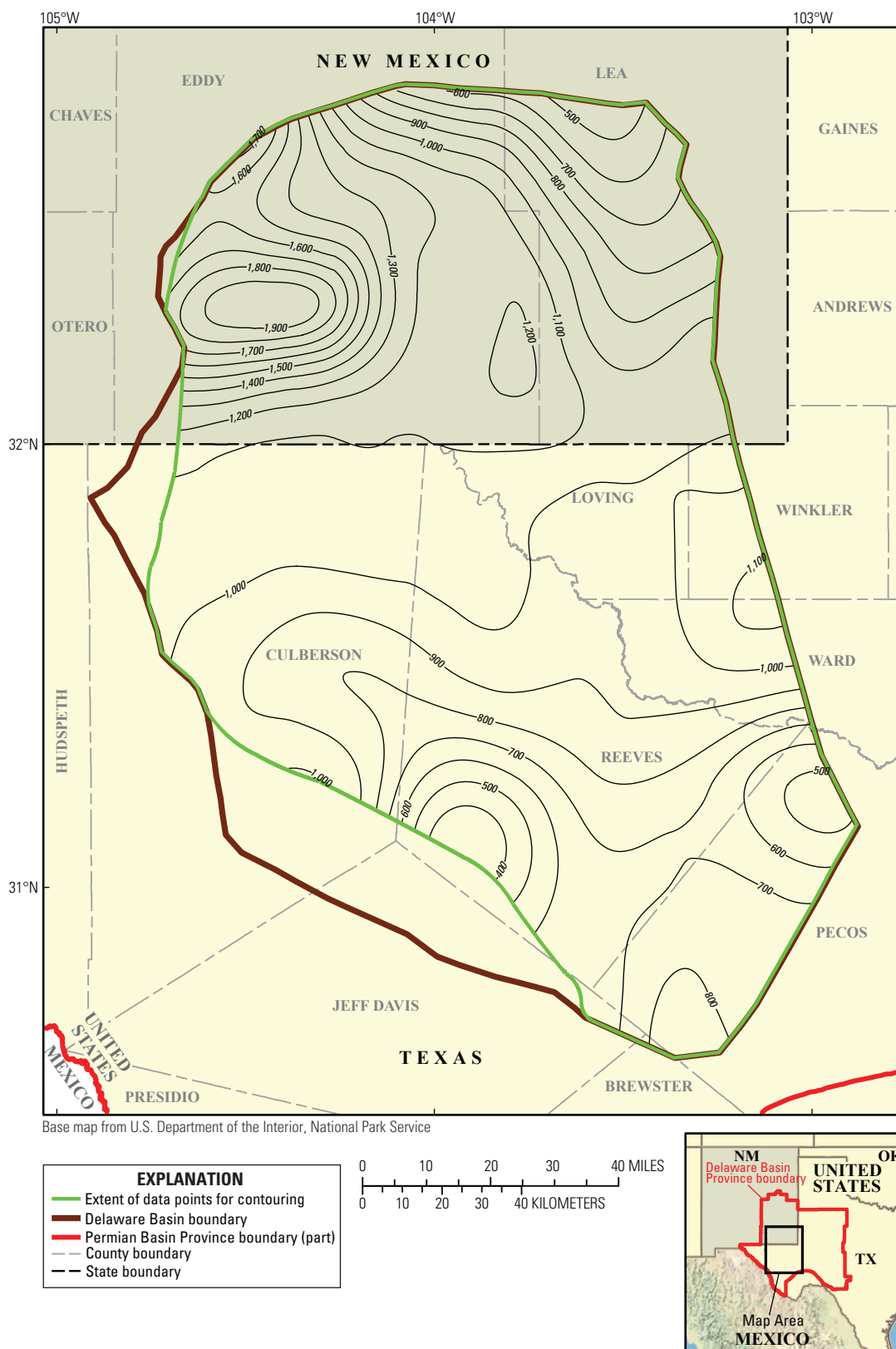


Figure 24. Isopach map of the Third Bone Spring, which is the interval from the top of the Wolfcamp A to the top of the Third Bone Spring carbonate interval of the Bone Spring Formation, Delaware Basin, Permian Basin Province, New Mexico and Texas. Contour interval is 100 feet, and 1,170 data points (wells with Wolfcamp A and Third Bone Spring carbonate interval tops) from PRODFit™ (IHS Markit®, 2018) were used to generate the contour map.

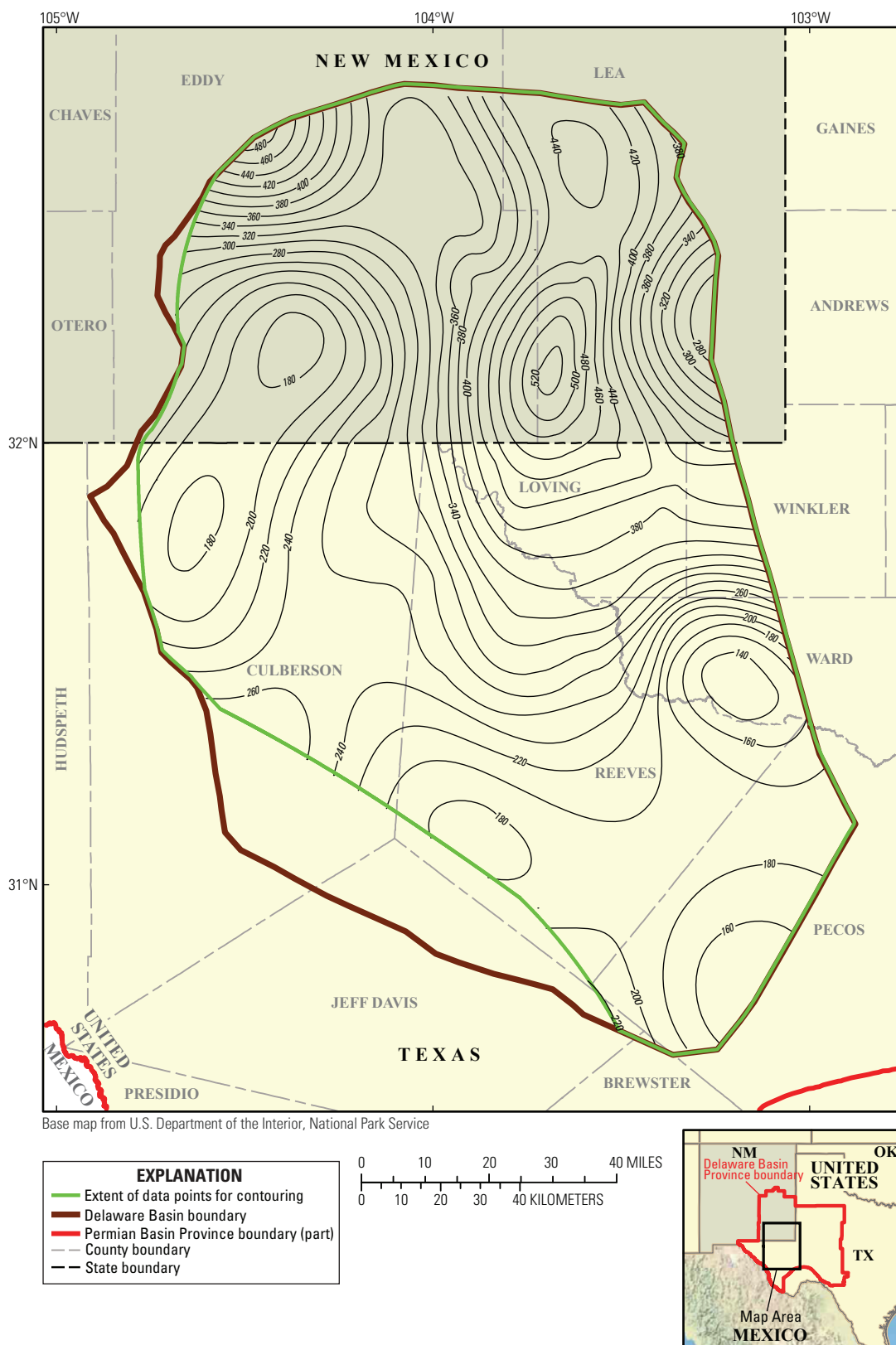


Figure 25. Isopach map of the Second Bone Spring sand interval, which is the interval from the top of the Third Bone Spring carbonate interval to the top of the Second Bone Spring sand interval of the Bone Spring Formation, Delaware Basin, Permian Basin Province, New Mexico and Texas. Contour interval is 20 feet, and 1,204 data points (wells with Third Bone Spring carbonate interval and Second Bone Spring sand interval tops) from PRODFit™ (IHS Markit®, 2018) were used to generate the contour map.

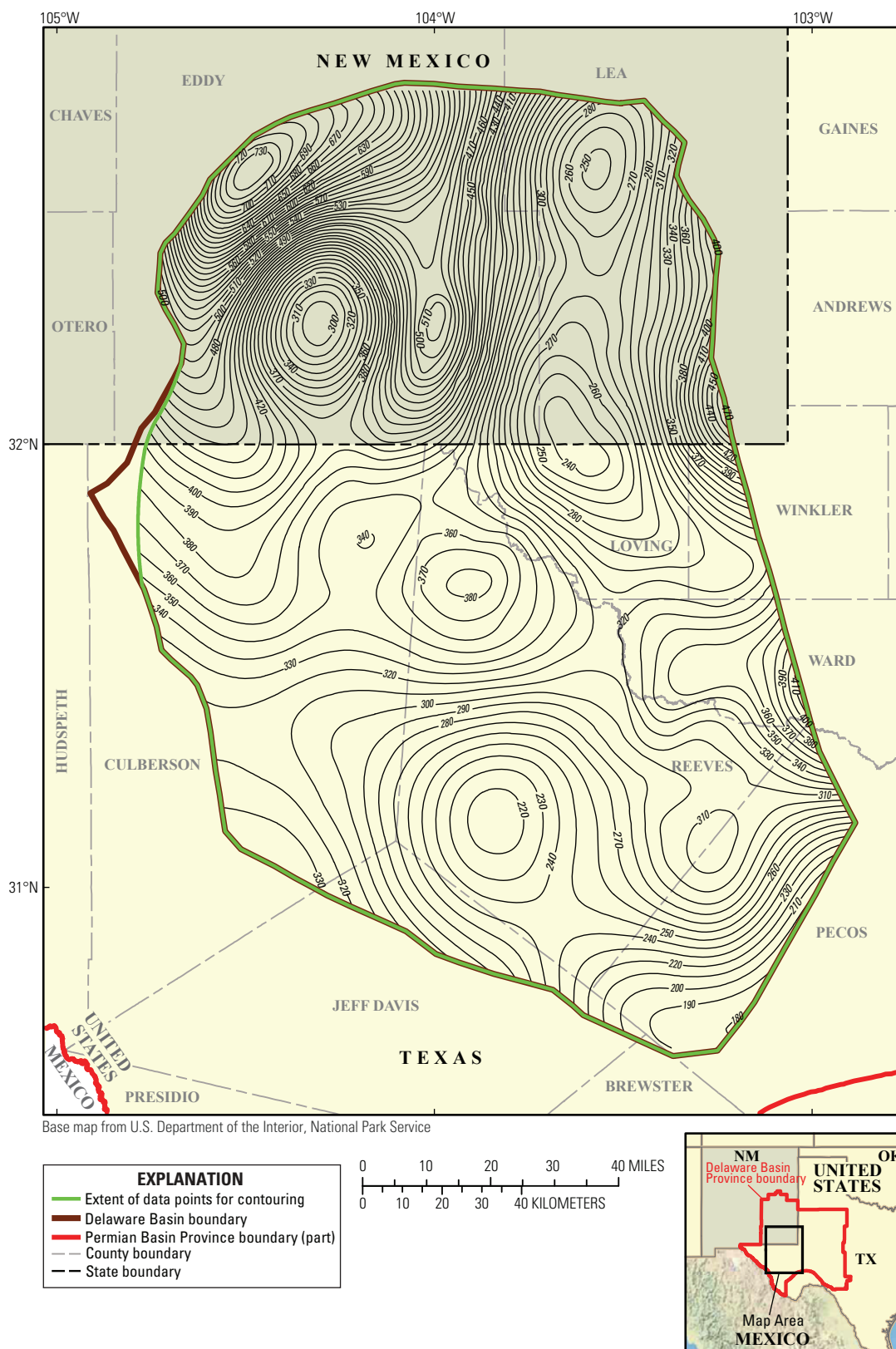


Figure 26. Isopach map of the Second Bone Spring carbonate interval, which is the interval from the top of the Second Bone Spring sand interval to the top of the Second Bone Spring carbonate interval of the Bone Spring Formation, Delaware Basin, Permian Basin Province, New Mexico and Texas. Contour interval is 10 feet, and 1,191 data points (wells with Second Bone Spring sand interval and Second Bone Spring carbonate interval tops) from PRODFit™ (IHS Markit®, 2018) were used to generate the contour map.

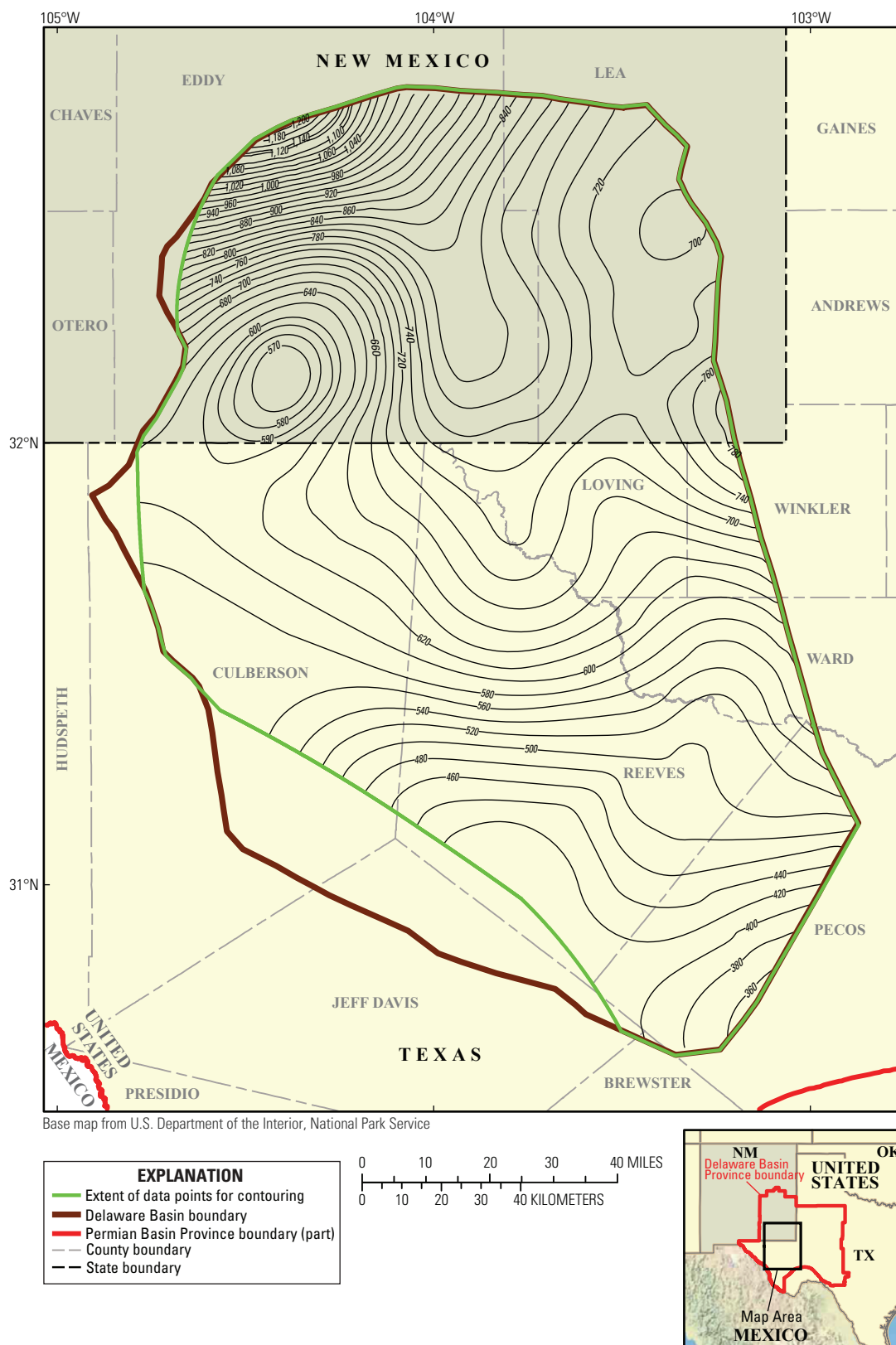


Figure 27. Isopach map of the Second Bone Spring, which is the interval from the top of the Third Bone Spring carbonate interval to the top of the Second Bone Spring carbonate interval of the Bone Spring Formation, Delaware Basin, Permian Basin Province, New Mexico and Texas. Contour interval is 20 feet, and 1,176 data points (wells with Third Bone Spring carbonate interval and Second Bone Spring carbonate interval tops) from PRODFit™ (IHS Markit®, 2018) were used to generate the contour map.

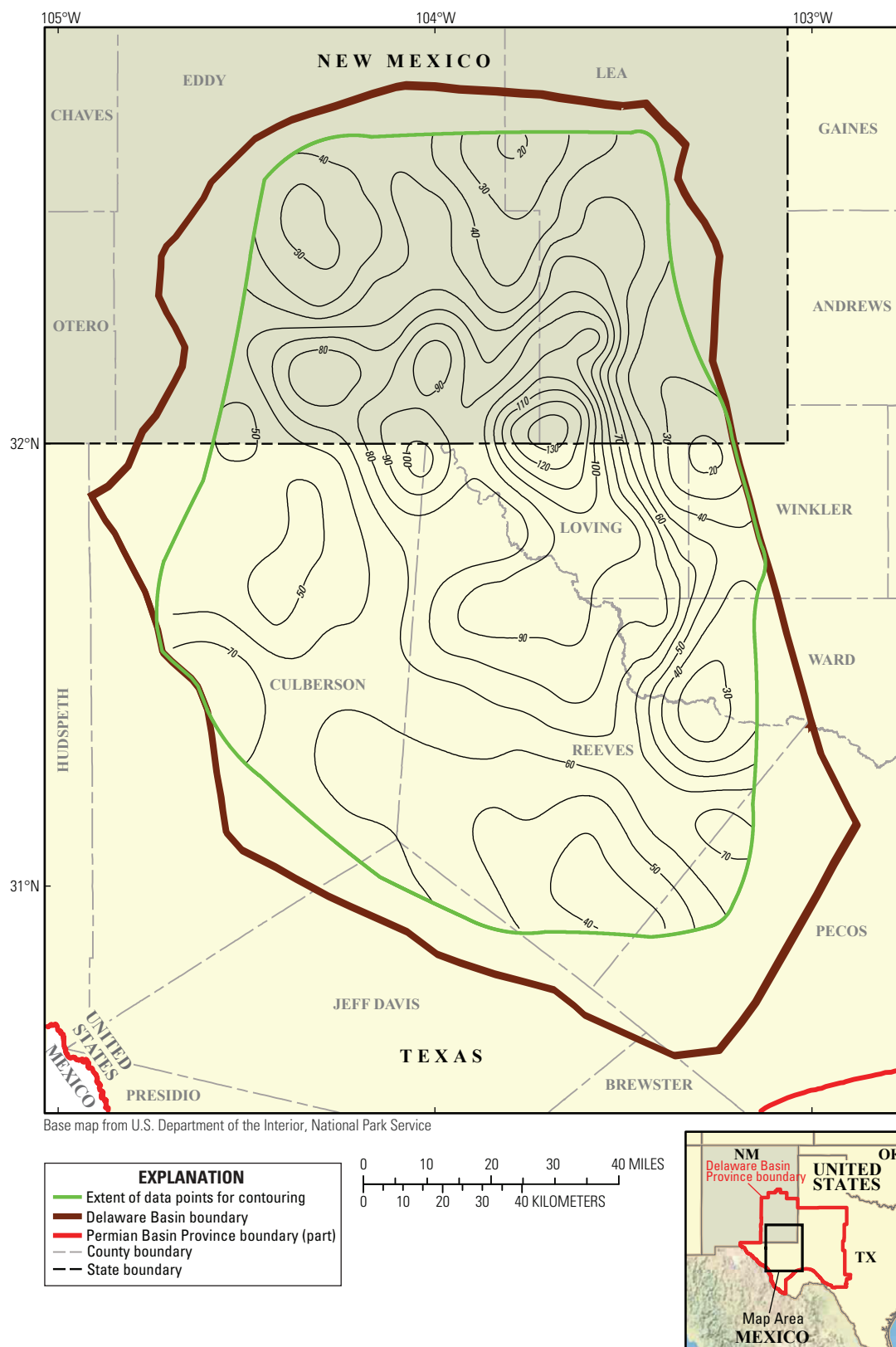


Figure 28. Isopach map of the First Bone Spring shale interval, which is the interval from the top of the Second Bone Spring carbonate interval to the top of the First Bone Spring shale interval of the Bone Spring Formation, Delaware Basin, Permian Basin Province, New Mexico and Texas. Contour interval is 10 feet, and 839 data points (wells with Second Bone Spring carbonate interval and First Bone Spring shale interval tops) from PRODFit™ (IHS Markit®, 2018) were used to generate the contour map.

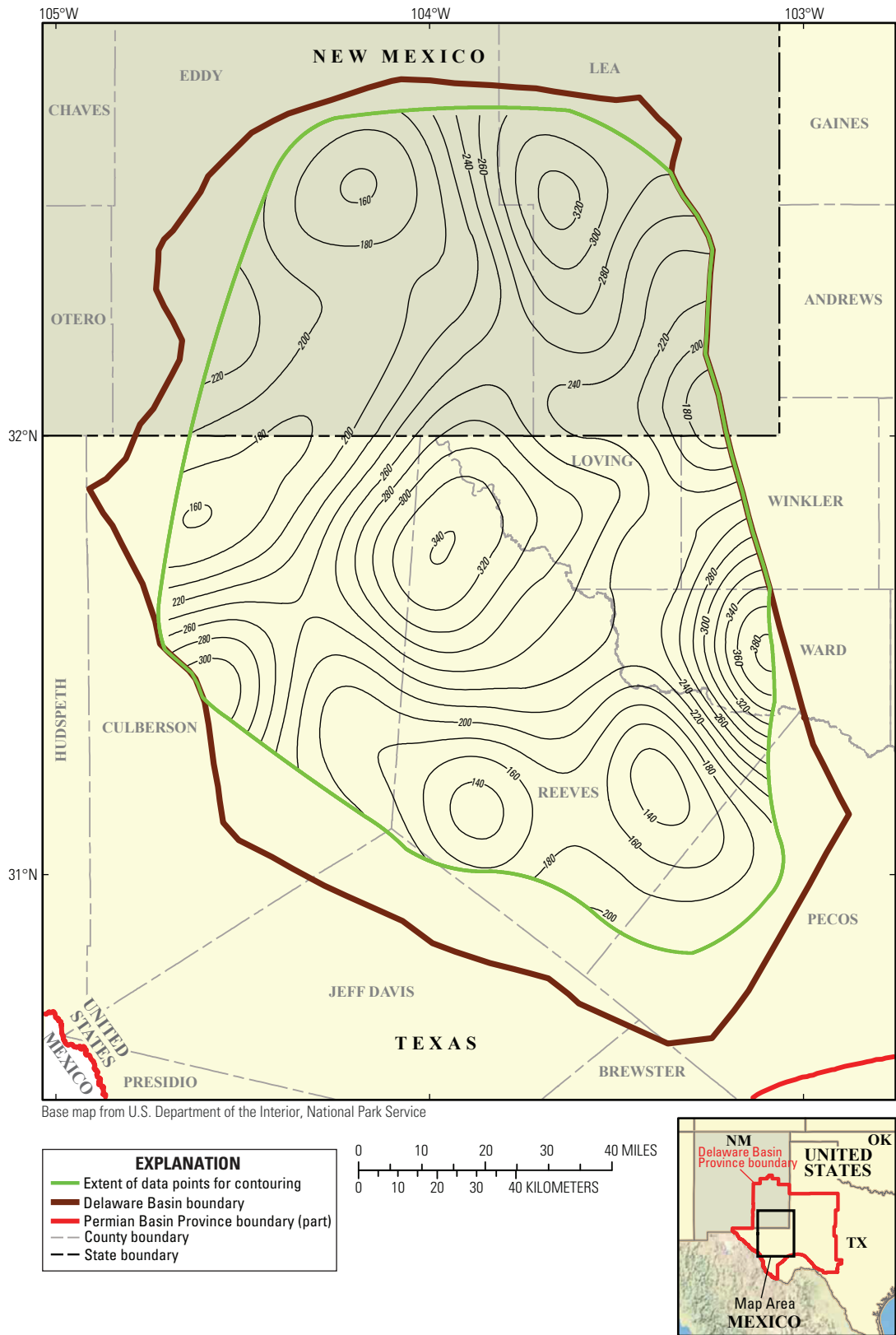


Figure 29. Isopach map of the First Bone Spring sand interval, which is the interval from the top of the First Bone Spring shale interval to the top of the First Bone Spring sand interval of the Bone Spring Formation, Delaware Basin, Permian Basin Province, New Mexico and Texas. Contour interval is 20 feet, and 861 data points (wells with First Bone Spring shale interval and First Bone Spring sand interval tops) from PRODFit™ (IHS Markit®, 2018) were used to generate the contour map.

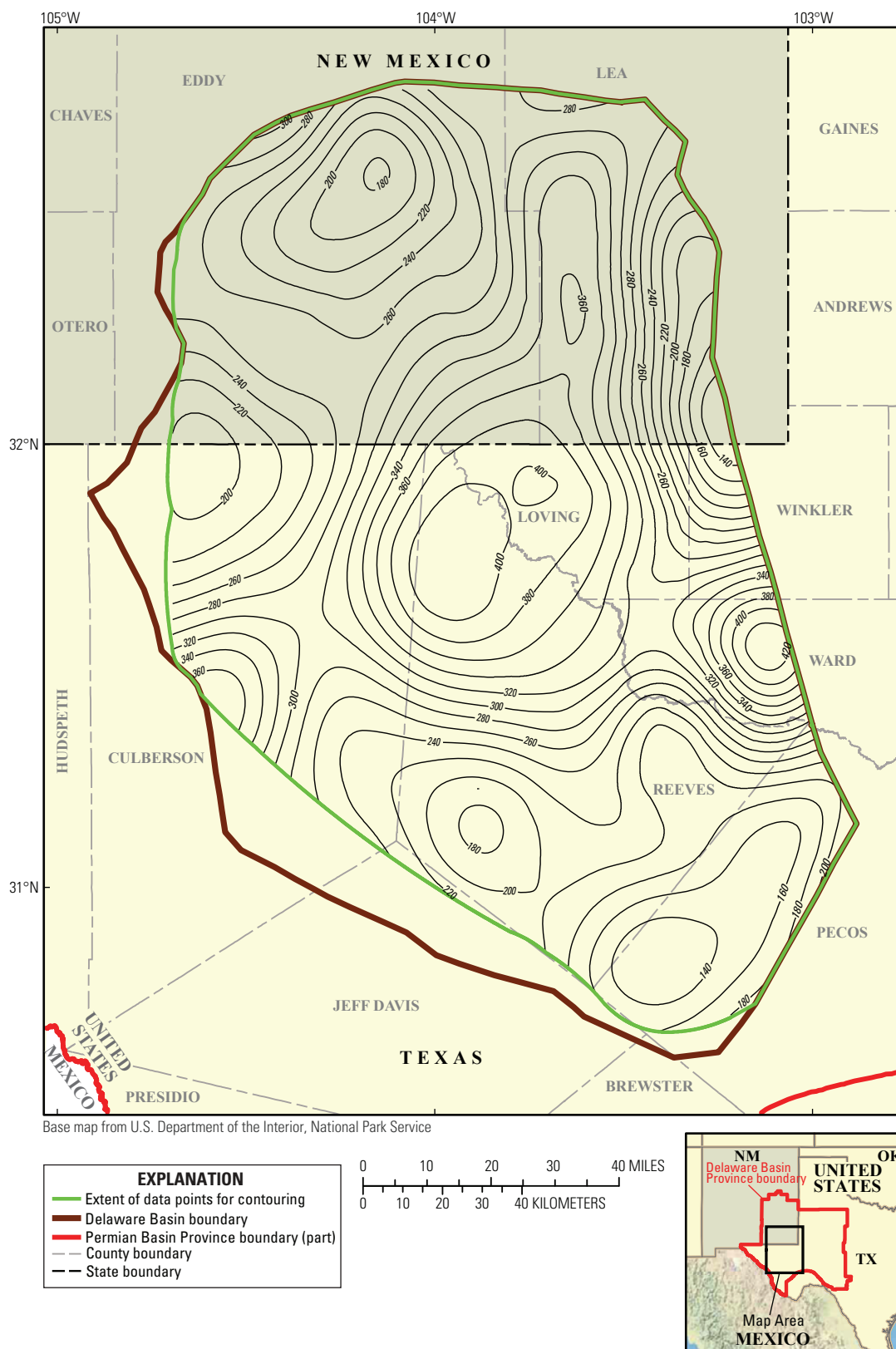


Figure 30. Isopach map of the First Bone Spring interval, which is the interval from the top of the Second Bone Spring carbonate interval to the top of the First Bone Spring sand interval of the Bone Spring Formation, Delaware Basin, Permian Basin Province, New Mexico and Texas. Contour interval is 20 feet, and 1,131 data points (wells with Second Bone Spring carbonate interval and First Bone Spring sand interval tops) from PRODFit™ (IHS Markit®, 2018) were used to generate the contour map.

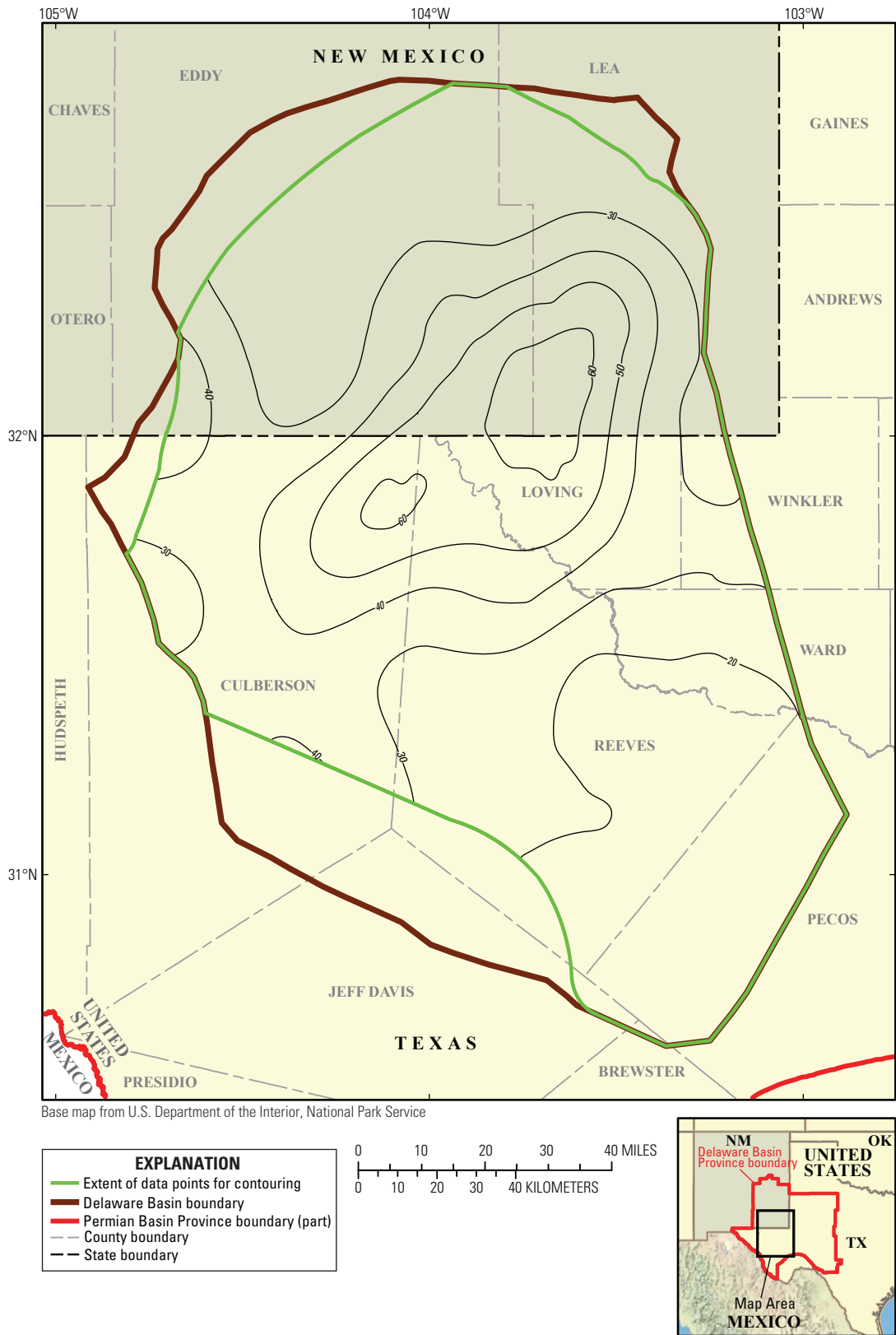


Figure 31. Isopach map of the Avalon lower shale interval, which is the interval from the top of the First Bone Spring sand interval to the top of the Avalon lower shale interval of the Bone Spring Formation, Delaware Basin, Permian Basin Province, New Mexico and Texas. Contour interval is 10 feet, and 669 data points (wells with First Bone Spring sand interval and Avalon lower shale interval tops) from PRODFit™ (IHS Markit®, 2018) were used to generate the contour map.

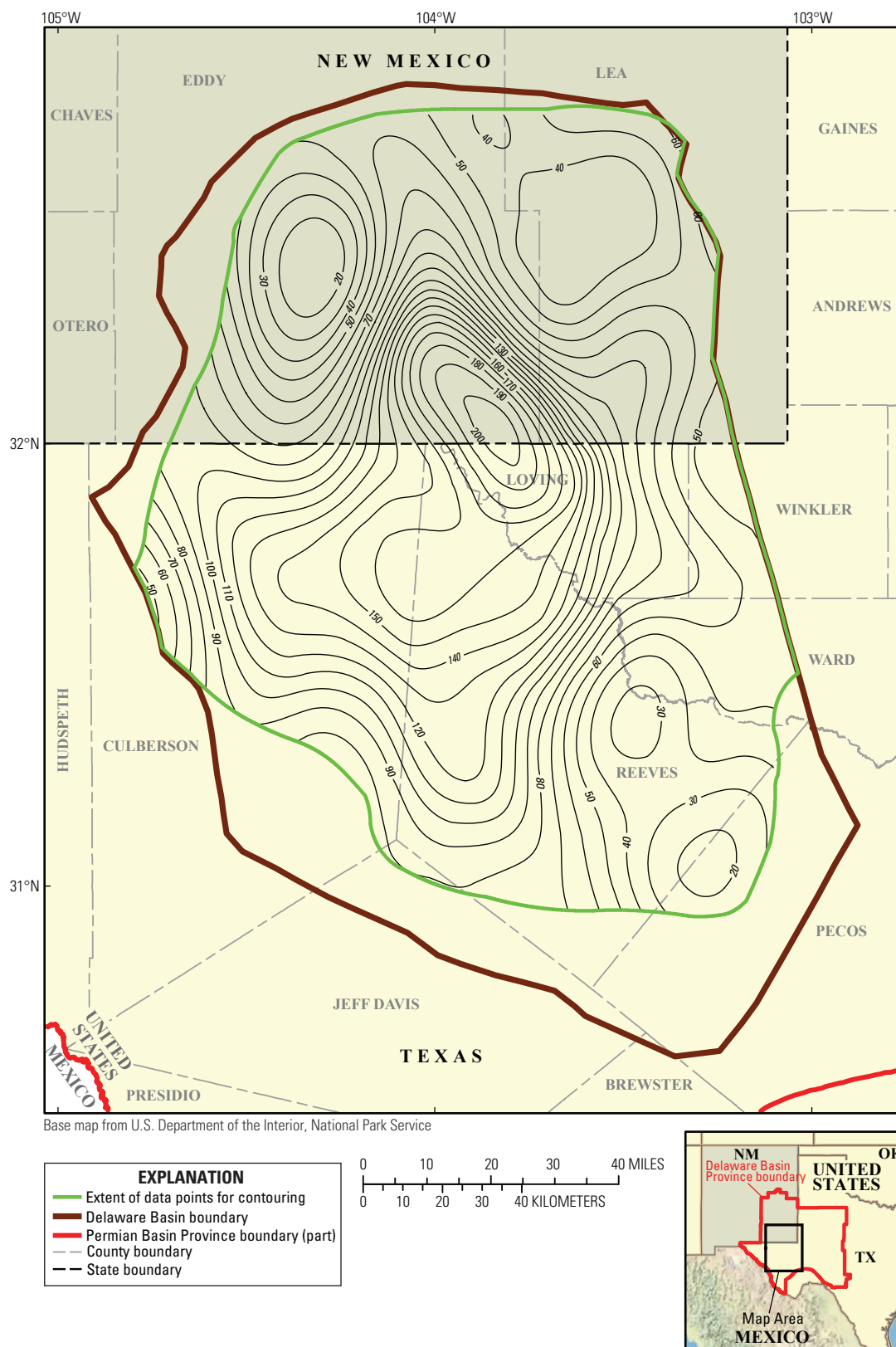


Figure 32. Isopach map of the Avalon upper shale interval, which is the interval from the top of the Avalon middle carbonate interval to the top of the Avalon upper shale interval of the Bone Spring Formation, Delaware Basin, Permian Basin Province, New Mexico and Texas. Contour interval is 10 feet, and 797 data points (wells with Avalon middle carbonate interval and Avalon upper shale interval tops) from PRODFit™ (IHS Markit®, 2018) were used to generate the contour map.

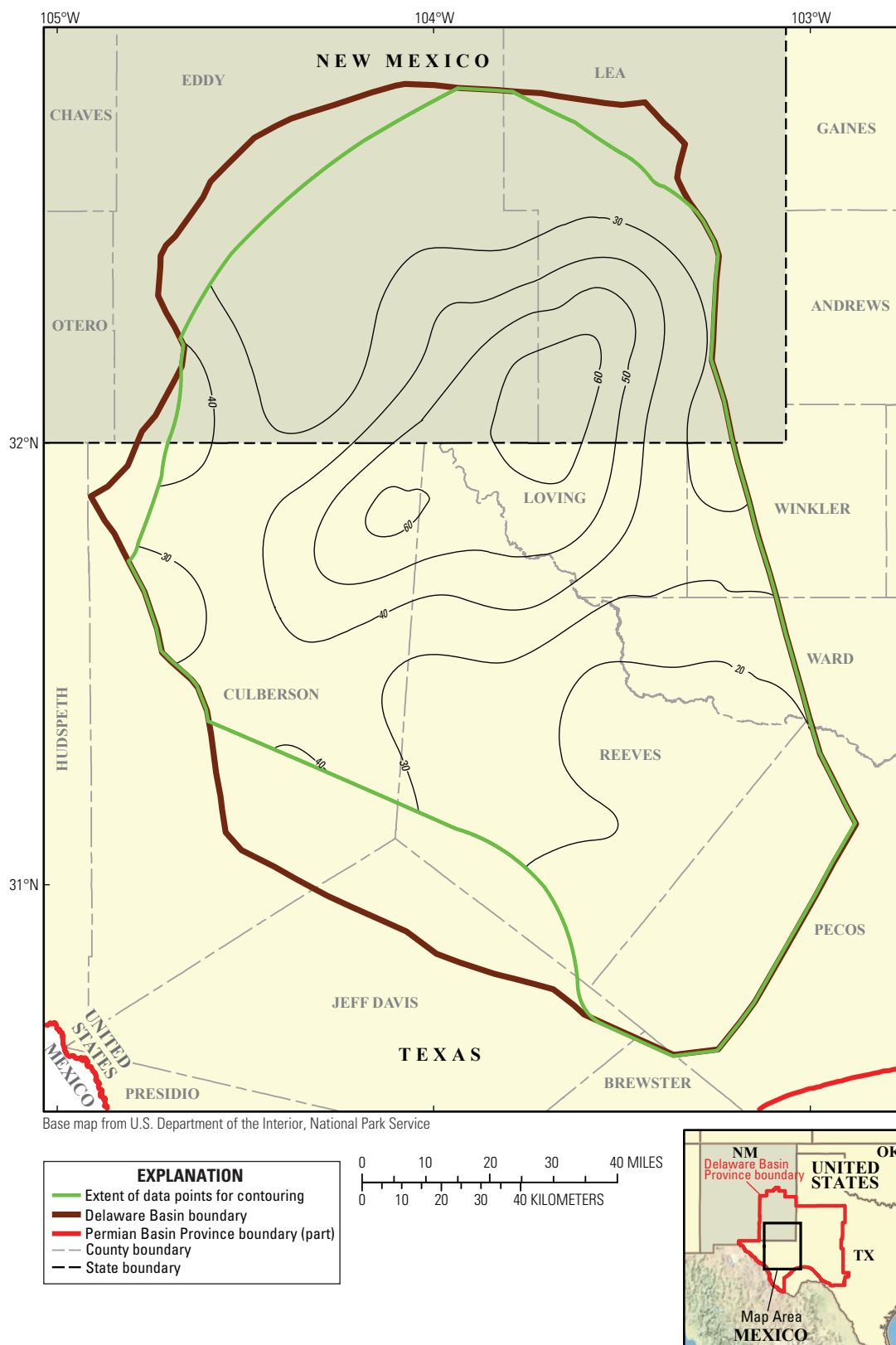


Figure 33. Isopach map of the Leonard shale interval, which is the interval from the top of the Avalon upper shale interval to the top of the Leonard shale interval of the Bone Spring Formation, Delaware Basin, Permian Basin Province, New Mexico and Texas. Contour interval is 10 feet, and 957 data points (wells with Avalon upper shale interval and Leonard shale interval tops) from PRODFit™ (IHS Markit®, 2018) were used to generate the contour map.

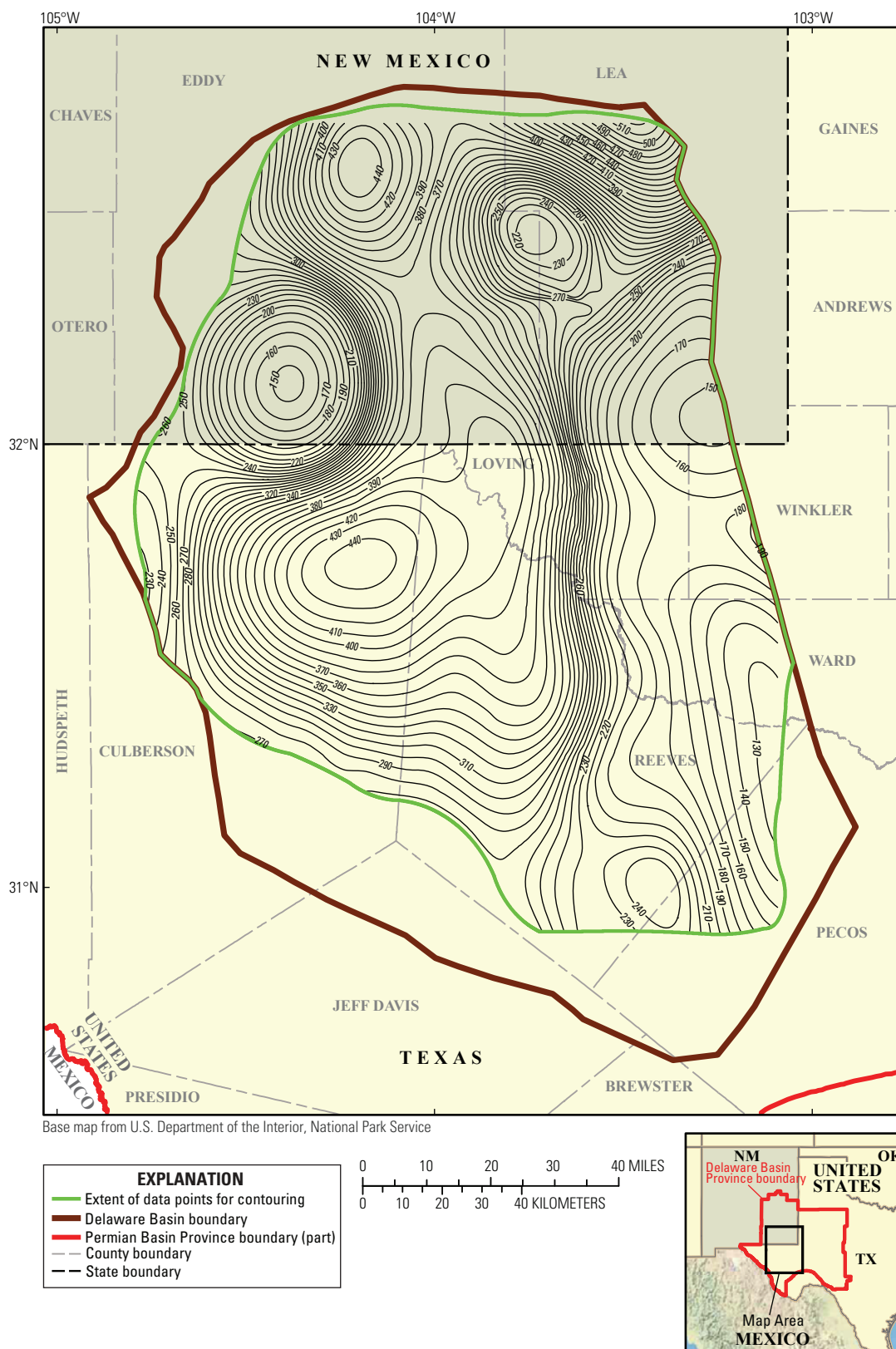


Figure 34. Isopach map of the Avalon upper shale interval and the Leonard shale interval, which is the interval from the top of the Avalon middle carbonate interval to the top of the Leonard shale interval of the Bone Spring Formation, Delaware Basin, Permian Basin Province, New Mexico and Texas. Contour interval is 10 feet, and 819 data points (wells with Avalon middle carbonate interval and Leonard shale interval tops) from PRODFit™ (IHS Markit®, 2018) were used to generate the contour map.

