An Integrated Workflow for Mapping Stratigraphic Features: Identification and Characterization of Channelized Debris Flows Within the Lower Wolfcamp Shale of the Midland Basin*

Daniel Spaulding¹, Lowell Waite¹, and Buzz Davis¹

Search and Discovery Article #51562 (2019)**
Posted May 13, 2019

*Adapted from poster presentation given at 2019 AAPG Southwest Section Meeting, Dallas, TX, United States, April 6-9, 2019
**Datapages © 2019. Serial rights given by author. For all other rights contact author directly. DOI: 10.1306/51562Spaulding2019

¹Pioneer Natural Resources, Irving, TX, United States (daniel.spaulding@pxd.com)

Abstract

The Spraberry and Wolfcamp formations in the Midland Basin of west Texas have been heavily logged in numerous vertical wells. Localized stratigraphic features, however, remain difficult to predict and/or correlate. In this study we focus on the identification and delineation of an extensive (> 20-mile long) channelized debris flow complex, identified within the Lower Wolfcamp shale. Originally observed as an amplitude anomaly of unknown origin in a 3D seismic volume, the mapping of different seismic attributes and use of advanced visualization techniques show that the feature contains the unmistakable form of a meandering submarine channel system. Integration of available well logs and a fortuitously placed whole core located in the center of the anomaly confirm the channelized debris flow interpretation. The vertical sequence of facies seen in the core indicate the presence of a stacked succession of multiple individual flows, suggesting the channel was actively constrained to the same location for an extended period of time. Similar features have been noted in the Monterey Basin, offshore California, and in the Amazon Fan, offshore Brazil, which provide modern analogs in terms of process and scale. Results of this work not only provide information on the debris flow architecture present in the Lower Wolfcamp shale but utilize techniques which apply to other deep-water units of the greater Permian Basin and elsewhere. These techniques have traditionally been used for conventional exploration; however, when utilized in resource plays, they can influence targeting, drilling and completions.
Abstract:
The Spadeer and Wolfcamp formations in the Midland Basin of west Texas have been heavily affected by several linear vertical fault systems, however, it is often difficult to predict and/or correlate. In this study, we focus on the identification and delineation of an extensive 3-D mile long, triangulated debris flow complex, identified within the lower Wolfcamp shale. Originally observed as an amplitude anomaly of unknown origin in a 3D seismic volume, the mapping of different seismic attributes and use of different acquisition parameters leads us to believe that this is the result of a sinuous channel system. Integration of available well logs and a fortuitously placed whole core located in the center of the anomaly confirms the triangulated debris flow interpretation. The vertical sequence of events seen in the core indicates the presence of a stacked succession of multiple individual flows, suggesting the channel was active and continuous in the same location for an extended period of time. Similar features have been noted in the Monterey Basin, offshore California, and in the Amazon Basin offshore Brazil, which provide modern analogs in terms of process and scale. Results of this work not only provide information on the debris flow architecture present in the lower Wolfcamp shale but also techniques which apply to other deep water units of the greater Permian Basin and elsewhere. These techniques have traditionally been used for conventional exploration; however, when applied in resource plays, they can influence targeting, drilling and completion.

Geobody Map (above left): Imaging and mapping capabilities have been applied to available amplitude (time) volume to help define production. Surficial mapping is applied to identify the extent of surficial channel forms within the larger incised submarine canyon. This geomorphology is supported by modern analogs. Geobody 3D section (above right): Incised channels are imaged using 3D seismic data, which is suggestive of a deep, fine grained debris flow.

Geobody Map (above left): Imaging and mapping capabilities have been applied to available amplitude (time) volume to help define production. Surficial mapping is applied to identify the extent of surficial channel forms within the larger incised submarine canyon. This geomorphology is supported by modern analogs. Geobody 3D section (above right): Incised channels are imaged using 3D seismic data, which is suggestive of a deep, fine grained debris flow.

Geobody Map (above left): Imaging and mapping capabilities have been applied to available amplitude (time) volume to help define production. Surficial mapping is applied to identify the extent of surficial channel forms within the larger incised submarine canyon. This geomorphology is supported by modern analogs. Geobody 3D section (above right): Incised channels are imaged using 3D seismic data, which is suggestive of a deep, fine grained debris flow.

Geobody Map (above left): Imaging and mapping capabilities have been applied to available amplitude (time) volume to help define production. Surficial mapping is applied to identify the extent of surficial channel forms within the larger incised submarine canyon. This geomorphology is supported by modern analogs. Geobody 3D section (above right): Incised channels are imaged using 3D seismic data, which is suggestive of a deep, fine grained debris flow.

Geobody Map (above left): Imaging and mapping capabilities have been applied to available amplitude (time) volume to help define production. Surficial mapping is applied to identify the extent of surficial channel forms within the larger incised submarine canyon. This geomorphology is supported by modern analogs. Geobody 3D section (above right): Incised channels are imaged using 3D seismic data, which is suggestive of a deep, fine grained debris flow.

Geobody Map (above left): Imaging and mapping capabilities have been applied to available amplitude (time) volume to help define production. Surficial mapping is applied to identify the extent of surficial channel forms within the larger incised submarine canyon. This geomorphology is supported by modern analogs. Geobody 3D section (above right): Incised channels are imaged using 3D seismic data, which is suggestive of a deep, fine grained debris flow.

Geobody Map (above left): Imaging and mapping capabilities have been applied to available amplitude (time) volume to help define production. Surficial mapping is applied to identify the extent of surficial channel forms within the larger incised submarine canyon. This geomorphology is supported by modern analogs. Geobody 3D section (above right): Incised channels are imaged using 3D seismic data, which is suggestive of a deep, fine grained debris flow.

Geobody Map (above left): Imaging and mapping capabilities have been applied to available amplitude (time) volume to help define production. Surficial mapping is applied to identify the extent of surficial channel forms within the larger incised submarine canyon. This geomorphology is supported by modern analogs. Geobody 3D section (above right): Incised channels are imaged using 3D seismic data, which is suggestive of a deep, fine grained debris flow.

Geobody Map (above left): Imaging and mapping capabilities have been applied to available amplitude (time) volume to help define production. Surficial mapping is applied to identify the extent of surficial channel forms within the larger incised submarine canyon. This geomorphology is supported by modern analogs. Geobody 3D section (above right): Incised channels are imaged using 3D seismic data, which is suggestive of a deep, fine grained debris flow.

Geobody Map (above left): Imaging and mapping capabilities have been applied to available amplitude (time) volume to help define production. Surficial mapping is applied to identify the extent of surficial channel forms within the larger incised submarine canyon. This geomorphology is supported by modern analogs. Geobody 3D section (above right): Incised channels are imaged using 3D seismic data, which is suggestive of a deep, fine grained debris flow.

Geobody Map (above left): Imaging and mapping capabilities have been applied to available amplitude (time) volume to help define production. Surficial mapping is applied to identify the extent of surficial channel forms within the larger incised submarine canyon. This geomorphology is supported by modern analogs. Geobody 3D section (above right): Incised channels are imaged using 3D seismic data, which is suggestive of a deep, fine grained debris flow.

Geobody Map (above left): Imaging and mapping capabilities have been applied to available amplitude (time) volume to help define production. Surficial mapping is applied to identify the extent of surficial channel forms within the larger incised submarine canyon. This geomorphology is supported by modern analogs. Geobody 3D section (above right): Incised channels are imaged using 3D seismic data, which is suggestive of a deep, fine grained debris flow.