

# Mapping shallow channels reduce potential geohazards in Woodford Shale wells

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**Introduction:** The Boiler Maker survey consists of complex river systems in multiple formation layers, in particular the Red Fork formation. These channel systems have smaller tributaries forming off of the main river system. To identify the smaller channels in the survey area or in areas like this environment the survey will have Spectral Decomposition applied on the seismic data. The Spectral Decomposition will identify structures below the tuning level. With the help of Spectral Decomposition and Coherence attributes the smaller channels that were previously indistinguishable will be identified.

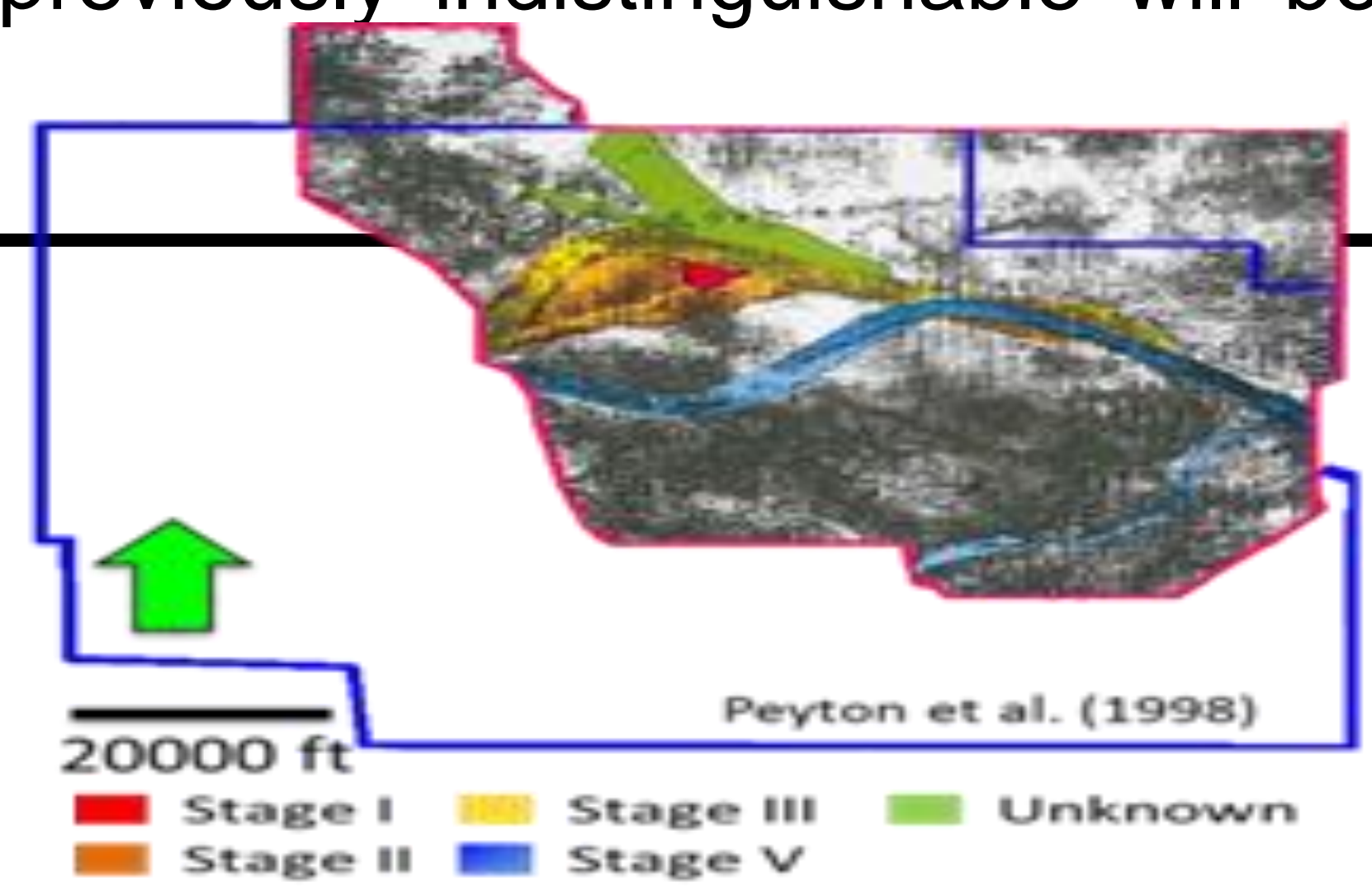


Figure 1: Survey location an outline

| SYSTEM        | SERIES              | GROUP           | UNIT             |
|---------------|---------------------|-----------------|------------------|
| PENNSYLVANIAN | VIRGINIAN           | Shawnee/ Cisco  | Topeka Ls        |
|               |                     |                 | Pawhuska Ls      |
|               |                     | Hoover Ss       |                  |
|               |                     | Elgin Sd        |                  |
|               |                     | Oread Ls        |                  |
|               | MISSOURIAN          | Douglas/ Cisco  | Heebner Sh       |
|               |                     |                 | Endicott Ss      |
|               |                     | Lovell Ls       |                  |
|               |                     | Haskell Ls      |                  |
|               |                     | Tonkawa Ss      |                  |
|               | DESMONIAN           | Lansing/ Hoxbar | Avant Ls         |
|               |                     |                 | Cottage Grove Ss |
|               |                     | Dewey Ls        |                  |
|               |                     | Hogshooter Ls   |                  |
|               |                     | Layton Ss       |                  |
| ATOKAN        | Kansas City/ Hoxbar | Checkerboard Ls |                  |
|               |                     | Cleveland Ss    |                  |
|               | Marmaton            | Big Lime        |                  |
|               | Oswego Ls           |                 |                  |
|               | Cherokee Marker     |                 |                  |
| MISSISSIPPIAN | CHEROKEE            | Atoka           | Pink Ls          |
|               |                     |                 | Red Fork Ss      |
|               | MORROWAN            | Morrow          | Inola Ls         |
|               |                     |                 | Mona             |
|               | SPRINGERAN          | Springer        | Novi             |
|               |                     |                 | 13 Finger Ls     |
|               | CHESTERIAN          | Chester         | Morrow           |
|               |                     |                 | Primrose         |
|               | MERAMECIAN          | Meramec         | Cunningham       |
|               |                     |                 | Britt            |
| OSAGEAN       | Osage               | Boatwright      |                  |
|               |                     | Chester Ls      |                  |
| KINDERHOOKIAN | Kinderhook          | Manning Ls      |                  |
|               |                     | Meramec Chat    |                  |
| CHATTANOOGIAN | Hunton              | Meramec Ls      |                  |
|               |                     | Osage Ls        |                  |
| ULSTERIAN     | Hunton              | Woodford Sh     |                  |
|               |                     | Misener Ss      |                  |
| NIAGARAN      | Hunton              | Hunton Group    |                  |
|               |                     | ALEXANDRIAN     |                  |

Figure 2: Geologic time location of formation

**Geology:** The Red Fork Formation was deposited in the eastern portion of the Anadarko basin during the Pennsylvanian period (Figure 3). The Red Fork is located in the middle of the Pink Limestone and the Inola Limestone (Figure 4). The formation has three subdivisions, the Lower, Middle, and Upper Red Fork (Peyton, 1998). The three subdivisions are separated by a sequence of marine clastics, which have then been eroded by incised valleys (Peyton, 1998). Peyton (1998) divides the incised valleys of the Upper Red Fork, the best reservoirs, into 5 stages of valley fill (Figure 1).

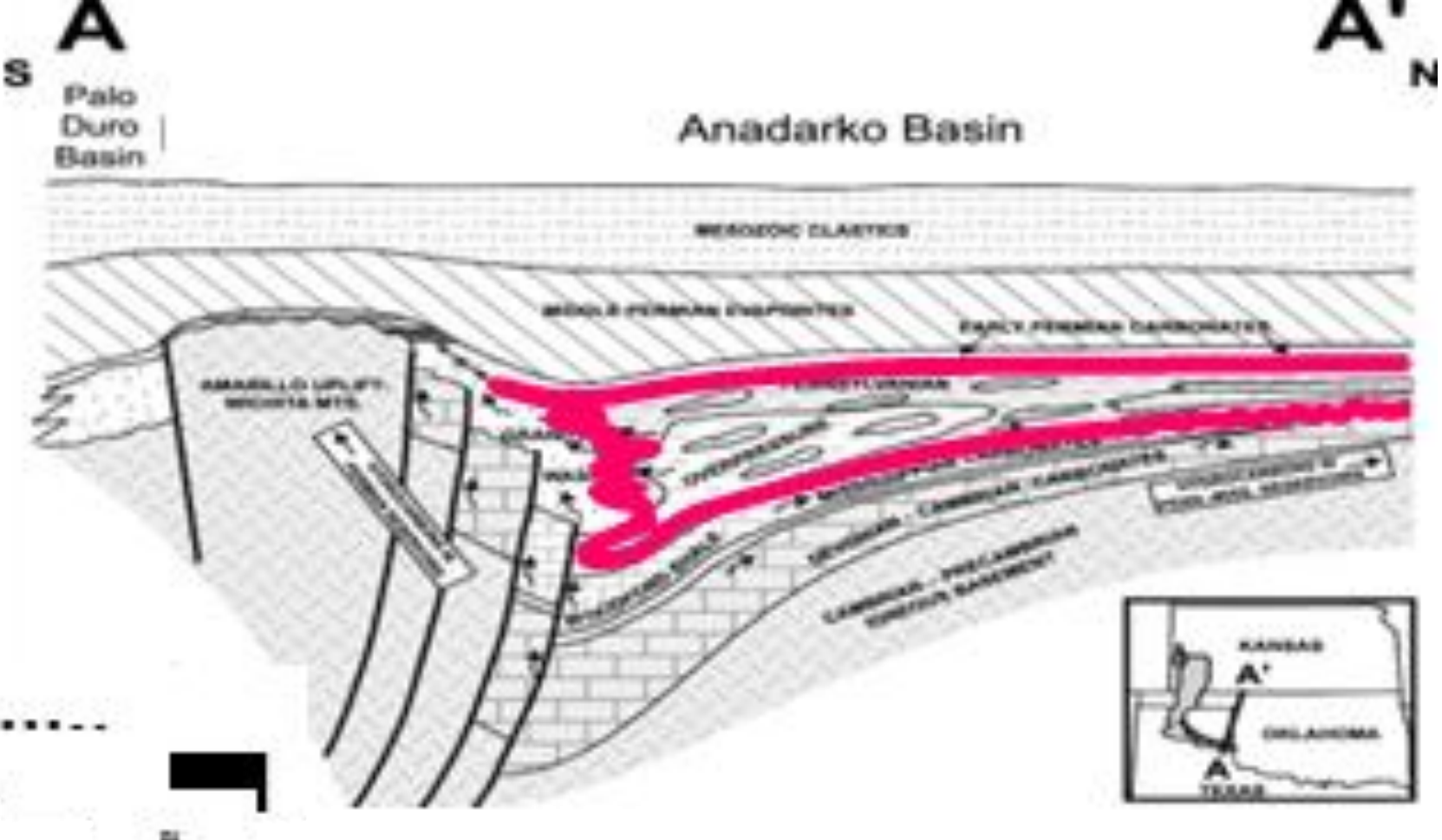


Figure 3 – Cross section through the Anadarko Basin. The Pennsylvanian aged lithologies are highlighted in red

This study focuses on two stages out of the five: Stage III and Stage V. Stage III is characterized by sandstones and is the last stage of incisement (Del Moro, 2012). It is productive and is targeted for drilling. Stage V is made mostly of shale a non-productive sands (Del Moro 2012). It tends to erode the more productive Stage III and is not usually a drilling target (Del Moro 2012).

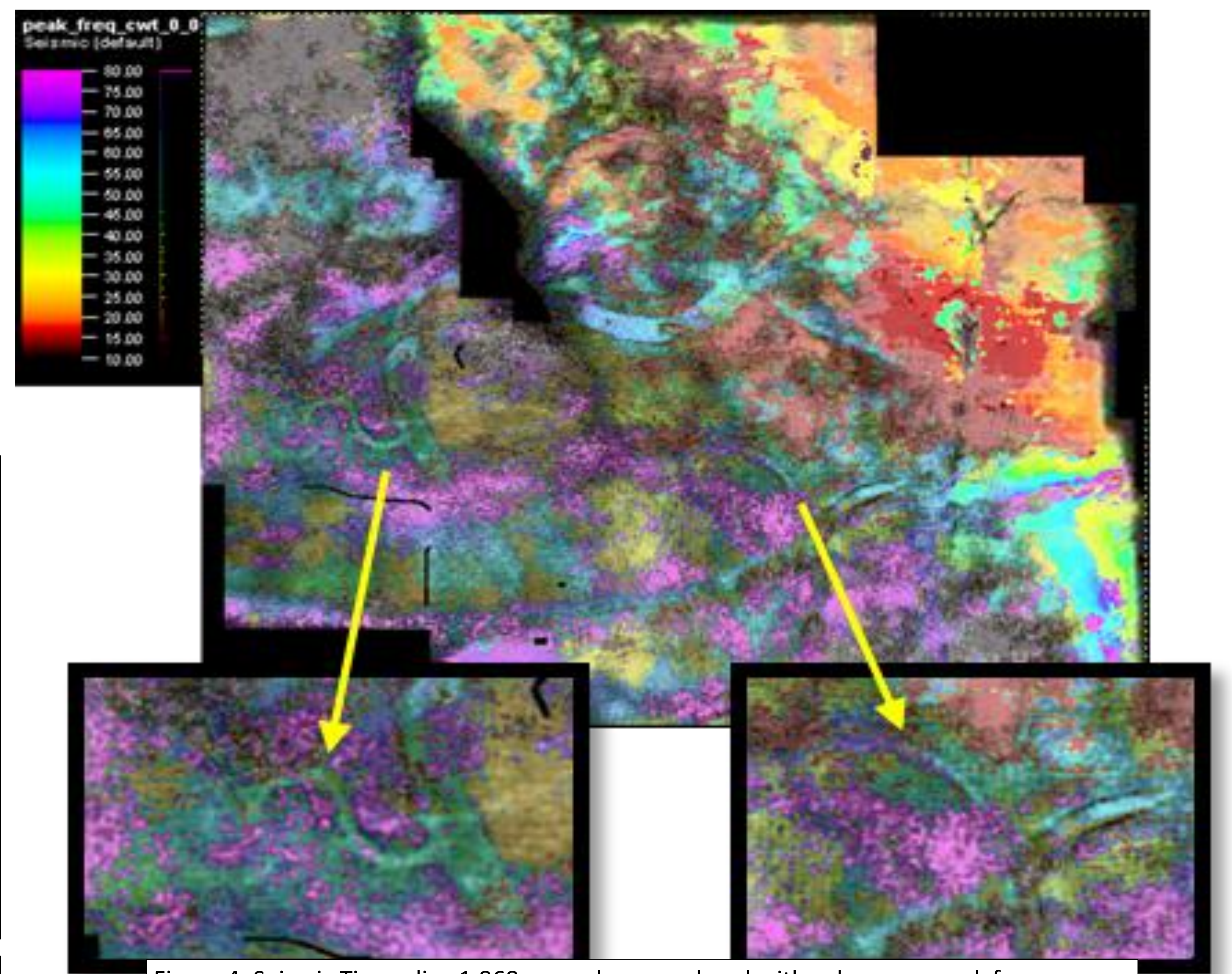


Figure 4: Seismic Time slice 1.868 seconds co-rendered with coherence, peak frequency, and peak magnitude

**Quality:** The Boilermaker survey is a mega merge survey of 244 mi<sup>2</sup> that combines the Watonga survey (Red outline in Figure 2) with newer data (Chopra & Marfurt, 2007). The merged data has improved balance and a larger fold in the survey. The acquisition footprint has been greatly reduced with the mega-merge reprocessing. For this project, the Boilermaker Survey was cropped from 1.7-1.8 ms. This depth is located above and below the the Red Fork Formation. The crop was then processed through the Attribute Assisted Seismic Processing and Interpretation Software (AASPI) with a Spectral Decomposition filter using the Continuous Wavelet Transform (CWT). Spectral Decomposition volumes of 14 Hz, 24 Hz, 34 Hz and 44 Hz were created and imaged in Petrel. Then the data was co-render the coherence to identify channels in the time slices (Figure 4). The data was first co-rendered, then the color bar was manipulated to see the smaller frequencies in the channels using hues of blues to identify the variations in the data. Thus, the channels that were indistinguishable before are resolved.

**Motivation:** The Woodford Shale is an unconventional play in the Anadarko Basin that many energy companies are targeting. To reach the Woodford, companies must drill through formations that have a high density of gas-charged channels. Two such formations are the Red Fork and Morrow, where drillers must adjust mud weight when a channel is encountered to avoid potential blowouts. Thin channels below seismic detection can still result in large gas kicks, which can cost the company thousands of dollars. We hope to develop a workflow using seismic attributes that will increase the limit of seismic detection for thin channels (Figure 5) in the Red Fork and Morrow formations.

**Future Work:** We hope to develop a workflow using seismic attributes that will increase our ability to identify thin channels in the Red Fork and Morrow formations. Our hope, is to increase the number of channels that can be imaged in the Anadarko Basin and use the results to help identify potential drilling hazards. Well information would help confirm our interpretations and tie the seismic data in the area.

**References and Acknowledgements:**  
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