Use of 3D Seismic Inversion Data in Sandstone Gas Reservoirs in the Arkoma Basin, Southeastern Oklahoma

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We have used 2D and 3D seismic, well logs, and core data to construct structural cross-sections to illustrate complex structure of the Arkoma Basin, a foreland basin located in southeast Oklahoma and western Arkansas. The basin produces gas mostly from the upper Paleozoic sandstone reservoirs such as the lower Atokan Spiro, Panola, Brazil and mid Atokan Red Oak sandstones. The Spiro is especially good reservoir when it contains chamosite facies which preserve primary porosity. Structure plays a major role in the productivity of the Spiro Sandstone. However, understanding and identifying changes in rock properties over an area is just as important as understanding the structure. Therefore, we have recently used 3D seismic acoustic inversion volume calibrated to well control to map porosity changes in the Spiro Sandstone. Every well with a sonic log within the survey area has been analyzed to understand velocity changes in the Spiro Sandstone along strike and dip of the main direction of thrusting. Our interpretation of the seismic inversion data suggest that a) areas of tighter anticlinal folds may correlate to lower acoustic impedance values due to fracture porosity; b) Spiro Sandstone structure contour maps may provide additional insight as to where areas of greater compression cause an increase in fractures; c) the absolute value of acoustic impedance is unaffected by structural position; d) acoustic impedance shows a reliable correlation with higher porosities as seen in areas of lower acoustic impedance; and e) in areas where the Spiro Sandstone experienced facies changes the acoustic impedance value is a good predictor of porosity.