Demystifying Tight-Gas Reservoirs using Multi-Scale Seismic Data

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Abstract/Excerpt

Low permeability sand and shale reservoirs in the US Rocky Mountain region are estimated to hold nearly 7000 tcf of gas reserves (DOE 2003). In a typical reservoir, hundreds or thousands of feet of stacked fluvial sands are gas charged, with natural and induced fractures being essential for economic gas production. While seismic data is useful for identifying major geologic interfaces and faults, the thin and complex nature of these channel sands are typically below seismic resolution confouding interpretation at the reservoir level. Well planning optimization generally consists of progressive downspacing of wells, aided by a regional understanding of pressure gradients and fracture and stress orientations.

Extensive seismic experimentation has been performed over the Rulison "tight-gas" field in westcentral Colorado, USA, as part of the multi-year Reservoir Characterization Project. Over the past five years, three separate seismic surveys have been performed over this field, using 9-component seismic technology. This combined application of time lapse and multi-component seismic techniques has provided unique insights into fault and fracture orientations and reservoir pressure changes resulting from gas production. An additional seismic technique, passive microseismic monitoring, is supplying an additional reservoir perspective, confirming hydraulic fracture orientation estimates and quantifying the effectiveness of well stimulation efforts. In combination, the integrated application of multi-scale seismic, spanning time-lapse, multicomponent and passive measurements, is leading to better understanding of key properties determining well production in a typical tight-gas reservoir