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3-D Seismic Horizon-Based Approaches to Fracture-Swarm Sweet Spot Detection In Low-Permeability Gas Reservoirs

Horizon attributes (e.g., dip, azimuth, and curvature) derived from 3-D seismic data hold considerable potential for identifying fracture-swarm sweet spots in low permeability reservoirs. Typically, these attributes are used to define subtle faults that can play important roles in compartmentalizing conventional reservoirs. However, in low-permeability gas reservoirs, where fracture permeability is critical, these same attributes can be used to define high-permeability fracture swarms. We illustrate this point with case studies (carbonate and clastic) from the San Juan Basin area of northwestern New Mexico. Our results indicate that development drilling plans for low permeability reservoirs should take into account geologic heterogeneity that can be associated with fracture swarms. Undrilled fracture swarms should be targeted to produce high-rate wells. On the other hand, offset wells should specifically avoid drilling into previously tapped fracture swarms to avoid drainage interference. Other factors that need to be considered are: a) the orientation of the fractures with respect to in-situ stress directions, b) lithologic (i.e., Stratigraphic) control on fracture density, and c) the scale of the curvature. Freeware for deriving curvature attributes used in this study is available from the following website:

http://www.eps.mcgill.ca/~hart/seismic_research_group.htm