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## Seismic Support for Finding and Developing Fractured Oil and Gas Reservoirs: The Russian Experience with 'Side-View' and Microseismic in Imaging Fracture Intensity and Hydrocarbon Saturation

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GCAGS Explore & Discover Article #00139\*

[http://www.gcags.org/exploreanddiscover/2016/00139\\_leroy\\_et\\_al.pdf](http://www.gcags.org/exploreanddiscover/2016/00139_leroy_et_al.pdf)

Posted September 13, 2016.

\*Abstract published in the *GCAGS Transactions* (see footnote reference below) and delivered as an oral presentation at the 66th Annual GCAGS Convention and 63rd Annual GCSSEPM Meeting in Corpus Christi, Texas, September 18–20, 2016.

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### ABSTRACT

Side-looking fracture imaging surveys have been successfully applied to oil and gas field development in Europe, Asia, and the Middle East. By processing long-offset seismic signals, the method directly images the intensity of open fracturing in the subsurface. Data are presented as 3D depth volumes showing relative intensity of open fracturing and, where possible, apparent fluid content. For active side-looking surveys seismic sources are set off on the surface and returning seismic wave-fields are recorded at ground level. Active surveys locate unfractured areas, clusters of intense open fractures, and degrees of open fracturing between these extremes. With higher energy seismic sources fluid content of open fractures (oil, gas, or water) can be estimated. Pre-existing 3D surveys can now be processed to recover this information. Passive surveys record naturally occurring micro-earthquakes. Recording is done over a period of two weeks to one month and the data are processed as in the active method. However, passive surveys also provide information about the fluid content and can be used to estimate permeability through the observed fracture network. Passive surveys also generate time-lapse movies of fracture systems opening and closing with a rhythm corresponding to lunar-solar-Earth tides. Three side-looking fracture surveys have been acquired in the U.S., all in Texas. Two are active and one is passive. All are being used for exploration of the Cretaceous and Jurassic sections of the Gulf Coast Basin. Both active and passive technologies imaged the fracture systems present with image quality as good as those previously recorded in Europe, Asia, and the Middle East.

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Originally published as: LeRoy, S., O. Kouznetsov, Y. Lyasch, I. Chirkin, E. Rizanov, and A. Radwan, 2016, Seismic support for finding and developing fractured oil and gas reservoirs: The Russian experience with 'side-view' and microseismic in imaging fracture intensity and hydrocarbon saturation: Gulf Coast Association of Geological Societies Transactions, v. 66, p. 997.