Geophysical Research Abstracts
Vol. 16, EGU2014-3457, 2014
EGU General Assembly 2014

Seismic attenuation: Laboratory measurements in fluid saturated rocks

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Seismic wave attenuation could be used as an indicator of reservoir fluids due to its dependence on rock and fluid properties. Over the past 30 years, many laboratory methodologies to study attenuation in rocks have been employed, such as ultrasonic (MHz), resonant bar (kHz) and forced oscillation methods in the low frequency range (0.01-100Hz) (Tisato & Madonna 2012; Madonna & Tisato 2013). Forced oscillation methods have gained prominence over time as the frequency range of measurements correspond to that of field seismic data acquired for oil/gas exploration. These experiments measure attenuation as the phase shift between the applied stress (sinusoidal) and measured strain. Since the magnitudes of measured phase shifts are quite low (Q^{-1} $\sim$0.01-0.1) and the amplitudes of strain applied to the rock samples are of the order $\sim 10^{-6}$ (i.e., similar orders of magnitude to seismic waves), it is challenging. A comparison of such forced oscillation setups will be presented to provide an overview of the various possibilities of design and implementation for future setups.

In general, there is a lack of laboratory data and most of the published data are for sandstones. Currently, attenuation measurements are being carried out on carbonate and sandstone samples. We employ the Seismic Wave Attenuation Module (SWAM, Madonna & Tisato 2013) to measure seismic attenuation in these samples for different saturation degrees (90% and 100% water) and under three different confining pressures (5, 10 and 15MPa). Preliminary results from these investigations will be discussed.

REFERENCES

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