Ding, Pinbo; Di, Bang-Rang; Wei, Jian-Xin; Li, Xiang-Yang. 2015 Experimental research on the effects of crack density based on synthetic sandstones contain controlled fractures. *Chinese journal of geophysics*, 58 (4). 1390-1399. 10.6038/cjg20150425

Fracture development and distribution in underground rocks have strong influence on rock properties, understanding the fracture system is critical to the oil and gas reservoir detection and production, groundwater resource, underground wastes storage, mining, seismology and CO2 capture and storage.Due to the complex fracture distribution and geometry in nature rocks, the lack of information about fracture parameters (fracture density, length and thickness) makes the nature rock cannot be used in laboratory experiments. Rock physics experiments require the controlled and known fracture parameters and orientation in rock samples, thus synthetic samples were used to represent fractured rocks in several previous studies. However, the fractures were represented by other week material, such as silica rubber imbedded in epoxy solid, to simulate the fractured rocks in previous studies. The materials used to construct the samples (Lucite, silica rubber, sand bonded by epoxy) were very different from nature rocks, the solid representing background matrix and the week material representing fractures have no porous and fracture space and saturated fluids. In this study, we use new construction method based on material science progress to build synthetic samples which have similar mineral component, porous structure, cementation as nature rocks. The synthetic rock containing controlled fracture geometry provides a different way to create fractured rocks to observe the seismic anisotropy influenced by fracture parameters and fluids. The synthetic rocks are tested under high pressure to observe the pressure sensitivity, and SEM is used to observe the porous structure and fractures distrubution. We build a set of synthetic rocks to observe the effect of fractures upon seismic wave velocity and anisotropy. The samples are measured with 0.5 MHz transducers. P and S wave velocity in different propagation directions of these four samples are measured when saturated by air and water.The experimental results can help in investigating the relationship between fracture density and P and S wave anisotropy in fractured reservoirs. The measurement results show that the P wave velocity and anisotropy is significantly influenced by saturating fluid. Shear wave velocity, shear wave splitting and shear wave anisotropy are less sensitive to saturating fluid but significantly affected by fracture density. P wave velocities in perpendicular direction show significant influences of fracture, the velocity decreases as the fracture density increases. Shear wave velocity in perpendicular direction decreases with the increasing fracture density, the difference between fast shear wave and slow shear wave velocity is smaller in this direction. However the slow shear wave velocity is more sensitive to fracture density than fast shear wave velocity in parallel direction, thus the difference of fast and slow shear wave velocity in parallel direction increases as the fracture density increases. P wave velocity is more sensitive to saturating fluids, as the velocity is higher in water saturation than air saturation. P wave anisotropy is much higher in air saturation, but decreases while saturated by water. Shear wave velocity and anisotropy is less sensitive to fluid saturation, but is more sensitive to fracture density since shear wave anisotropy increases significantly with increasing fracture density.The new construction process can provide more realistic rocks for rock physics experiments, in which the fracture parameters can be controlled. The measurement results show that P wave velocity and anisotropy is very sensitive to fluid saturation, P wave anisotropy decreases while rock is saturated by fluid with higher modulus. Shear wave velocity is not sensitive to fluids but is significantly influenced by fracture density.