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Experiment and simulation of stress-dependent P-wave velocity anisotropy in sandstone

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Velocity anisotropy is particularly important in field applications of seismic monitoring or exploration [1]. We investigate the stress-dependent P-wave velocity anisotropy of sandstones with triaxial experiments and PFC based numerical simulation [2-3]. The sandstone sample was taken from the lower Shaximiao formation, Sichuan Basin, China [4]. The evolution of anisotropy is discussed with the ellipse least-squares fitting method. The results show that the P-wave velocity is affected by both the bedding plane and loading conditions. As confining pressure increases, the anisotropy magnitude decreases for each sample. The direction of anisotropy is along with the direction of the bedding plane. Under deviator loading, the anisotropy is strengthened for the sample with bedding parallel to the maximum principal stress. The direction of anisotropy reversal occurs in the sample with bedding normal to the maximum principal stress. And the anisotropy magnitude of that sample is reduced firstly and then improved. The P-wave velocity anisotropy is originated from preferred mineral orientation and aligned cracks in these samples. The stress has little effect on the mineral orientation. The evolution of P-wave velocity anisotropy is related to closing and reopening of microcracks.

Keywords: Velocity anisotropy; Anisotropy reversal; Triaxial experiment; PFC2D; Sandstone

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