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Laboratory measurements of seismic velocity anisotropy of salt diapirs: Implications for wellbore stability and seismic processing

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A set of ten evaporite samples collected from outcrops in a single diapiric province in Cape Breton Island (Canada) have been tested for seismic velocity anisotropy using three methods: 1) conventional ultrasonic pulse transmission method, where velocities are found from the travel times and the known dimensions of the samples. In order to obtain the entire suite of elastic constants, both P- and S-wave velocity measurements were taken in three different directions of cuboid rock samples. Velocities have been measured under dry, ambient conditions of temperature and pressure in halite-, gypsum- and anhydrite-dominated samples; 2) optical microscopy and scanning electron microscopy on thin sections to define the spatial distribution of minerals, their crystallographic preferred orientations (CPO); and 3) a numerical 'rock-recipe' approach based on Tatham et al. (2008) to calculate seismic velocity anisotropy using arbitrary composites of evaporite minerals and different CPOs. These three methods are then compared to understand the controlling factors of the anisotropic elastic properties. The elasticity data are used to guide geomechanical modeling for wellbore stability and to provide insights for the seismic data processing and seismic imaging of salt diapirs.

Reference
Tatham, D.J., Lloyd, G.E., Butler, R.W.H. and Casey, M, 2008, Amphibole and lower crustal seismic properties: Earth and Planetary Science Letters, 267, 118–128.