

P-wave anisotropy estimation from 3D VSP data acquired with geophones and DAS at Otway Site

Sofya Popik^{1,2}, Roman Pevzner^{1,2}, Andrej Bona^{1,2}

¹Curtin University, ²CO2CRC

Stage 2C of the Otway Project involves monitoring of a small-scale (15 kt) CO₂-injection using an extensive time-lapse active seismic program. The main components of this seismic monitoring program are 4D surface seismic and 4D Vertical Seismic Profile (VSP) surveys acquired before, during and after the injection. Data analysis reveals significant seismic anisotropy of the subsurface, which needs to be estimated and taken into account to improve the quality of imaging with both VSP and surface seismic data.

A wide range of offsets obtained during fifth monitoring survey of the Stage 2C of the Otway Project provides a unique opportunity for anisotropy estimation from 3D VSP data. In this study we compare geophone and Distributed Acoustic Sensor (DAS) VSP data and their applicability for anisotropy analysis. Analysis of DAS data gives anisotropy parameters for the entire depth of the well.

We estimate P-wave anisotropy by analyzing direct-wave VSP arrival times. The study demonstrates significant presence of both polar and azimuthal anisotropy. While vertical-plane anellipticity remains almost constant at 0.1 level for the whole depth range, azimuthal anisotropy changes significantly with depth: from negligibly small in the shallow part with significant increase below the 600 m depth, which most probably indicates the change of stress field at this depth.