

Walkaway VSP for CO₂ monitoring at the Penn West pilot, Alberta, Canada

*Marcia L. Couëslan*¹, Don C. Lawton¹, and Michael Jones²*
¹CREWES, University of Calgary ²Schlumberger Canada

At the Penn West CO₂ pilot project, 100 km southwest of Edmonton, Alberta, CO₂ is being injected into the Cardium Formation at a depth of 1620 m in the Pembina Oil Field for enhanced recovery and carbon sequestration purposes. The reservoir is being monitored using simultaneously acquired time-lapse multicomponent surface and borehole seismic surveys. Together, these provide lateral coverage of the survey area as well as high-resolution images near the observation well. The baseline survey was acquired in March 2005 prior to CO₂ injection. Both the P-wave and PS-wave VSP images show excellent ties with the P-wave surface seismic data and have higher frequency bandwidth and resolution. The migrated images cover a 200 m radius of the reservoir around the observation well.

The first monitor survey was acquired in December 2005 after eight months of CO₂ injection. Comparisons between the baseline and monitor borehole seismic surveys show an increase in reflectivity at the reservoir, and crosscorrelations show a time shift of 0.2 ms on two of the walkaway lines. This time shift is in the range predicted by the Gassmann modelling. The baseline and monitor surveys also have nearly identical amplitude and phase spectra up to 80 Hz.

The next monitor survey is due to be acquired in 2007. It is expected that the time-lapse effects will increase as the volume of CO₂ in the reservoir increases.