**Methods for the Prediction, Monitoring and Verification of CO2 Movement: Results from the IEA Weyburn CO2 Storage and Monitoring Project**

Don White[1] , Keith Hirsche[2], Tom Davis[3], Ernie Majer[4], Ian Hutcheon[5], Geoff Burrowes[6], Ryan Adair[6], Sean Maxwell[7] and Hubert Fabriol[8]
Geological Survey of Canada[1], Hampson- Russell Software[2], Colorado School of Mines[3], Lawrence Berkeley National Lab[4], University of Calgary[5] , EnCana Corporation[6], Engineering Seismic Group[7], Bureau de Recherches Géologiques et Minières[8]

The International Energy Agency (IEA) Weyburn $CO_2$ Monitoring and Storage Project is designed to investigate the technical and economic feasibility of $CO_2$ storage in a partially-depleted oil reservoir in conjunction with enhanced oil recovery operations. A key element of the project is development and application of monitoring and verification methods to track the spread of $CO_2$ within the thin (~25 m) reservoir located at ~1450 m depth.

The ability of seismic and geochemical methods to detect changes in the Weyburn reservoir induced by $CO_2$ injection has been clearly demonstrated. The path of injected $CO_2$ can be traced geochemically due to distinct isotopic signatures associated with the injected $CO_2$. The primary effect observed by P-wave seismic monitoring is $CO_2$ saturation with pressure effects being a secondary factor. Generally, the time-lapse seismic anomalies around the horizontal injection wells are proportional to the cumulative amount of $CO_2$ injected. There are also smaller off-trend anomalies that suggest that channelling of the $CO_2$ is occurring in some areas, supported by S-wave images of fracture-related anisotropic zones, and high-resolution images from horizontal crosswell tomography. Reservoir simulation-production history matching is integrated with time-lapse seismic measurements in an iterative process to reduce the non-uniqueness in the time-lapse seismic interpretation and to provide more efficient history matching. Low levels of microseismicity concentrated around a production area (~12 events of M=-1.5 to –2.5) have been observed over a 4-month period at distances of 200 to 500 m from a downhole passive monitoring array located above the reservoir.