

AAPG HEDBERG CONFERENCE
"Geological Carbon Sequestration: Prediction and Verification"
August 16-19, 2009 – Vancouver, BC, Canada

**Experimental Application of In-SAR Technology to Assess Surface Deformation around Oil
Fields and Water Wells in Saudi Arabia**

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Ground surface subsidence can be natural, due to tectonic activities for example, or due to human activities, as in the case of oil/gas or ground water mining. Carbon injection or carbon sequestration can also cause an uplift (surface deformation) around injection area. In general, surface deformation can be damaging to the infrastructure in the vicinity of the reservoirs as well as to the reservoir itself and thus should be closely monitored. Ground deformation can be estimated by various means among which GPS surveying, ground leveling, and Interferometric Synthetic Aperture Radar or InSAR. When compared to the other techniques, InSAR offers fast and relatively reliable estimates. InSAR results can be used as a preliminary alarm for area that needs further investigation. For the InSAR, the variation in ground surface can be estimated by processing a selected pair of Synthetic Aperture Radar (SAR) scenes taken in two different periods of time in a similar satellite attributes. The deformation would appear as fringes (due to signal phase changes) that reflects the movement of the ground.

The InSAR technique has been successfully used to detect surface deformation caused by human activities in oil/gas fields as well as near ground water wells. Our goal is to use the InSAR technique to investigate surface deformation in selected areas of the Kingdom and correlate the results with recorded seismicity and ground observations. Using the InSAR technique, subsidence has been detected southeast of Tabouk in a seismically active area. A 5 stations portable network has been placed in the area to monitor the seismic activity and compare the results with the observed subsidence. Subsidence has been also observed in the eastern part of Saudi Arabia near Dhahran. We have failed to observe any subsidence near Khafji, a small city near the Kuwait border, which was a good indication that oil/gas production had no effect at the surface in that region. We are planning to continuously monitor the affected areas using the InSAR technique in addition to GPS surveying. The result of this project will be very helpful in searching for suitable carbon sequestration sites as well as monitoring any future carbon sequestration places. This project is a cooperation project with the Japan Cooperation Center, Petroleum (JCCP).