

**Department of Structural Engineering
University of California, San Diego
SE 290 Seminar**



Professor Marte Gutierrez
J.R. Paden Distinguished Professor
Colorado School of Mines

**"Coupled Geomechanics and Two-Phase Fluid Flow Aspects of CO₂
Geological Sequestration"**

Monday, April 9, 2018
12:00 pm - 12:50 pm, Center Hall, Room 214

<https://structures.ucsd.edu/seminars>

Abstract

CO₂ geological sequestration (GS) in saline reservoirs involves several interacting processes. One of the processes is two-phase immiscible fluid flow which occurs when CO₂ gas as the non-wetting fluid phase displaces saline water as the wetting fluid. Another important phenomenon comes from geomechanical interactions due to the pore pressure changes from fluid flow in the reservoir and the ensuing effective stress changes. Changes in effective stresses will induce reservoir deformation. In turn, reservoir deformation will cause pore pressure changes leading to a fully coupled interaction where fluid flow affects rock deformation and vice versa. The presentation will consist of four parts. The first part provides a brief overview of the need to reduce anthropogenic CO₂ in the atmosphere to mitigate its impact on climate change. The second part provides a complete fundamental background on the coupling between fluid flow and geomechanics in deformable fluid saturated porous media based on Biot's poromechanics theory. Computational strategies to solve the resulting coupled equations

from Biot's theory are reviewed. The third part reviews the suitability of the coupled geomechanical and two-phase fluid flow simulation technique in FLAC (Fast Lagrangian Analysis of Continua developed by ITASCA) to model CO₂ GS is reviewed. The coupled technique is FLAC is used to model CO₂ injection field case histories including the Sleipner gas field in the North Sea, Norway, and the In Salah gas field in Algeria. The modeling of the field histories will highlight the importance of geomechanical effects and the coupling of geomechanics with fluid flow in understanding and prediction of the behavior of geological sequestration reservoirs during CO₂ injection. The final part demonstrates the use of Biot's theory on modeling the CO₂-saturation dependent seismic velocity of sandstone injected with a mixture of supercritical CO₂ and saline water.

Biography

Dr. Marte Gutierrez is the James R. Paden Distinguished Professor at the Department of Civil and Environmental Engineering and the Director of the University Transportation Center for Underground Transportation Infrastructure (UTC-UTI) at Colorado School of Mines. Formerly, he was Post-Doctoral Fellow, Senior Engineer and Program Leader at the Norwegian Geotechnical Institute, and Associate Professor/Professor at Virginia Tech. He has held visiting professorship and researcher positions in China, Chile, France, Japan, Norway and South Korea, and was the Founding Chair of the Department of Civil Infrastructure and Environmental Engineering, Khalifa University, Abu Dhabi, UAE. He has published more than 260 papers in book chapters, journals and conference proceedings, and has given keynote and invited lectures at a number of conferences. He has been involved in several landmark and groundbreaking Civil Engineering projects while working in Norway. He is a member of the Editorial Board of five International Journals, and is the recipient of the Geotechnical Research Medal from UK's Institute of Civil Engineers, the Peter A. Cundall Honorable Mention Award, the Applied Rock Mechanics Research Award from the American Rock Mechanics Association, and the Kwanghua Visiting Professorship from Tongji University.

<https://structures.ucsd.edu/seminars>

*Sponsored by Professor John McCartney
For more information on this seminar, contact Amber Samaniego,
at [858-534-4282](tel:858-534-4282) or a2samaniego@ucsd.edu*