



## The Risk of Formation Fracturing from CO<sub>2</sub> Sequestration in Geological Formations

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### Abstract:

In this work we investigate numerically the injection of supercritical carbon dioxide into deep saline reservoirs from a single well. We analyze systematically the sharp-interface evolution in different flow regimes. The flow regimes can be parameterized by two dimensionless numbers, the gravity number,  $\Gamma$  and the mobility ratio,  $\lambda$ . Numerical simulations are performed utilizing the Volume of Fluid (VOF) method and the results are compared with the solutions of the self-similarity equation established in previous works which describes the evolution of the sharp interface. We show that these theoretical solutions are in very good agreement with the results from the numerical simulations presented over the different flow regimes, thereby showing that the theoretical and simulation models predict consistently the spreading and migration of the created CO<sub>2</sub> plume under complex flow behavior in porous media. Furthermore we compare the numerical results with known analytic approximations in order to assess their applicability and accuracy over the investigated parametric space. The present study indicates that the self-similar solutions parameterized by the dimensionless numbers  $\lambda$ ,  $\Gamma$  are significant for examining effectively injection scenarios, as these numbers control the shape of the interface and migration of the CO<sub>2</sub> plume. This finding is essential in assessing the storage capacity of saline aquifers. Furthermore, we extend this work to the pressure analysis in order to perform the integrity analysis (risk of formation fracturing).

### Biography:

Dr Sarris Ernestos completed his undergraduate studies (B.Sc. in Mineral Resources Engineering in 2004) at the Technical University of Crete (GR). He has pursued postgraduate studies (M.Sc. in Environmental Geotechnology) from the same Technical University where he graduated with honours. He has received his Ph.D degree (2011) in the area of Petroleum Geomechanics (hydraulic fracturing) from the University of Cyprus (UCY) on academic scholarships, while during 2011-2014, he continued at Nireas International Water Research Centre (I.W.R.C) as a post-doctoral researcher (computational modelling) and at the Research Unit for Nanostructured Materials Systems (2011-2013) at the Cyprus University of Technology (Modelling Nano-indentation). During his graduate studies and as a post-doctoral researcher he has attracted external funding about one quarter of a million euros from the Cyprus Research Promotion Foundation (RPF) (36-month project YDRATHRAUSI and 30-month project CO2FRAC). He is an active member of: Society of Petroleum Engineers (SPE), American Rock Mechanics Association (ARMA) and at the Scientific and Technical Chamber of Cyprus (TCC). He is also a reviewer in the following scientific journals: International Journal for Numerical and Analytical Methods in Geomechanics, Applied Mathematical Modelling and Simulation Modelling Practice and Theory. His areas of specialization are: **Petroleum Geomechanics:** Petroleum rock mechanics which includes problems in hydraulic fracturing, sanding prediction and control, wellbore stability, multiphase flows with applications in the CO<sub>2</sub> geological storage and enhanced oil recovery EOR. **Applied Mechanics:** Poromechanics with applications; transport phenomena in porous media, fracture mechanics, plasticity theory, nano-indentation, analytical methods utilizing the Muskhelishvili-Kolossov complex potential theory, aquifer recharge in hydrology. **Computational Methods:** Finite elements, finite volumes, singular integral equations.

