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A FEM approach to investigate hydraulic fracturing fluid transport within faulted geological reservoirs

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The continuously increasing global energy demand has directed the oil and gas industry's attention towards hydraulic fracturing (HF) operations that assist in the economic exploitation of unconventional hydrocarbon bearing formations (HCBF) (e.g. "shale gas" and "tight gas", TG resources) (Taherdankoo et al. 2017). However, in recent years, concerning environmental speculations regarding the in-situ, high-pressurized reservoir stimulation practice has surfaced. These claims have led to select nations (e.g. Germany) carrying an interest in the technique's future application to necessitate prior research and investigations to better understand possible HF induced environmental implications (Kissinger 2013). For this particular investigation, two finite-element, 3D models were utilized to simulate a hypothetical field scale HF operation occurring within a pre-existing, overlooked fault zone in the Marcellus shale formation. Each model will individually test a differently developed fracture-fault orientation (e.g. perpendicular, parallel). The aim of the study is to identify and rank key parameters and site geometries (e.g. HCBF permeability, fault width, injection pressure, etc.) based upon their contribution towards inducing the migration of fracturing fluid (FF) from the HCBF (i.e. source), via the more conducive fault zone media, into the above-lying aquifer (i.e. target). Results intend to be collected from a series of parametric sweeps that involve testing a range of individual parameter values and comparing resulting concentration migrations to a base case scenario (i.e. all parameters set to mid-range values). Utilizing this method of analysis, in combination with statistical calculations, a ranking of parameters/site geometries and their influential degree can be formulated. This study's intent is to build upon/contribute to research conducted within the EU Horizon 2020 FracRisk project, an EU funded research project aiming to expand the HF knowledge base for reducing the environmental footprint from hydrocarbon production (www.fracrisk.eu).

FracRisk. 2015. Furthering the Knowledge Base for Reducing the Environmental Footprint of Shale Gas Development (FracRisk). EU Horizon 2020 [Internet]. Available from: http://cordis.europa.eu/project/rcn/193422_en.html

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