EXPERIMENTAL OBSERVATION OF FLUID FLOW IN SINGLE ROUGH FRACTURES USING DIGITAL OPTICAL IMAGING AND PET SCANNING

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We have developed digital optical imaging apparatus to monitor the flow of dyed miscible and non-miscible fluids through high fidelity polymer models (HFPMs) of rough fractures using high resolution (640×480 pixel), 12 bit colour digital cameras, specialized optics and back-lighting. The high fidelity polymer models are cast from moulds of the original fractures and are faithful reproductions of the original fracture to within 1 μm, allowing structures as small as booklets of mica to be reproduced. Images of fluid flow are possible from 5×5 mm up to 300×300 mm, resulting in lateral resolutions as low as 8 μm. A range of flow experiments has been carried out at different flow rates, fluid densities and fluid viscosities for both miscible and immiscible fluids. These experiments allow the interplay between dynamic fluid transport and diffusive transport to be assessed, which is of direct relevance to the management of fractured hydrocarbon reservoirs and water aquifers, where open fractures may by-pass large fluid volumes, and in the assessment of the transport of radionuclides in fractures surrounding repositories for nuclear waste. We have also undertaken positron emission tomography (PET) scanning of fractures to visualize the influence of these features as barriers to fluid flow. The application of image analysis to images obtained from these techniques allows the effect of fractures on volume flow and transport of dissolved contaminants to be assessed quantitatively.

Supporting Information

1. EGS 2000
2. First submission
3. Experimental observation of fluid flow in single rough fractures using digital optical imaging and PET scanning
4. Ogilvie, S.R.; Orribo, J.M.; Glover, P.W.J
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