Japan Geoscience Union Meeting 2014
(28 April - 02 May 2014 at Pacifico YOKOHAMA, Kanagawa, Japan)

HRE31-P01 Room:Poster Time:May 2 16:15-17:30

Use of sodium polytungstate as an X-ray contrast agent to reduce beam hardening in hydrogeological experiments

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Iodine is conventionally used as a contrast agent in hydrogeological experiments using polychromatic X-ray computed tomography (CT) to monitor multi-phase Darcy flow in porous geological media. Undesirable beam hardening artifacts, however, make the quantitative analysis of the obtained CT images difficult. CT imaging of porous sand packs saturated with iodine and tungsten-bearing aqueous solutions, respectively, was performed using a medical CT scanner. The result (Fig. 1) shows that sodium polytungstate ($Na_6H_2W_{12}O_{40}$) significantly reduced the beam hardening compared with potassium iodide (KI). This result is due to the location of the K absorption edge of tungsten, which is nearer to the peak of the polychromatic X-ray source spectrum than that of iodine. As sodium polytungstate is chemically stable and less toxic than other heavy element bearing compounds, we recommend it as a promising contrast agent for hydrogeological CT experiments.

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Keywords: beam hardening, contrast agent, Darcy flow, porous media, multi-phase flow, relative permeability

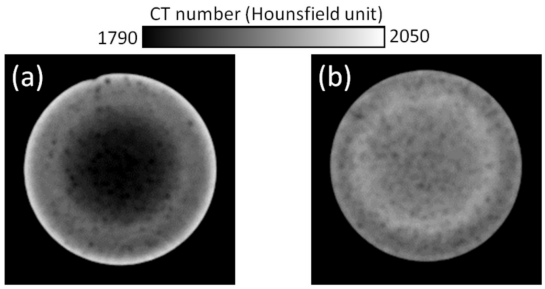

Fig. 1. Two-dimensional CT slices of homogeneous sand pack samples (diameter, 56 mm) saturated with a heavy-element-bearing fluid. Each image dimension is 210^2 voxels = 66^2 mm^2. The image for KI 9.16 wt.% (a) shows marked beam hardening compared with $Na_6H_2W_{12}O_{40}$ 8.80 wt.% (b). Numerous dark spots are small bubbles.

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Gravity monitoring at the Farnsworth CO2-EOR site, TX

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Time-lapse gravity measurements with a combination of absolute and relative observation array will reduce uncertainties caused by regional gravity variations. The technique is called hybrid gravity measurement. By adding continuous measurement with a superconducting gravimeter (SG) to the hybrid system we are applying the super-hybrid gravity monitoring at the Farnsworth unit (FWU) in TX along with SWP. We started baseline measurement in January 2013. Using SG and barometric data at FWU, we obtained average gravity-atmosphere admittances. The observed admittances during storms can be far from the mean admittance. We often observed several outstanding responses to atmospheric pressure changes. Comparing with precipitation, soil moisture and atmospheric pressure the residuals were attributed to hydrologic components and/or local atmosphere admittance. Several circular irrigation systems work at FWU. At each system water is pumped from a nearby well to the center of the system. The process will result in the redistribution of mass which may result in gravity signals. Basically the booms rotate to cover the circular field over an approximately three day cycle during agricultural season, however the exact watering pattern varies from field to field. We have tried to monitor the watering effects.

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Keywords: Fansworth, CO2-EOR, gravity monitoring, superconducting gravimeter