Geophysical Research Abstracts
Vol. 16, EGU2014-3880, 2014
EGU General Assembly 2014

Spatial resolution of gas hydrate and permeability changes from ERT data in LARS simulating the Mallik gas hydrate production test

Mike Priegnitz, Jan Thaler, Erik Spangenberg, Judith M. Schicks, and Sven Abendroth
GFZ German Research Centre for Geosciences, 4.2: Inorganic and Isotope Geochemistry, Potsdam, Germany
(mikep@gfz-potsdam.de)

The German gas hydrate project SUGAR studies innovative methods and approaches to be applied in the production of methane from hydrate-bearing reservoirs. To enable laboratory studies in pilot scale, a large reservoir simulator (LARS) was realized allowing for the formation and dissociation of gas hydrates under simulated in-situ conditions. LARS is equipped with a series of sensors. This includes a cylindrical electrical resistance tomography (ERT) array composed of 25 electrode rings featuring 15 electrodes each. The high-resolution ERT array is used to monitor the spatial distribution of the electrical resistivity during hydrate formation and dissociation experiments over time. As the present phases of poorly conducting sediment, well conducting pore fluid, non-conducting hydrates, and isolating free gas cover a wide range of electrical properties, ERT measurements enable us to monitor the spatial distribution of these phases during the experiments.

In order to investigate the hydrate dissociation and the resulting fluid flow, we simulated a hydrate production test in LARS that was based on the Mallik gas hydrate production test (see abstract Heeschen et al., this volume). At first, a hydrate phase was produced from methane saturated saline water. During the two months of gas hydrate production we measured the electrical properties within the sediment sample every four hours. These data were used to establish a routine estimating both the local degrees of hydrate saturation and the resulting local permeabilities in the sediment's pore space from the measured resistivity data. The final gas hydrate saturation filled 89.5% of the total pore space.

During hydrate dissociation, ERT data do not allow for a quantitative determination of free gas and remaining gas hydrates since both phases are electrically isolating. However, changes are resolved in the spatial distribution of the conducting liquid and the isolating phase with gas being the only mobile isolating phase. Hence, it is possible to detect areas in the sediment sample where free gas is released due to hydrate dissociation and displaces the liquid phase. Combined with measurements and numerical simulation of the total two-phase fluxes from the sediment sample (see abstract Abendroth et al., this volume), the LARS experiments allow for detailed information on the dissociation process during hydrate production.

Here we present the workflow and first results estimating local hydrate saturations and permeabilities during hydrate formation and the movement of liquid and gas phases during hydrate dissociation, respectively.