Meso-Scale Clathrate Experiments: Effect of Grain Size on Formation Pathways. J.R. Leeman[1], M.E. Elwood Madden[1], J.E. Alford[2] ,T.J. Phelps[2], C.J. Rawn[2], [1]School of Geology and Geophysics, University of Oklahoma 100 E Boyd, Norman, OK, melwood@ou.edu [2] Oak Ridge National Laboratory, Oak Ridge, TN

Clathrates, or gas hydrates result from a guest gas molecule populating a cavity in a cage of water molecules. Gas hydrates naturally occur on Earth under low temperature and moderate pressure environments such as seafloor or permafrost sediments. Gas hydrates are a large sink of methane, a major greenhouse gas and a possible energy reserve. A release from these reservoirs has been hypothesized to have had a major role in climate change throughout geologic time as clathrates are sensitive to pressure and temperature. Hydrates can also be used as a storage technology for both transport and sequestration of carbon. To properly utilize hydrates a thorough understanding of formation characteristics/preferences is essential. Gas hydrates are predicted to show a preference of forming in materials with a large grain size. Verification of this model could aid prediction of natural clathrate reservoirs and make methane production from hydrates economically viable. Predicting the location and extent of clathrate reservoirs throughout geologic time will also aid paleo-climate modeling and improve the accuracy of models of modern global change

A mesoscale gas hydrate formation experiment was designed within ORNL's Seafloor Process Simulator (SPS) to determine how sediment grain-size and synthetic mesh planes affect hydrate formation pathways. The 72-liter pressure vessel was fitted with a sediment column which was vertically split with one-half of the cylindrical vessel containing sand of 500 microns and half containing silt of 65 microns. Inside the column a diffuser injected gas into both sediments at equal flow rates and the formation of clathrate was tracked with both 'bulk' pressure/temperature data from the vessel and via approximately 150 sensors embedded in each of four fiber optic planes, which were placed at four levels in the sediment column.

Experiments concluded that clathrate formation is more likely to occur in coarse materials due to the high porosity and high permeability or gas diffusion rates. The data suggest that hydrate formation could be highly concentrated in areas bounded by a silt or clay material. Such confined reservoirs could provide massive hydrate volumes which might be cost effective to extract for energy, or represent a significant volume in relation to global climate modeling. Similarly, confined structures could also provide ideal storage locations for sequestering carbon dioxide.

This work is sponsored by the Office of Fossil Energy under Field Work Proposal FEAB111. Oak Ridge National Laboratory is managed by UT-Battelle LLC, for the U.S. Department of Energy.