Characterization of Petrophysical Properties for CO_2 Sequestration Models in the Mississippian Madison Group, Moxa Arch-La Barge Platform, Southwestern Wyoming

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Petrophysical data for the Mississipian Madison Group in southwestern Wyoming was compiled and evaluated to relate petrophysical properties to stratigraphic facies in the Madison Group. The study was performed to help develop accurate storage estimates and provide baseline data for the geologic model required for carbon sequestration. Public-domain geological and petrophysical data from core analyses, wire-line logs and core from wells that penetrate the Madison Group were used to place the wells within the regional structural and sequence stratigraphic framework, and detail porosity-permeability relationships. The use of log-based porosity calibrated against core-based porosity greatly extended petrophysical characterization. Log-based porosity allowed regional-scale observation of trends in petrophysical properties.

Based on statistical analysis, we characterize the Madison as having three petrophysical facies. The first facies is characterized by low porosity (<4%) with a highly variable permeability to porosity relationship. Preliminary data indicate the low porosity carbonate facies' highly variable permeability is related to micro-fracturing. Examination of core with accompanying petrophysical data showed that the lower porosities are mostly present in micritic to wackestone facies, and also thinly-bedded packstones and grainstones. The second petrophysical facies has intermediate porosity (4-12%) with a variable-to-log permeability to porosity relationship. The third petrophysical facies has higher porosity (>12%) with a log permeability to porosity relationship. The higher porosities are present in packstone- to grainstone-dominated facies. The best porosity in the study area is present in the lower portion of the formation in dolomitic packstone-to-grainstone dominated facies near the top of the trangressive systems tract, with high porosity zones extending over 10's of kilometers. In terms of porosity, all of these petrophysical facies can be related to depositional facies as a first-order control.