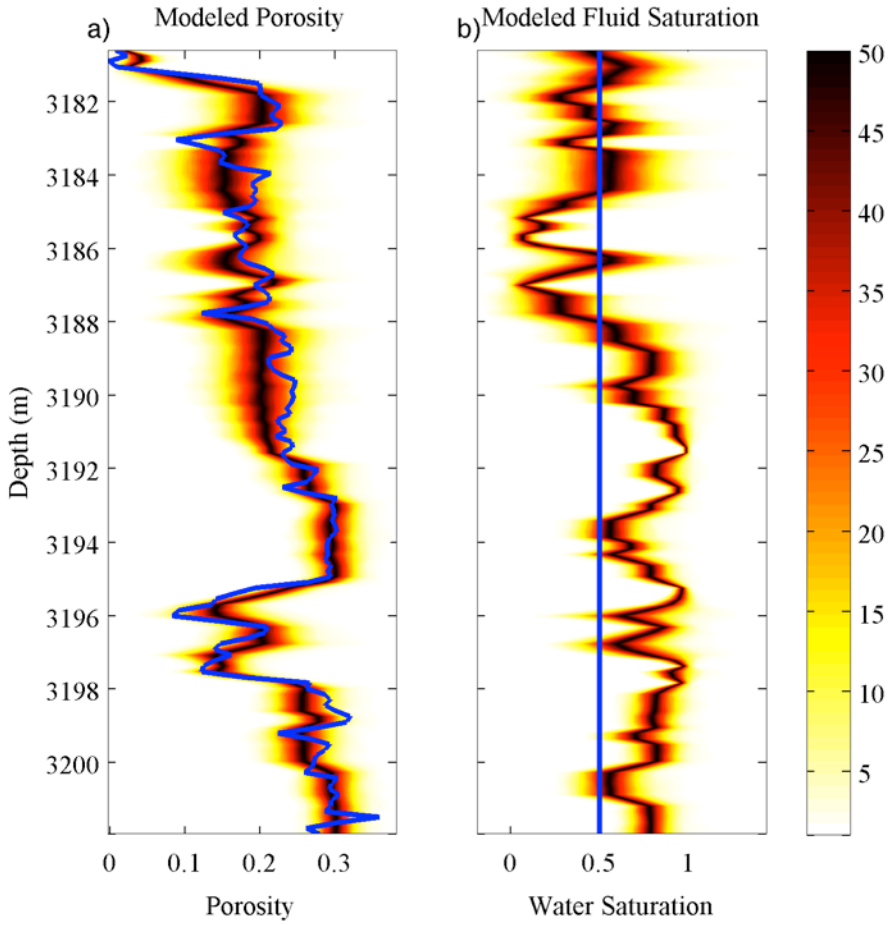
MODELING FLUID COMPOSITION IN CO_2 SATURATED SANDSTONE USING STATISTICAL ROCK PHYSICS, CRANFIELD FIELD, CRANFIELD, MS

Russell W. Carter

Department of Geological Sciences
The University of Texas at Austin

ABSTRACT

Analysis of the effects of injected CO_2 on the seismic response of reservoirs is important because it can provide improved characterization and monitoring of sites undergoing CO_2 injection. In this study we completed a joint inversion of the contact cement model to better understand the effect of CO_2 saturation on the relationship between elastic parameters and reservoir properties of the Cranfield reservoir. We used p-impedance and the Vp/Vs of well logs to invert the rock physics model for porosity and then jointly for porosity and fluid composition. We calibrated a rock physics model to well data from the Cranfield reservoir interval. For the contact cement model to bound the data and correctly model porosity at the Cranfield reservoir, a p-wave coefficient of 1.1 was needed. This term is analogous to a pressure coefficient and simulates increased velocity associated with overburden pressure. We then performed fluid substitution to model density and velocity logs for different in situ CO_2 saturations. The logs, calculated to have a uniform pore fluid composition for all depth points, were input into the inverted model to generate modeled logs of CO_2 saturation and porosity. Results indicated that the model was relatively accurate when inverted for just porosity. Joint inversion for porosity and pore fluid composition predicted porosity successfully but was not able to give as accurate a prediction of fluid composition. Porosity and fluid saturation are linked through the influence of Vp on both Ip and Vp/Vs therefore some parallel trending may arise from the joint inversion.



Results of the joint inversion for porosity and water saturation are shown in panels a) and b) respectively. The blue line shown in both panels shows the porosity and pore fluid composition for the input data in panels a) and b), respectively. The colored region in each panel represents the probability of a given porosity or saturation value being generated for a given depth point. Input CO_2 in the model has been set to a constant 50% with the remainder of the pore fluid being brine. Because of the influence of Vp on both Ip and Vp/Vs there is some parallel trending in the porosity and water saturation logs. This is most apparent at 3916 and 3187 meters in depth.