

UNCONVENTIONAL RESERVOIR CHARACTERIZATION BY SEISMIC INVERSION AND MACHINE LEARNING OF THE BAKKEN FORMATION

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ABSTRACT

The research reported in this work focuses on characterizing the unconventional reservoir of the Bakken Formation, specifically within northwest North Dakota using 3D seismic and well log data. Prediction of reservoir parameters and their uncertainties are analyzed within a quantitative and seismic interpretation problem, where a workflow is described for estimation of total porosity and Total Organic Carbon (TOC) by using the results from pre-stack seismic inversion. Seismic inversion, when integrated with well log data, can be used to predict these petrophysical properties by first establishing a relationship between the two, and then predicting petrophysical values away from the well log data. The prediction problem is confronted by employing a Bayesian Neural Network (BNN) model that utilizes Markov Chain Monte Carlo (MCMC) via Langevin Dynamics in order to sample from the probability distribution and to estimate uncertainty. This method establishes a good correlation between estimated P-impedance from seismic inversion and total porosity from well data. This procedure will ultimately allow for the prediction of total porosity and TOC away from the well log location over an inverted 3D volume, aiding in the assessment of the risk associated in drilling an unsuccessful oil producing well. Thus, by integrating these techniques, a better understanding of the parameters useful for reservoir characterization is possible given a degree of uncertainty, thereby improving oil and gas exploration and risk assessment.

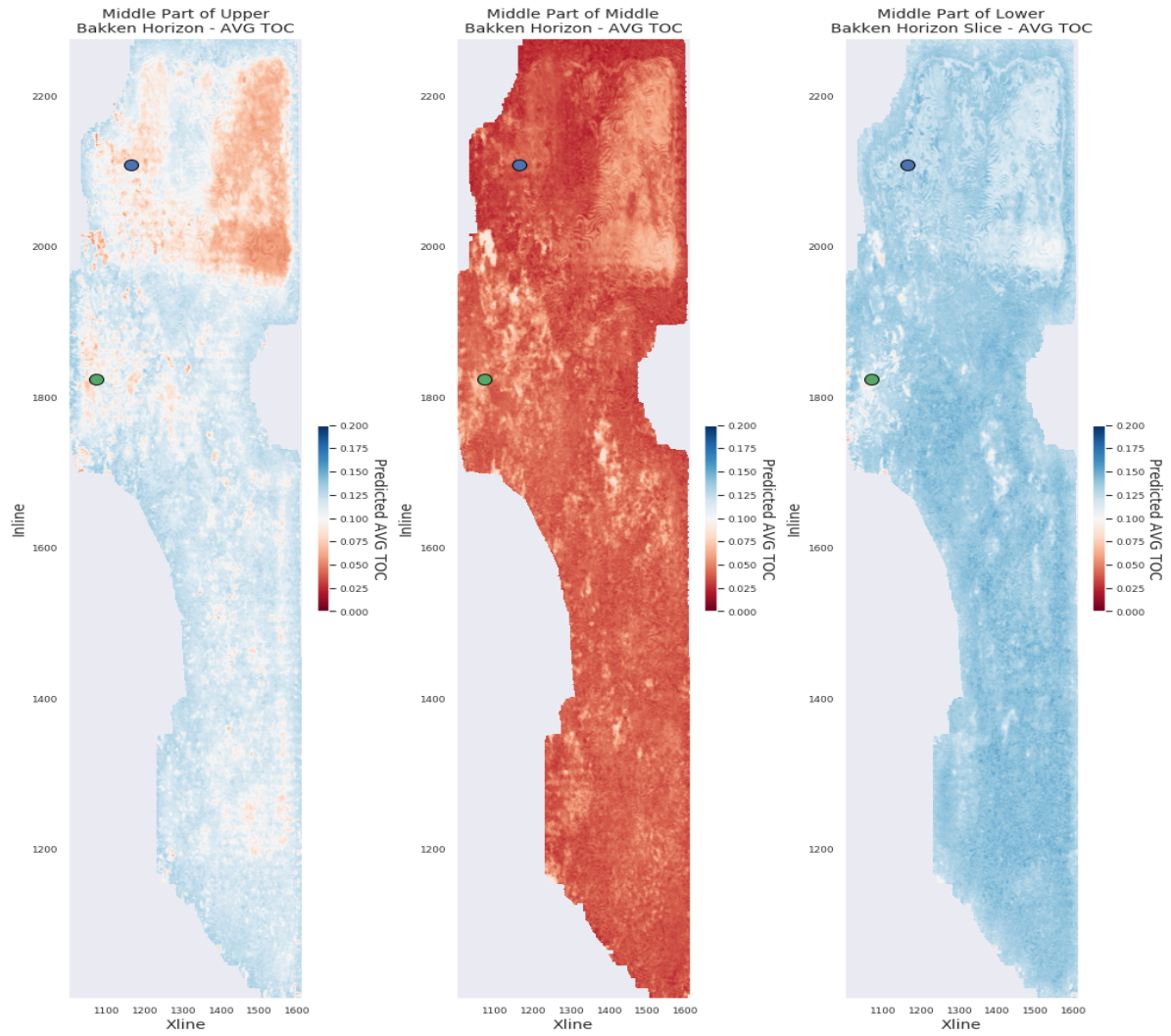


FIGURE: Predicted mean TOC horizon slices for the three estimated horizons. Blue indicates higher values whereas red indicates lower values of predicted mean TOC. Note that the blue dot represents the Lucy well log location and the green dot represents the Edwards well log location.