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Exploiting Pseudo Wells in a Synthetic Sedimentary Basin: a simulation in the Santos Off-Shore Basin in the Southeast Atlantic portion of Brazil, using synthetic TOC for k-means classification.

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Shales are important rocks that store a significant amount of Organic Content. In this work, we present applications of realistic synthetic simulations using real-scaled geological sections. The case of the study is Santos Sedimentary Basin, a well-known and well-studied Geologic Basin. This synthetic data improves the performance of our IA for TOC estimators. Besides, it reduces costs and resources concerning data acquisition for IA simulations. The work consists of reconstructing a pseudo-well formed in a fracture zone modelled through an accurate 2D geological section. To simulate the effects of a fracture zone on geophysical logging data, we present the law of mixtures based on well-drilling concepts, whose objective is to impose geometric conditions on the set of subsurface rock packages. We generated four rock packs belonging to two mixed classes. Tests with noisy synthetic data produced by an accurate geological section were developed and classified using the proposed method (Carreira et al., 2024). Firstly, we go for a more controlled problem and simulate well-log data directly from an interpreted geologic cross-section. We then define two specific training data sets composed of density (RHOB), sonic (DT), spontaneous potential (SP) and gamma-ray (GR) logs, and Total Organic Carbon (TOC), spontaneous potential (SP), density (RHOB) and photoelectric effect (PE) all simulated through a Gaussian distribution function per lithology. Acquiring the sonic profile is essential not only for estimating the porosity of the rocks but also for in-depth simulations of the Total Organic Content (TOC) with the geological units cut by the synthetic wells. Since most wells Exploitation does not have this profile well and it is not economically viable to make a new acquisition, resorting to the nonlinear regression models to estimate the sonic profile showed that it is an important feature. We estimate the observed Total Organic Carbon (TOC) measurements using Passey and Wang's (2016) methodology to input data into the k-means classification model. The synthetic model proposed showed promissory results indicating that linear dependency may underscore k-means shale classification.