Characterization of Sub-Log Scale Variability in Mudstones and the Effects of Variable Sampling Scales on High Resolution Models; Examples from Bone Spring Formation, West Texas

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The oil and gas industry faces the challenge of adapting many of its workflows for applicability in unconventional plays, which account for much of the current exploration activity. The high frequency of lithological variability observed in most unconventional reservoirs yields the need to characterize the small scale lithological changes. Most mudrock successions are heterogeneous and exhibit facies changes on the scale of inches, which is particularly problematic when most down-hole logging tools have a sampling resolution of 1.5 to 2 feet. Down-hole log data serve as the basis for many petrophysical and geomechanical models as inputs to various completion and reservoir simulations. With this understanding, collecting high resolution data sets (core) to calibrated low resolution data (field logs) has become a viable approach for better optimization techniques. The use of sub log-scale analytical techniques will be examined, specifically, geochemical/mineralogical and Unconfined Compression rock Strength (UCS) testing on three cores from the lower Bone Spring formation of the southern Delaware Basin, West Texas. The effects of sampling scale on volumetric calculations, lithofacies and wellbore stability will be explored to exemplify the contrasting results when samples are not taken at an appropriate resolution. Once relationships are established between geochemical signatures (XRF, XRD, UCS and TOC) and down-hole logs within one well, calibrated well logs can be developed from the high tier data well and extended to nearby offset wells to model any new area of interest. These relationships can be used to infer rock properties from nearby wells where geochemical data from core and petrophysical logs may not exist. Examples of how these relationships can be extrapolated between wells will be demonstrated for the three Bone Spring cores and for nearby wells using cuttings data. Preliminary results show good correlation between the high resolution geochemical data and sonic log as well as between the UCS calculated from rock hardness testing and sonic.