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Mineralogical and Geochemical Characterization of the Santos Shale, San Joaquin Basin, California

Nicholas Mitchell[1] and Junhua Guo[1]

[1]California State University, Bakersfield

ABSTRACT

The Santos shale is an underdeveloped and understudied formation that had very limited oil and gas development. However, with modern technical applications it could prove to be economical. This study aims to better understand its mineralogical and geochemical characteristics by utilizing 40 samples from 5 different wells with ranging depths from 1061 to 14,970 ft. Analyses conducted include X-Ray Diffraction (XRD), X-Ray Fluorescence (XRF), Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) and Loss-On-Ignition (LOI). Depositional conditions were constrained by geochemical indices such as detrital influx proxies, redox-sensitive element evaluation and paleoproductivity. XRD semi-quantitative analyses results indicate that the average bulk composition of the Santos shale is composed of 77.5 wt-% quartz, 13.4 wt-% clays and 9.1 wt-% carbonate with TOC of 7.7 wt-%. The high quartz and TOC values are likely the main contributors to the highly fractured nature of the Santos noted in conventional and sidewall cores. Relationships between iron, TOC and total sulfur suggest the Santos was deposited in an oxic environment with a well circulated ocean. Diagenetic effects can be seen at different burial depths. The shallow burial depths are dominated by sulfate reduction. The intermediate burial depths are characterized by smectite to illite transformation and the deep burial depths by late stage compaction. The implications of this study will help evaluate the Santos shale as a potential source rock or as a fractured shale reservoir.