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Litho Facies And Semi-Quantitative Analysis By X-Ray Diffraction/Scanning Electron Microscopy For Evaluating The Impact Of Mineralogy On Reservoir Quality Of Organic Shale In Cambay Basin

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ABSTRACT

This work presents findings of sedimentological studies on a total of twenty seven cored sections from six wells: Gandhar#GAG, Wadu#EF, Mahelaj#AE, Linch#ACB, Kalol#GAB and S. Kadi#AFC. The main objective of this study is sedimentological analysis of various members/horizons of the Cambay shale section encountered in the wells being drilled for delineation of the shale Gas/oil reservoirs in the study area to facilitate fracture stimulation jobs and for future regional correlation. The detrital assemblages in the studied Cambay Shale samples, as determined from thin section and qualitative X-Ray Diffraction analyses comprise quartz, feldspar (plagioclase and K-feldspar), clay minerals (kaolinite and illite), dolomite and organic matter. No biogenic silica (either in form of radiolarian tests or sponge spicules) was observed. Quartz cement is seen as patches of microcrystalline quartz (crystal size up to 10 µm), commonly occurring as scattered patches of euhedral crystals. Possible sources for quartz authigenesis include: (i) dissolution of unstable framework grains and (ii) mass transfer of silicon ions into the pore water from the interbedded fine-grained sediments. Petrographic including microscopic as well as Scanning Electron Microscopic studies reveal presence of euhedral crystals and overgrowths of kaolinite, chlorite and silica. A few primary intra granular pores associated with the body cavities of fossils such as foraminifera are present. However, most fossil-related, primary intra particle pores are filled with clays, silica, and/or pyrite cement. Clay minerals form a dominant part of the finer grained detrital component, with a mix of illite/smectite, chloritic and kaolinitic clays, apparent from qualitative X-Ray Diffraction analysis. The occurrence of nano pores is typically associated with detrital grains, disseminated organic matter, and authigenic euhedral quartz and pyrite crystals, whereas the secondary porosity exists in the form of micro fractures. These micro fractures are a common feature in all studied wells which are found mostly in association with sideritic shales. When compared to the wells Gandhar#GAG and S.Kadi#AFC, the samples from wells Wadu#EF, Linch#ACB, Mahelaj#AE and Kalol#GAB show poor silica content with higher amount of clay minerals, which are dominantly ferruginised in nature. The wells Gandhar#GAG and S.Kadi#AFC show high silica content, evident in photomicrographs, Scanning Electron Microscopic images and X-Ray Diffraction data. It has been widely accepted that the mineralogy and texture can be a critical component in the resource potential of shales. Rocks with high silica (quartz) and or sideritic nature along with low clay content make them more brittle, more prone to natural fractures and are good candidate for fracture stimulation.