CHARACTERIZATION OF PETROGRAPHIC AND PETROPHYSICAL PROPERTIES FROM 3D DIGITAL ROCK IMAGES: A CASE STUDY ON BEACH-BAR SANDSTONE OF BOXING SAG, EAST CHINA

Muhammad Aleem Zahid[1,2,*], Muhammad Jawad Munawar[2], Dong Chunmei[2], Alexandra N. Golab[3] and Chengyan Lin[2]

[1]Faculty of Marine Sciences, Lasbela University of Agriculture, Water and Marine Science, 90250, Pakistan
[2]School of Geosciences, China University of Petroleum, Qingdao, 266580, China,
[3]FEI Australia Pty Ltd, Suite 102, Level 1, 73 Northbourne Avenue Canberra, 2600, Australia
mazahid.ms@luawms.edu.pk

Abstract

To identify and elucidate pore types, connectivity and distribution in a texturally low maturity, thin bedded, medium to low permeability silt to sand sized clastic reservoir, precise and fine mapping of minerals, pores and microporous phases with 3D X-ray micro-computed tomography (3D μ-CT), 2D back-scattered scanning electron microscope (BSEM) imagery and 2D quantified, automated SEM-EDS mineral analysis (QEMSCAN) can play a significant role in reservoir characterization. In this paper, an integrated core to pore scale approach is adopted to compute macro scale petrophysical rock parameters such as porosity, permeability, formation factor, and pore throat size and distribution directly from 3D digitized rock images. A sub-plug of sandstone was imaged in 3D μ-CT in dry and saturated states. A quantified, 3D pore space map, including microporosity, was created by registering into perfect geometric alignment the two tomograms. Quantified, 3D mineralogical mapping along with association of pore and grain structure was performed by registering the high-resolution BSEM image and quantified 2D mineral map with the 3D μ-CT images. The association was characterized by the matching of microporosity to the mineralogical information. Interconnectivity of primary and secondary porosity and nature of secondary porosity was also determined and quantified. Computational results of porosity and permeability from digital rock show good agreement with laboratory core measurements. Results show that the computed properties from this technique are reliable and can be used for reservoir quality assessment and field development programs. Imaging and visualization of core material with 3D μ-CT at the pore scale and subsequent analyses give significant insights into properties of low permeability reservoir core material and further developments will make this technique more common and easy to use.

Keywords: 3D μ-CT; BSEM; QEMSCAN; Porosity; Permeability; Digital rock images