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Microstructural controls on reservoir quality in tight oil carbonate reservoir rocks

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#### 10 Abstract

In carbonate reservoir rocks the complex interaction between the petrophysical 11 properties corresponds to the various depositional microstructures which are modified 12 by various diagenetic processes that ultimately define the reservoir guality, and pose 13 challenges to the prediction of permeability. The permeability heterogeneity in the 14 15 carbonate oil reservoirs of northern Iraq varies widely and is thought to be controlled by a number of different factors. In this work, controls of matrix permeability for the 16 Cretaceous Kometan formation selected from five oil fields in Kirkuk embayment zone 17 have been investigated. Helium porosity, helium pulse decay permeability, brine 18 permeability, Nuclear Magnetic Resonance (NMR), Mercury Injection Capillary pressure 19 (MICP), Scanning Electronic Microscopy (SEM), X-Ray diffraction (XRD), and 20 photomicrography of thin section have been used to investigate the effect of 21 microstructure on the variation of permeability in the Kometan Formation. The formation 22 has porosities and permeabilities which range from 0.5±0.5% to 29±0.5% and from 23 0.65±0.08 µD to 700±0.08 µD respectively. Three types of pore systems have been 24 investigated using pore type, pore size and pore-throat size as characterizing 25 parameters. We have recognized three microstructural types: (i) matrix composed of 26 nano-intercrystalline pores (pore diameter  $d_p$  smaller than 1 µm and a nanoporous pore-27 throat size), (ii) matrix composed of micro-intercrystalline pores  $(1 < d_p < 10 \ \mu m$  with a 28 corresponding micron-scale pore-throat distribution), and (iii) meso-intragranular and 29 moldic pores ( $d_p$ >10 µm) also with microporous pore-throat radii. The nano-30 intercrystalline pore system is common across northern Iraq and represents the 31 effective pore system type in the reservoirs of the Kirkuk embayment zone. For these 32

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