[PS]Morphological and Topological Characterization of Coquinas' Porous System through X-ray Computed Tomography and its Correlation with Depositional Cycles*

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Abstract

Petrography and X-ray micro-CT analyses were integrated to determine the main depositional and diagenetic textural characteristics related to reservoir quality of coquinas of Itapema Formation (Cretaceous), Santos Basin, offshore Brazil. Petrography, porosity, permeability, and X-ray micro-CT analyses were performed on 44 plugs taken from the 19 m (62.3 ft) core. In this interval 21 depositional cycles were identified, each one with a thickness varying from 0.5 to 1.0 m (1.6 to 3.3 ft). The coquinas' samples were classified as skeletal rudstones composed mainly of bivalve fragments, but also containing peloids, oncolites, and intraclasts (lacking carbonate mud). Diagenesis shows strong correlation to primary texture, since cementation and dissolution effectiveness depends on grain size and sorting (which control primary pore size), and composition (dissolution is intense in shells, but very weak or absent in peloids, oncoids, and intraclasts), and consequently it shows correlation with depositional cycles. Five pore types were identified in the plugs: interparticle, moldic, vug, breccia, and fracture. Interparticle porosity was significantly reduced by calcite fringe cement. Moldic porosity was created by partial to total dissolution of bivalve shells. Vuggy porosity occurs close to fractures, locally enhancing porosity and permeability. Discontinuous microfractures occur with different intensities, enhancing pore connection. A peculiar brecciation, resulting from calcite fringe cement collapse, greatly increases permeability values. Pore system heterogeneity, morphology, and connectivity were characterized through X-ray micro-CT analyses. Pore elongation measurements showed correlation with pore types. Dissolution of bivalve shells resulted in elongated moldic pores, whereas interparticle and breccia pores are more equidimensional. The prevalence of one pore type over another produced distinct porosity vs. elongation curve shapes. Pore connectivity was evaluated through a method in which spheres are virtually placed inside the pores, starting with larger spheres and then gradually changing to smaller ones. When spheres approach pore-throat sizes, two or more pores become one bigger pore. In samples with relatively large pore-throats, pores are easily connected when spheres are reduced. In this case pore size distribution changes significantly, which indicates a well-connected pore system.