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Reservoir Quality of the Carbonate Outcrop of the Permo-Triassic Upper part of Khartam Member of the Khuff Formation, North Central Saudi Arabia

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This study examines the quality of the carbonate reservoir of the Permo-Triassic Upper part of Khartam Member of the Khuff Formation, North of Unayzah City, Qasim region, northcentral Saudi Arabia. This study aimed to examine the porosity in different scales starting by the microscale of the thin-section focusing on identifying the geometrical characteristics (aspect ratio and roundness factor), then relate these distinctive geometries to the pore type, depositional texture and post depositional alterations. In addition, to measure the porosity and permeability on the core plug scale. Finally, to link the identified porosity from the thin section and core plugs with their depositional texture and their reservoir quality index (RQI) in order to identify the reservoir quality variations from thin section scale to the outcrop scale. Typical thin section petrography methods were utilized to recognize porosity types, diagenetic alterations and the depositional texture of studied samples. JMicroVision software was used to extract the geometrical characteristics of the identified porosity (pore sizes, aspect ratio, roundness factor). Scanning Electron Microscope (SEM-EDX) used to examine the presence of microporosity in selected samples. Water saturation measurements (poroiometer and permeameter) of total porosity and permeability was conducted on core plugs samples extracted from the vertical sections of the studied outcrop. The field study revealed that the outcrop strata is primarily composed of graded mudstone to packstone facies, cross bedded oolitic skeletal grainstone facies and well sorted oolitic grainstone facies. Geometrically, moldic porosity appeared in two different shapes identified in this study by oomoldic and skelmoldic porosities. In addition, vuggy porosity showed two distinctive shapes named vuggy-1 and vuggy-2 porosities. Calculation based on the data extracted from JMicroVision software was made to rank the porosity type based on the pore sizes into eight quality rankings. The highest pore size on average were Oomoldic and vuggy-1 in which they were ranked at the top quality pores, whereas, intracrystalline and intragranular porosities were ranked at the least quality pores that mainly associated with dolomite cemented layers and in the graded mudstone to packstone facies. Incorporation the Reservoir Quality Index (RQI) calculations with porosity and permeability of the core plugs results and outcrop lithofacies revealed a better understanding of the distribution of the reservoir quality in the outcrop and their lithological and diagentical factors laterally and vertically.