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Please fill in your abstract title.	New Pore System Index in Order to Understand the Heterogeneity of Carbonate Rocks, from a Mono-Mineral Case Study

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Abstract

The P wave velocity-porosity relationship of core-plug samples from a mono-mineral case study, shows an inverse proportional relationship in first-order trend, however, with a scattering of 2000 m/s at a given porosity. The large scatter of data seems not be explained by mineralogy since most samples contain nearly 100% of calcite and only minor amounts of other minerals. In order to understand the large scattering of P wave velocity-porosity trend, firstly some factor have been studied a) depositional environments; b) dominant pore types; c) depositional textures. The study focuses on 4 cored wells and 488 plugs from a Cretaceous (Cenomanian to Early Turonian) carbonate ramp in the Middle East. The crossplots show that the three factors have no major impact on velocity-porosity scattering. The pore diversity index (PDI) is newly proposed technique here, which presents the polymorphism of the pore systems. This technique permits to consider multi pore type as an index. Following pore-throat aperture studies four classes of pore diversity index, named PDI 1 to 4, have been classified for the diversity of pore throat radii : PDI1 as cemented, PDI 2 as unimodal, PDI3 as bi-modal, and PDI4 as polymodal (more than 2). The PDI2 class represents only microporosity. The PDI3 represents 2-pore type mode as mainly moldic pores and micropores. The PDI4 represents more than 3 pore types with the presence of molds, vugs, micropores and/or intergranular pores. For all depositional environments, except for the inner platform one (named E), PDI4 shows a higher porosity with the lowest velocity while cemented samples. In contrast, PDI1 is associated with the lowest porosity and the highest velocity. PDI3 is located at intermediary of porosity and velocity ranges overlapped by PDI2 for the highest velocity values. A contingency table, shows the repartition of PDI by depositional environments. It is obvious that PDI2 is assigned with more 85% to the inner depositional environment (E) with dominant micropores. The shallowest environment (named A) mainly consists of PDI 1 with close to 82%, and it corresponds to cemented facies with pyrite. The inter-biostrome depositional environment (named B) has more 70% of PDI 3 and PDI4. Only shoal fringe depositional environment (named C) consists of PDI 2-3-4 with an equivalent proportion. In all depositional environments, the pore diversity index plays a good discrimination for velocity porosity relationship. However, in depositional environment E, samples cover the entire velocity-porosity space with a large scattering, probably due to a multiple diagenetic stages and the intensity of microporosity. Several diagenetic stages could have been responsible for moldic macropores and vugs as 1) early dissolution of aragonite, and 2) a late stage of dissolution in grainstones and rudist floatstones. According to the matrix correlation, the P-wave velocity displays a good association with PDI. The matrix correlation analysis confirms the strong anti-correlation between the velocity (Vp) and porosity (r^2=-0.75). The presence of diversity of pore throat, mainly for rudist and shoal depositional environments (BC), decreases the P-wave velocity values and increases the porosity values.