

# Impact of Pore Types and Mineralogical Composition on Seismic Wave Velocity of Khuff Carbonates, Central Saudi Arabia

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## Abstract

The understanding of the impact of various geological factors on seismic wave velocities is crucial for hydrocarbon exploration and development in carbonate reservoirs. The Khuff Formation carbonates contain the largest non-associated gas reservoir in the world. This study aims to investigate the impact of pore types and mineralogical composition on the P-wave velocity using samples of the Khuff Formation from Central Saudi Arabia. Ninety samples from the Upper Khartam Member of Khuff Formation were used to investigate the relationship between the P-wave velocity and sedimentological and petrophysical characteristics, including porosity, permeability, pore type, and mineralogical composition. Thin-sections were described for lithological and diagenetic variations, and XRD, and SEM analysis were conducted as well as porosity and permeability measurement of plugs. P-wave velocities were measured at room pressure and ambient (air dry) saturation. The samples showed that the porosity is a main influencing factor on the P-wave velocity; P-wave velocity decreases with increasing porosity. Our analysis showed that the permeability and velocity are not a function of the total porosity only, but are also influenced by the dominant pore types. At the same porosity values, samples dominated by moldic, vuggy and intra-frame pores have a higher velocity than samples characterized by other types of pores such as intercrystalline, interparticle pores and microporosity. Dolomite and quartz content had no significant impact on P-wave velocity. The results of this study may enhance our understanding of the seismic wave propagation through the Khuff

Formation, which is considered as a strong seismic reflector in the subsurface.

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