EVALUATING PETROPHYSICAL PROPERTIES OF VOLCANO-SEDIMENTARY SEQUENCES: A CASE STUDY IN THE PARANÁ-ETENDEKA LARGE IGNEOUS PROVINCE

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ABSTRACT: The Paraná-Etendeka represents a major magmatic province associated with the rifting of West Gondwana and the formation of the South Atlantic Ocean. The area represents a direct analogue for similar aged volcanic rocks buried within hydrocarbon rich basins offshore the South Atlantic margin. We present here a detailed integration of outcrop data with laboratory measurements of porosity, permeability, and ultrasonic acoustic velocities (P- and S-waves) for volcanic and interbedded sedimentary rocks of the Paraná-Etendeka Province in southern Brazil. The lava pile is formed of compound pahoehoe basaltic lavas at the base (Torres Formation) followed by thick tabular rubbly pahoehoe basaltic andesites (Vale do Sol Formation) and the upper stratigraphy is characterized by local fed and extensive tabular dacitic/rhyolitic units. Sedimentary interbeds occur along with the entire lava pile. For the volcanic rocks petrophysical properties have a cyclic variation controlled by the lava internal structure. Lava upper and lower crust have relatively high porosity (> 10%) and low acoustic velocities, whilst lava flow core is characterized by porosities of less than 5% and velocities typically 0.5-1.0 kms^{-1} higher. The highest porosities are found in the upper crust of both rubbly pahoehoe (c. 28.3%) and pahoehoe lavas (c. 26.6%) where vesicles account for most of the pore space. Permeability is relatively low in the volcanic facies (< 1 mD), and this fact is associated with pore infilling during hydrothermal alteration. Sedimentary interbeds preserve relatively high porosity (>15%) and permeability (avg. 450 mD) and represent the best reservoir rocks in the Paraná-Etendeka Province. Nevertheless, where diagenesis is intense porosity and permeability are significantly diminished. The petrophysical properties of volcanic rocks is controlled primarily by lava emplacement mechanisms (e.g. degassing and flow fragmentation), and secondarily by bulk mineral composition. Petrophysical properties can be further modified by diagenetic and/or hydrothermal alteration processes. Understanding the interplay between primary and secondary processes on the final petrophysical characteristics of the rocks is key on defining reservoir properties in offshore areas, such as the North and South Atlantic margins, where volcanic rocks are intrinsically associated with prolific hydrocarbon bearing sedimentary basins.

KEYWORDS: *VOLCANIC RESERVOIRS; LAVA FLOW RESERVOIR; BASALT POROSITY; ROCK PHYSICS; ACOUSTIC VELOCITY*