Petrophysical characteristics of the volcanic succession at IODP Site U1513: Implications for stratigraphy and alteration

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International Ocean Discovery Program (IODP) Expedition 369 recovered the volcanic rocks at Site U1513 on the eastern flank of the Naturaliste Plateau, offshore southwest Australia. The volcanic succession (Lithostratigraphic Unit VI) is defined as the syn-rift volcanic rocks emplaced during the Valanginian breakup between Greater India and Australia-Antarctica. Based on a total cored thickness of 82.2 m, it is subdivided into nine lithologic units: Units 1, 3, 5, 7 and 9 are classified as basaltic flows, and Units 2, 4, 6 and 8 as volcaniclastic flows. Dolerite dikes and hydrothermal veins intruded the whole volcanic succession. During the expedition, the excellent correlation between physical properties and the lithologic units in Hole U1513D was used as a guide to correlate the lithologic boundaries in Hole U1513E. We define that the variation in the petrophysical datasets correspond to the lithologic boundaries and mineralogical composition of/within the units in Holes U1513D and U1513E. We present the physical properties, lithologic descriptions as well as XRF data, acquired during and after the expedition, and demonstrate the good correspondence between lithologic/mineralogical and petrophysical characteristics. In both holes, the top of the volcanic succession is characterized by sharp increases in bulk density and *P*-wave velocity and a drop in Natural Gamma Ray (NGR) values. Within the succession, intervals of low bulk density, low *P*-wave velocity and high porosity, with coinciding spikes in NGR, define the volcaniclastic units, and correspond well to highly altered basalts. The increase of alteration degree in basaltic units contributes to a decrease in bulk density, *P*-wave velocity and an increase in porosity, NGR values. Comparatively high bulk density, high *P*-wave velocity and low porosity are associated with dikes. Magnetic susceptibility in the succession is high, and varies downhole with occasional sharp increases that are attributed to alteration by iron-bearing minerals and paramagnetic clay minerals. Our results show that systematic acquisition and assessment of physical properties in the volcanic succession can be used to discriminate lithologic boundaries, mineralogical composition, and alteration type and degree. Such correlation can be a useful tool for drilling and core description strategies in future ocean drilling expeditions.

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