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Effect of the mineralogical composition on the petrophysical behavior of the amygdaloidal and vesicular basalt of Wadi Wizr, Eastern Desert, Egypt

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Abstract

This paper gives an account of the petrophysical characteristics and the petrographical descriptions of Tertiary vesicular and amygdaloidal olivine basalt flows from Wadi Wizr in the central Eastern Desert of Egypt. The petrographical studies indicated that the studied vesicular basalts are rich in calcic-plagioclase, augite and olivine in addition to numerous amounts of fine opaque minerals and vesicles filled with carbonate and quartz amygdales. The degree of oxidation and alteration of magnetite and ilmenite are discussed in detail. Petrophysically, the studied samples can be grouped into two main groups; the first group includes amygdaloidal basalts and the second group consists of vesicular basalts. The vesicular group (the permeable one) is characterized by fair to very good porosity (∅), good permeability (k), very low true formation resistivity factor (F) and contain micro to ultra micropores. On the other hand, the amygdaloidal basalt group (impermeable group) is characterized by very low storage capacity properties, fair porosity, negligible permeability, medium to high true formation resistivity factor and ultra micropores. The mercury injection capillary pressure technique (MICP) indicates that the pore throats of the studied vesicular samples have a binomial distribution (rank IV), while that of the amygdaloidal samples have a trinomial distribution (rank V). It has been found in this study that the petrophysical behavior of basalts is dependent on the degree of oxidation and alteration; and in particular on the rate of cooling and oxidation of the opaque minerals which caused filling in the primarily produced vesicles by low temperature secondary minerals.

Keywords: Vesicular, amygdaloidal, basalt, petrophysics, Eastern Desert, Egypt

1. Introduction

The naturally fractured basement and vesicular volcanic rocks have been known for many decades as reservoirs and aquifers, but mostly ranked as non-productive/non-economic. Although the fractures seem to form a limited volume of the