

Textures, Mineralogy, and Reservoir Properties of an Altered Mafic Tuff Core from the Upper Cretaceous (Lower Campanian) of Central Texas

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Abstract

The Upper Cretaceous Balcones Igneous Province of Central and South Texas includes volcanic deposits (mounds) of tuffaceous rocks, and, where shallowly buried, these tuff mounds have high porosities, so some mounds have proven to be oil reservoirs. In this study, a core from the Ballard #2–C well, Dale Field, Caldwell County, Texas, has been investigated for fabric, texture, mineralogy, porosity, and permeability. Extensive alteration has not erased much of the original igneous texture and fabric, but volcanic glass and phenocrysts have been largely altered, primarily to interlayered smectite/vermiculite. Extensive cementation by a variety of minerals has also reduced porosity. Mean porosity of the samples measured is 28.8%. Pores are present predominantly in four locations: between lapilli (interparticle), in partly replaced dissolved phenocrysts (intraparticle), in partly cemented vesicles (intraparticle), and between phyllosilicates replacing volcanic glass (intraparticle). Pore sizes extend from nanometers to millimeters in diameter. Measured permeabilities range from <1 md to 6 md, although the values may be high because of postcoring microfractures in sample plugs. The core has few natural macrofractures and little fracture porosity. Mercury-injection capillary-pressure tests show that most pore throats are <250 nm in diameter, forming a nano- to micropore system. Nuclear magnetic resonance scans also show a predominance of nanometer-scale pores. Given observed properties, the tuff studied should have high storage capabilities (i.e., pore volume) but low permeability.

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