Pore Systems and SEM Lithologies for the Permian Wolfcamp Shale From the Delaware Basin, Texas

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9.29.2020 - 10.1.2020 – AAPG Annual Convention and Exhibition 2020, Online/Virtual

Abstract

Two cores of the Permian Wolfcamp Formation from the southern part of the Delaware Basin provide an opportunity to study this complex mudrock assemblage. This study seeks to integrate XRF-aided core logging with petrographic studies using both light and scanning electron microscopes with the purpose of determining differences in pore systems between lithologies. Results will be compared to porosity and permeability measurements whichwere obtained from eleven samples using a modified gas-expansion method on core plugs. One core was taken primarily in the uppermost Wolfcamp “A”, the other core was taken in the underlying Wolfcamp “B” unit. Sample depths for this study range from 10,486 to 11,110 ft. Limited vitrinite reflectance data is consistent with calculated Roof 0.9 to 1.0% Initial core sampling was based on visual examination for textures combined with handheld X-ray fluorescence measurements at a 2-inch interval. Plug porosities range from 0.2% to 4.8%. Siliceous mudstone samples have higher porosities, up to 4.4%. Carbonate clast floatstone (coarse debrite) porosities are dependent on the type of matrix, with a siliceous mudstone matrix floatstone having a higher porosity (4.8%) than the floatstone with a very fine sand matrix (2.1%). Samples from the siliceous fine-grain debrites and carbonate concretion/zone lithologies generally have porosities less than 1.2%. The majority of lithologies in the core (argillaceous, calcareous, and siliceous mudstones) show a mix of interparticle and organic-matter pores. The numerous interparticle pores are primarily associated with clay minerals in the matrix. The siliceous fine-grain debrites and the silica concretion (chert) show few pores. The carbonate floatstones turn out to be lithologically complex, and thus have a variety of pore systems related to the matrix material in which the carbonate

clasts are found. Matrix permeabilities range from 2.1 nD to 3295 nD. Siliceous mudstones or carbonate clast floatstones with a siliceous mudstone matrix showed the highest permeability measurements. One calcareous mudstone sample also had a relatively high permeability. Samples of siliceous mudstone or having siliceous mudstone matrix generally have permeabilities above 1000 nD. Carbonate-rich lithologies (other than the calcareous mudstone) have permeabilities less than 100 nD and as low as 2.1 nD.