AAPG Datapages/Search and Discovery Article #90301 © 2017 AAPG Rocky Mountain Section Annual Meeting, Billings, Montana, June 25-28, 2017

The Influence Of Paleoceanography In Controlling Diagenetic Pathways In The Phosphoria Rock Complex Of The Bighorn Basin, Wyoming

Edward Matheson[1] and Tracy Frank[1]

[1]University of Nebraska, Lincoln, NE

ABSTRACT

The Permian Phosphoria Rock Complex (PRC) is a succession of bioelemental (phosphorite and chert), carbonate, evaporite, and siliciclastic rocks that stretches across parts of Idaho, Utah, Wyoming, and Montana. The PRC contains economic phosphate deposits and a prolific petroleum system with both source and reservoir rocks. It has received continued attention due to its economic significance and unique facies that suggest atypical paleoceanographic conditions. Oceanographic models have invoked upwelling, intermediate water masses, and temperature and salinity stratification, among other processes, in explaining the atypical oceanography. Despite continued debate, it is clear that the PRC accumulated in settings where oceanographic conditions were geographically and temporally variable. This study utilizes 35 stratigraphic sections and cores within the Bighorn Basin of north-central Wyoming to analyze the influence of the paleoceanographic conditions in determining diagenetic pathways and the modern expression of facies. In the Bighorn Basin the PRC consists predominantly of Park City Formation carbonates and Goose Egg Formation siltstones and evaporites. Depositional facies range from open-marine heterozoan carbonates to peritidal carbonates containing coated grains, fenestral fabric, microbial laminations, and teepee structures to supratidal and terrestrial red beds with carbonate and gypsum-anhydrite salina deposits. Overprinting the depositional facies are a diverse set of diagenetic processes and products. They include synsedimentary marine cementation; authigenic mineralization; synsedimentary and reflux dolomitization and displacive nodular evaporite growth; burial cementation and replacement by quartz, calcite, and dolomite; and telogenetic replacement of evaporites. In many cases diagenetic overprinting is pervasive with very little original material preserved. Both peritidal and open- marine reservoir facies have been exploited in plays with stratigraphic, structural, and diagenetic controls on trap locations. Thus, an important consideration is the diagenetic pathways that the rocks followed, and whether their modern composition is, at least indirectly, predestined by original oceanographic conditions. Oceanographic influence would have combined with burial history, structural activity, geographic variability, and other controls in determining the diagenetic modification of the PRC. Some of the oceanographic conditions that could affect diagenetic pathways include ocean chemistry, seafloor oxygenation, seawater temperature, and the influence of physical processes. These mechanisms control diagenetic pathways because they can affect skeletal mineralogy, matrix preservation (and its role in early cementation or porosity preservation), bioturbation and its influence on fluid flow, and authigenic mineralization (silicification, glauconitization, phosphatization, etc.) and its role in decreasing the diagenetic potential of allochems. The implications of paleoceanographic conditions influencing diagenetic pathways is that similar depositional facies deposited under differing oceanographic conditions could have variable modern expressions due to progression down different diagenetic pathways. As a result, the relationship between oceanographic, sedimentologic, and diagenetic characteristics is an important consideration with regards to the nature of the Phosphoria Rock Complex reservoir facies present within the Bighorn Basin.