Facies Distribution and 3-D Reservoir Characterization of a Silurian (Cayugan) Reef Slope: Pipe Creek Jr. Quarry, Grant County, Indiana

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ABSTRACT

Silurian pinnacle reefs are prolific oil and gas reservoirs which have been studied extensively in the northern region of the U.S Midwest and southern Ontario. Most of the previous research has been focused on the reef cores, while relatively little work has been done on the debris slopes which flank the core. Previous work on the Tengiz buildup in Kazakhstan and the Malampaya-Camago buildup in the Phillipines has shown that often the best reservoir intervals occur in the foreslope of the buildup. It has also been shown through work on Niagaran-aged reefs in the Michigan Basin that the fore-reef and back-reef slopes are compositionally and depositionally distinct. Understanding the mechanics and geometry of these slopes and modeling the reservoir quality of these beds is an important step in characterizing the reservoir quality of any reef complex.

The Pipe Creek Jr. Reef has been extensively studied with previous work focusing on the paleontology and faunal assemblages, the dolomitization of the reef, and the depositional facies and diagenesis of the reef. The reef complex has an inferred circular structure, with a minimum thickness of 48m, and the original height of the reef has been speculated as being anywhere from 35 to 200 meters. The exposed reef flank facies consist of a mixture of coarse skeletal grainstone-packstones, stromatactis mudstone-wackestones, and argillaceous silty dolomite mudstones. Slump scars and channels are common, as are resedimented blocks from the inferred reef crest. Synsedimentary dikes filled with carbonate lithologies similar to the host rock and marine cements are also common.

This study of the Pipe Creek Jr. Reef is an in-depth analysis of the facies distribution and bed geometries, reservoir characterization of the reef slope, and the development of a georeferenced, 3-D outcrop model in Petrel. Mehtods include analysis of 4 cores taken in the quarry and drone photogrammetry of the quarry face. Drone-based aerial and orthogonal photography is utilized in order to develop a georeferenced base model of the quarry face. This base model is then imported into Petrel, along with petrographic and sequence stratigraphic data from cores and outcrop, in which facies, porosity, and permeability relationships are modeled. Data and information gathered in this study will help to better understand the compartmentalization of reservoirs in reef flank facies.