Assessing the Development of Porous and Permeable Burrow Networks

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Summary

Recent ichnological investigation has focused on the relationship between trace fossils and fluid flow properties in petroleum reservoirs. Burrowing organisms affect sediment sorting characteristics, and thereby, the porosity and permeability distribution. In cases where burrows are more porous than their surrounding matrix, they constitute flow conduits through which oil and natural gas are extracted (e.g., Sag River Formation, Alaska; Arab-D reservoir, Saudi Arabia; Ben Nevis Formation, Newfoundland). However, the potential for fluid flow through burrowed horizons is contingent upon the presence of a network of interconnected burrows.

In this study, five burrow types (*Skolithos, Planolites, Thalassinoides, Zoophycos,* and *Phycosiphon*) were digitally modeled using 3-dimensional geometric shapes. The “digital burrows” were randomly populated into a representative elementary volume to test for the development of percolation (burrow interconnections) over a range of bioturbation intensities. Simulations were run on volumes containing a single burrow type, and on combinations of burrow types chosen to represent some of the common marine ichnofacies.

Computer simulations indicate that, regardless of burrow type, percolation is established at low bioturbation intensity (Bioturbation Index 2). Burrow connectivity in the horizontal direction emerges before vertical connectivity when the burrows are primarily horizontal to inclined (e.g., *Planolites* and *Zoophycos*), whereas, the opposite is true for suites dominated by vertical forms (e.g., *Skolithos* and *Thalassinoides*). In mixed suites, horizontal and vertical percolation occur concurrently. The results are important because they suggest that networks are more pervasive in burrowed sediments than previously surmised. This may lead to the recognition of other intervals of burrow-enhanced permeability elsewhere.