

## **Expanding the Build-and-Fill Model: ‘Phylloid-Algal’ Carbonate Mound Development**

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### **ABSTRACT**

The build-and-fill model for mixed carbonate-clastic systems was originally developed to explain complex internal architectures of relatively uniform and widespread sequences (cyclothem), which consist of both topography-filling and topography-building depositional phases. These sequences often contain complex depositional motifs with rapid facies changes and lithological heterogeneity that result from carbonate mound build-up, providing localized relief, and the infilling of that relief by siliciclastics or a combination of siliciclastics and carbonates.

Build-and-fill successions are critical components of upper Paleozoic hydrocarbon systems throughout the Mid-continent and southwestern United States, thereby making the build-and-fill model integral for hydrocarbon exploration. During the Late Paleozoic Ice Age (Pennsylvanian-Permian) ‘phylloid-algae’ were a critical relief-building component of these sequences and have been attributed to both relief-filling and relief-building depositional phases of the build-and-fill model, which hinders the predictability of lithofacies distribution and mound geometries, thereby limiting the broader application of this model for hydrocarbon exploration in other carbonate-mound settings.

This study includes the type strata for the Paleozoic example of the original build-and-fill model developed by McKirahan et al. (2003) and includes detailed sequence- and biostratigraphic analyses of 33 drill core, 36 outcrop and quarry localities, 165 geophysical logs, and re-mapping of Upper Pennsylvanian strata over roughly 3000 km<sup>2</sup>. The findings from this study demonstrate that the dominant role of the ‘phylloid-algae’ lithofacies is that of relief-builder with relief building (aggradation) predominantly during the regressive phase of each sequence, later switching from aggradation to progradation (resulting in moderate relief-filling) during continued regression, before nearshore shales were brought into the basin, filling in bathymetric lows produced by the ‘phylloid-algal’ mounds.

By expanding the geographic coverage of previous studies, we are able to improve our understanding of the sequence stratigraphic patterns, mound geometries, and lithological distributions within the type strata of the original build-and-fill model, and we can now demonstrate more completely the role played by ‘phylloid-algae’ in a build-and-fill depositional sequence.