# Burial Diagenesis and Carbonate Reservoir Quality

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## Abstract

Burial diagenesis exerts a strong control on reservoir quality in carbonates. Increases in effective stress and temperature during burial commonly lead to chemical solution and cementation, which drive the loss of porosity and permeability. Burial trends are important for assessing potential hydrocarbon volumes in exploration, which require pre-drill estimates of the porosity of the producible reservoir and consequently of net to gross (NtG: the proportion of gross rock volume that could contribute hydrocarbons to a wellbore). The complex pore types in carbonate reservoirs commonly produce non-linear relationships between porosity and permeability, so porosity is a weak proxy for flow (producibility) and thus NtG. The permeability data needed for robust NtG assessments are most readily available from core analyses. A new method of generating success-case porosity and NtG assessments for exploration is here derived from a sub-set of an extensive global database of carbonate core analyses. Core data allow NtG cutoffs based on permeability thresholds, which can be calibrated to the expected fluid viscosity and recovery mechanism. Using permeability rather than traditional porosity thresholds commonly leads to higher NtG values but lower average reservoir porosity. The results illustrate that for all permeability thresholds, porosity and NtG decline with increasing maximum burial depth. Depositional facies do not exert a systematic control on success-case porosity or NtG in the current dataset. Dominant pore types, reflected by the Lucia petrophysical class, do vary systematically. For a given burial depth, higher porosities are generally associated with class 2 and 3 fabrics (grainy to muddy, or medium to finely crystalline). Additionally, class 3 fabrics (muddy/microporous) are more common in shallowly buried reservoirs, and class 1 fabrics (grainy/intergranular-vuggy) are more common in deeply buried

reservoirs. The porosity-depth trends from this core-based approach differ from other published burial curves (Schmoker & Halley, 1982; Ehrenberg & Nadeau, 2005). Important distinctions are that the current method calculates porosity only for the net reservoir, applies a consistent NtG methodology, excludes pore systems not captured by core (fracture, vug), and assesses maximum rather than present-day burial depth. Though facies are critical at the play- or reservoir-scale and for prospect risk, it is unclear if they exert any global control over success-case porosity and NtG.

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