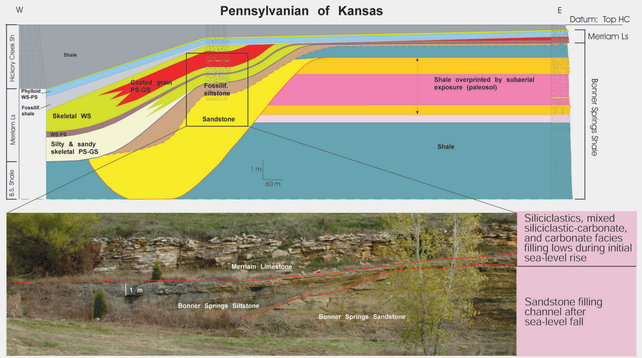
FILLING OF TOPOGRAPHIC RELIEF (CONTINUED)

Mixed Carbonate-Siliciclastic & Carbonate Facies Filling During Initial Sea-Level Rise



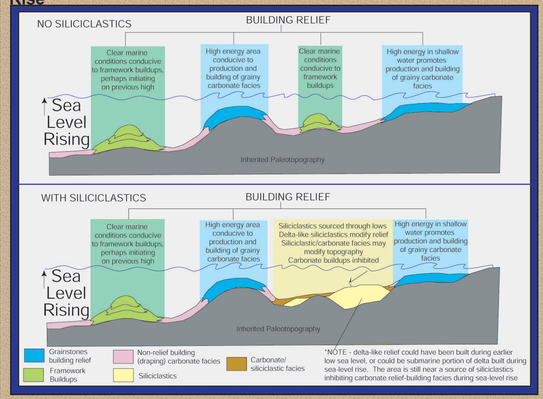
Modified from Washburn and Franseen (2003)

FILLING OF TOPOGRAPHIC RELIEF-SUMMARY

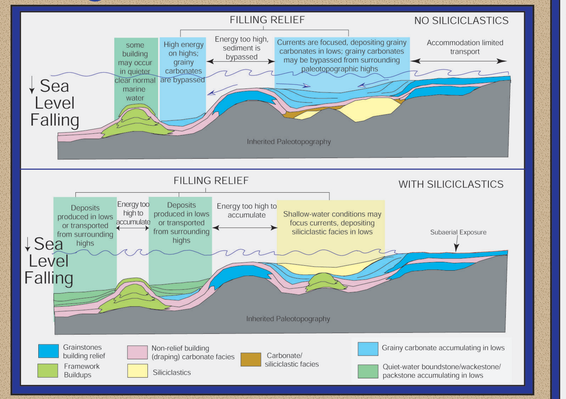
- Filling of relief by carbonates mostly during falls; phylloid algal and oolite facies are common
- Fast fall over mid-shelf/ramp position limits accommodation on highs; grains are redistributed to lows
- Controls are base level with accommodation limited to paleo-low areas and focus of currents in lows
- Siliciclastics may fill lows when sea level is low
- Siliciclastics, mixed carbonates/siliciclastics, and carbonates may fill lows during transgression
- Filling phase caps sequence to produce a laterally extensive thin sequence of even thickness with

SUMMARY MODEL

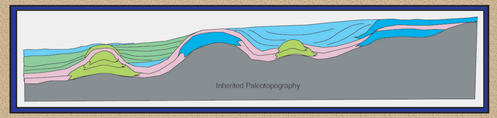
1 TOPOGRAPHY BUILDING AND DRAPE DURING SEA-LEVEL RISE



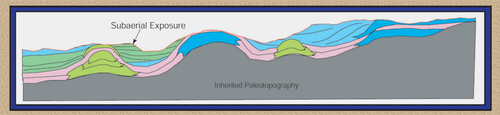
2 TOPOGRAPHY FILLING DURING SEA-LEVEL FALL



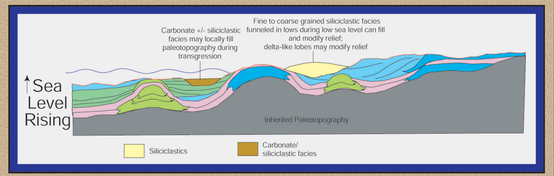
3 TOPOGRAPHY FILLED RESULTING IN NEARLY EQUAL-THICKNESS SEQUENCE



4 EROSION (LOWSTAND) RE-INITIATES VARIABLE PALEOTOPGRAPHY PRIOR TO DEPOSITION OF NEXT SEQUENCE



5 INITIATION OF NEXT BUILD-AND-FILL SEQUENCE



FACTORS THAT COULD PREVENT BUILD-AND-FILL SEQUENCES

- Long-lived structural highs
- Siliciclastic depocenters that are long-lived
- Highstand or lowstand position
- Slow rates of sea-level change
- Carbonate productivity optimized

SOME SUBSURFACE EXAMPLES WITH BUILD-AND-FILL CHARACTERISTICS

Building Relief

- Boundstone facies: Pennsylvanian, Paradox basin (Weber et al., 1995)
- Grainy carbonate facies: Pennsylvanian, Kansas (Watney et al., 2000), Pennsylvanian, Paradox basin (Weber et al., 1995)

Filling Relief

- Coarse-grained siliciciclastics (incised valleys): many examples (e.g. Dalrymple, 1994)
- Fine-grained siliciclastics - Pennsylvanian, Nebraska (Dubois, 1985)
- Carbonate grainstone: Pennsylvanian, Paradox basin (Weber et al., 1995)
- Quiet-water boundstone/wackestone/packstone: Pennsylvanian, Paradox basin (Matheny and Longman, 1996); Pennsylvanian, Kansas (Watney, 1980)

Dalrymple, Robert W., Boyd, Ron, and Zaitlin-Brian A. 1994, Incised-Valley Systems: Origin and Sedimentary Sequences, Special Publication 51 SEPM , 391 p.
Dubois, M.K., 1985, Application of Cores in Development of an Exploration Strategy for the Lansing-Kansas City "E" Zone, Hitchcock County, Nebraska: Kansas Geological Survey Subsurface Series 6, p. 120-132.
Matheny, J. Paul, Longman, M. W., 1996, Power Desert Creek Reservoirs in the Paradox Basin; examples of phylloid algae filling depositional lows related to salt dissolution, in Paleozoic Systems of the Rocky Mountain Regions, Rocky Mountain Section, SEPM, p. 267-282.
Weber, J.L., Wright, F.M., Sarg, J.F., Shaw, Ed, Harman, L.P., Vanderhill, J.B., and Best, D.A., 1995, Reservoir delineation and performance: Application of sequence stratigraphy and integration of petrophysics and engineering data, Aneth field, southeast utah, U.S.S., SEPM Short Course 34, p. 1-29.
Watney, W.L., 1980, Cyclic Sedimentation of the Lansing-Kansas City Groups in Northwestern Kansas and Southwestern Nebraska: Kansas Geological Survey Bulletin 220, 72 p.
Watney, W.L., Bujs, G., Byrnes, A.P., Guy, W.J., and Dubois, M.K., 2000, Task 4. Reservoir Characterization of Hall Gurney Field: Kansas Technology Enterprise Corporation Report, p. 4.1 D 4.71.

CONCLUSIONS

*A build-and-fill sequence is formed during a single sea-level cycle to produce a thin, widespread sequence with complex internal architecture.

*The sequences develop from glacioeustatic high-frequency, high-amplitude sea-level fluctuations when carbonate production is not optimal.

*They form in the build-and-fill zone, in middle ramp/shelf settings that lie between highstand and lowstand positions. Mid-ramp/shelf settings are subjected to the most rapid rates of rises and falls.

*Many shallow-water carbonate facies, such as phylloid algal and oolitic facies, fill low areas rather than building relief on highs. These typically form during sea-level falls and smooth topography because of accomodation limitations.

*Relief building carbonates include coral reefs, thrombolites, phylloid algal facies, and grainstone facies. These typically form in underfilled accomodation during sea level rise.

* Pennsylvanian, Permian, and Upper Miocene examples illustrate that the build and fill character of sequences is a response to sea-level position over paleotopography, water energy, water quality, and location of siliciclastic depocenters.