

Climatic Influences on Stratigraphy - Applications of Numerical Models

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Numerical models can serve to explore the effects of key boundary conditions, like tectonics, sea level change, and climate changes, on stratigraphic architecture.

Climate changes are explored most often through the effects of changes in sediment supply to the depositional basin. Recent model experiments show complexities of sediment supply in response to climate change and take this into account to provide stratigraphic responses. A first complexity is that drainage basins in a similar climate zone can have a large variation in responses due to differences in basin geometry or the relative influence of glaciation. A second complexity we recognize, sediment supply can vary 'in-phase' or 'out-of-phase' with sea-level change depending on the coherency between climate change in the drainage basin and eustatic change. Such factors impact stacking patterns in both onshore and offshore environments.

However, geomorphological and process studies show that the influence of climate on stratigraphy goes beyond sediment supply. Climate can have an impact on much smaller-scale architectural characteristics as well, for example in fluvial systems climate influences the delivered grain size, it may affect sinuosity, flooding profile, channel pattern and depth. Similarly, wave climate impacts frequency and thickness of storm layers in shallow marine depositional architecture, and deepwater systems may be partly forced by climate-driven events.

This level of process control detail is still a state-of-the-art research topic, which is being addressed within the modeling framework of the Community Surface Dynamics Modeling System (CSDMS). We will show examples of sophisticated climate model realizations and process-based terrestrial models which are presently being coupled to stratigraphic models to investigate predictability of the relation between climate controls and stratigraphic architecture.