Scaling Issues in Sedimentary Deposit Modeling

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In hydrocarbon reservoir description, the successful inference of bulk properties from point data has opened the door to practical applications of subsurface flow simulation. This review contends that in sedimentary process modeling, the successful inference of the behavior of large sedimentary systems from an understanding of local phenomena is the key to achieve wider practical applications of modeling.

Most geologic processes operate differently at various spatial and time scales. In order to use a model at a scale for which it was not originally designed, one must change the relative importance of terms in the governing equations to the point of eliminating some and introducing others. This procedure is illustrated by examples of upscaling and downscaling. Upscaling concerns sedimentation modelers because it remains difficult to use local principles of flow and sedimentation over periods of geologic time. Yet some examples show that models may actually become simpler (and not less rigorous) after upscaling.

A few geologic processes operate similarly over a wide range of scales. They result in truly fractal distributions of spatial properties. No change in the simulation model of such processes is necessary to make it operate successfully across many scales, but it remains the modeler's responsibility to validate the assumption of scale invariance.

Examples of published and proposed models support the conclusion that the study of scaling behavior leads to better theoretical foundations for sedimentation models while facilitating their practical application by revealing the model's properties that are most relevant to the problem's scale.