

## **Structural reconstruction combined with heat and pressure calculations: implications for building numerical models**

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Structural reconstruction software adds considerably to our ability to understand the evolution of sedimentary basins. However, the integration of a backwards-through-time structural restoration with a forward basin model, gives rise to significant mathematical difficulties. Whilst many of these problems are esoteric we have also had to solve problems of more general interest.

Firstly, we not only have a moving frame of reference; we also have arrival of new material - the deposition of sediment. This is a four-dimensional problem requiring the use of a truly 4-D discretization. We illustrate this by progressively generalising from the simple approximation of linear interpolation, of both movement and deposition, from one stage of structural reconstruction to the next.

Secondly, the PDEs used to model heat flow and pressure are both coupled and non-linear, leading to a computationally intensive solution. A fully implicit, non-linear solver is currently impractical. Calculation complexity is therefore reduced by extrapolating pressure values for coupled terms in the heat equation and extrapolating heat and pressure values for non-linear terms in both PDEs. We do this using high-order extrapolation of values from previous time-steps, whilst non-coupled and linear terms in the PDEs are formulated implicitly. This maintains the stability of the implicit numerical method whilst achieving the efficiency of an explicit scheme.

Finally, in addition to the problem of constraining heat and fluid flow at the model boundary, structural reconstruction creates structural edge effects. We present analyses using coarse external meshing to mitigate these effects, together with numerical results.

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