HARVARD UNIVERSITY

New approaches to 3D structural restorations using mechanical constraints for improved petroleum trap and reservoir characterizations

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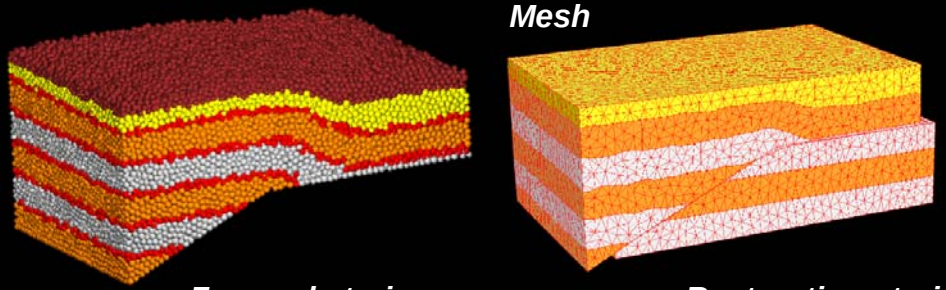
We are investigating a fundamentally new approach of performing 3D structural restorations to develop better methods for characterizing complex petroleum traps and reservoirs. These new methods use finite element techniques and consider mechanical rock properties in calculating fully 3D restoration displacement and strain fields. Thus, they offer promise for better defining the geometry and evolution of petroleum traps, as well as constraining patterns of natural fractures and other strain properties in reservoirs that influence oil and gas production.

Restoration of forward models and comparisons of strain fields

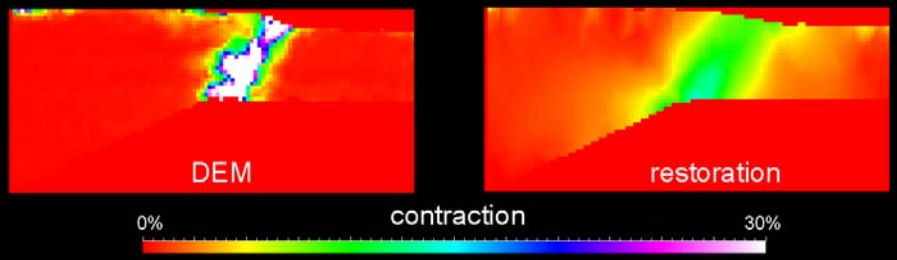
DEM model

Mesh

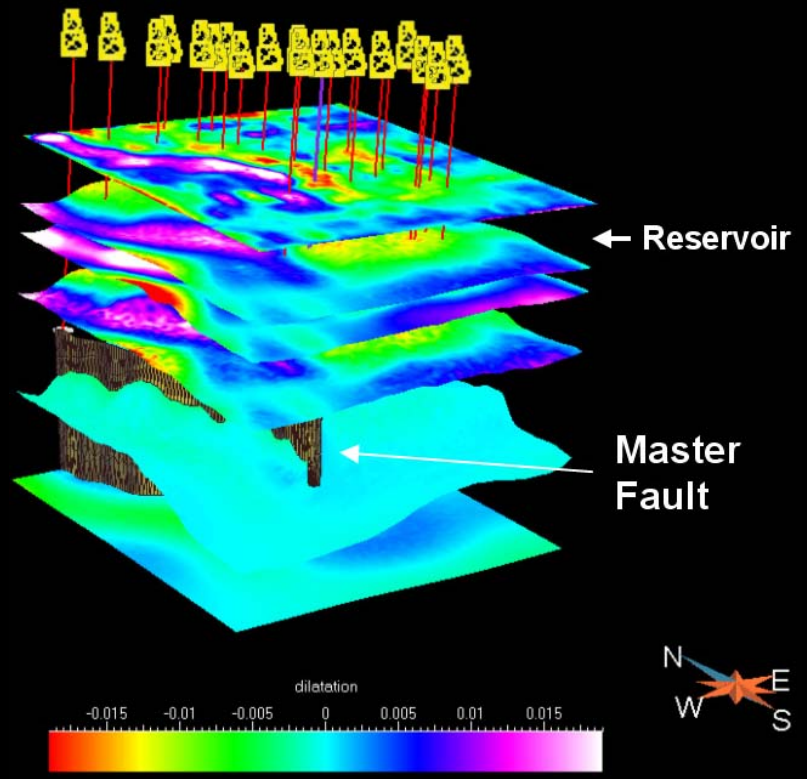


Forward strain

Restoration strain



Restored trap with calculated strains



Our project involved rigorously benchmark these new methods by restoring a series of mechanical forward models (left). These benchmarks demonstrate that the restoration methods are able to restore complex 3D structures and recover strain patterns that may influence reservoir performance. In petroleum fields, we find that values of strain derived from the restorations (above) generally correlate strongly with natural fracture patterns observed in well and seismic data, thereby helping to characterize these reservoirs.