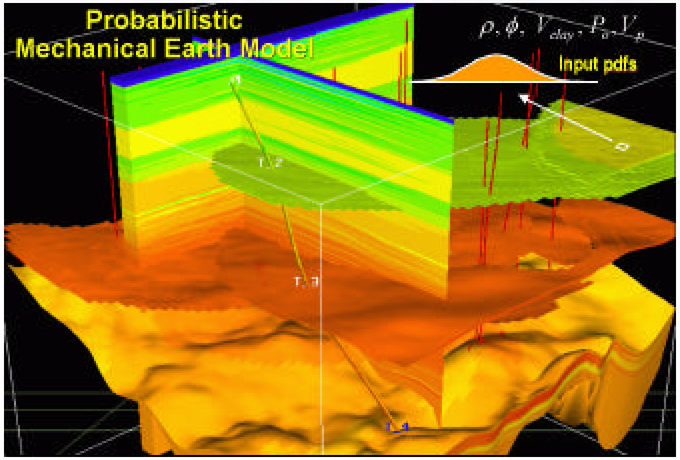
Geomechanical Performance of Hydrate-Bearing Sediments in Offshore Environments



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Richard A. Plumb

N.E.T.L, Morgantown W.Va.

January 19, 2007

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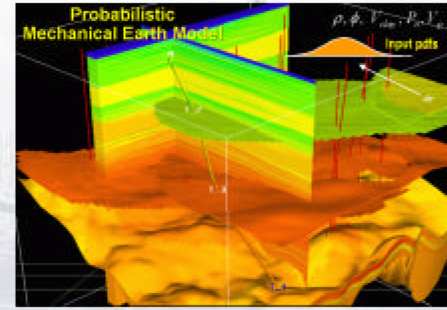
Objectives



Develop the capability of building 4D Geomechanical models of the near-seafloor deep-marine hydrate-bearing sediments.

- Interface Petrel framework model with FLAC3D

Develop 4D geomechanics models of the near-wellbore region of hydrate-bearing deep-marine sediments

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Scope of work 2006

H1 2006

- Review the geological structures on the U.S. continental margins characteristic of the gas hydrate stability zone (GHSZ).
- Determine whether Petrel's framework modeling tools can reproduce realistic fault and sedimentary structures of the (GHSZ)

H2 2006

- Evaluate the capability to interface Petrel with FLAC3D
- Recommend improvements to Petrel developers
- Contract ITASKA to interface Petrel to 3DShop and FLAC3D
- Selected Keathley Canyon as a field test site
- Build a small Petrel model
- Exported Petrel surfaces and geological properties to ITASKA software

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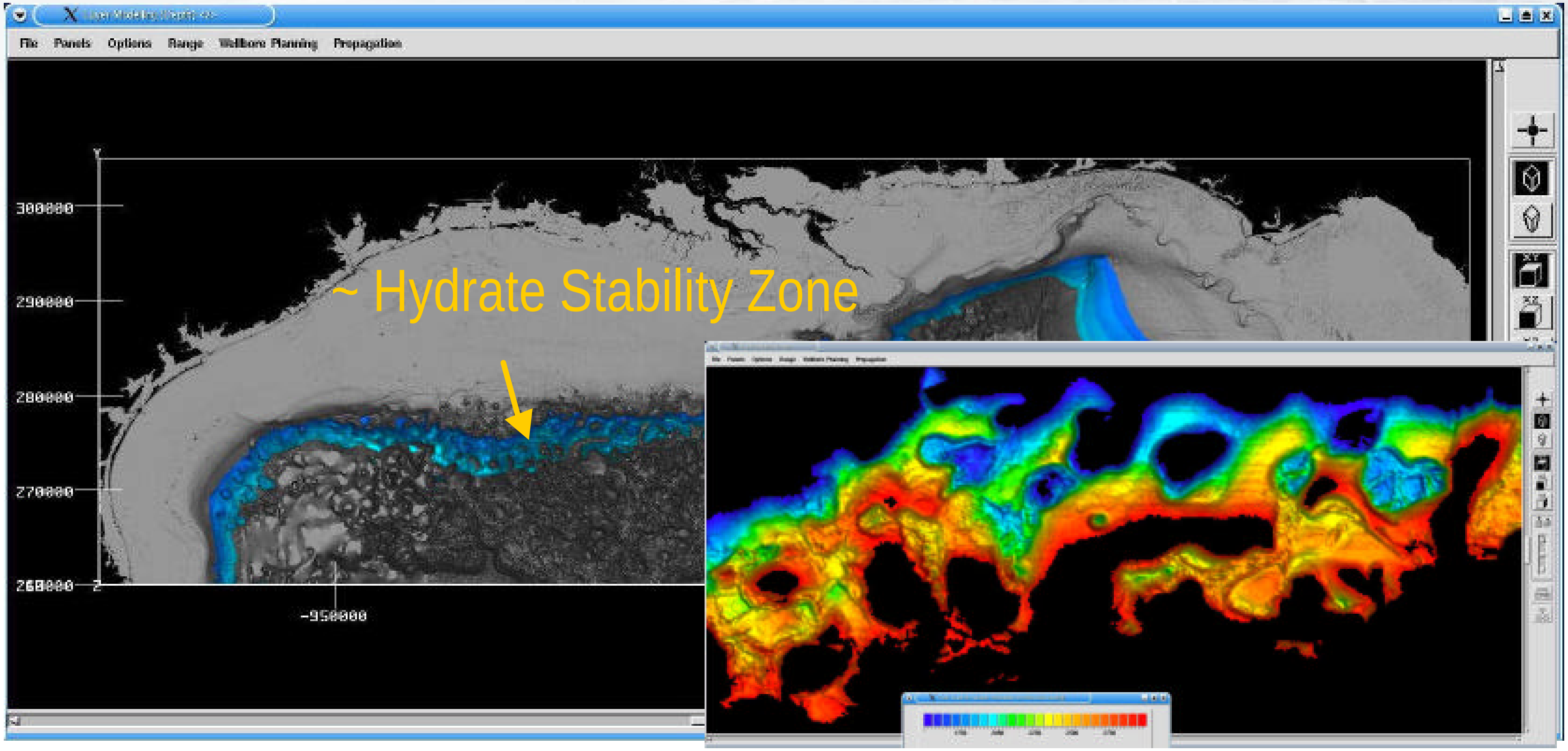
Geological environment



Complex structure due to salt diapirism

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Gulf of Mexico Gas Hydrates Joint Industry Participation Project

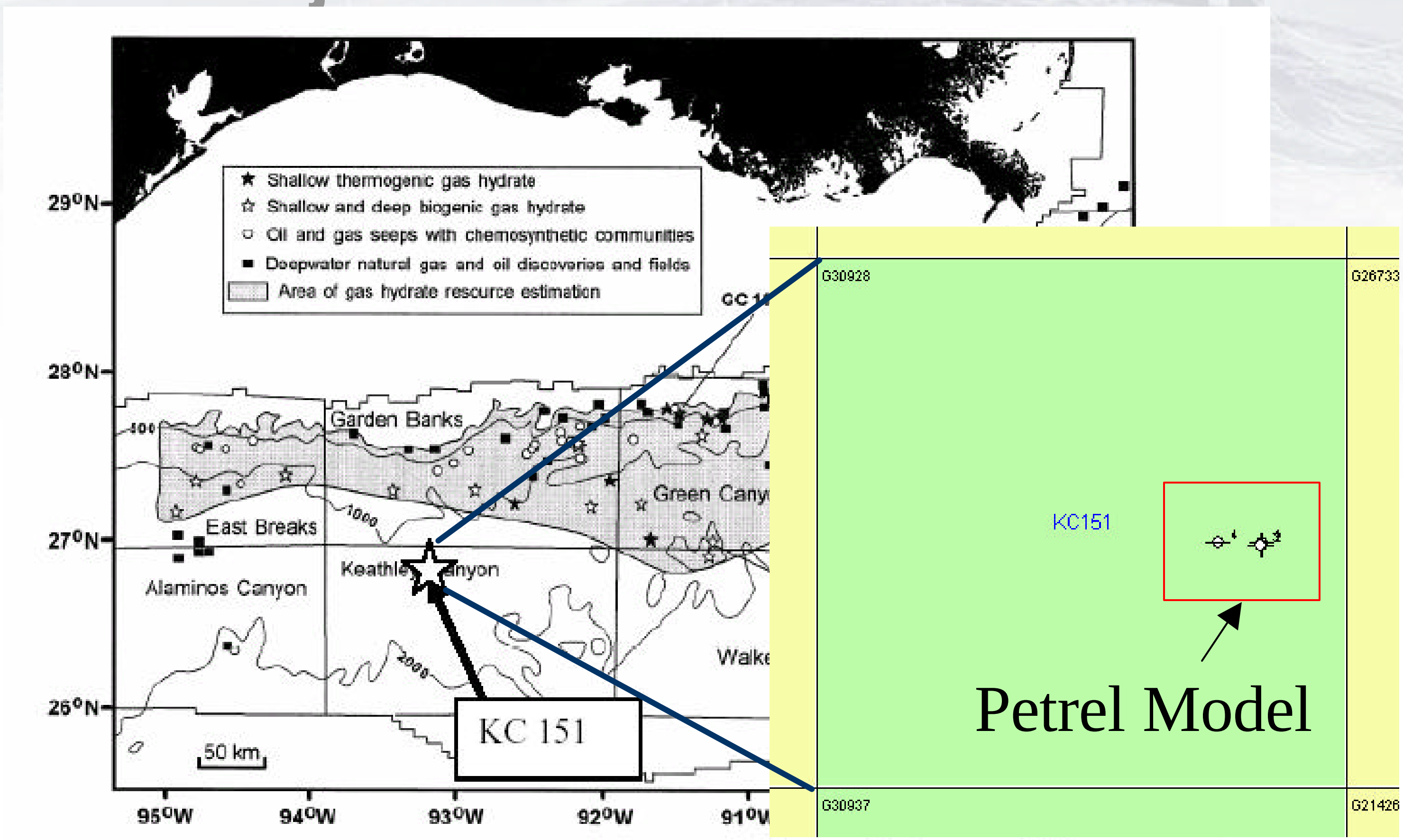

Figure 1. Map showing location of planned JIP coring/logging sites relative to gas hydrate sites and petroleum occurrences in the Gulf of Mexico (modified from Milkov and Sassen, 2001). Water depth contours shown in meters.

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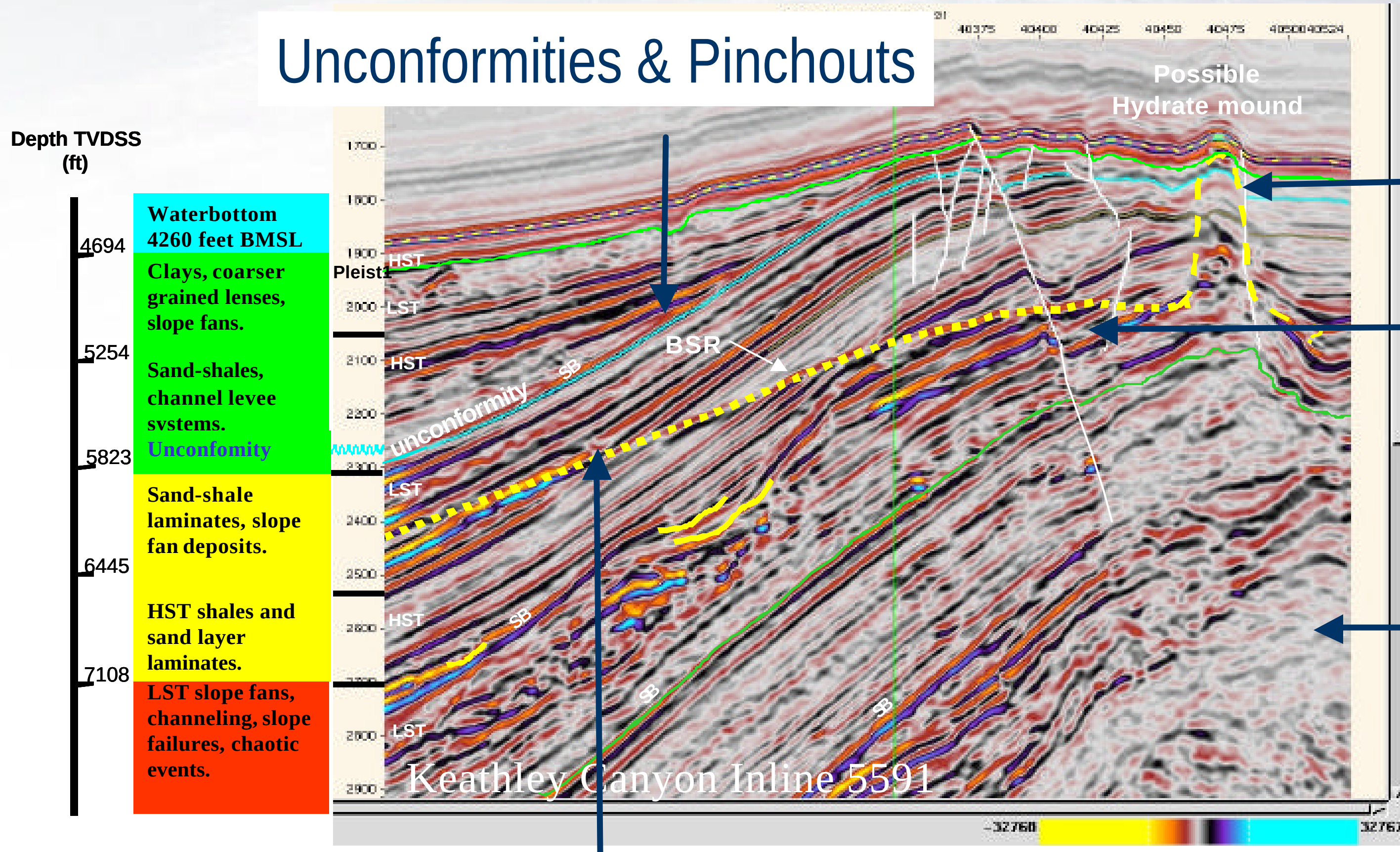
Modelling challenges seen in seismic section at Keathley Canyon

Unconformities & Pinchouts



Hydrate mounds

Faults

Salt bodies

Discordant contacts-e.g. BSR

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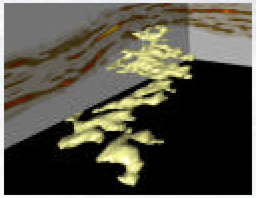
Geomechanical Property Modelling Workflow

Vp

Bulk Density

Pp

3D seismic volumes
(time domain)



Interactive, Seismic volume extraction

Geophysical Logs

Petrel
Property Modeling

Framework model

Bulk density

Lithology

Porosity

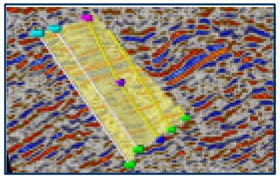
Elastic parameters

Strength parameters

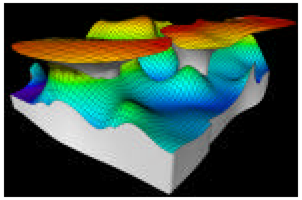
Pp

3D geo-property volumes
(depth domain)

FLAC3D
Geomechanics Simulator



Digitize faults in, 3D Seismic volume



Model complex geobodies

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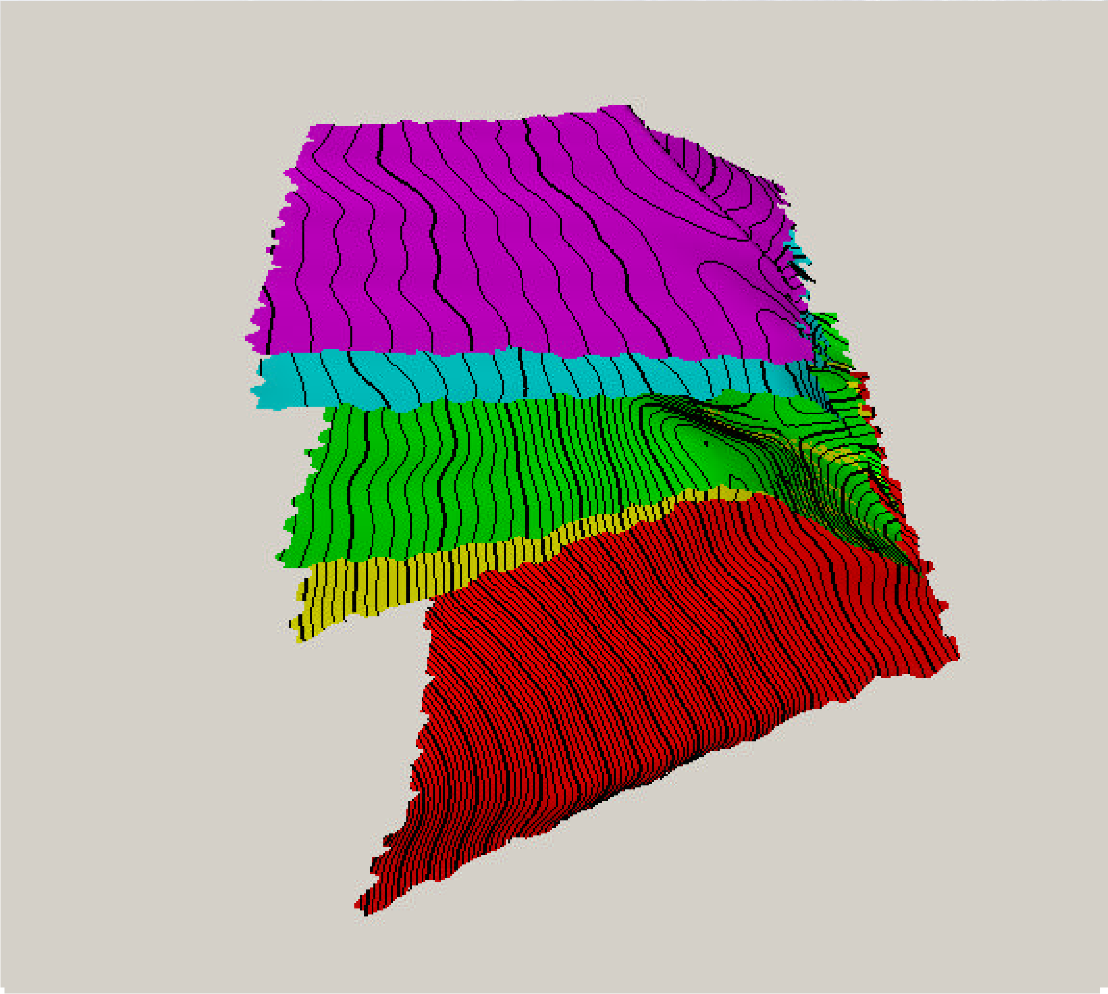
Keathley Canyon Horizons in Petrel



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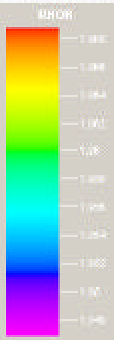
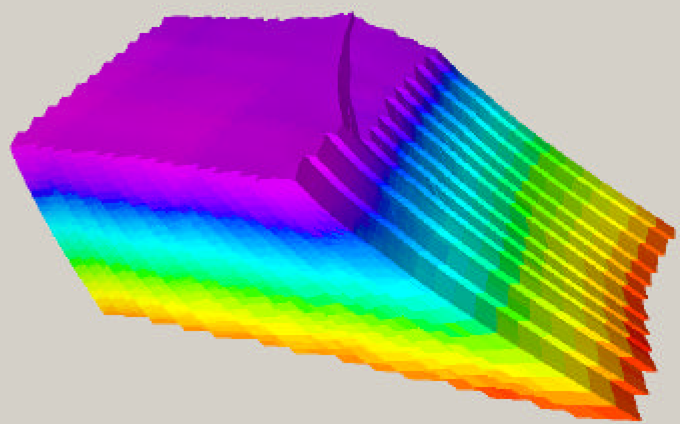
Keathley Canyon- preliminary bulk density volume



Gardner's relationship:
RhoB= a(Vp)^b



Coefficients for mudstone: a=1.75, b=0.265

Coefficients for sandstone: a=1.66, b=0.261

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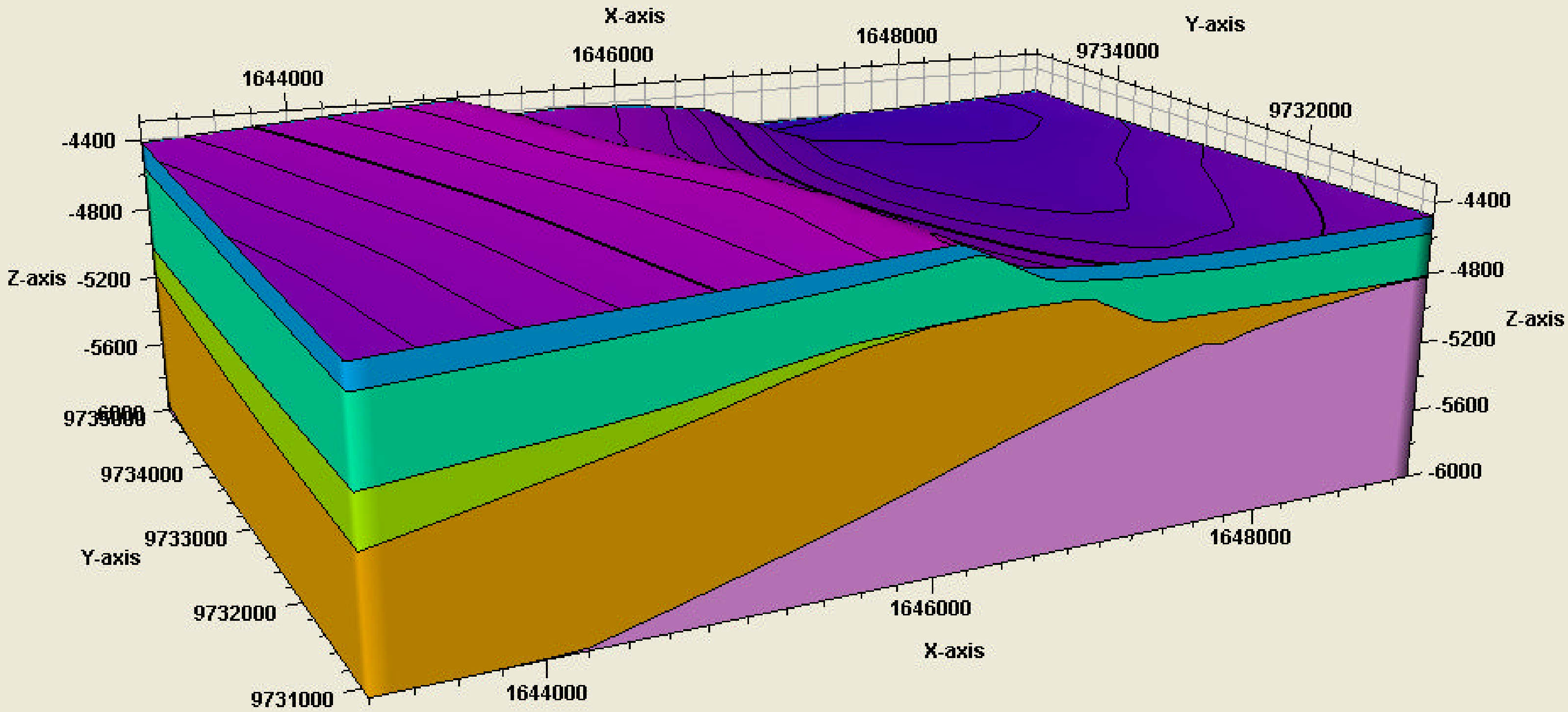
Simplifiled Keathley Canyon model in Petrel



Faults are not explicitly modeled in ITASKA's initial surfaces data set

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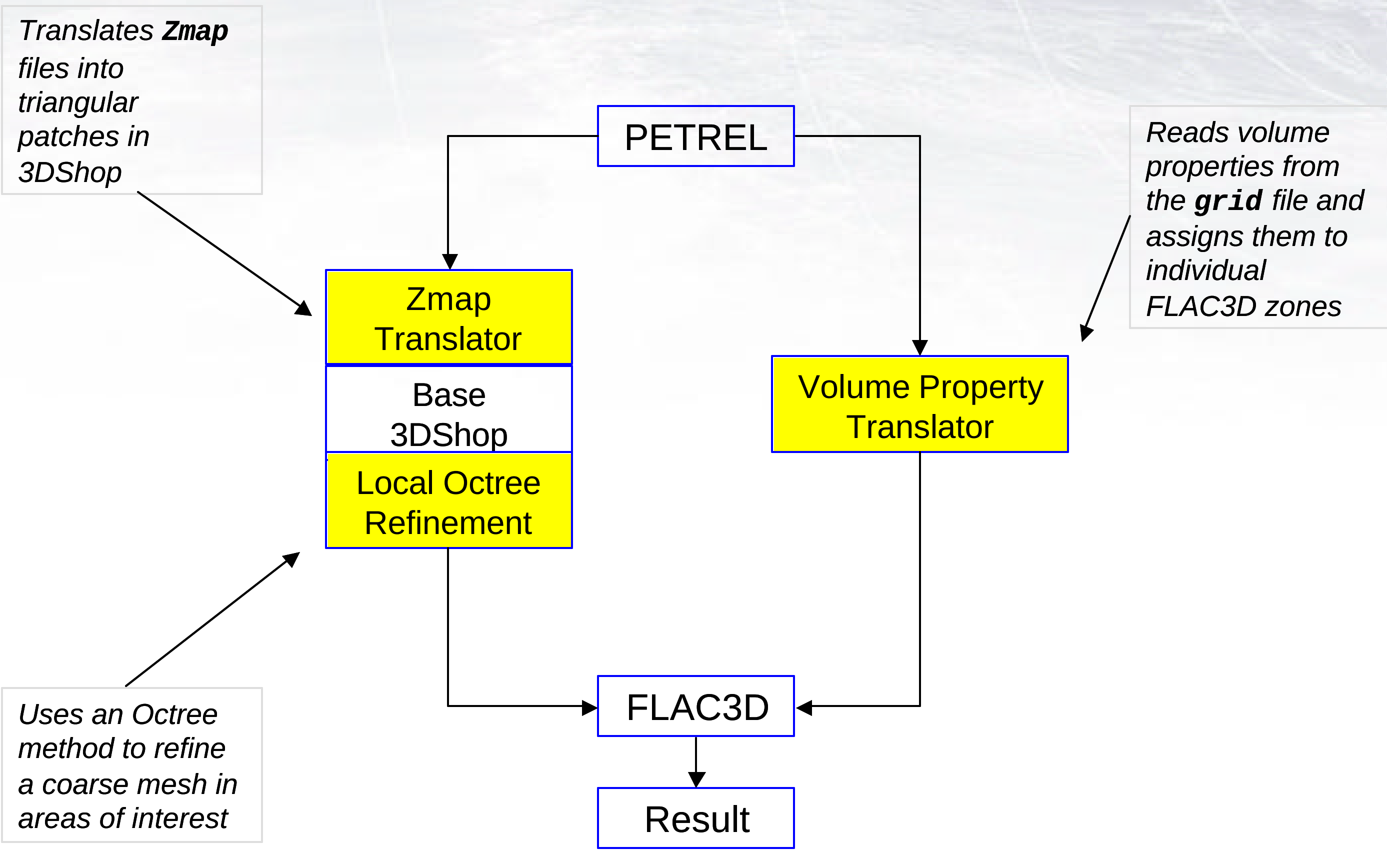
ITASKA's Modelling Workflow



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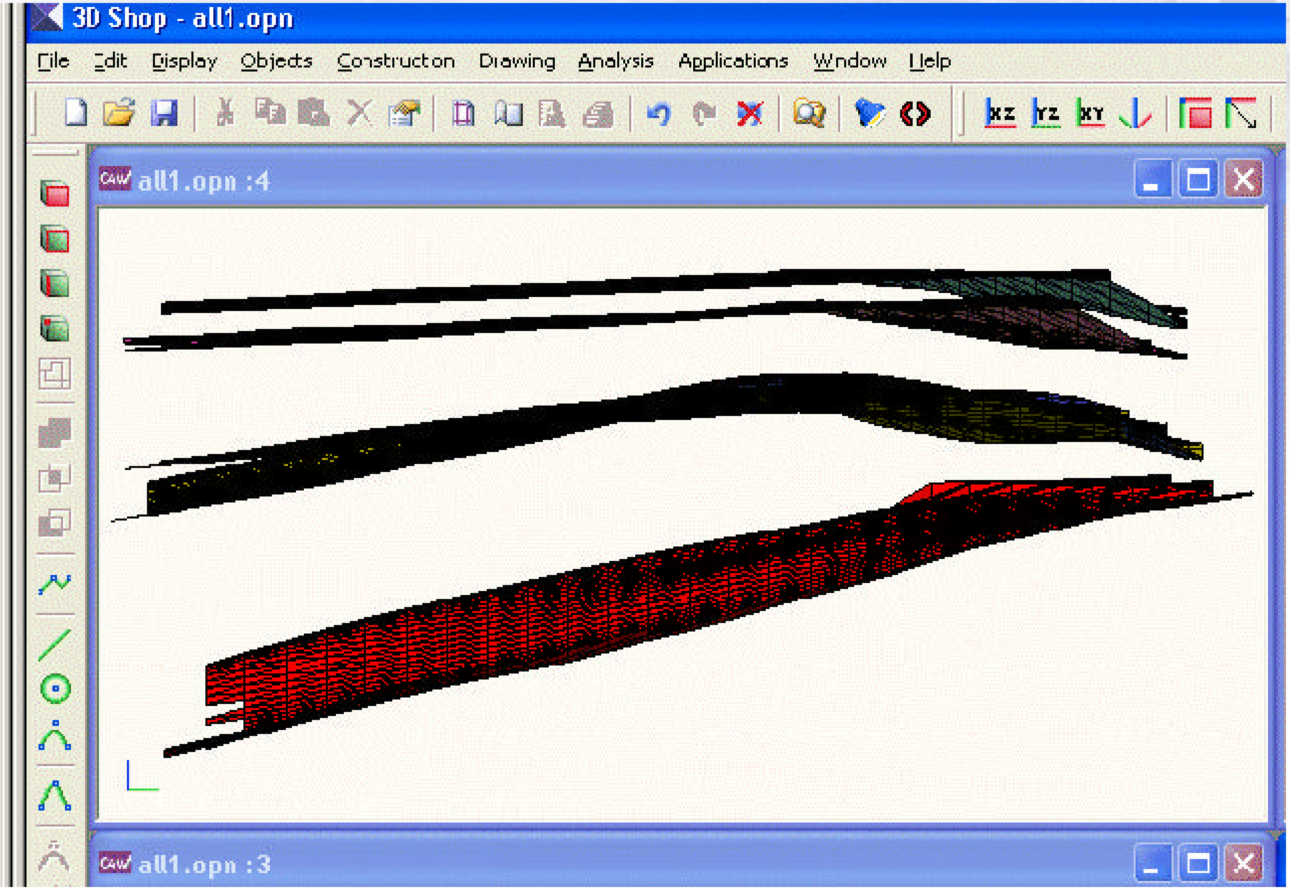
Geologic Horizons in ITASKA's 3DShop



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Proposed Next Steps 2007

ITASKA

- Read Petrel property volume
- Design the software interface
- Perform a sample geomechanical calculation in FLAC3D

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- Refine the input velocity model
- Introduce well log data and perform log-guided seismic inversion
- Construct geomechanical property volumes
- Perform a sample geomechanical calculation in FLAC3D

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Questions/Discussion

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