A 3D geological model of the Dutch Central Graben

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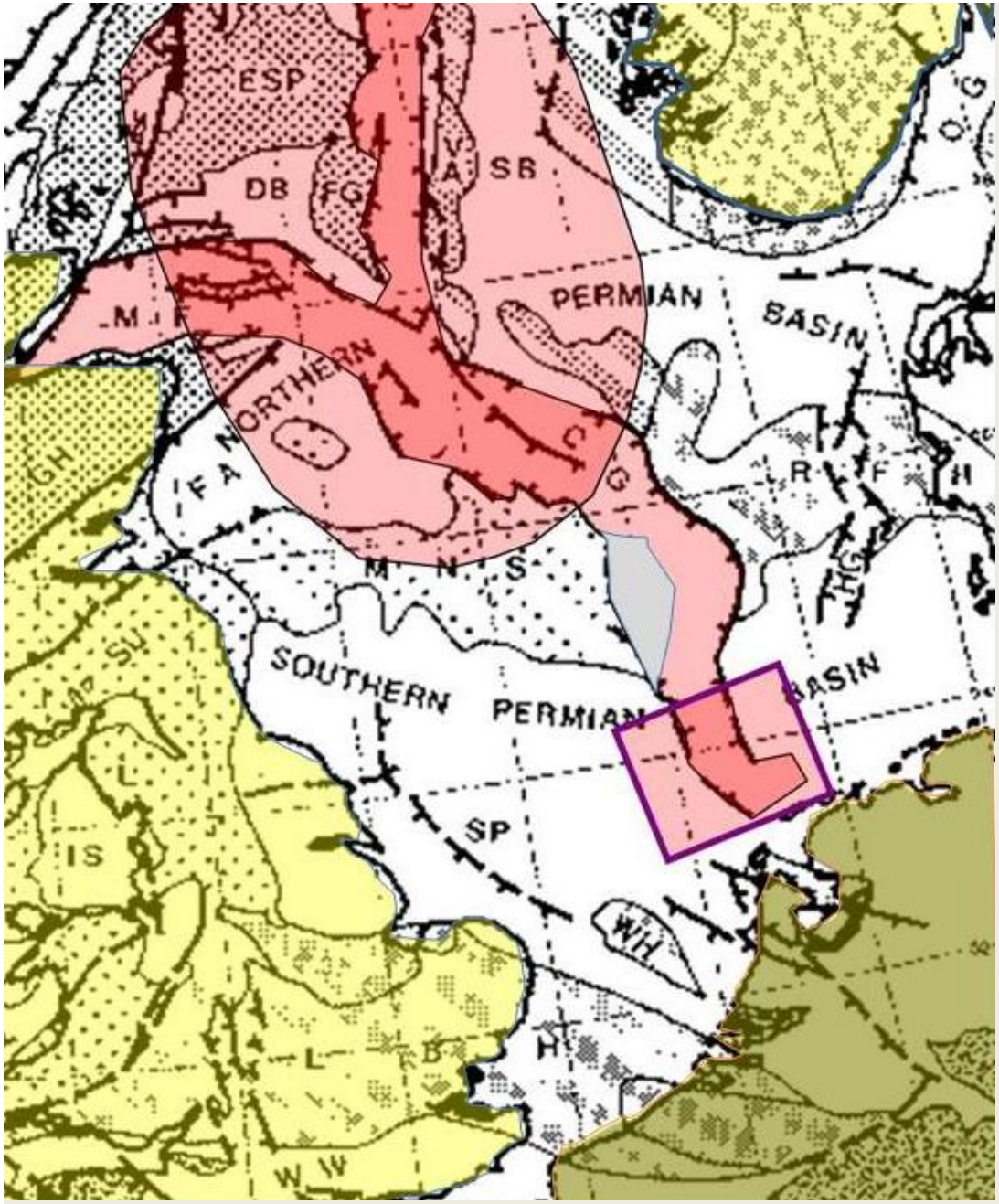
Wintershall Noordzee B.V.
Energie Beheer Nederland B.V
Total E & P Nederland B.V.

Outline

- Introduction
- Building the Model
- Dutch Central Graben mega structure
- Some remarks on erosion
- Some remarks on salt structuration
- Conclusions

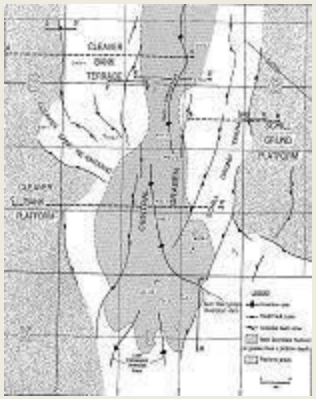


Introduction

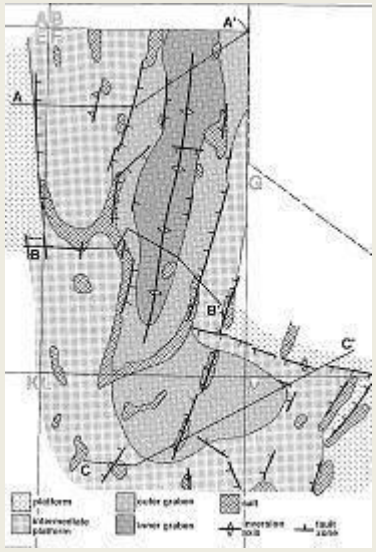
- Trilete rift system North Sea
- Central Graben south branch
- Dutch Central Graben

Dutch Central Graben
2 D models

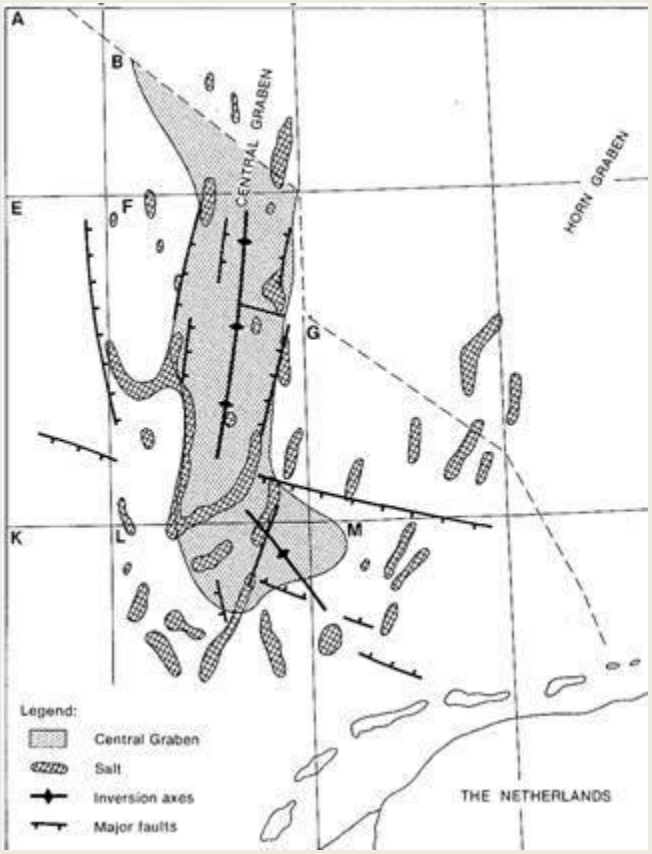
Heybroek., 1975



Clark-Lowes et al., 1987

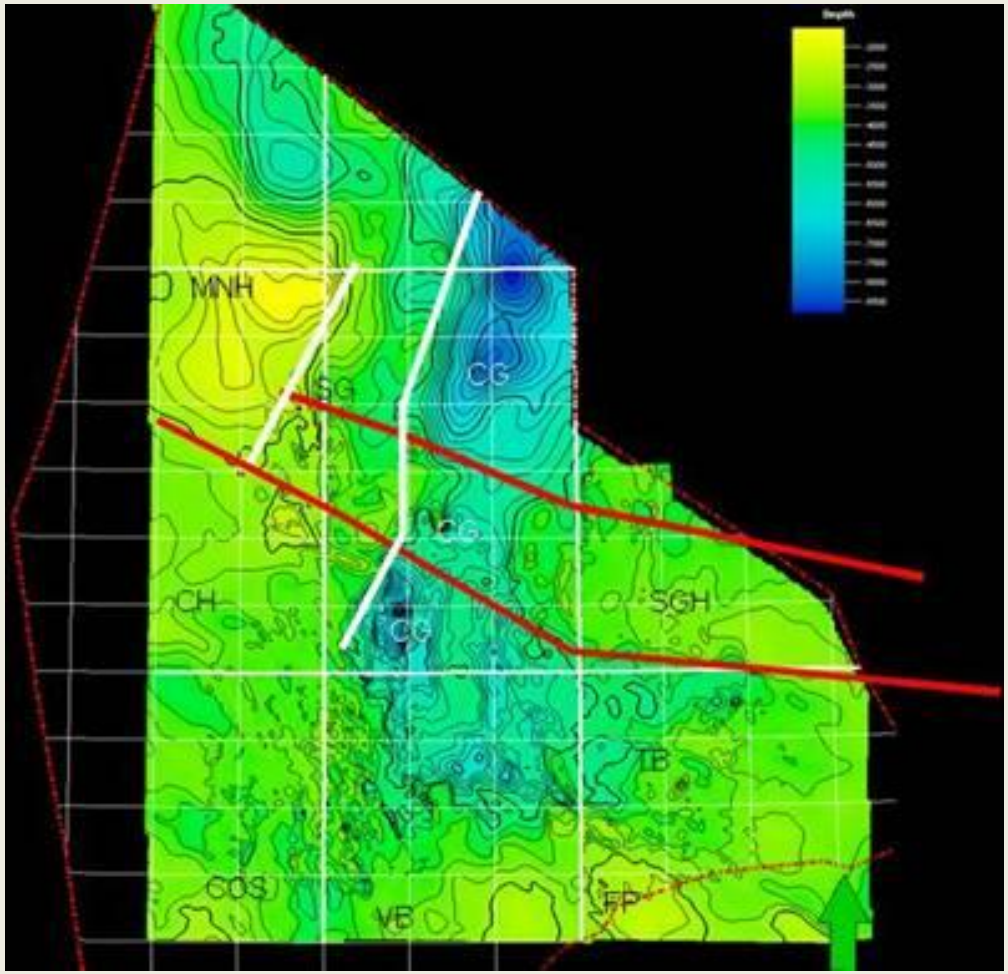


Wong et al., 1989



Schroot, 1991

Structural elements



Highs

- CH=Cleaver Bank High
- SGH=Schillgrund High
- MNH =Mid North Sea High

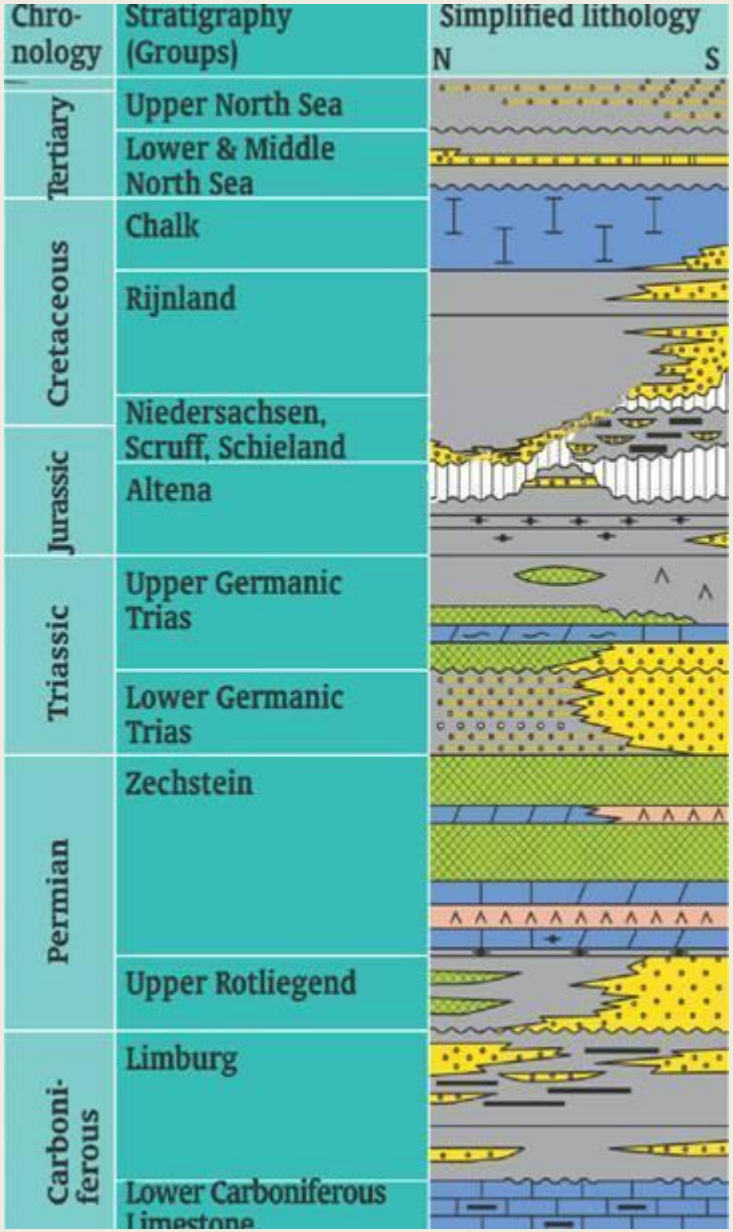
Basins

- CG= Central Graben
  - North part
  - High part
  - Southern part
- SG=Step Graben
- TB=Terschelling basin

- VB=Vlieland Basin
- COS=Central offshore Saddle

Stratigraphy

Dutch Central Graben



Tertiary

Major rifting

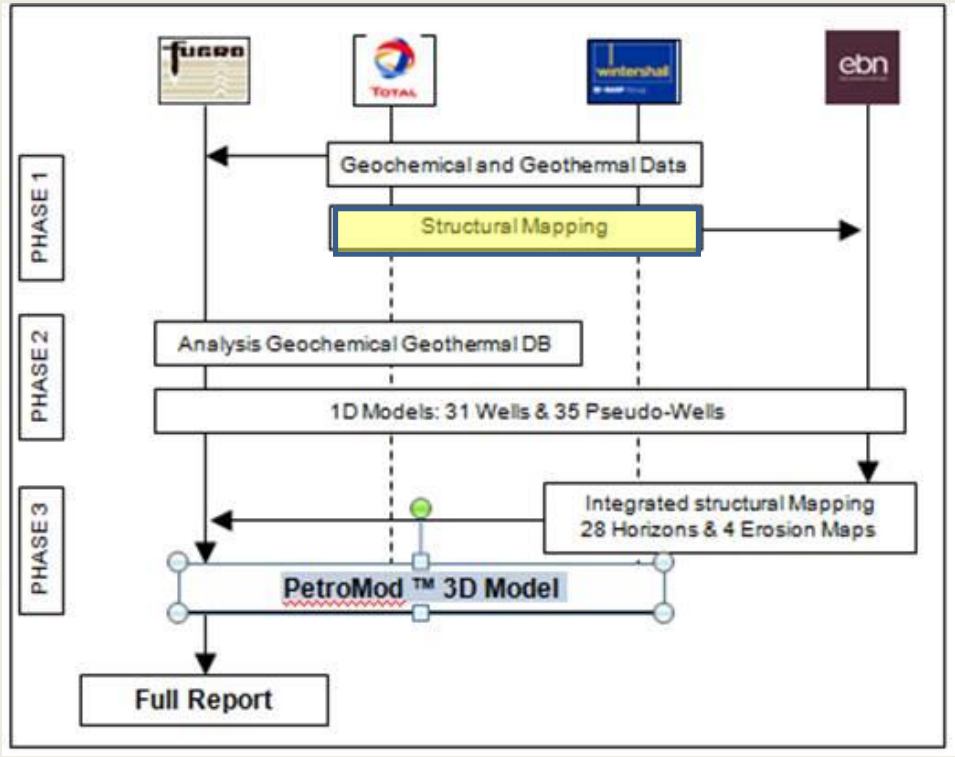
Minor rifting

Mesozoic

Paleozoic

Dutch Central Graben - Joint Industry Project

- Predict timing/maturity of known and potential **source rocks**
- Modeling their burial and thermal history
- **PetroMod ™ 3D Model**



A 3D geological model of the Dutch Central Graben

Building the Model

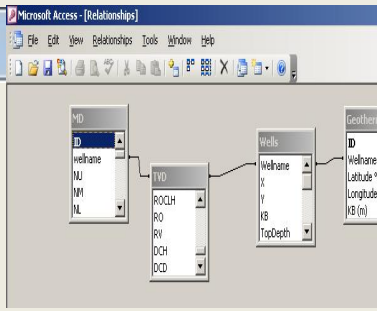
Stratigraphic markers

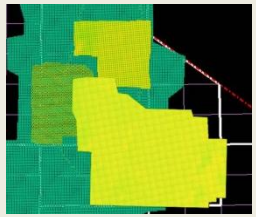
Coordinates

3D horizons

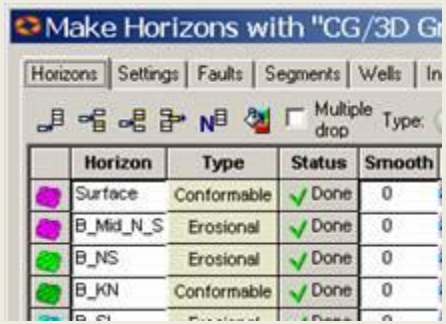
Database

Microsoft Access





Petrel Model



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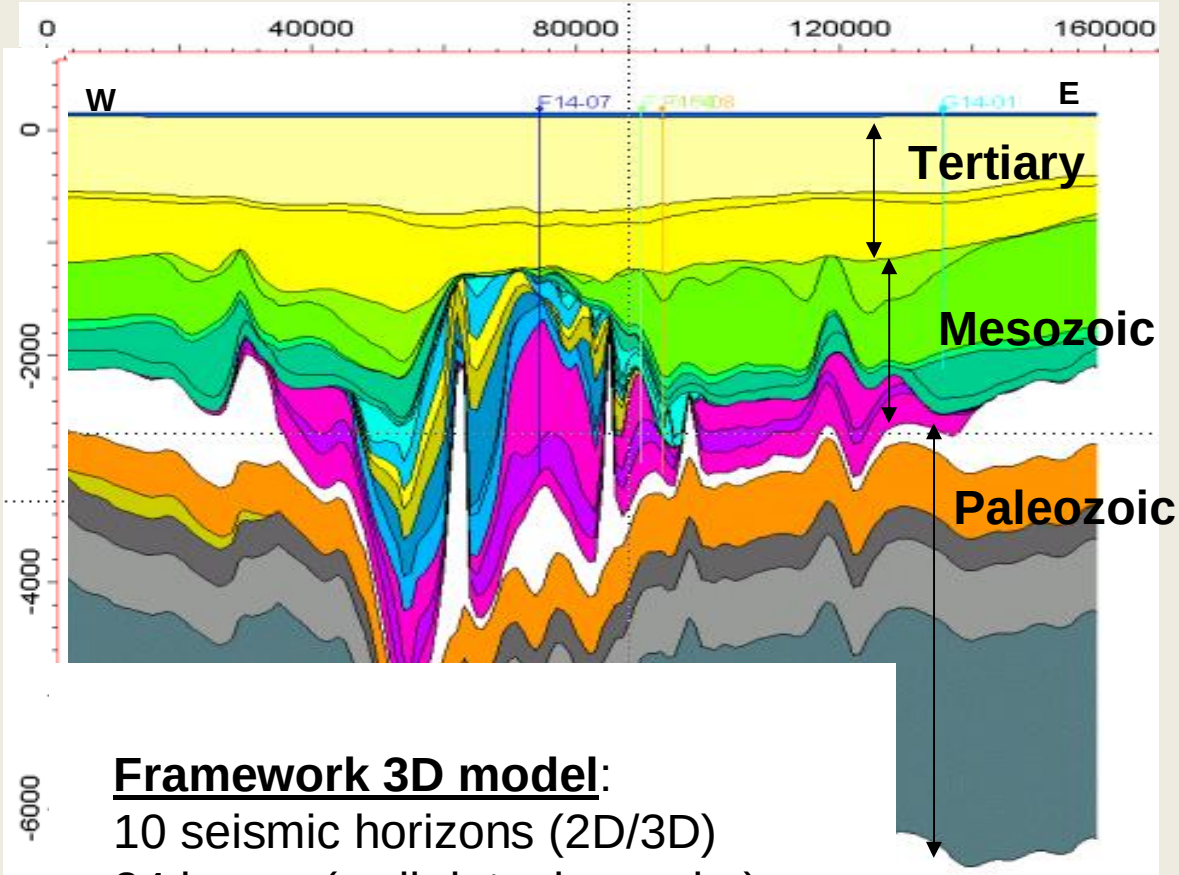
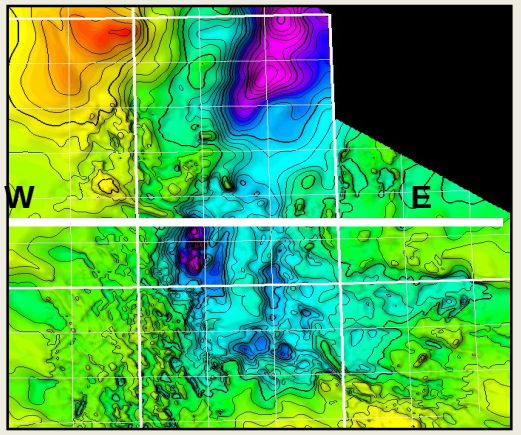
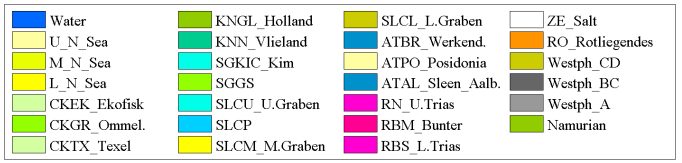
A 3D geological model of the Dutch Central Graben

Building the Model





Framework 3D model:
10 seismic horizons (2D/3D)
24 layers (well data, isopachs)
25.000 km2 (area)
1*1 km grid size

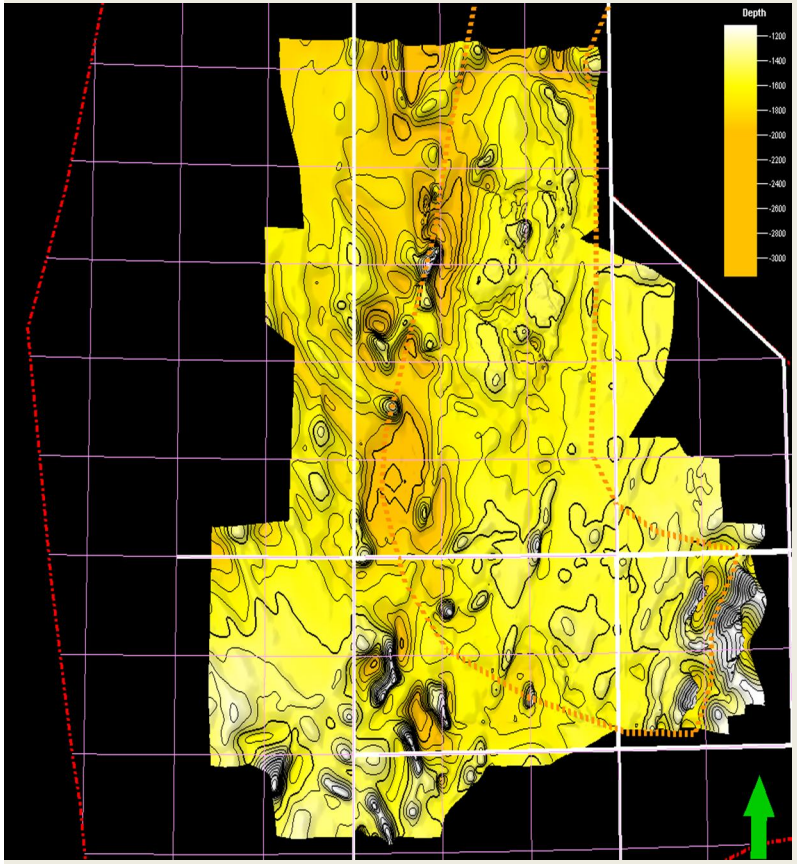


Building the Model
Merging

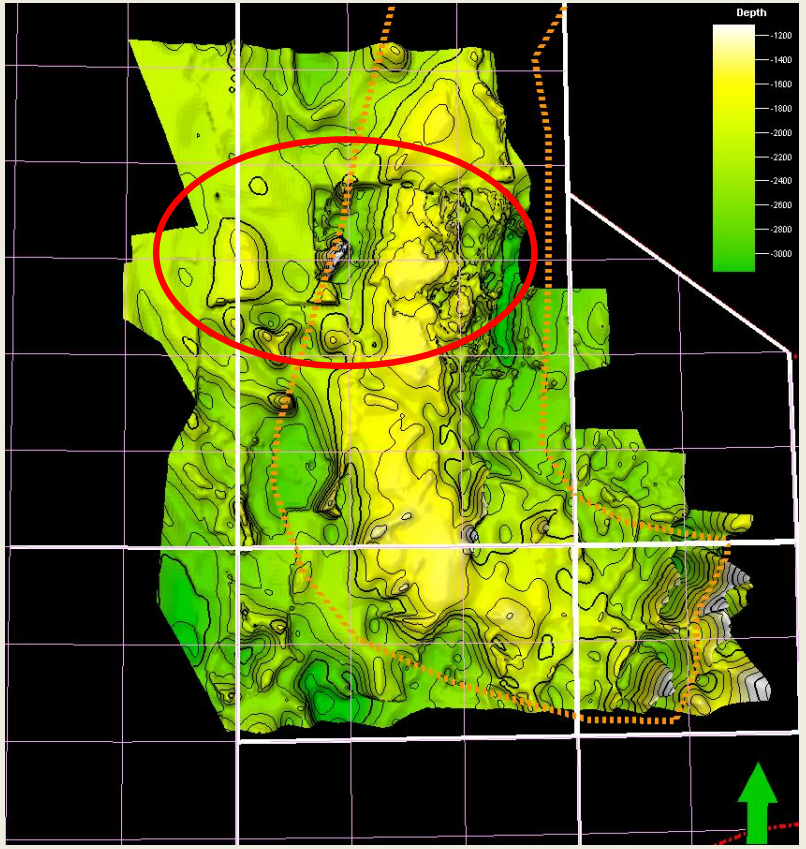
- Artifacts
- Some outside areas have no data
  - Extrapolation
  - Well data
  - Literature

25.000 km2 (area)
1*1 km grid size

Building the Model
Merging 3D seismic



Base Tertiary



Base Cretaceous

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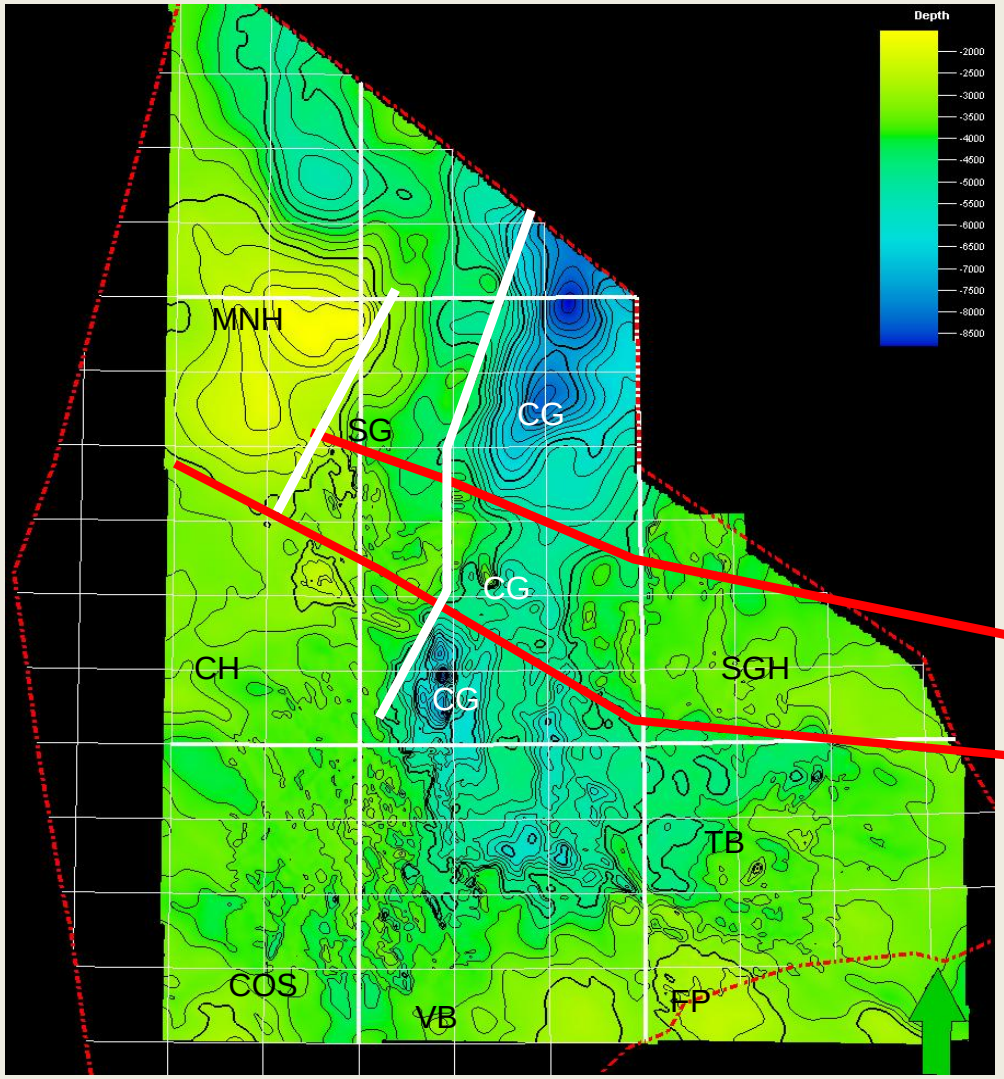

Mega structure

Highs

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- SGH=Schillgrund High
- MNH =Mid North Sea High

Basins

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  - North part
  - High part
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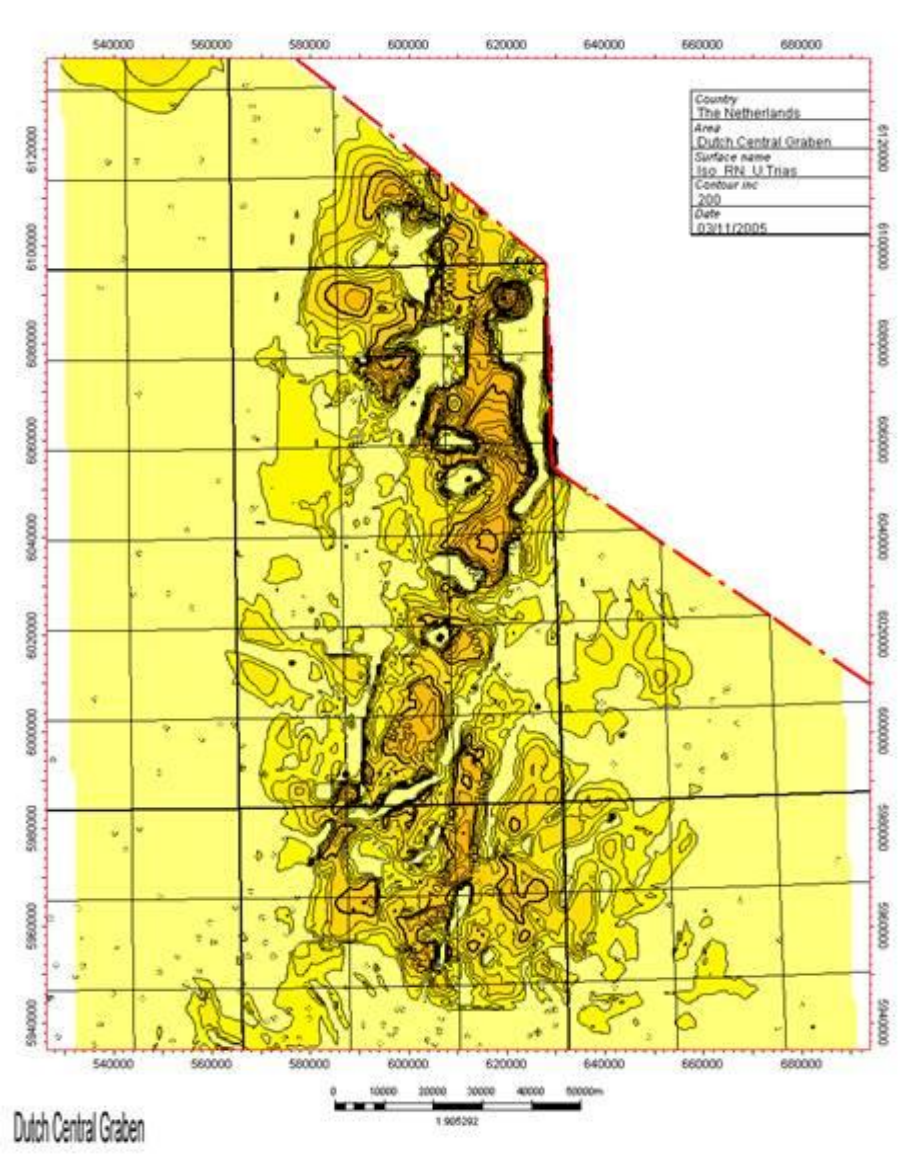


Mega structure

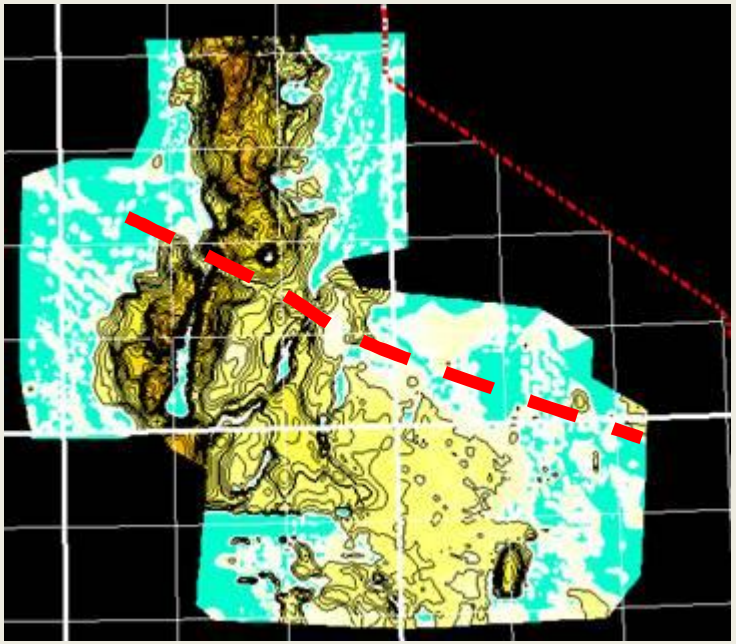
Isopach Upper Triassic

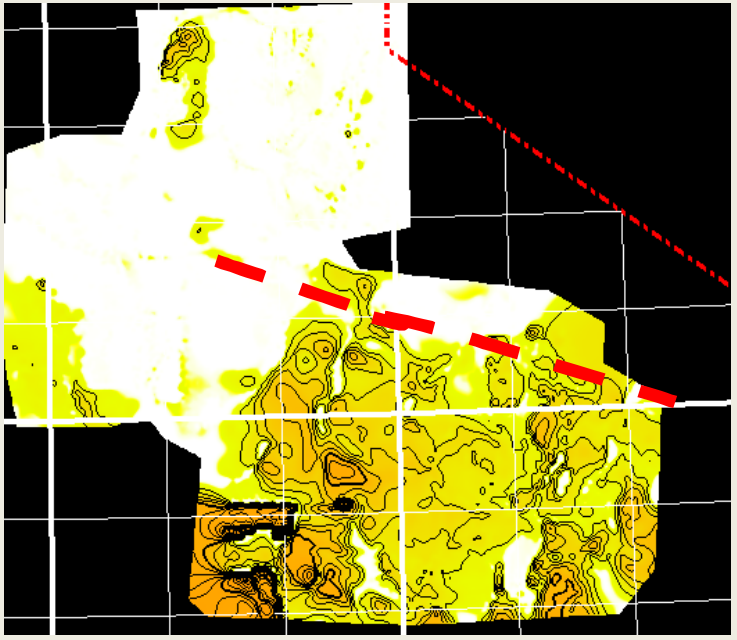
Triassic Rifting

- N-S trend

Into the Terschelling basin

- Part salt withdrawal



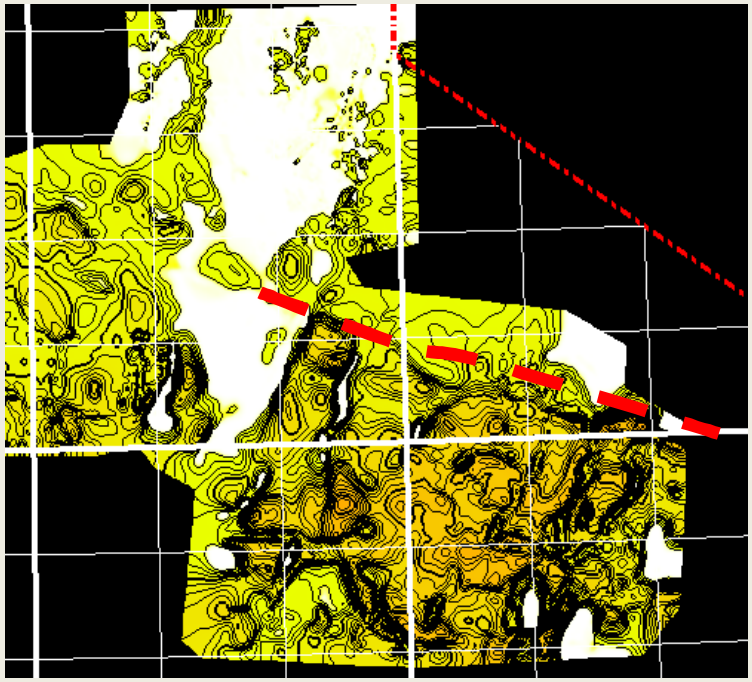


Scruff

- Mega structure
  - Lineaments Terschelling basin
  - Inversion hides the basin fill trends

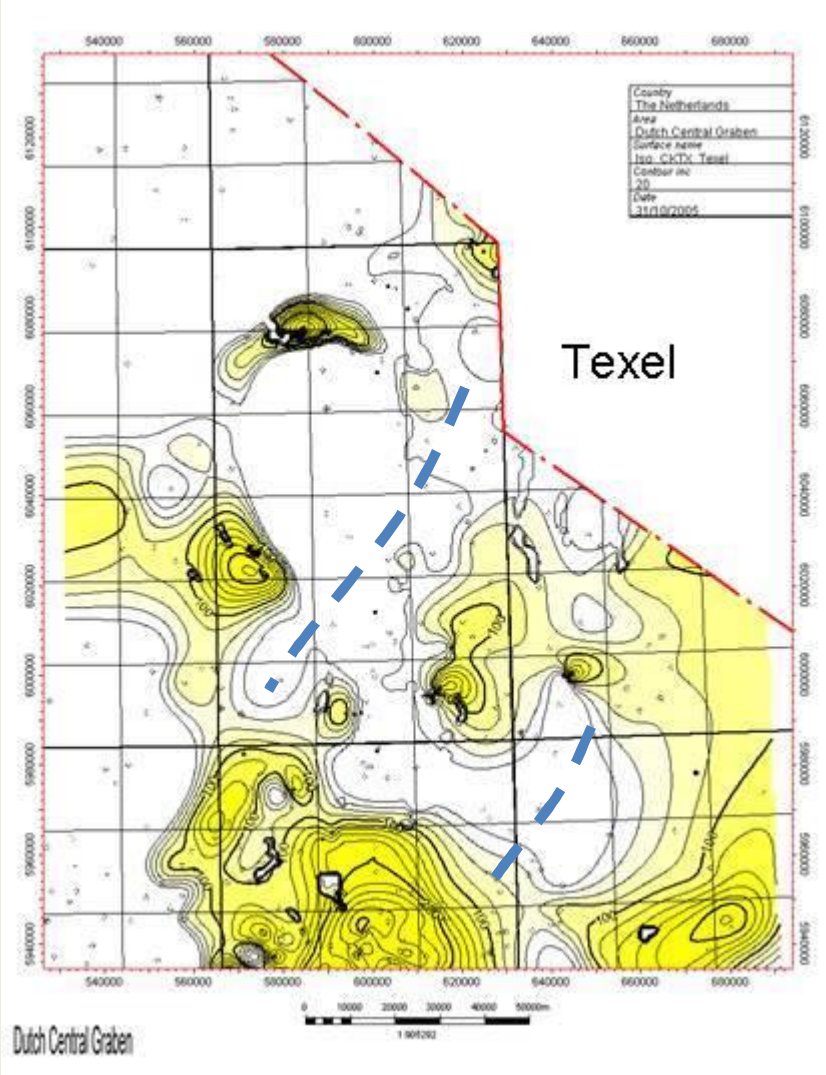
Schieland

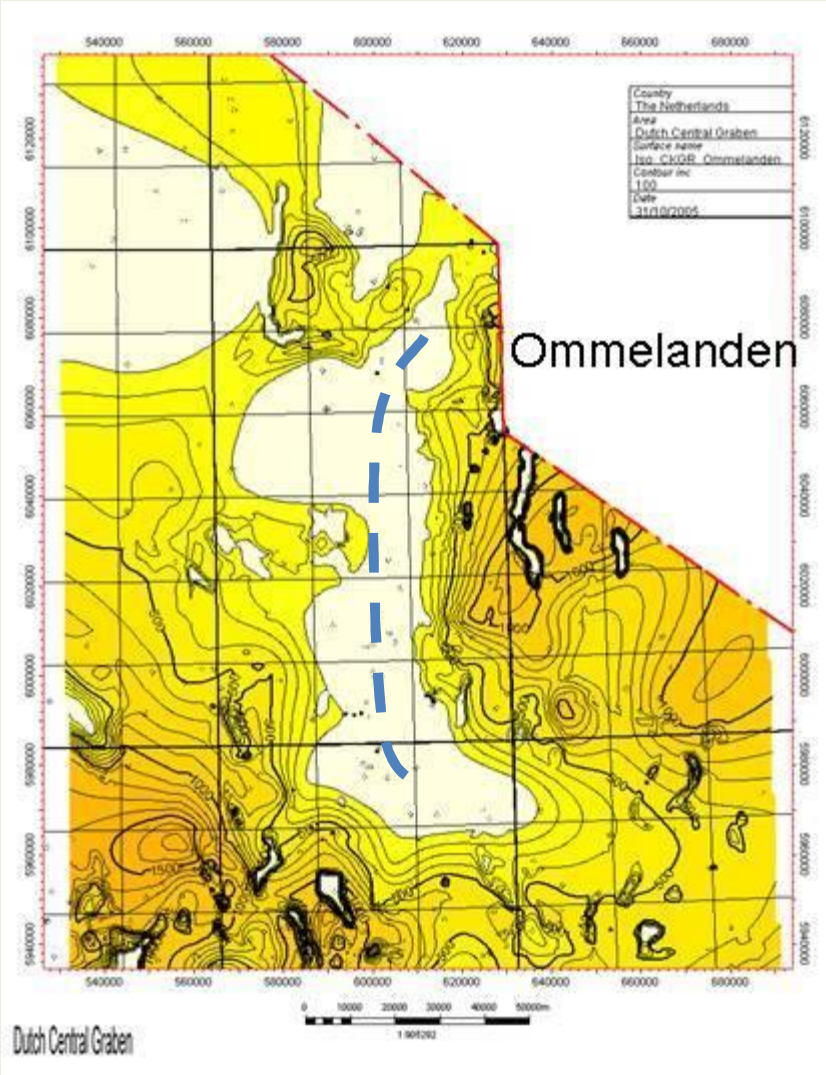
Lower Cretaceous



A 3D geological model of the Dutch Central Graben

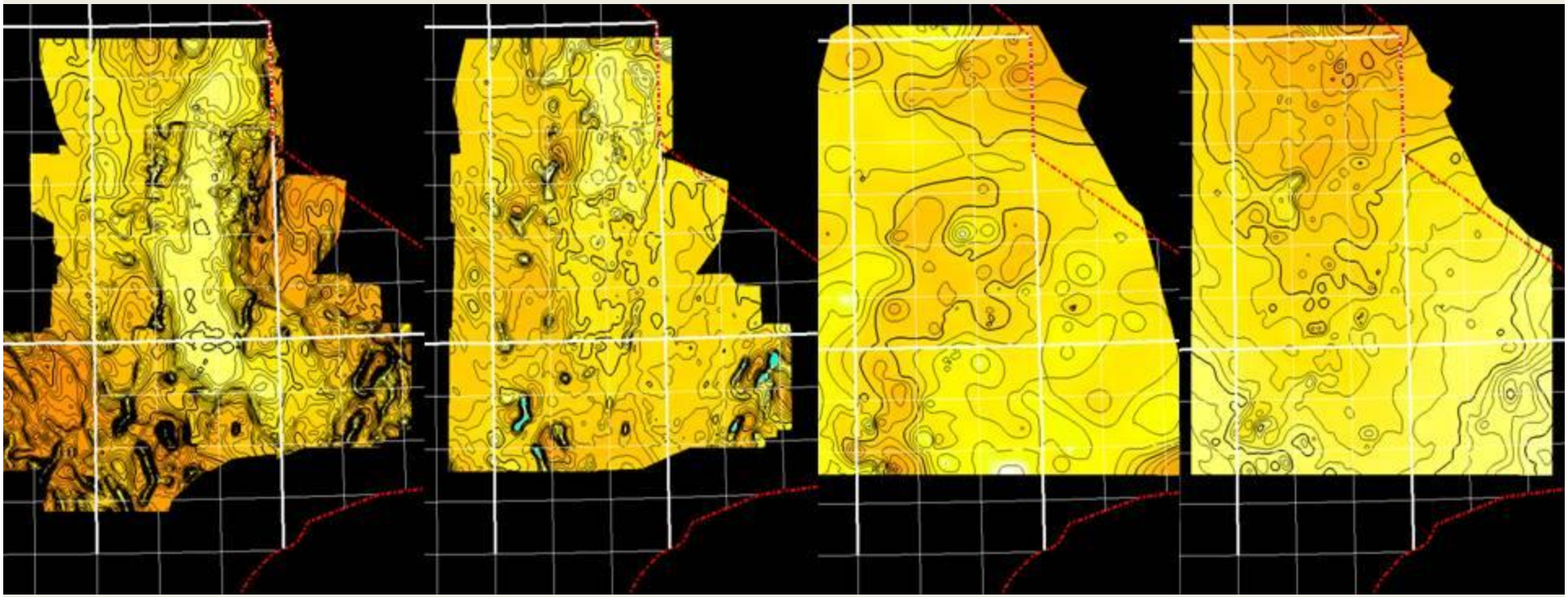
Mega structure - Inversion





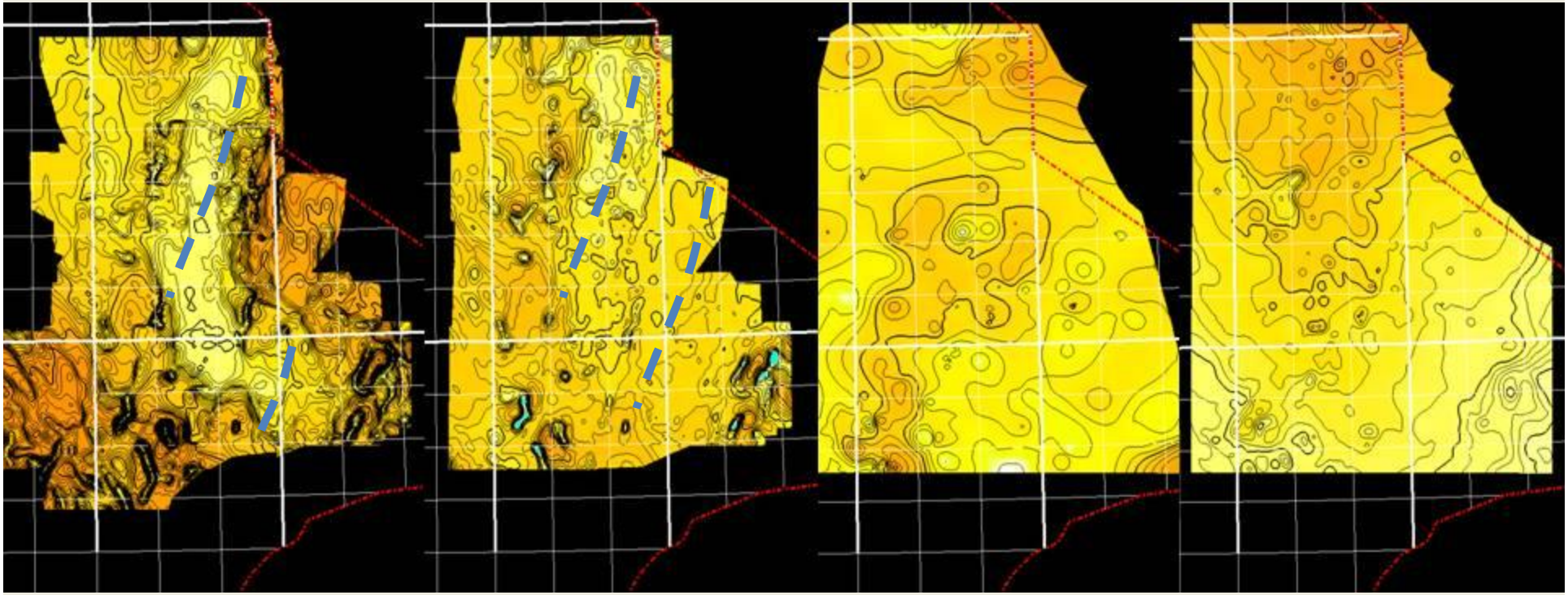
Mega structure

Cretaceous and Tertiary isopachs



Upper Cretaceous Lower North Sea Mid North Sea Upper North Sea

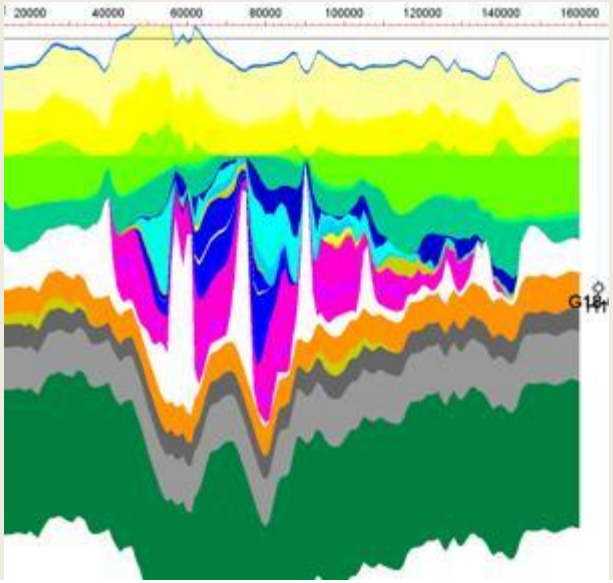
Mega structure
Cretaceous and Tertiary isopachs



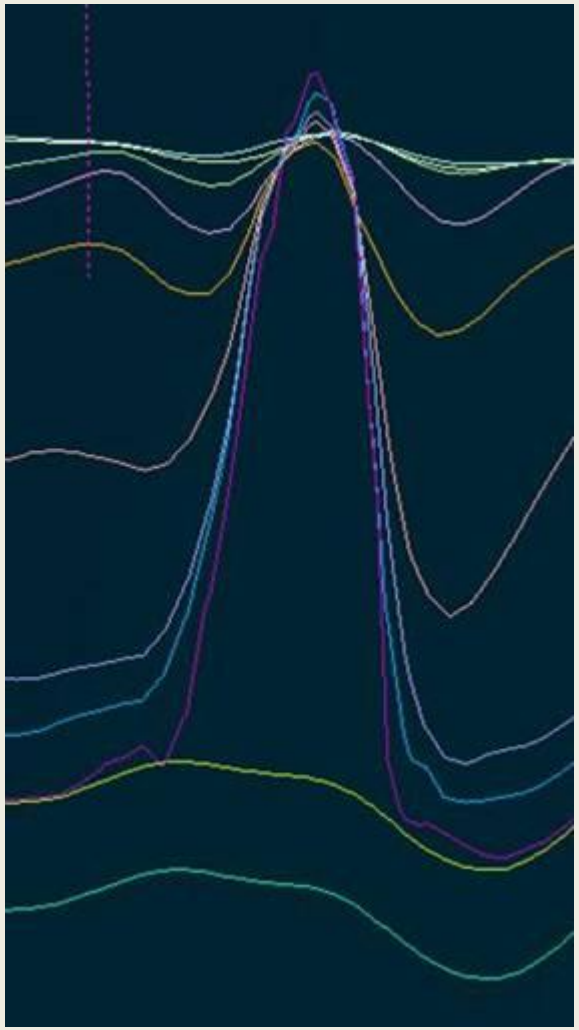
Upper Cretaceous | Lower North Sea | Mid North Sea | Upper North Sea

Erosion Challenges

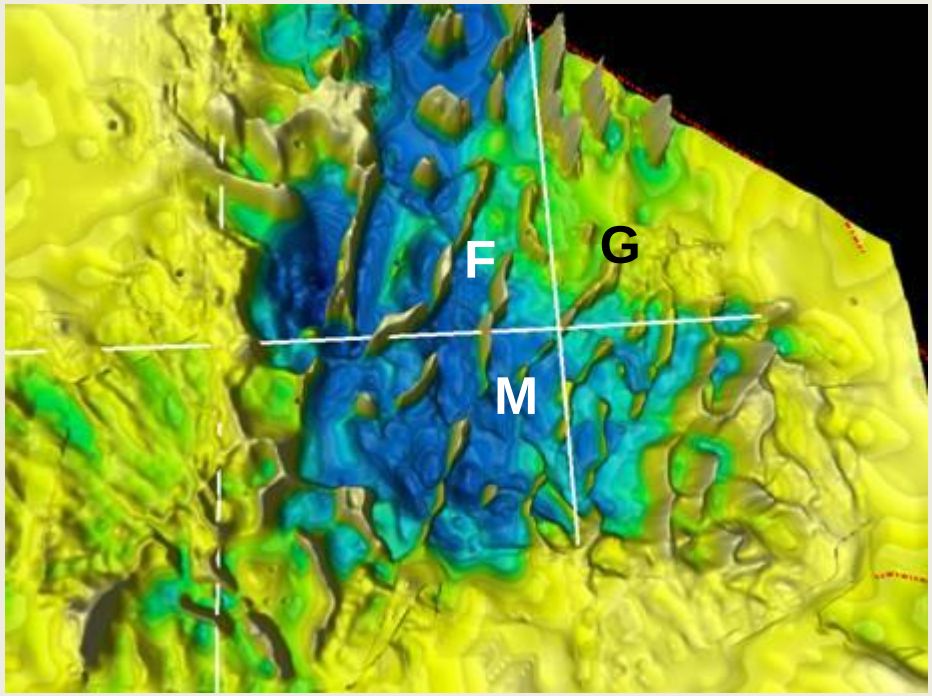
- Identification of missing section
  - Well data
  - Seismic (structural) interpretation
  - Regional trends
- No assistance form Vr profiles (present day overprint)
- Impact of salt-doming and salt-withdrawal on missing section



Salt challenges



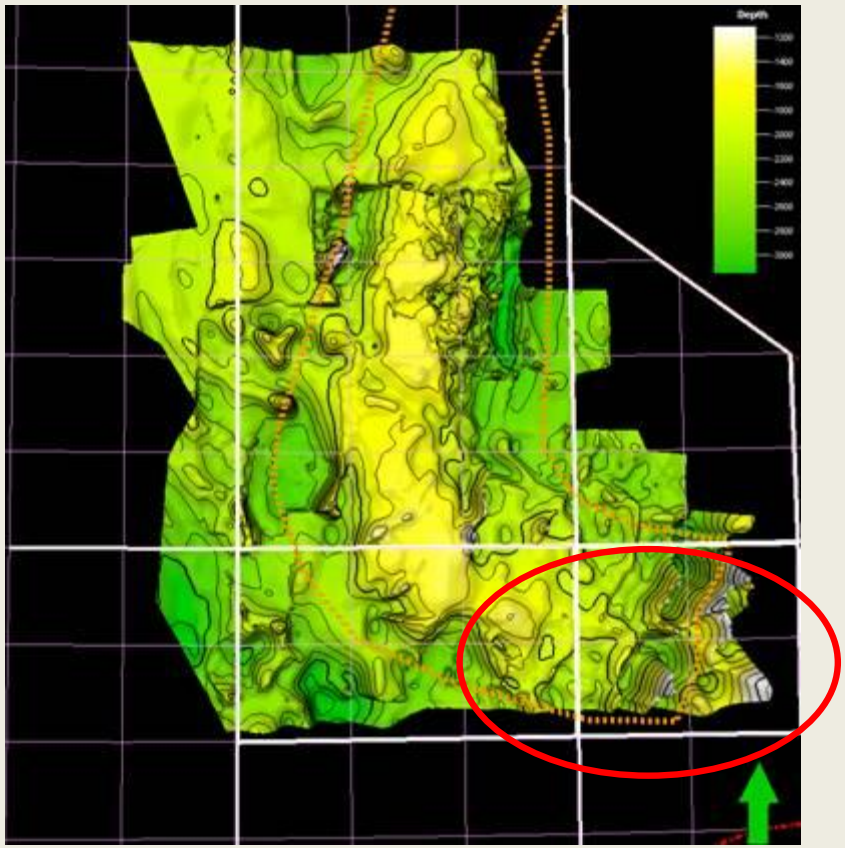
- Salt hard to model
- Salt affects isopachs overburden



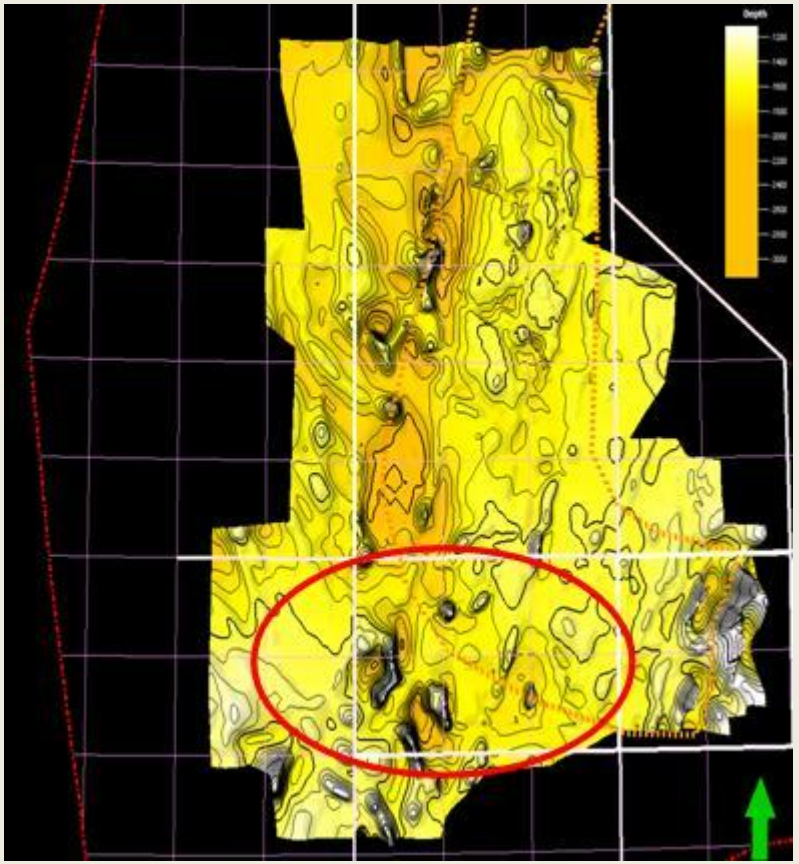
Base Triassic

Salt Challenges

Salt active in different periods



Base Cretaceous



Base Tertiary

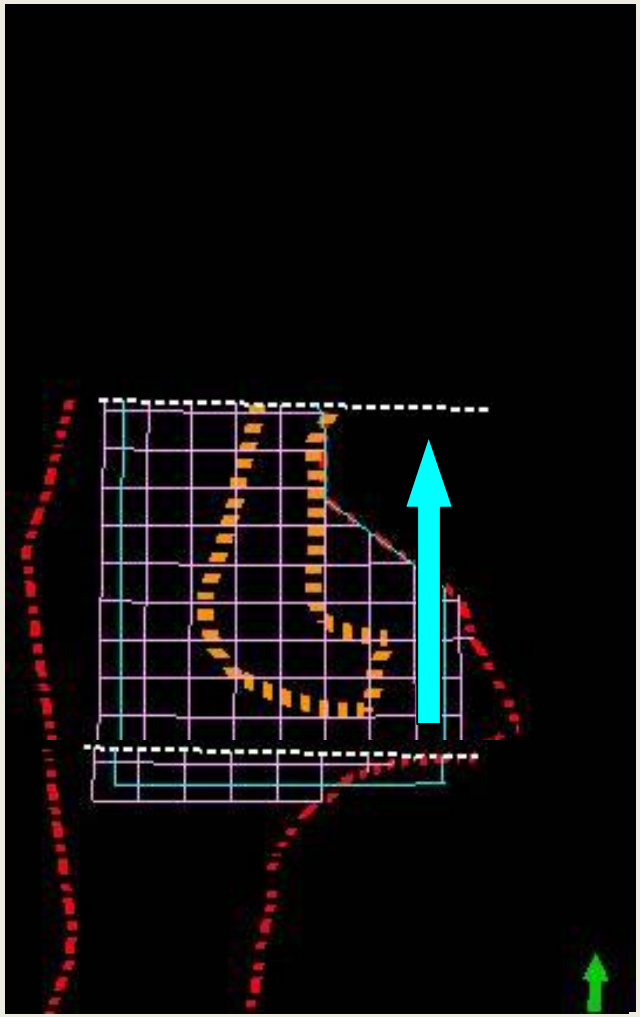
Conclusions

- 3D model
  - Good visualization
  - Easy to adjust
  - Easy to export
  - Limitations with salt in the model
  - Erosion can be estimated better with model

Conclusions

- Structural model Dutch Central Graben
  - Terschelling Basin area different compared to Step Graben Area in the North
  - Central Graben subdivision in Northern-, Mid- and Southern-area
  - Inversion direction N-S
  - Salt domes indicate late movements southern area

E-W sections – Dutch Central Graben



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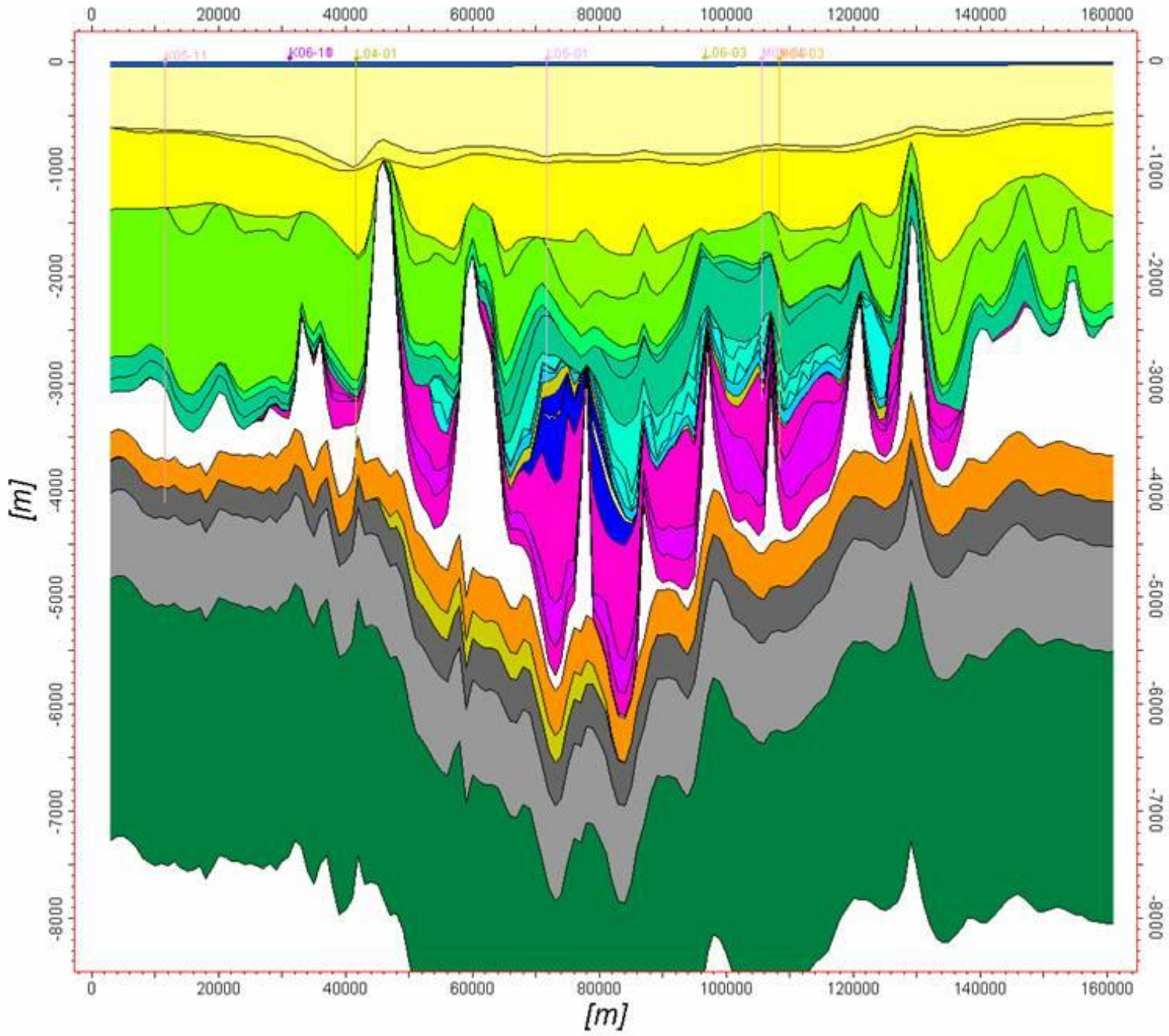
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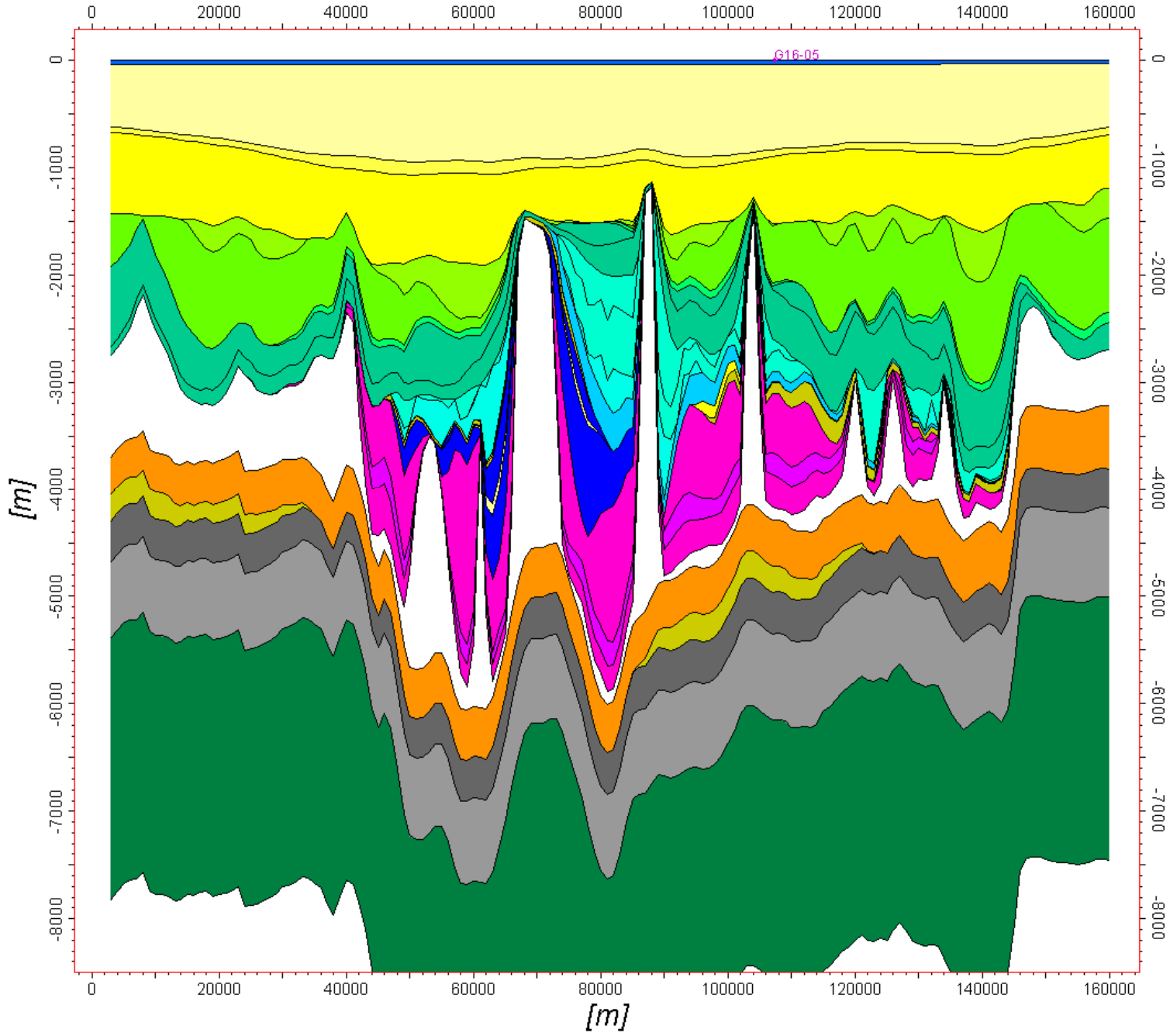
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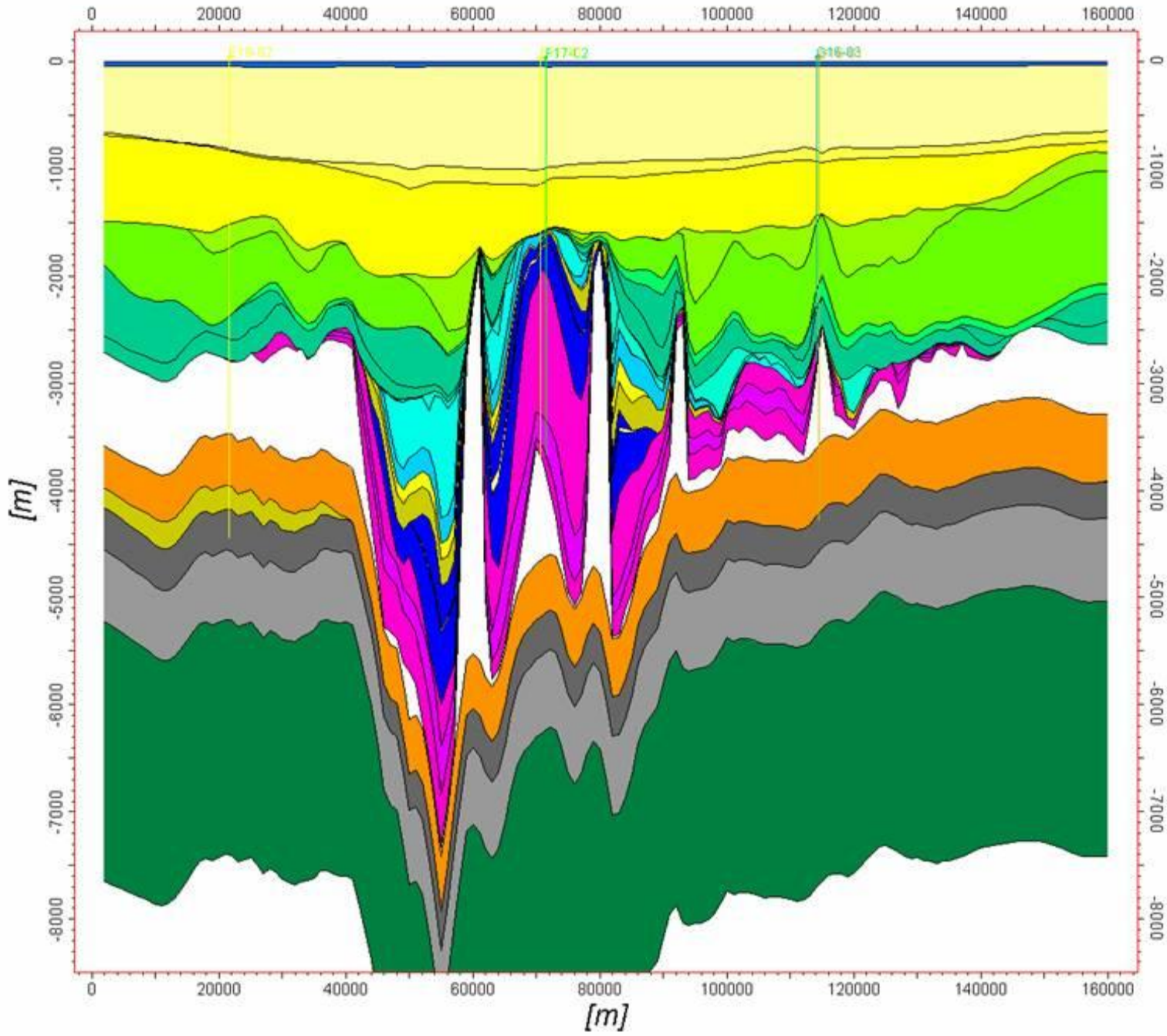
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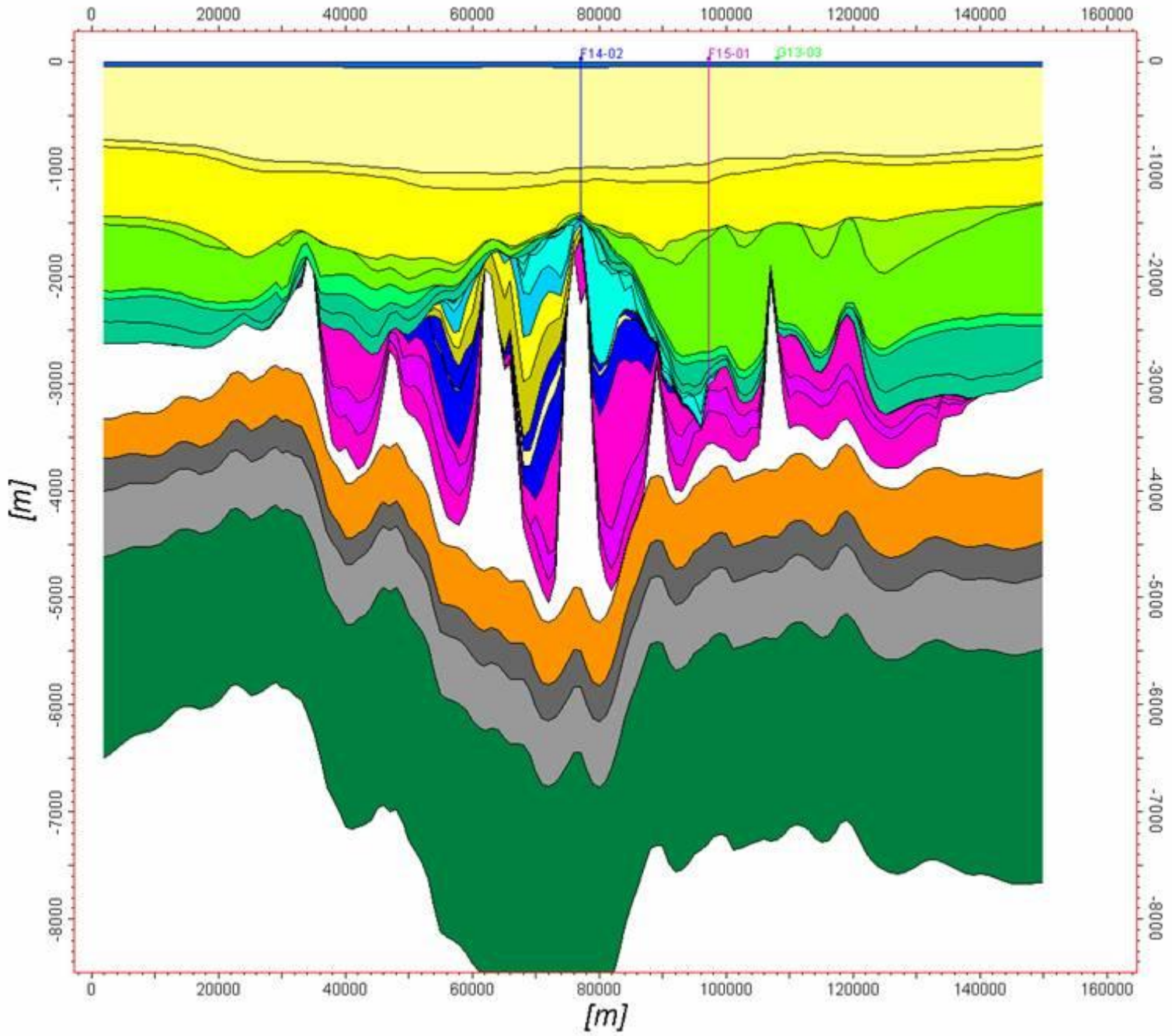
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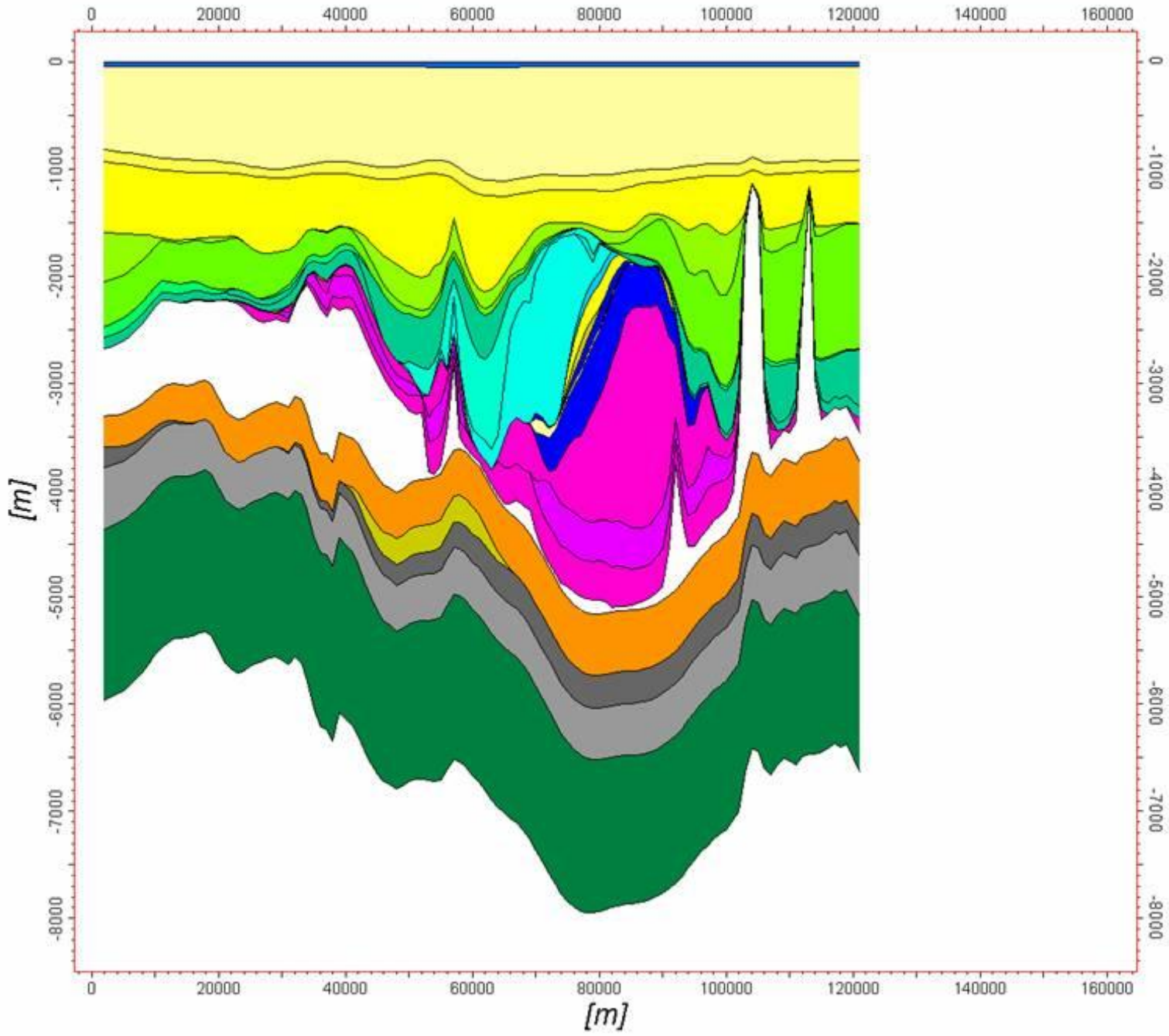
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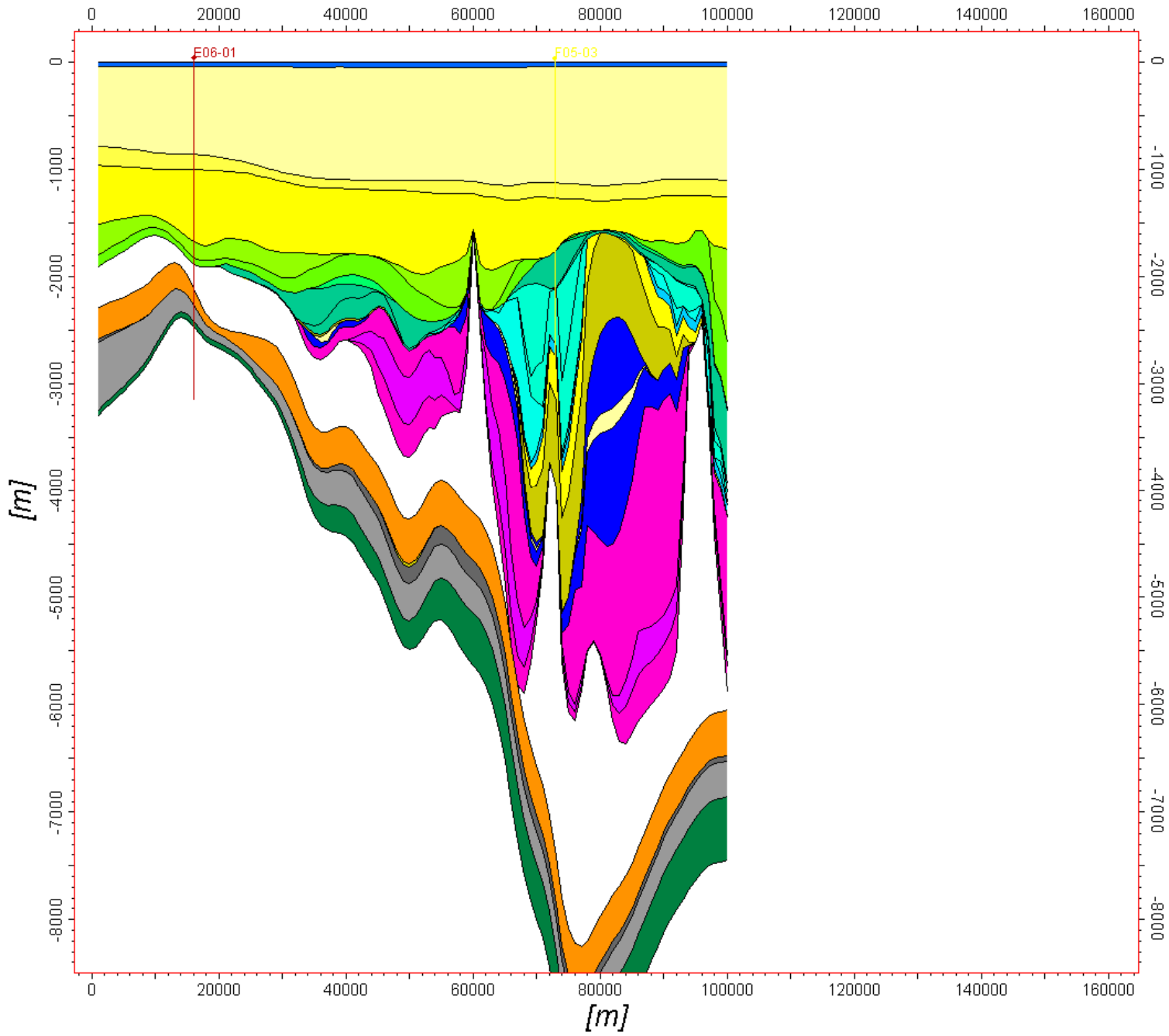
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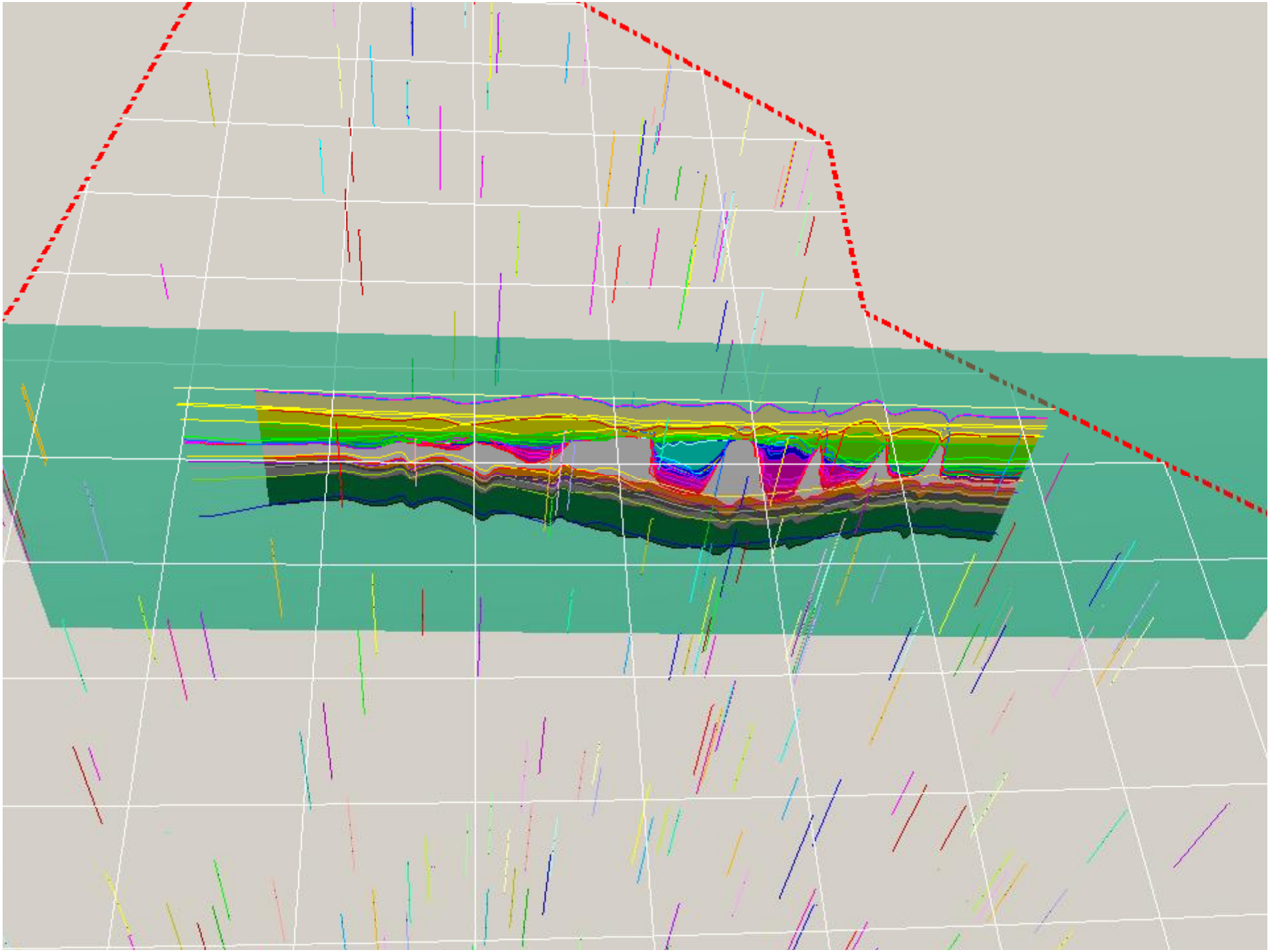
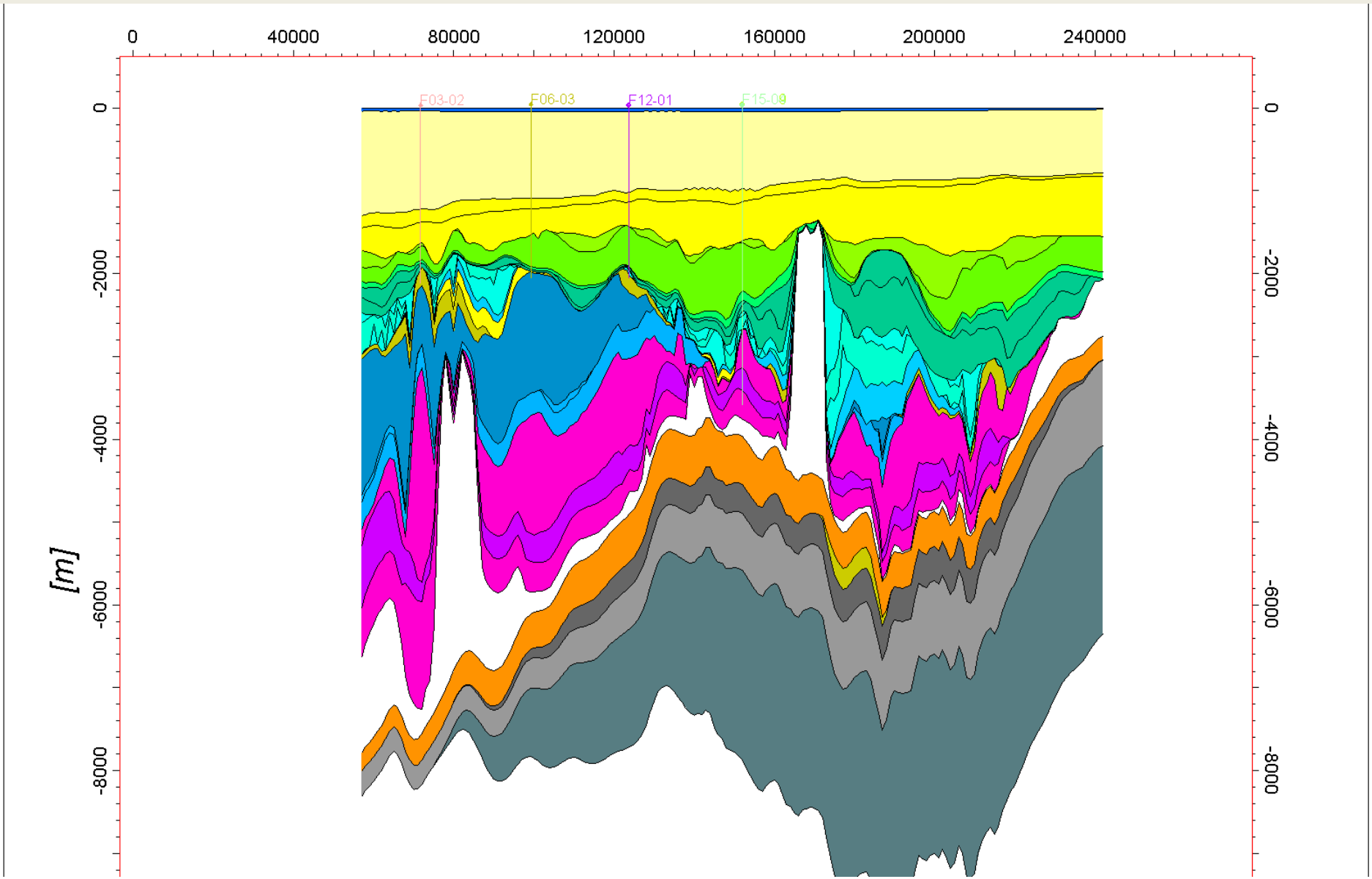
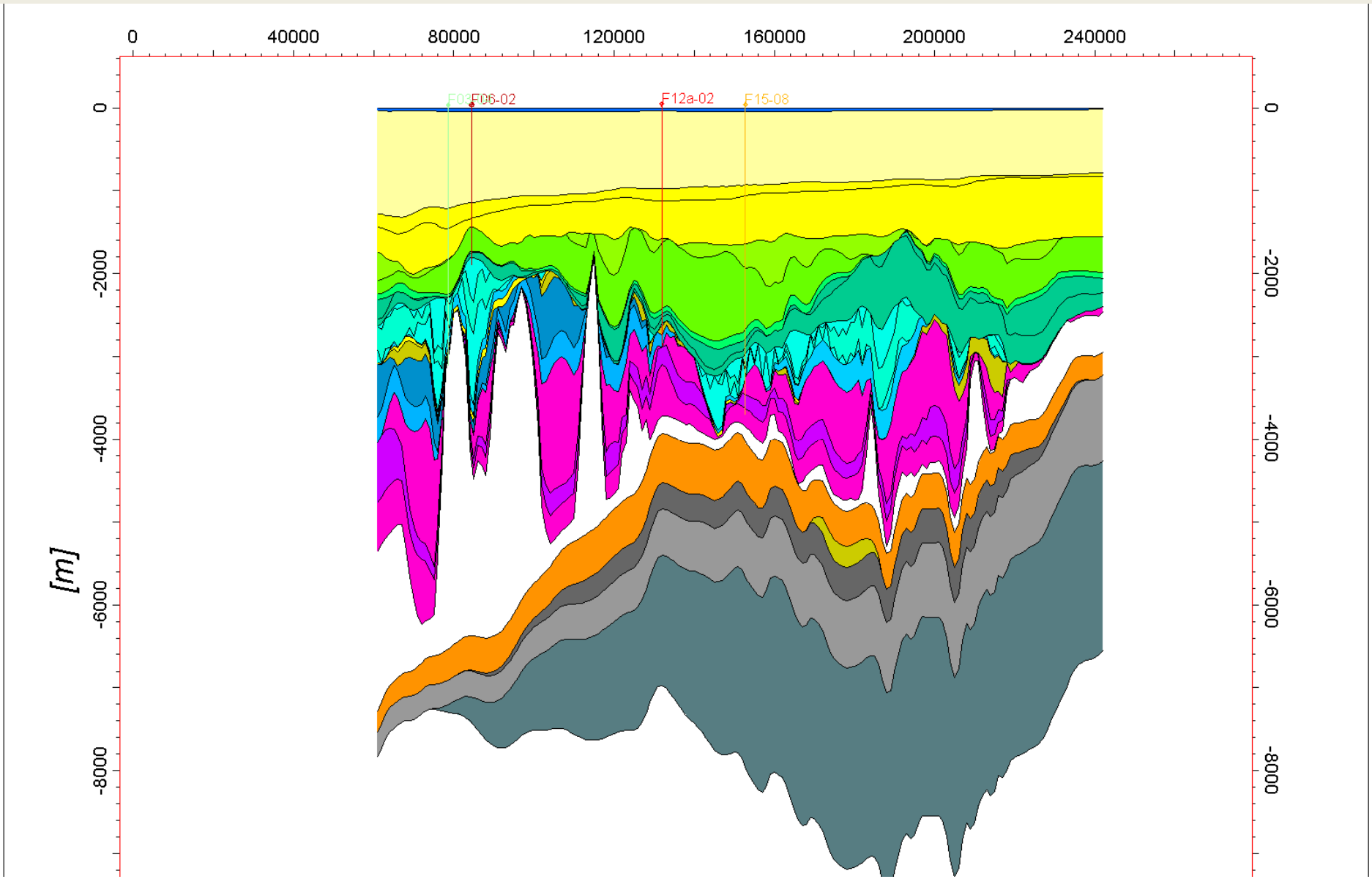


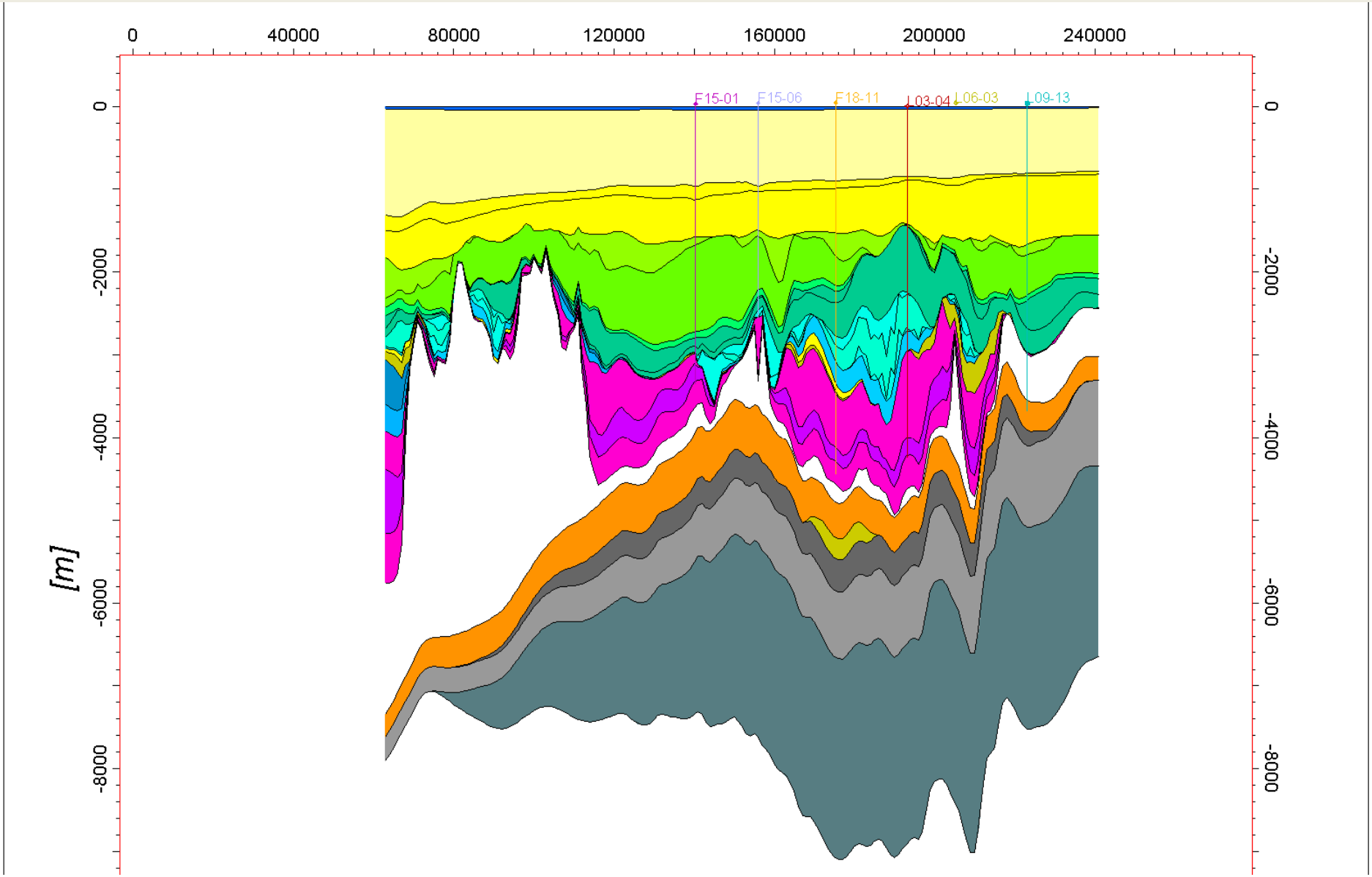
N-S sections 1

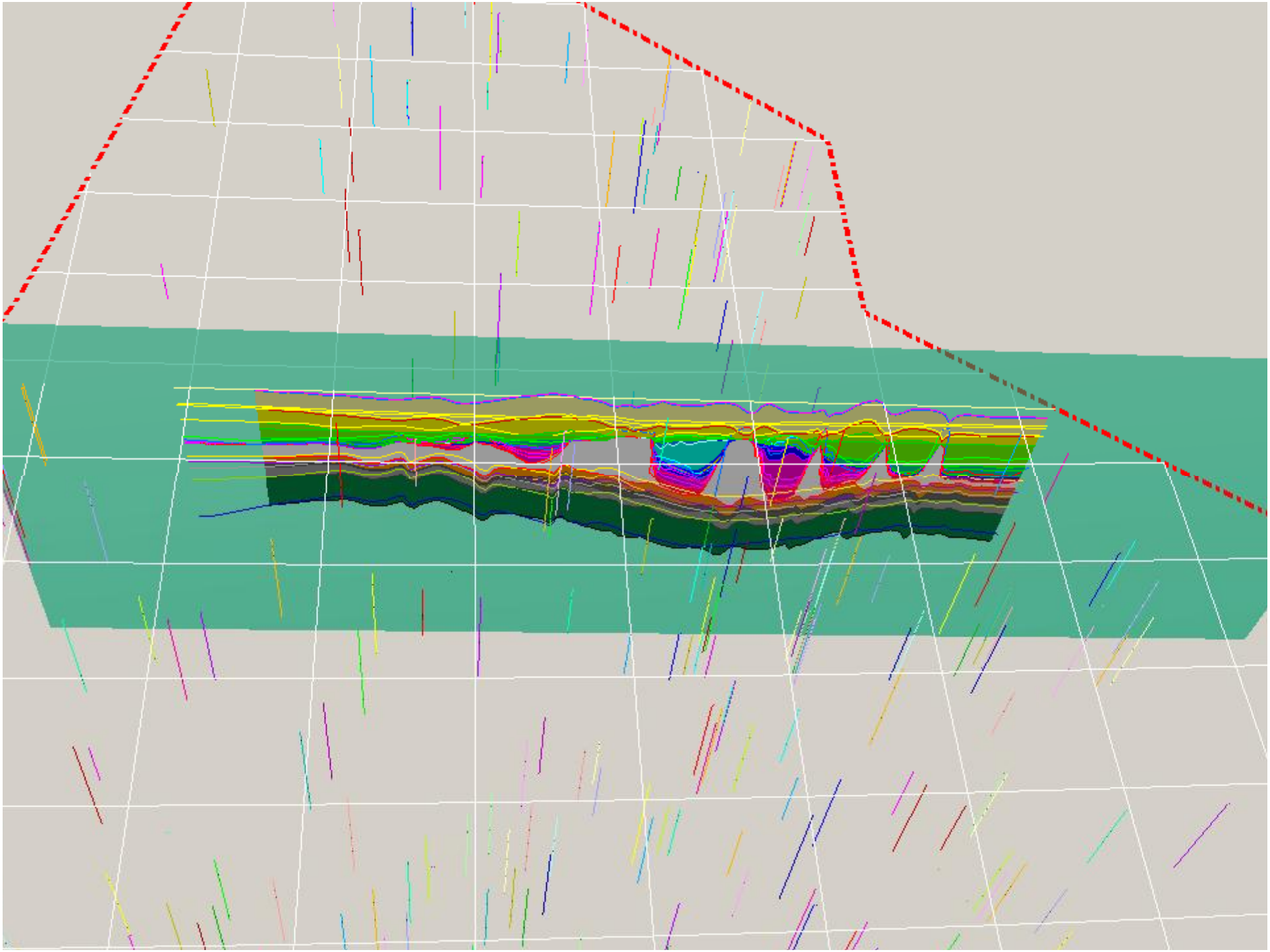


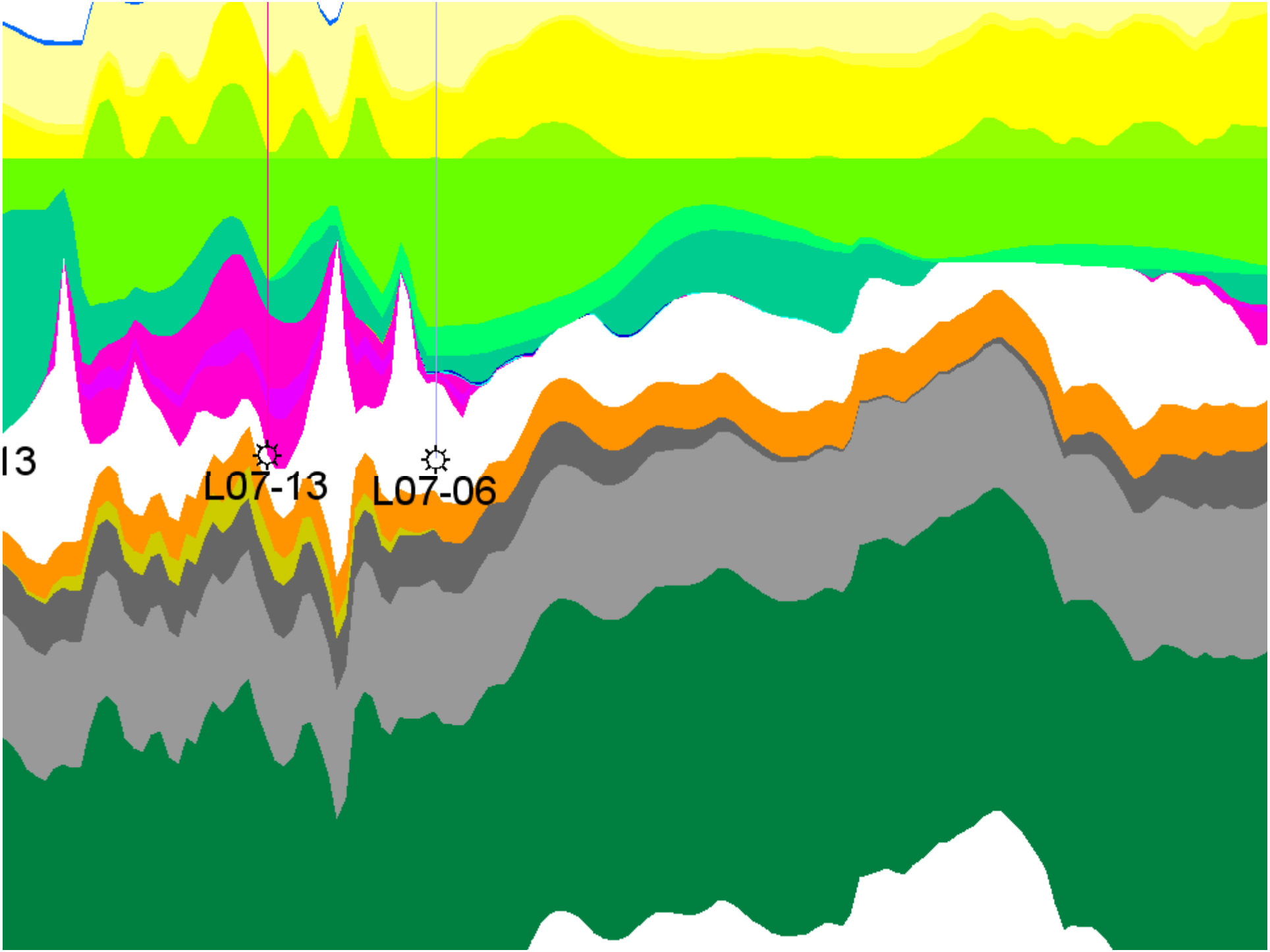
N-S sections 2



N-S sections 3



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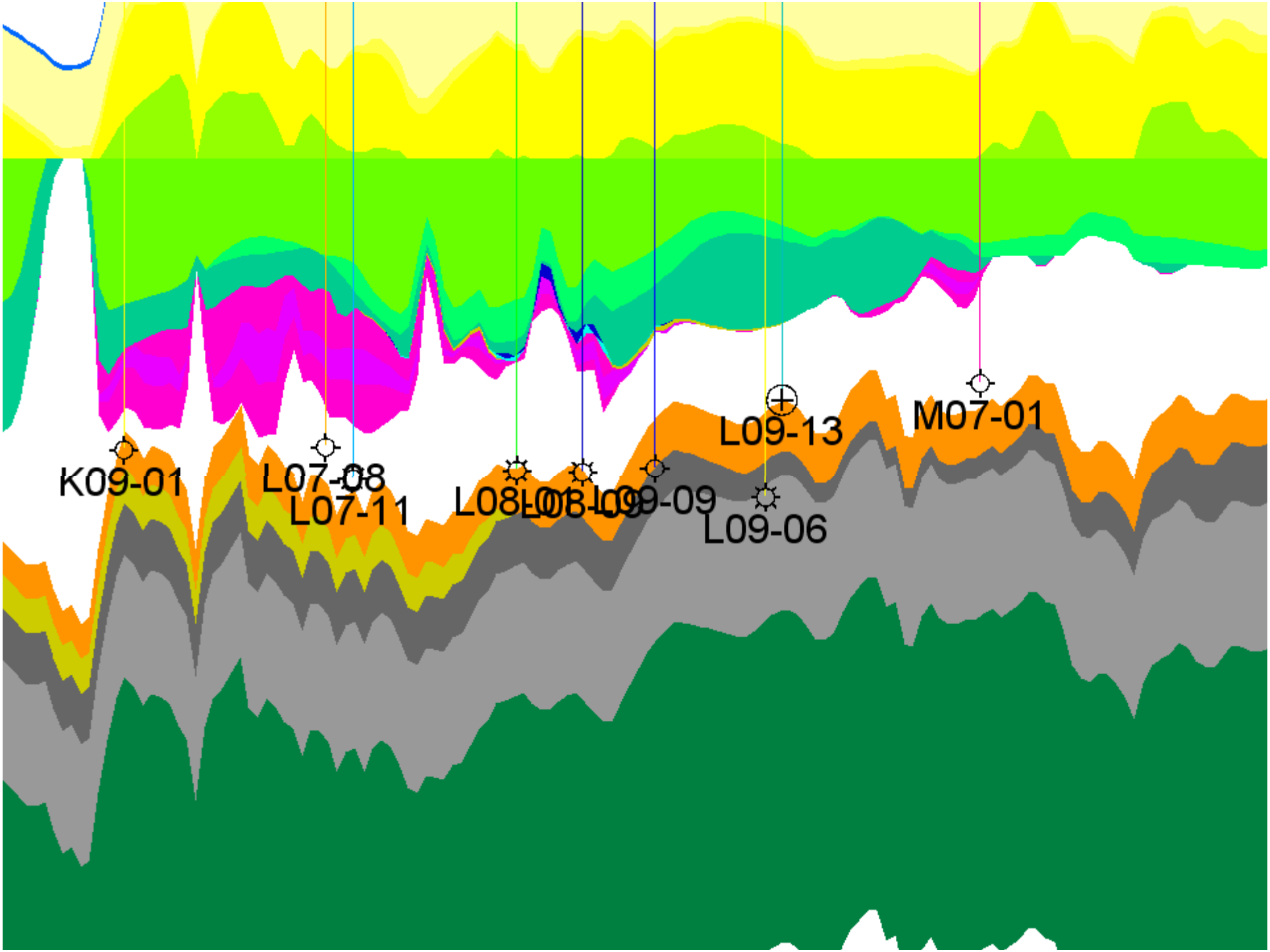
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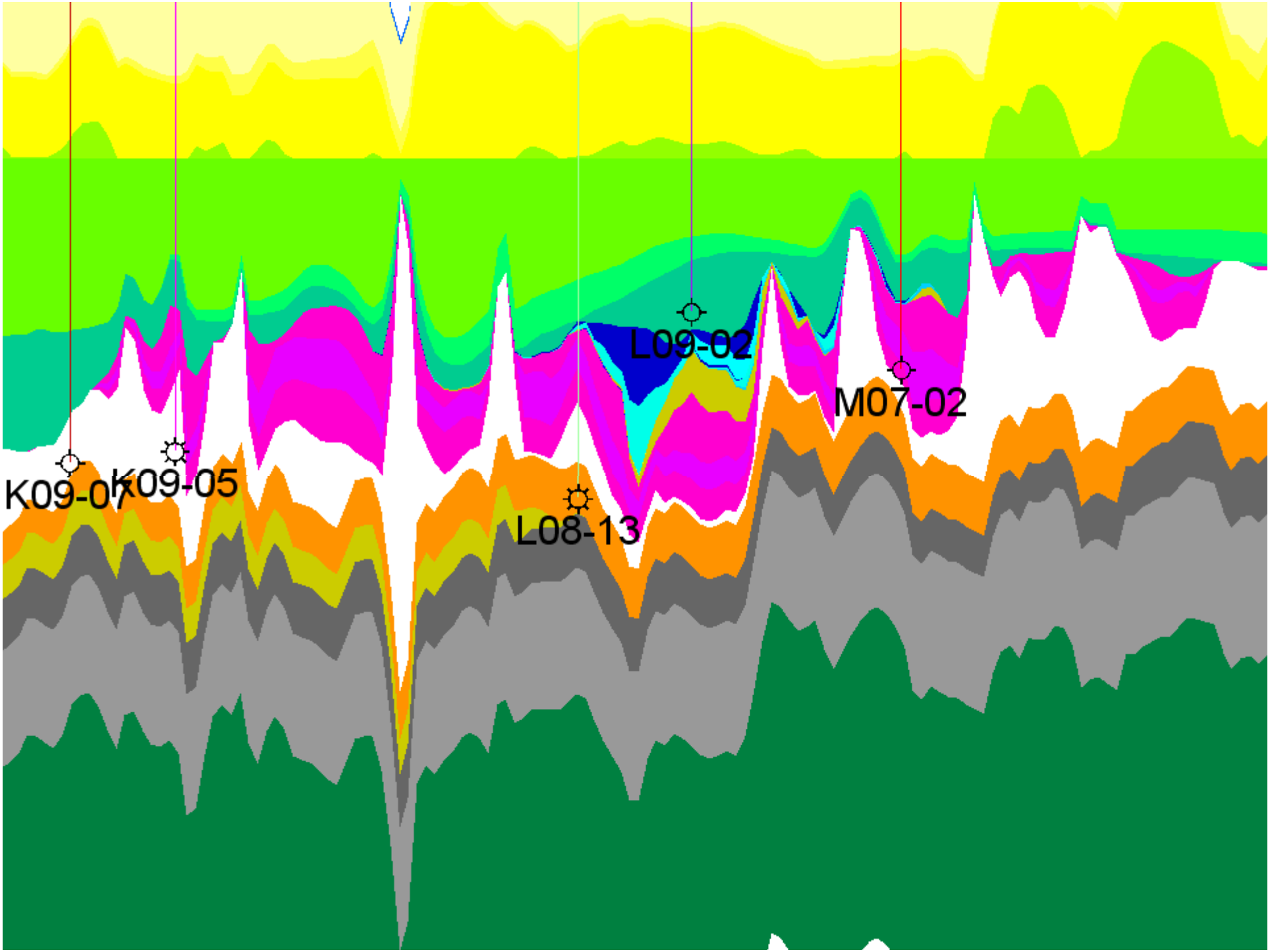
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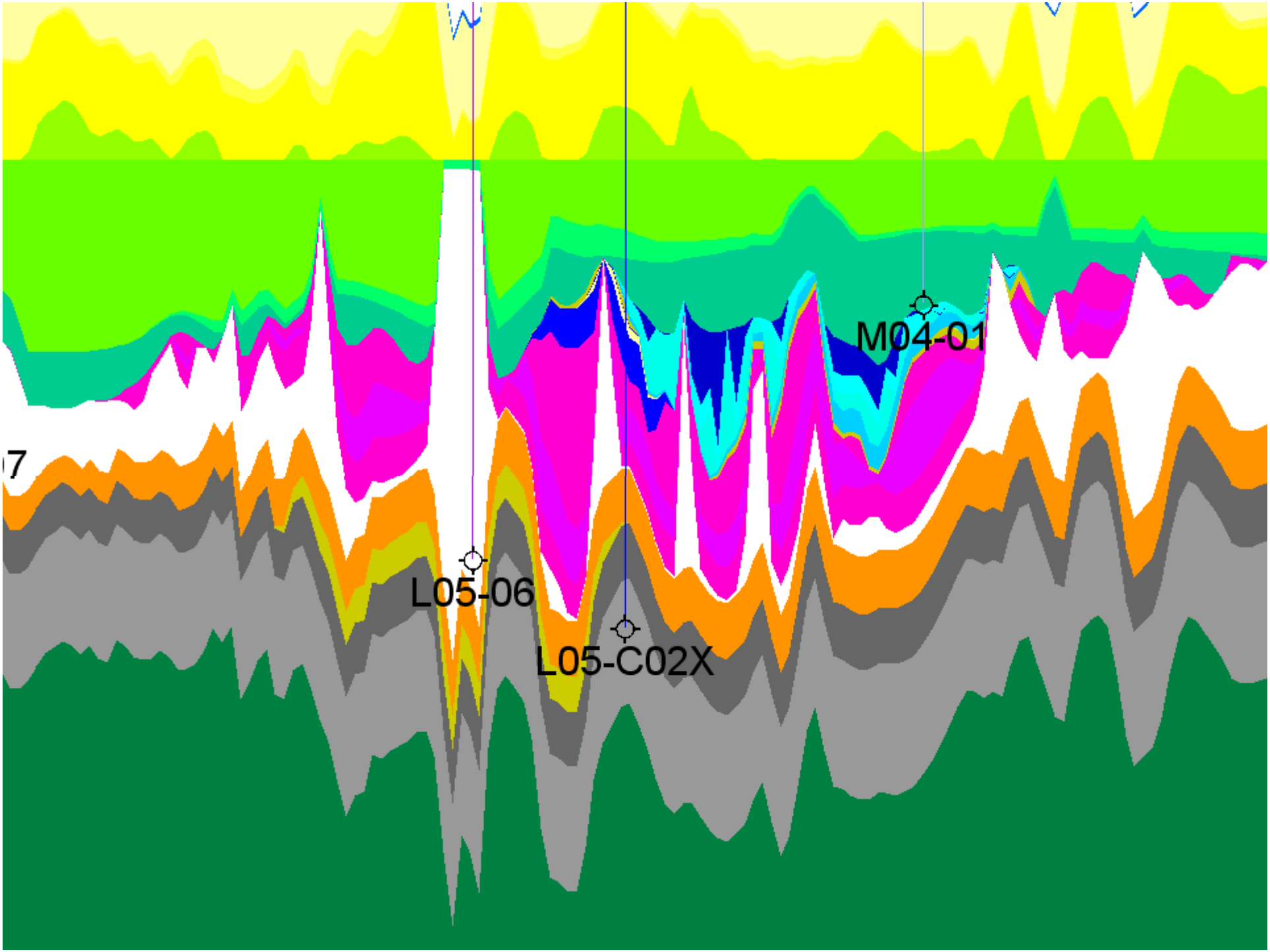
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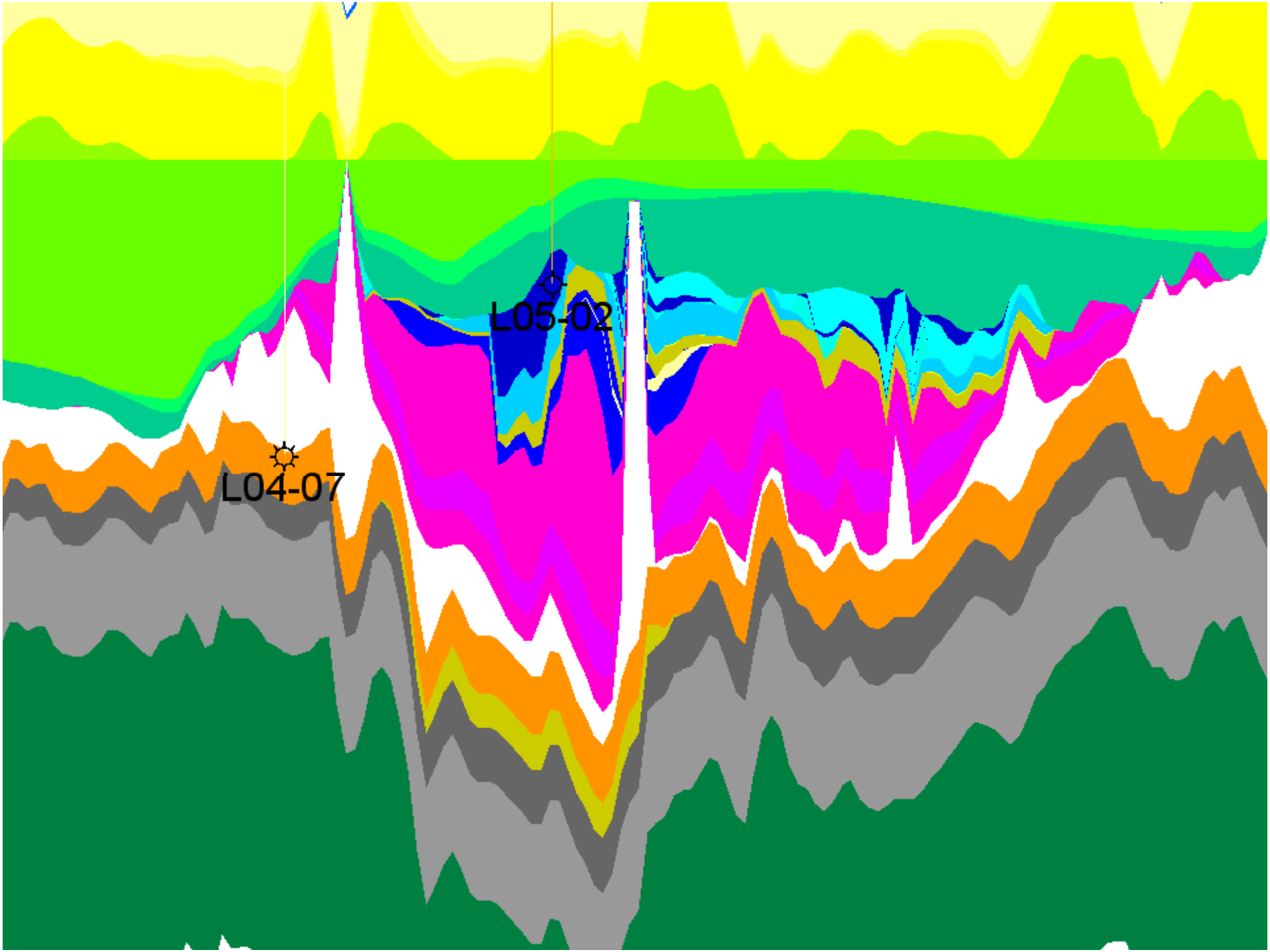
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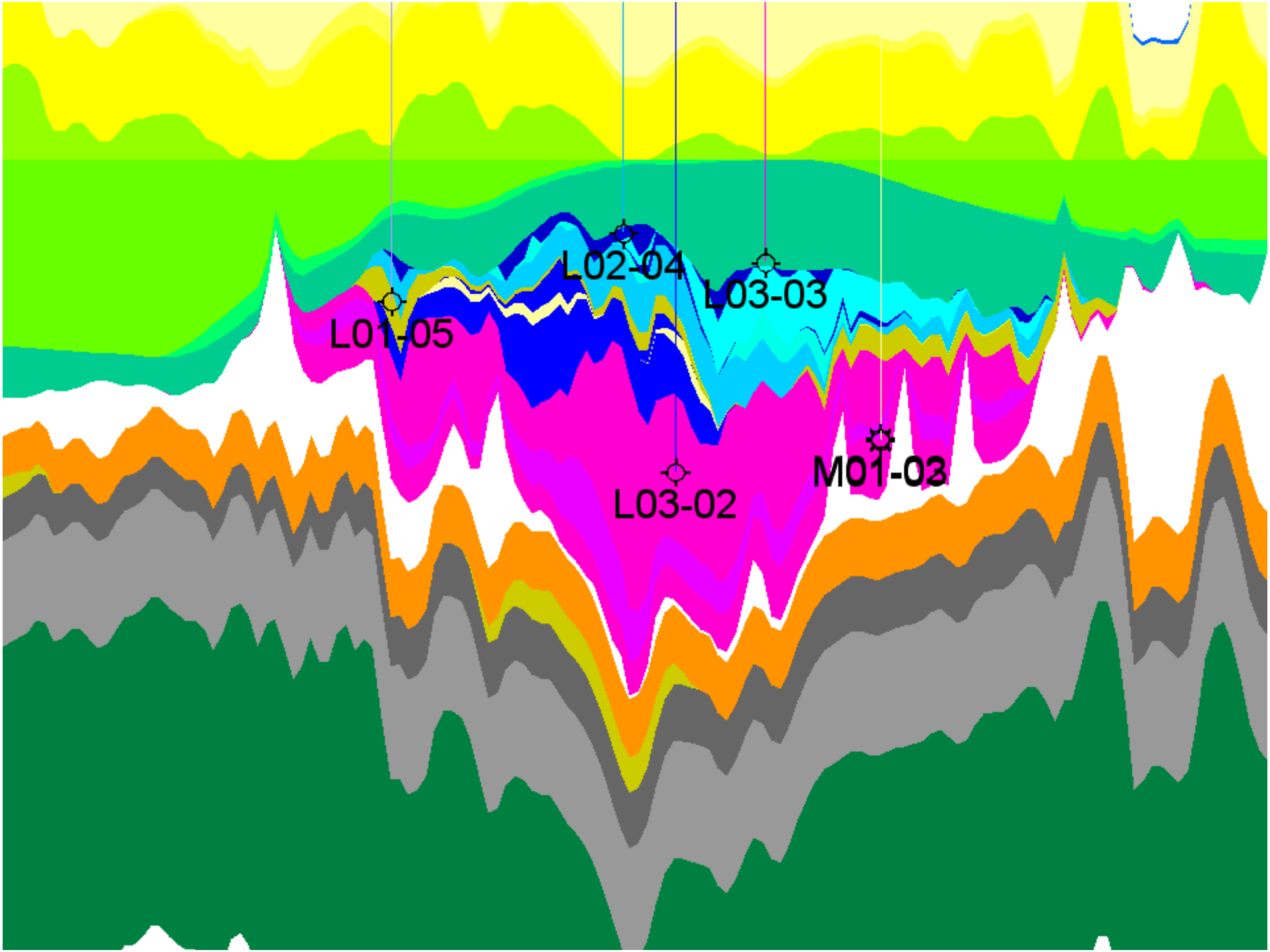
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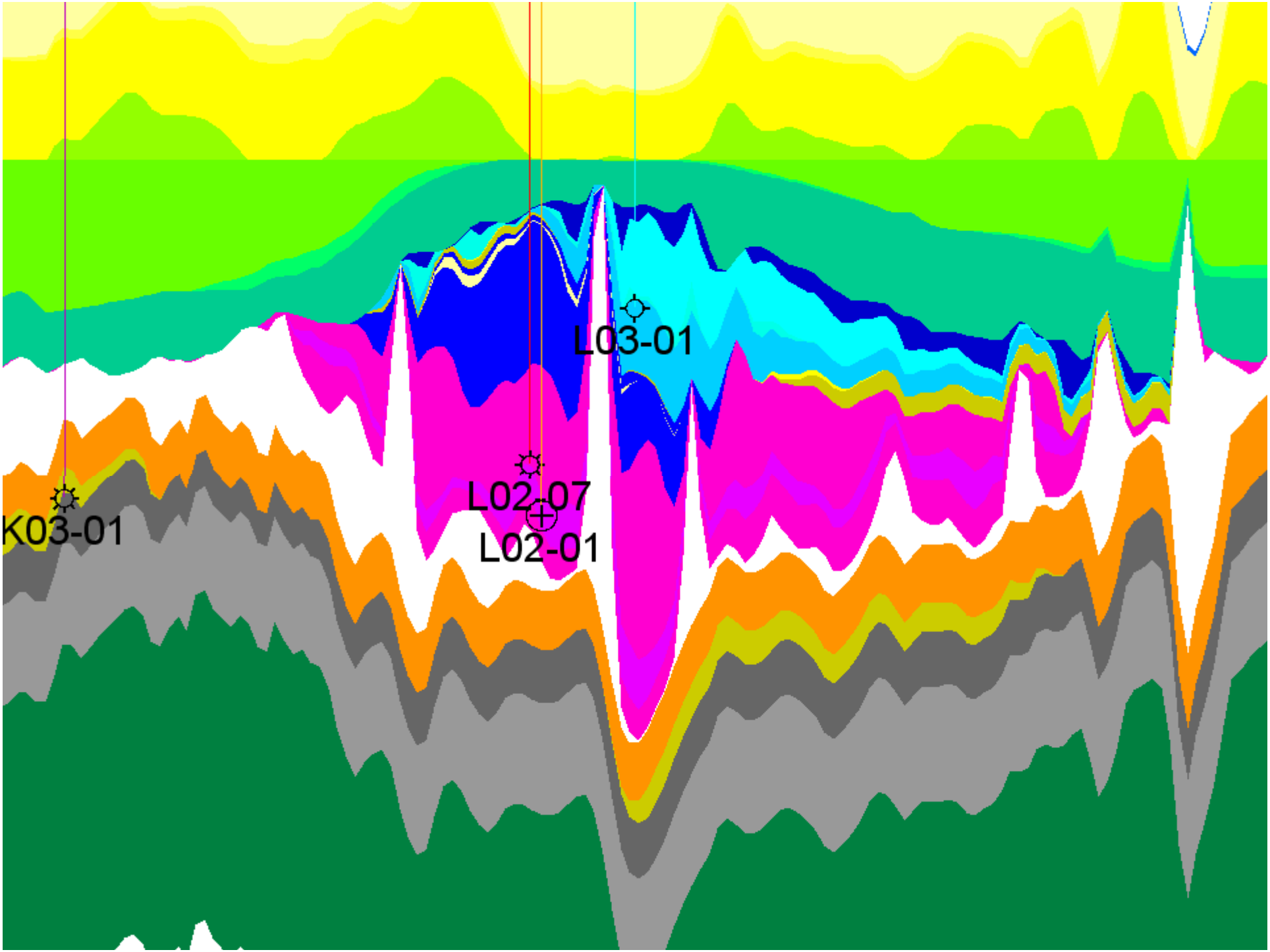
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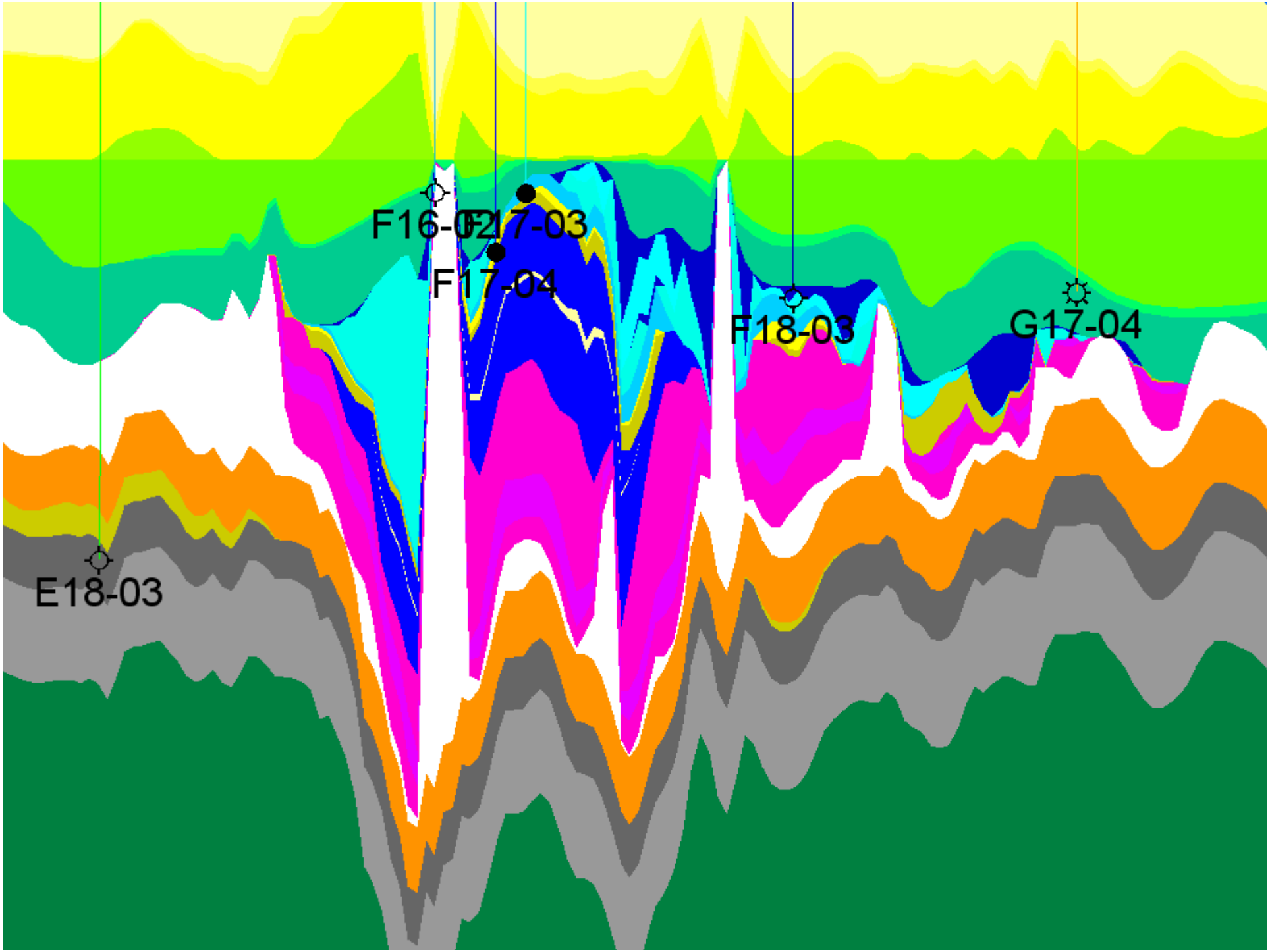
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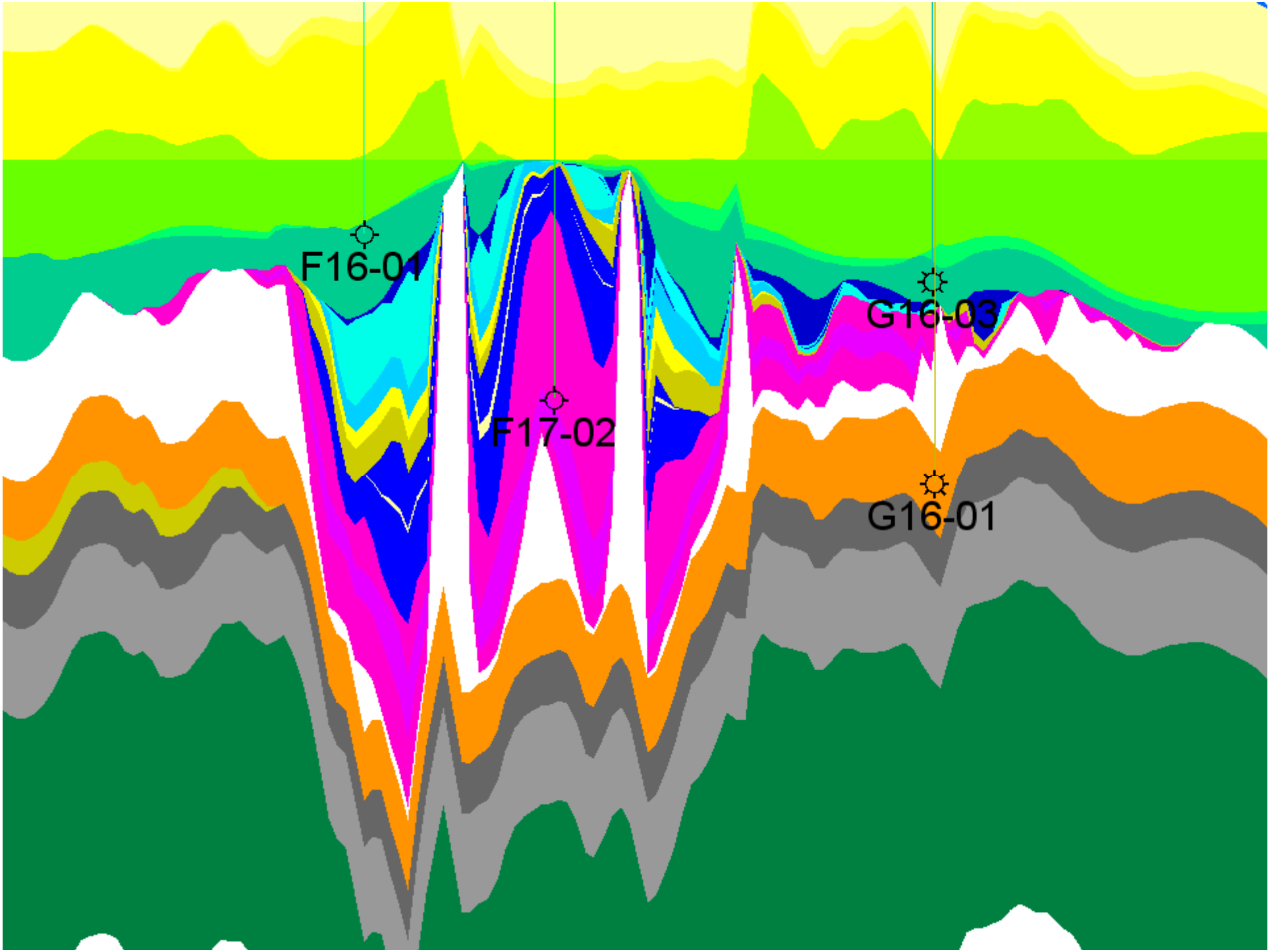
F17-03
F17-04
F18-03
G17-04
E18-03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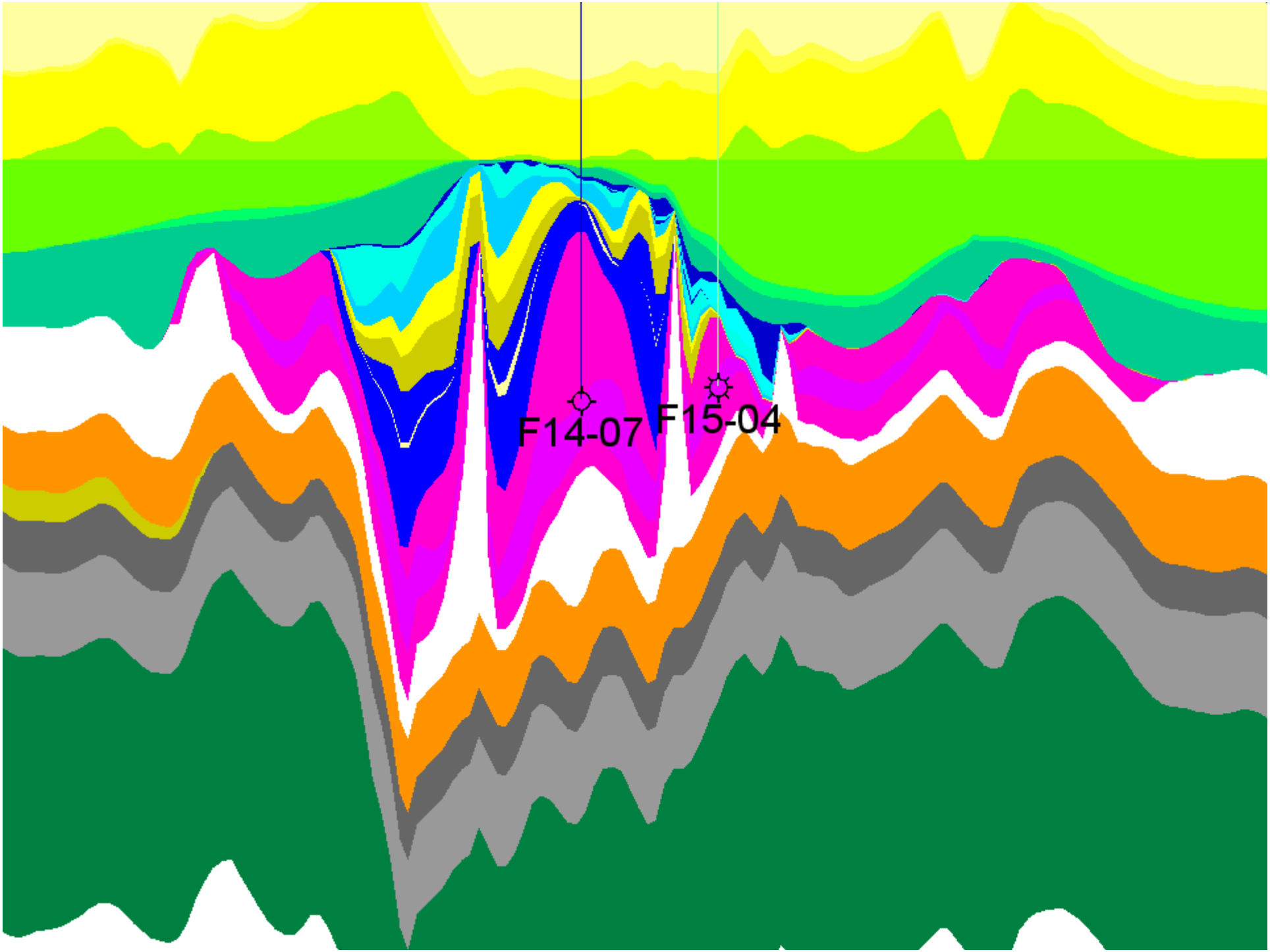
G16-01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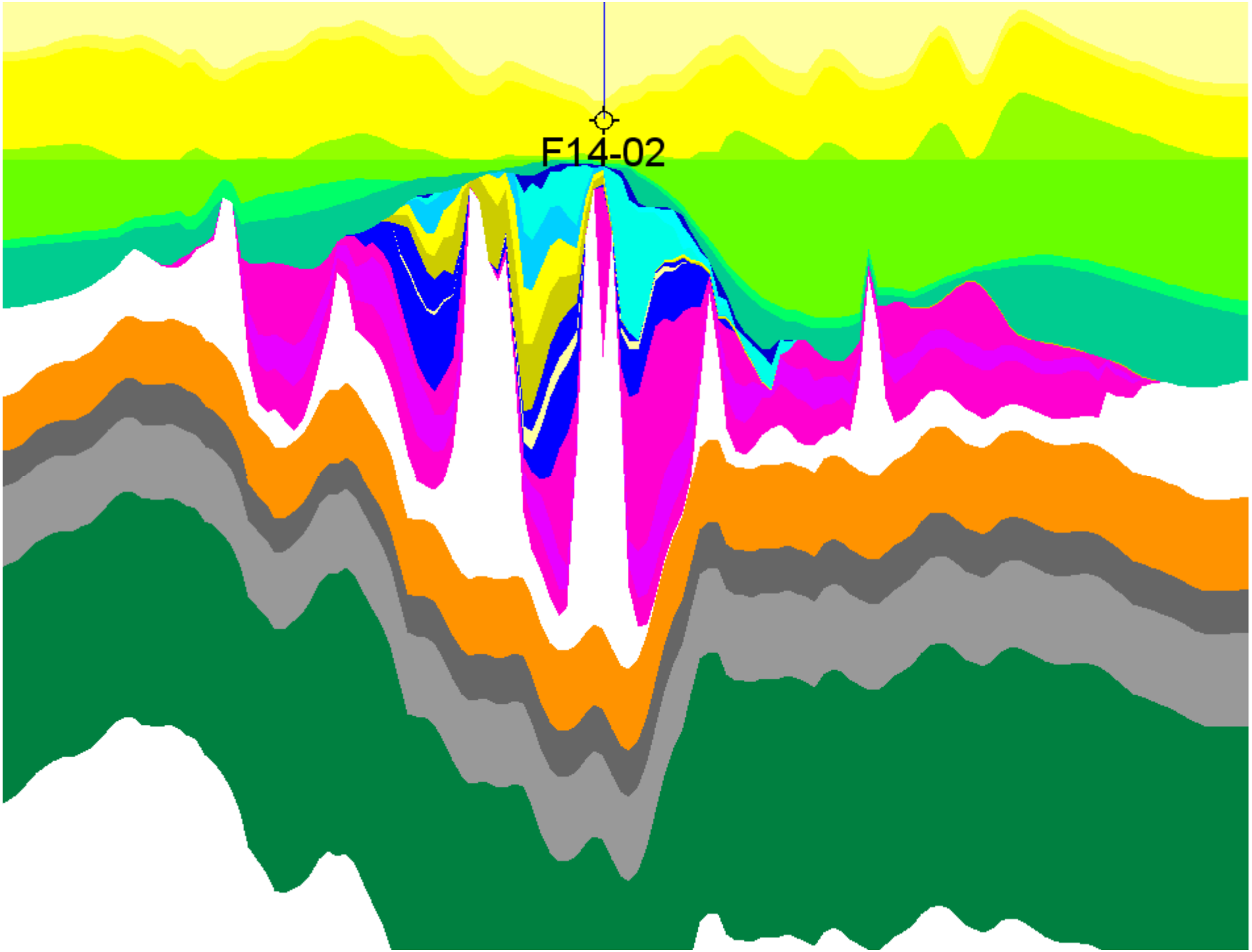
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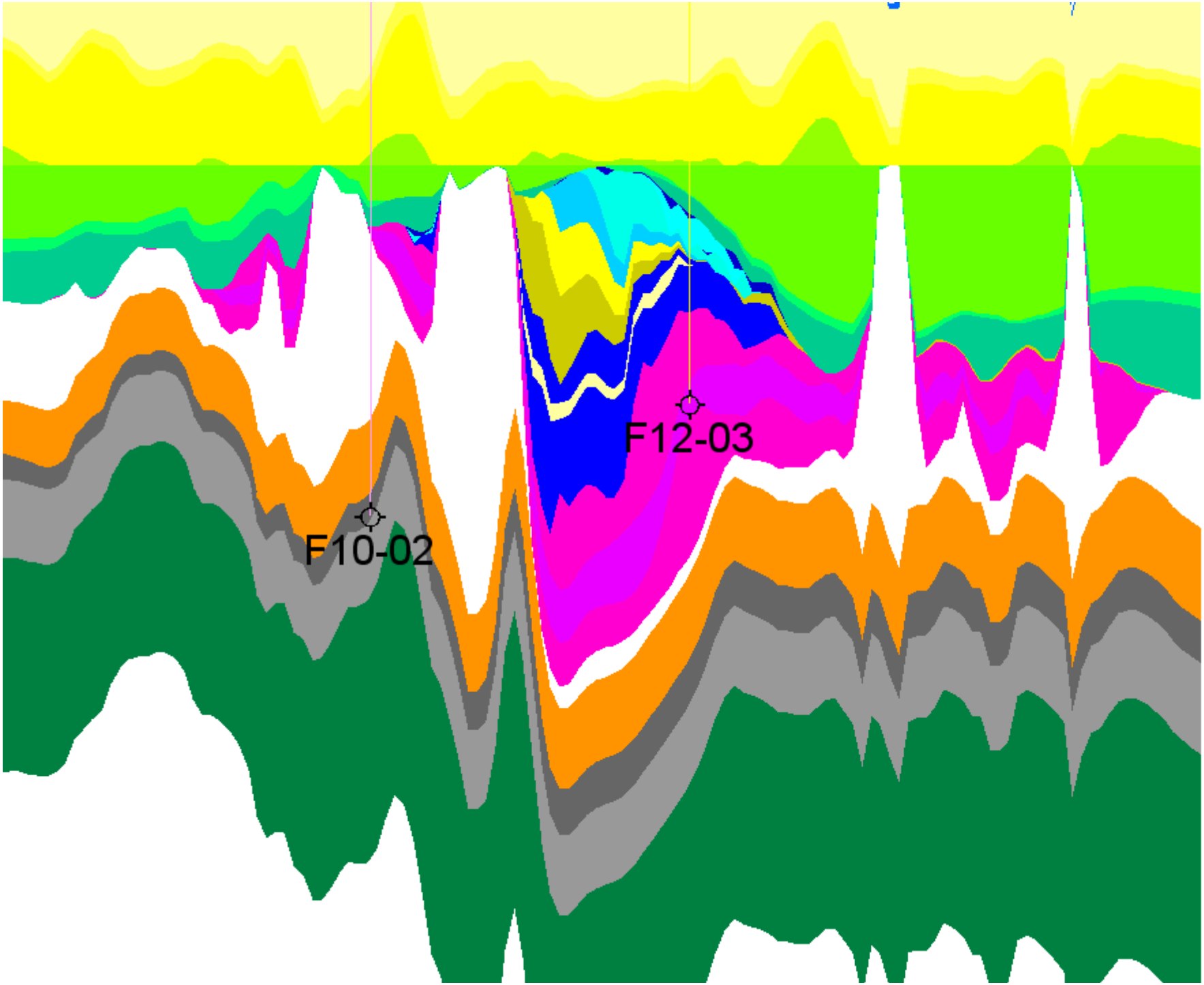
F12-03
F10-02