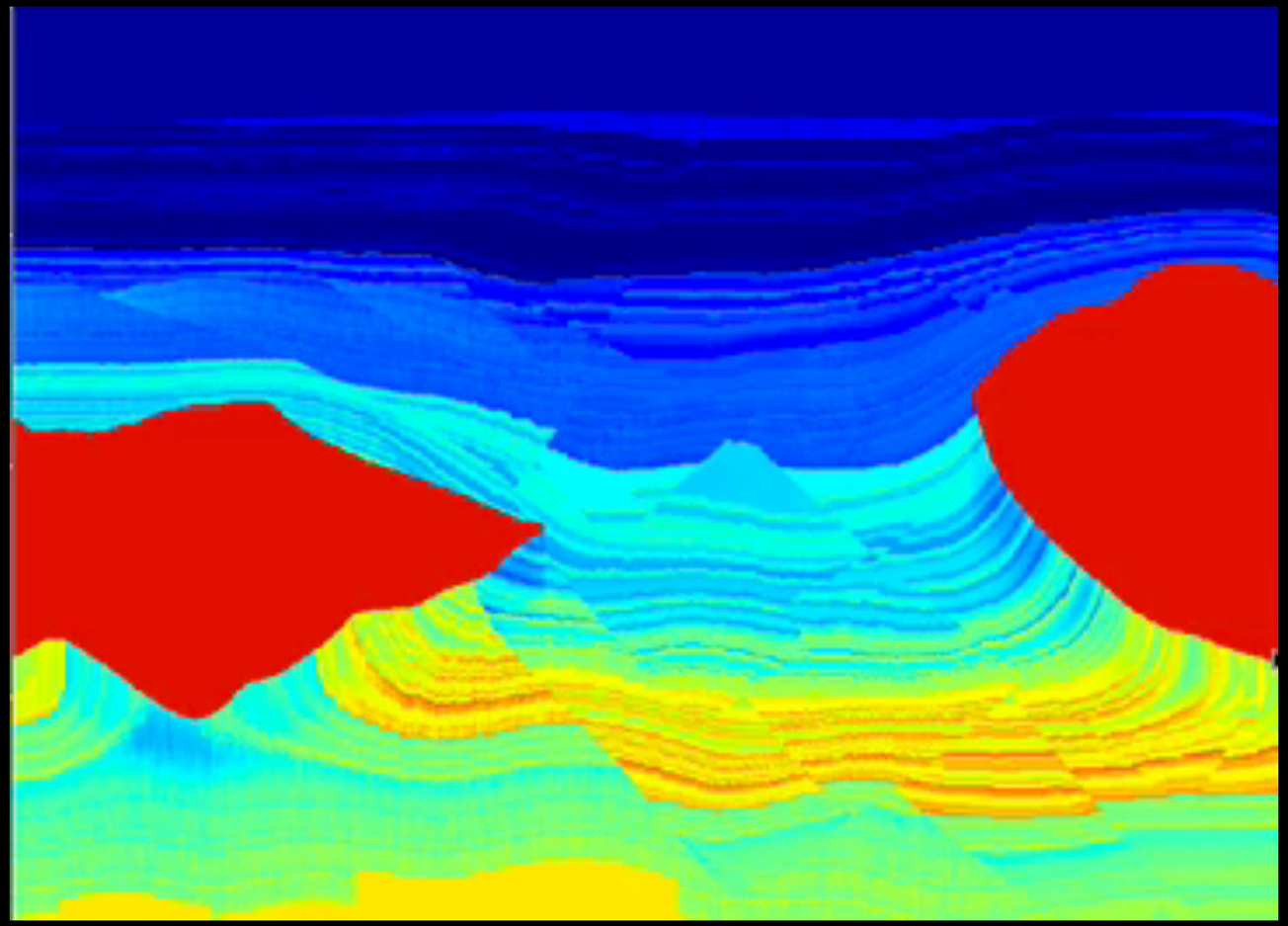


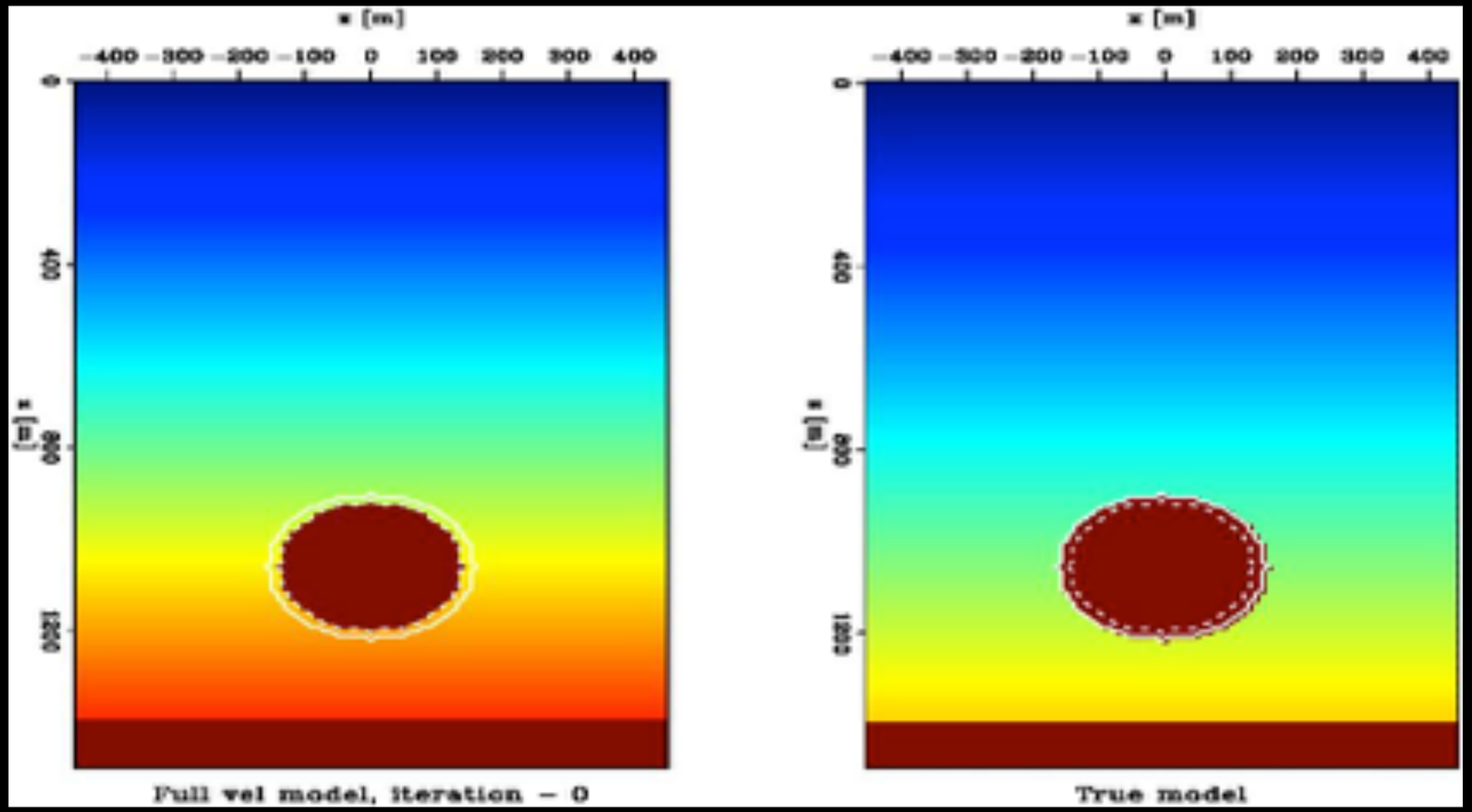
Synthetic seismic model building using an event based approach

SEP meeting 2015

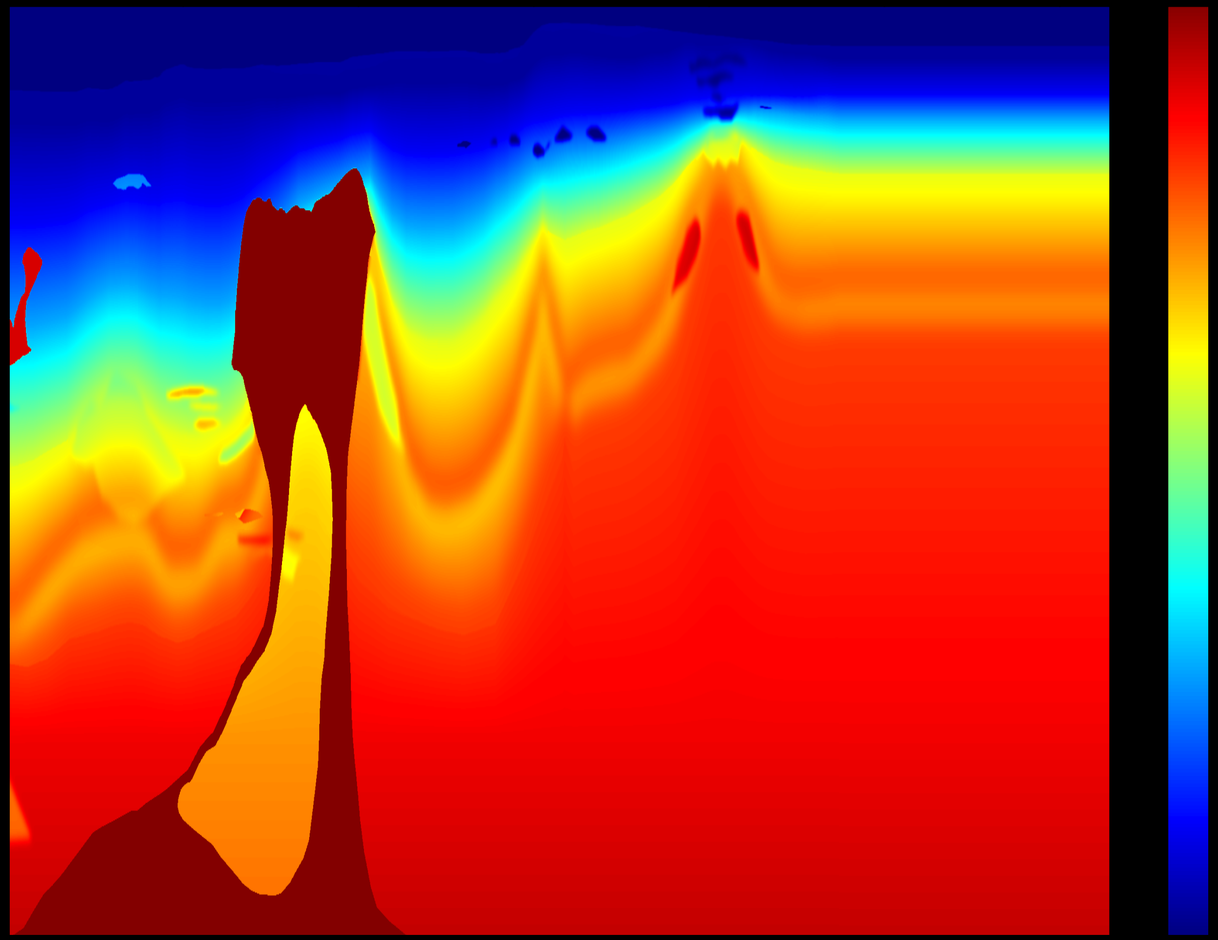
Bob Clapp


Motivation
Modeling approach
Wrapper

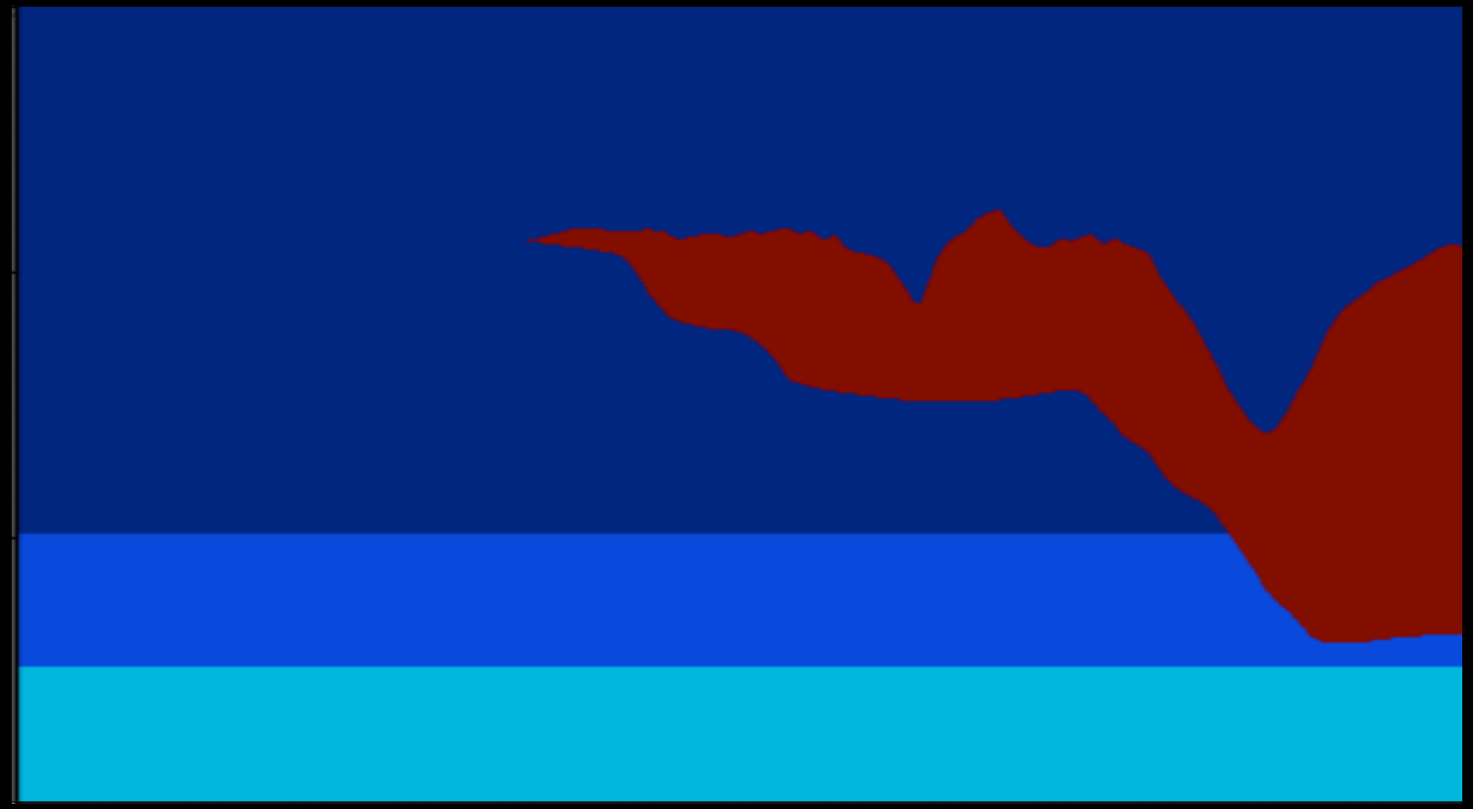
Motivation


x [m]
-400 -300 -200 -100 0 100 200 300 400
z [m]
0
400
800
1200
Full vel model, iteration - 0
True model

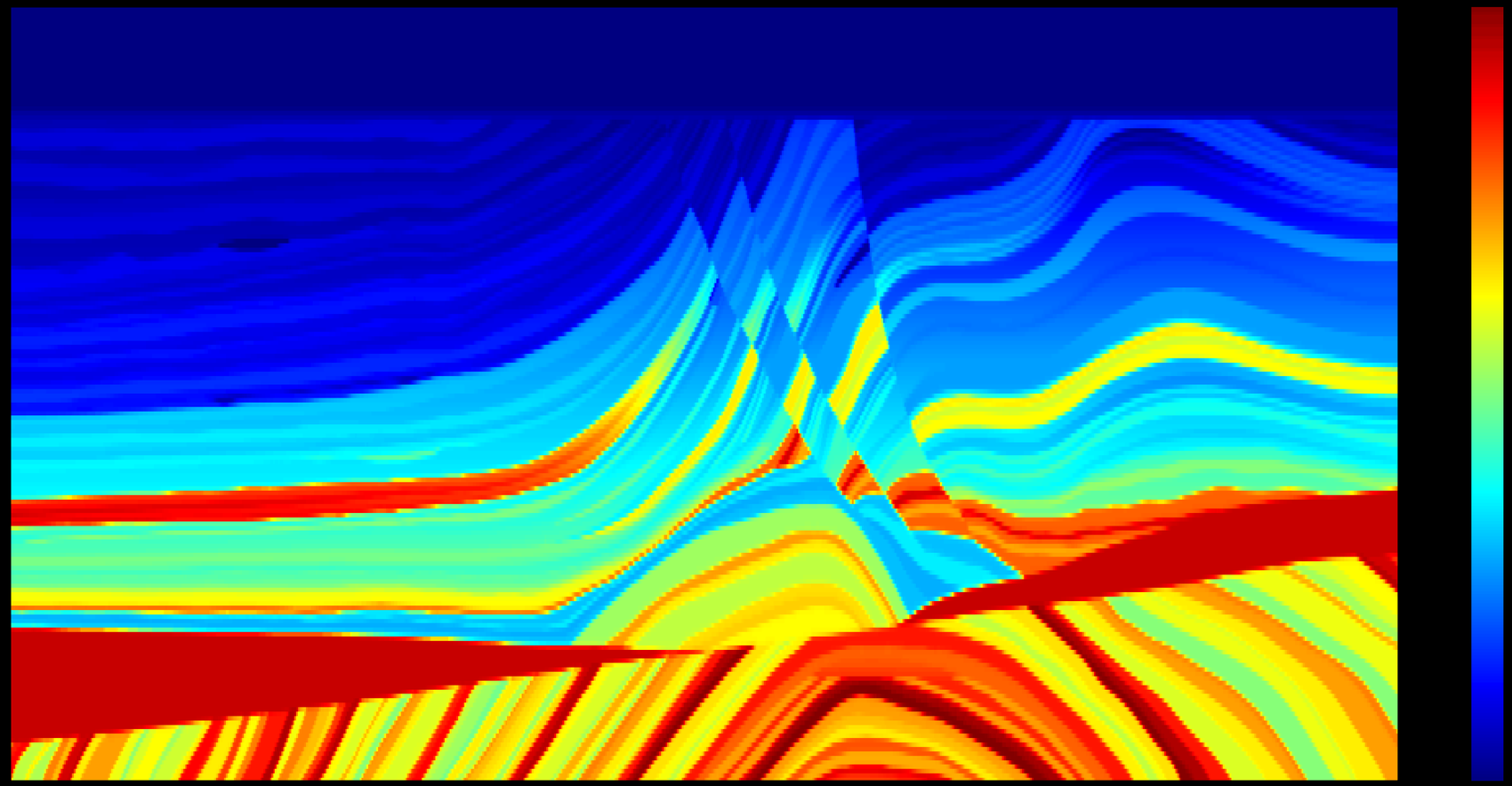
Motivation



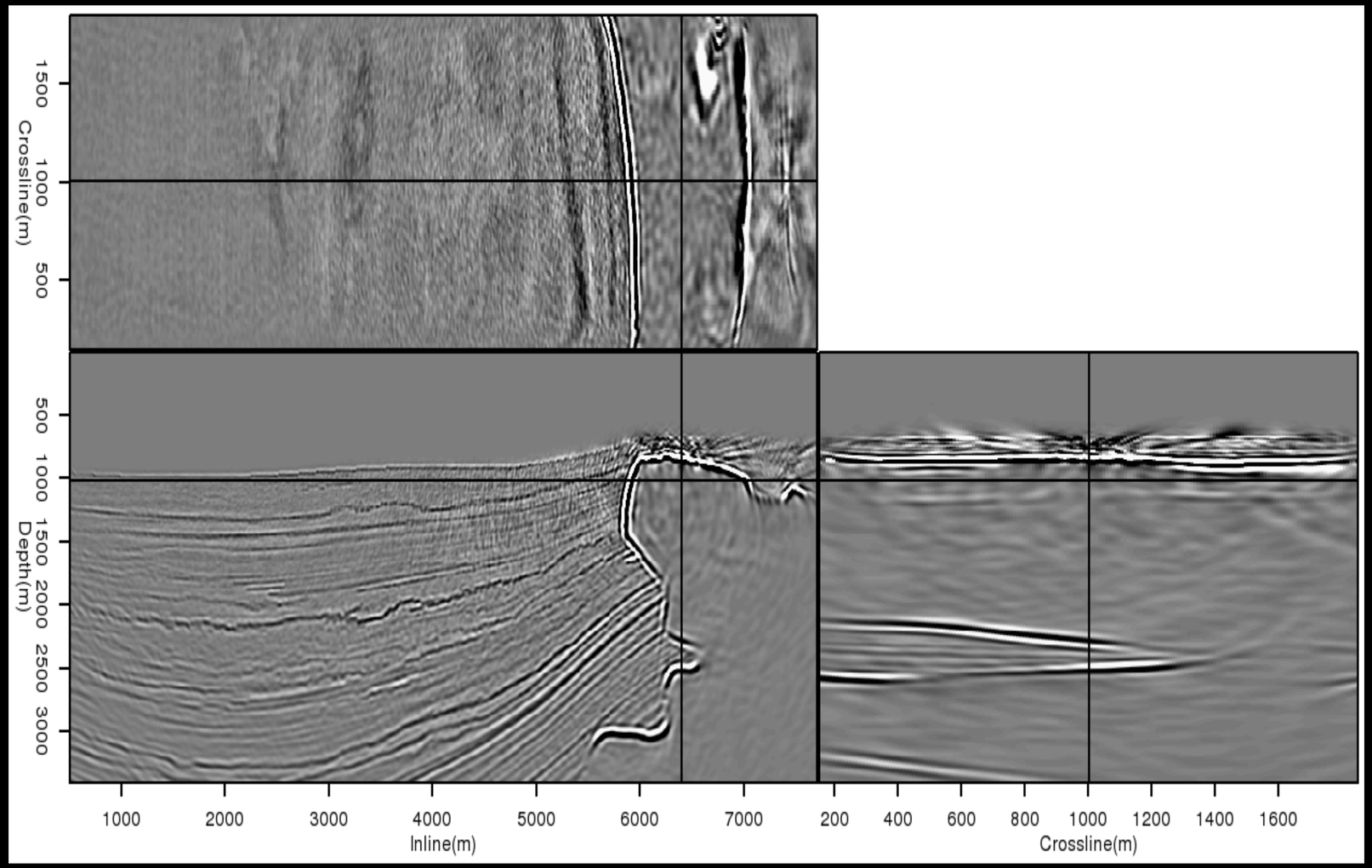
Motivation



Motivation



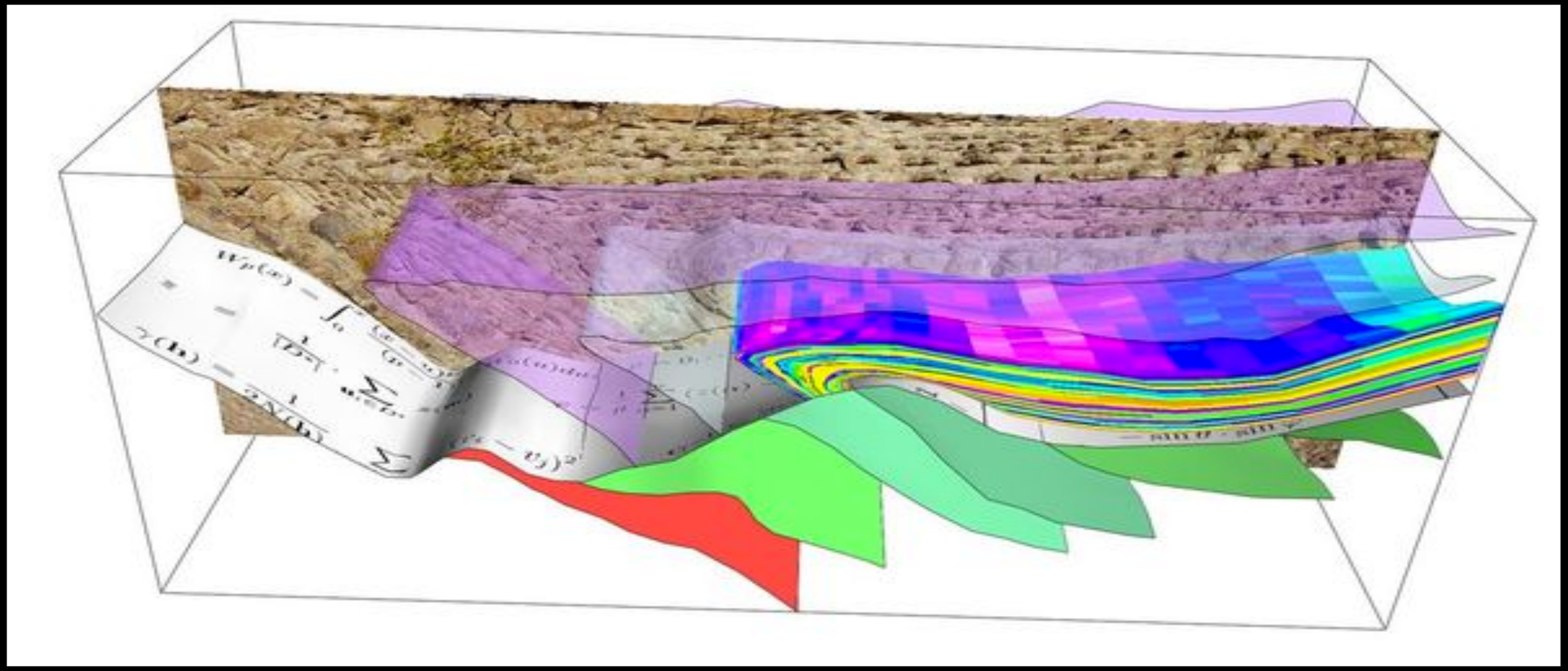
Motivation


Crossline(m)
1500
1000
500
Depth(m)
500
1000
1500
2000
2500
3000
1000
2000
3000
4000
5000
6000
7000
Inline(m)
200
400
600
800
1000
1200
1400
1600
Crossline(m)

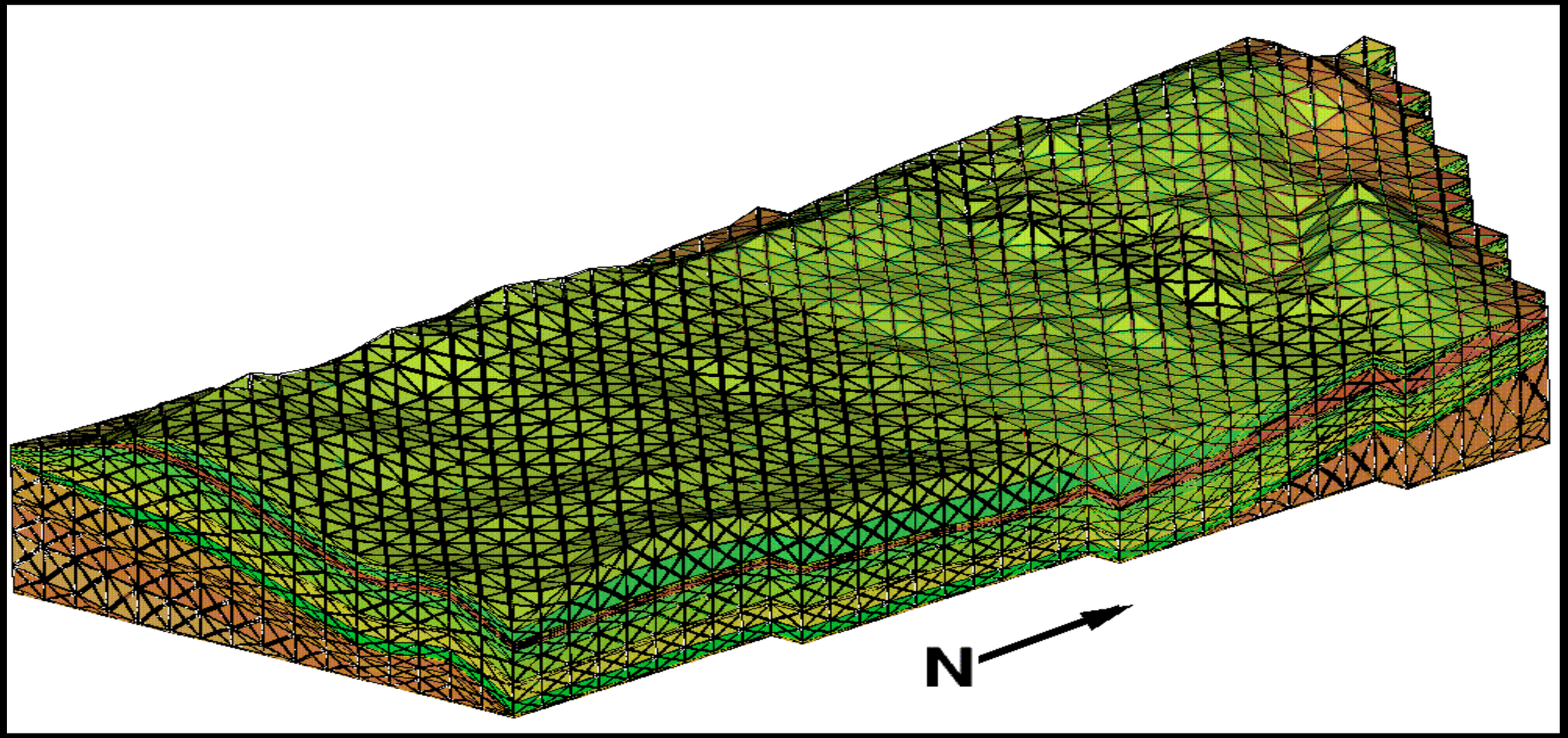
Motivation

- Synthetic models are often either to simple or to complex
- Building 3-D synthetic models is significantly more challenging
- Need an ability to build models quickly with variable complexity

Approach #1 surfaces



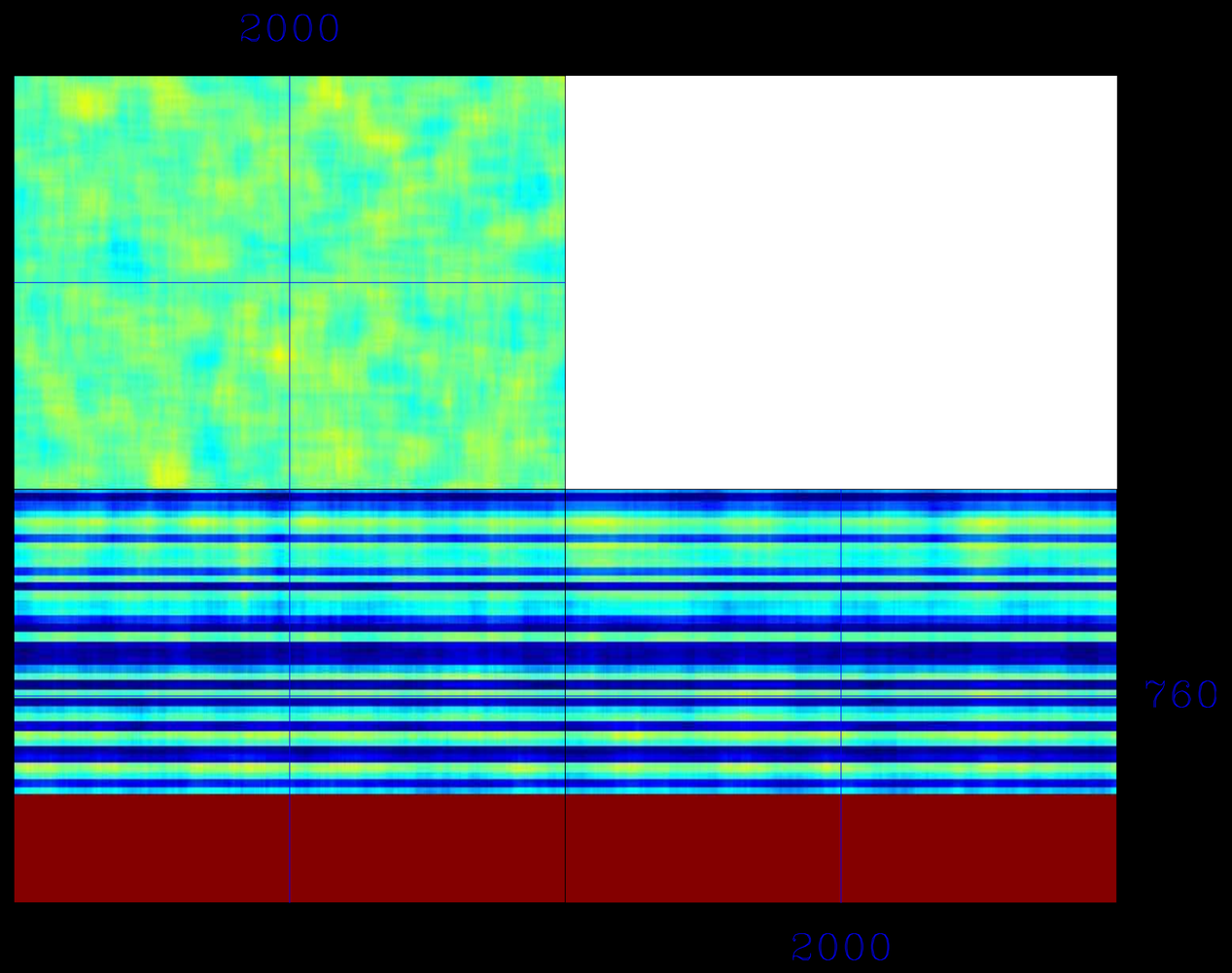
Approach #2 Meshes



Approach #3 Events

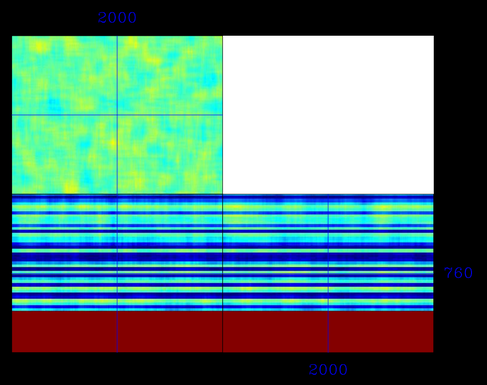
- Pseudo basin modeling
- Build a model by describing a series of geologic events
- Model complexity can be easily be controlled by adding/subtracting events

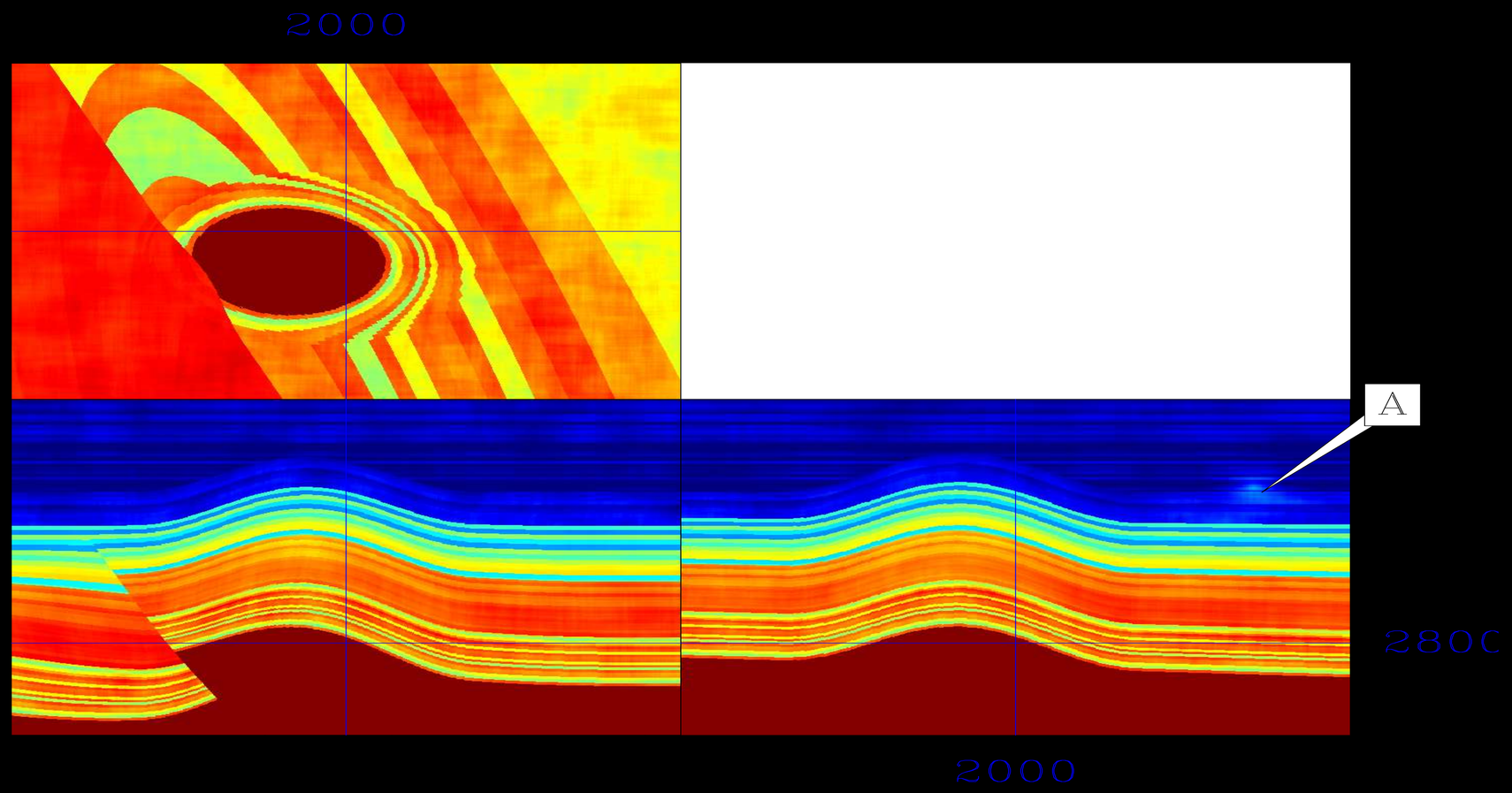
Event Types



Deposition

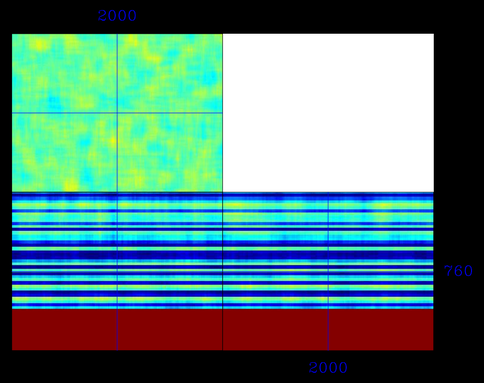
Event Types

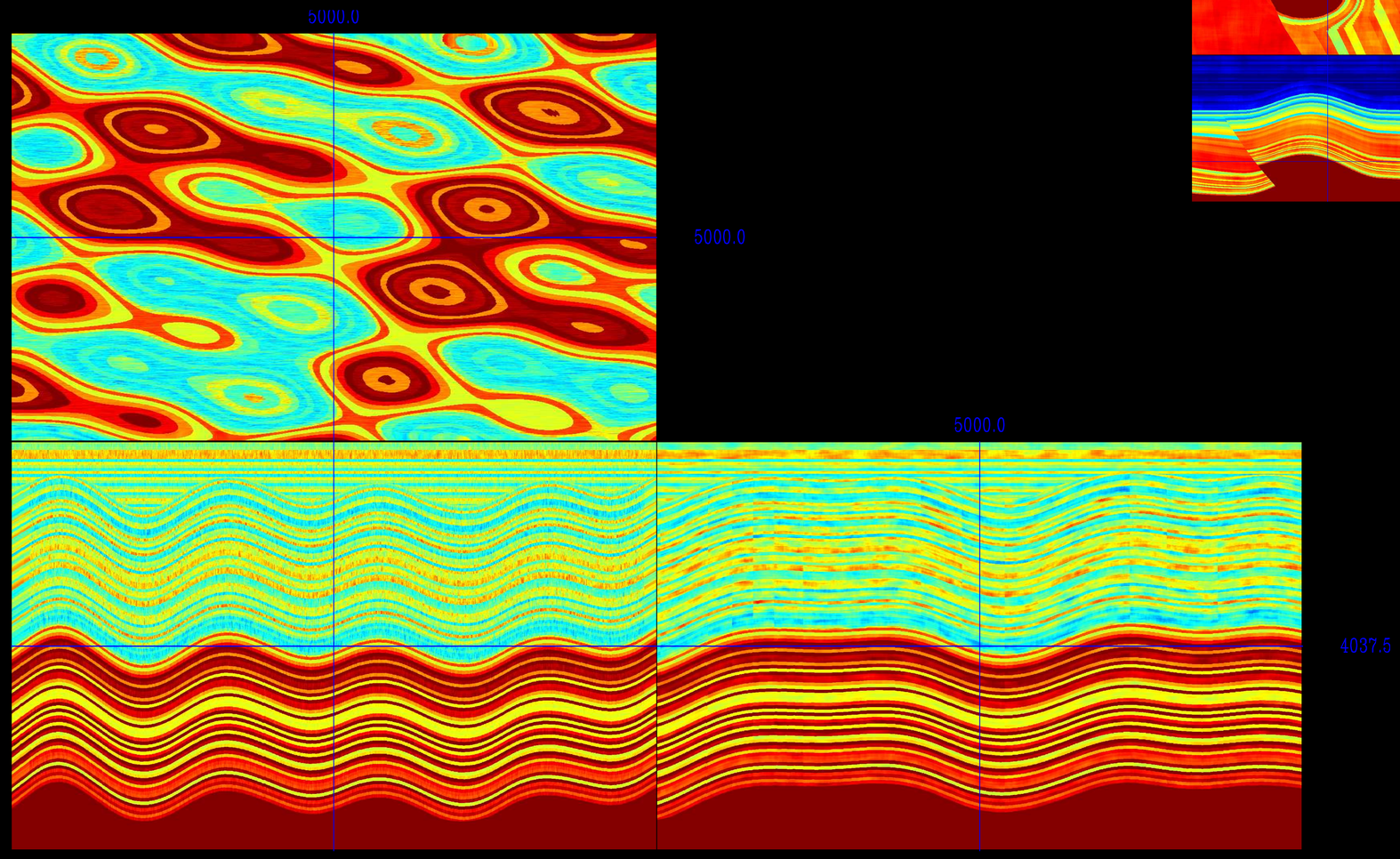


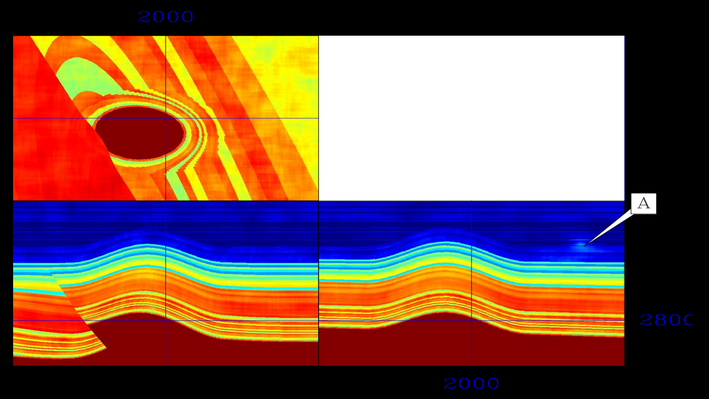


Uplift

Event Types

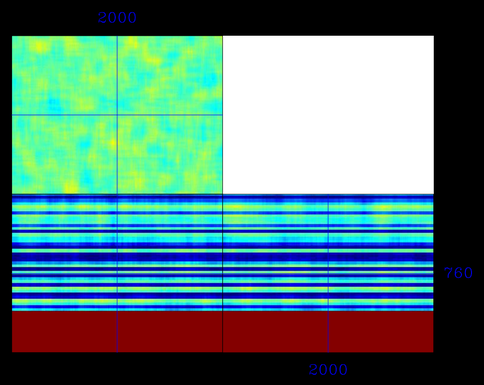


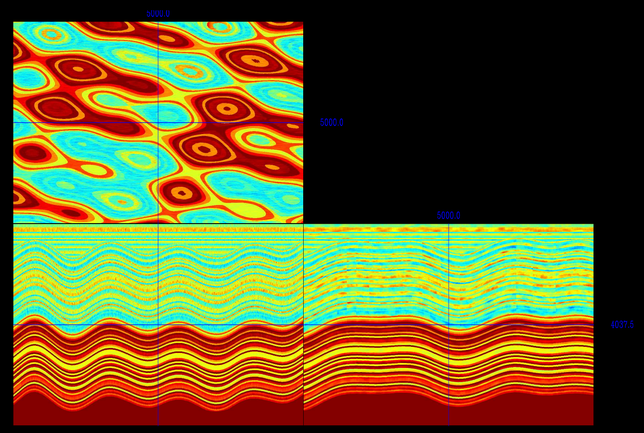


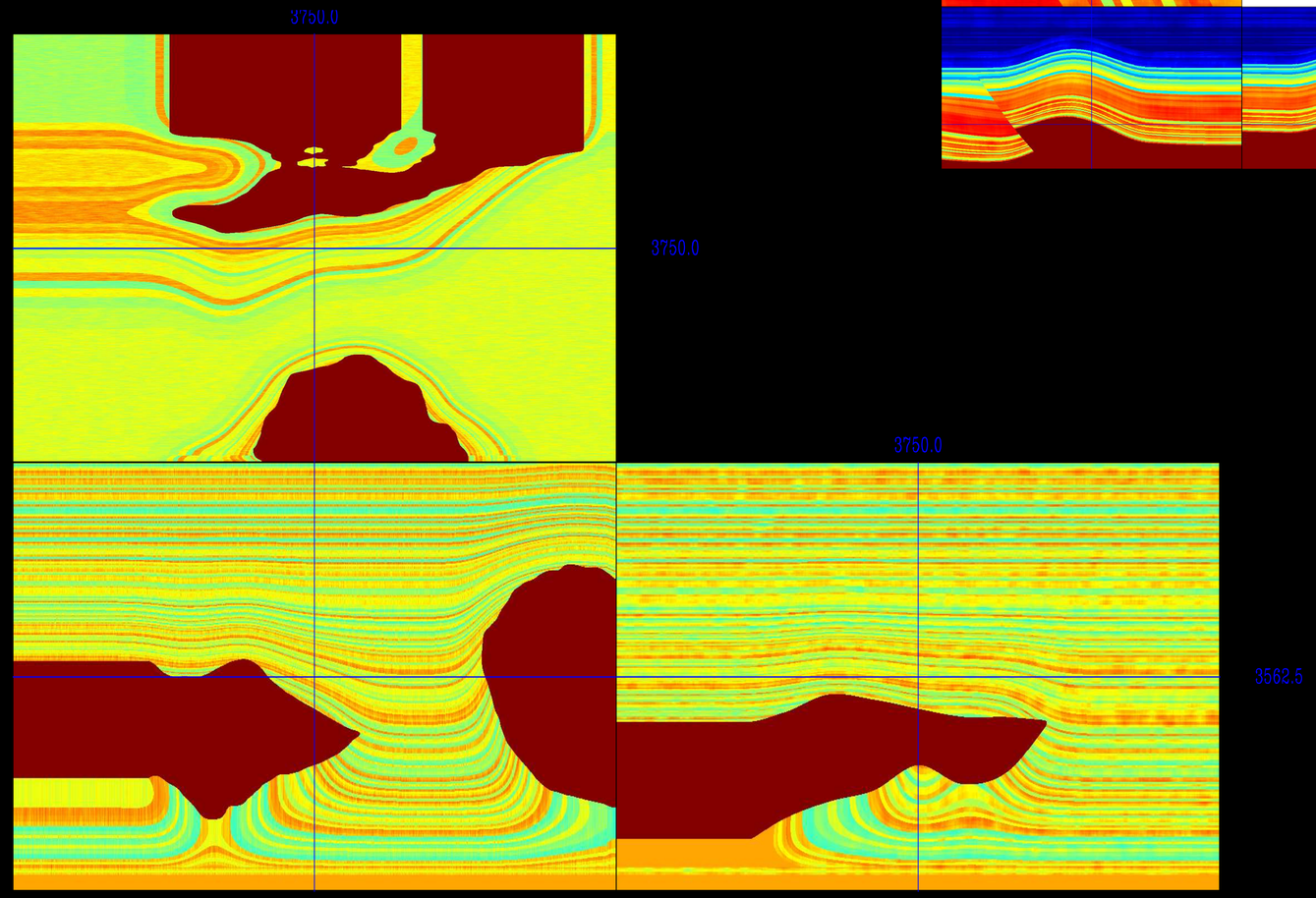


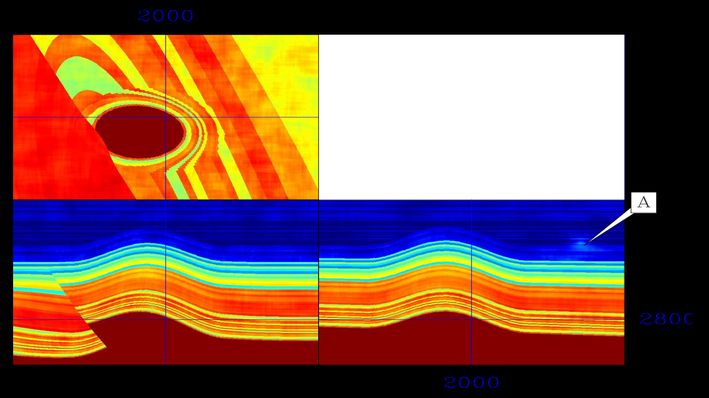
Compression

Event Types



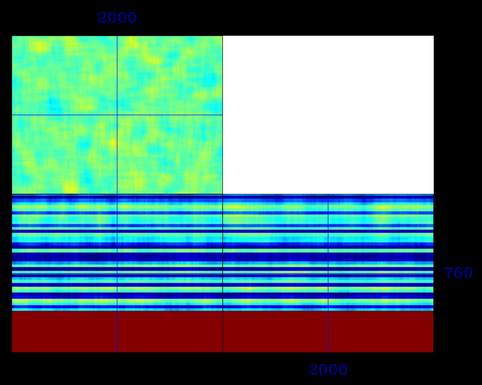


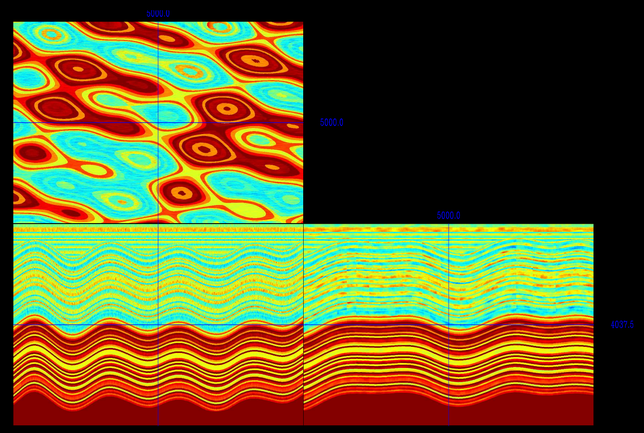


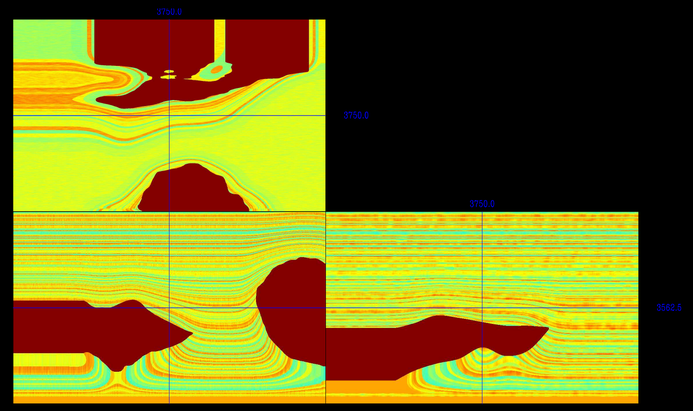


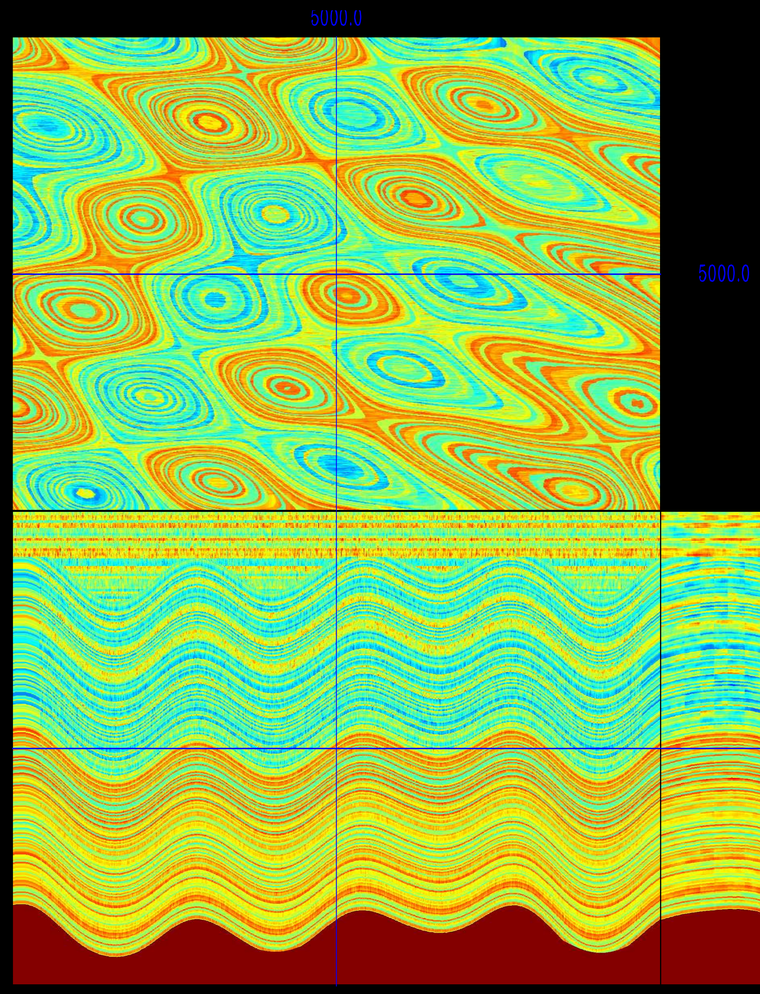
Emplacement

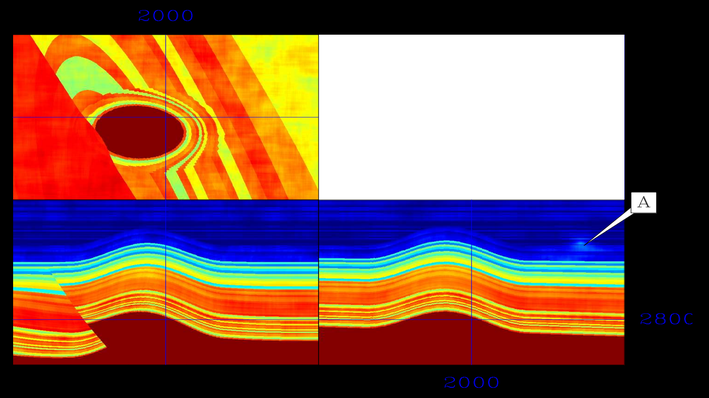
Event Types





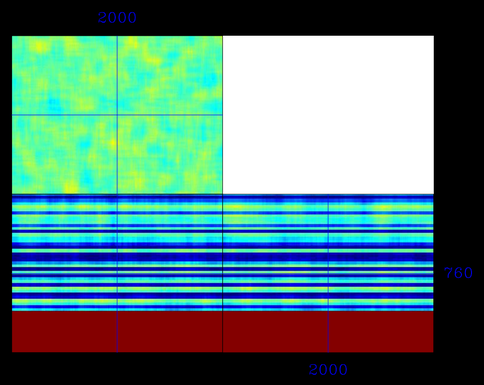


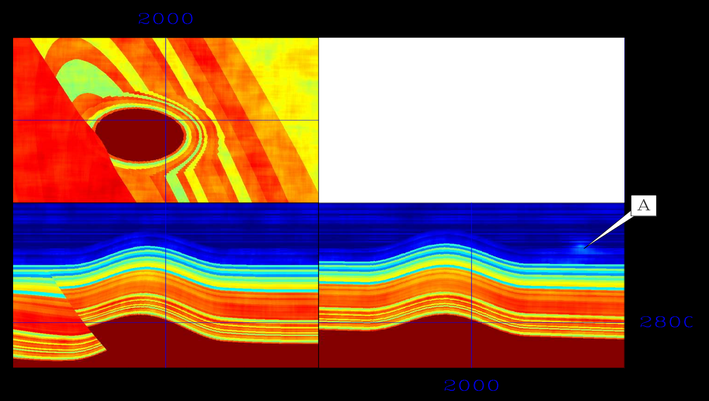


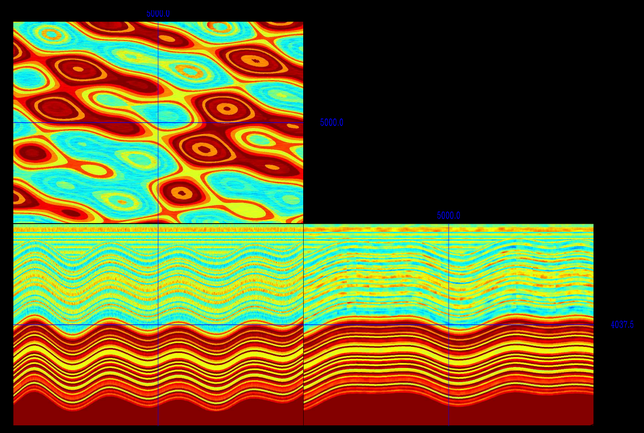


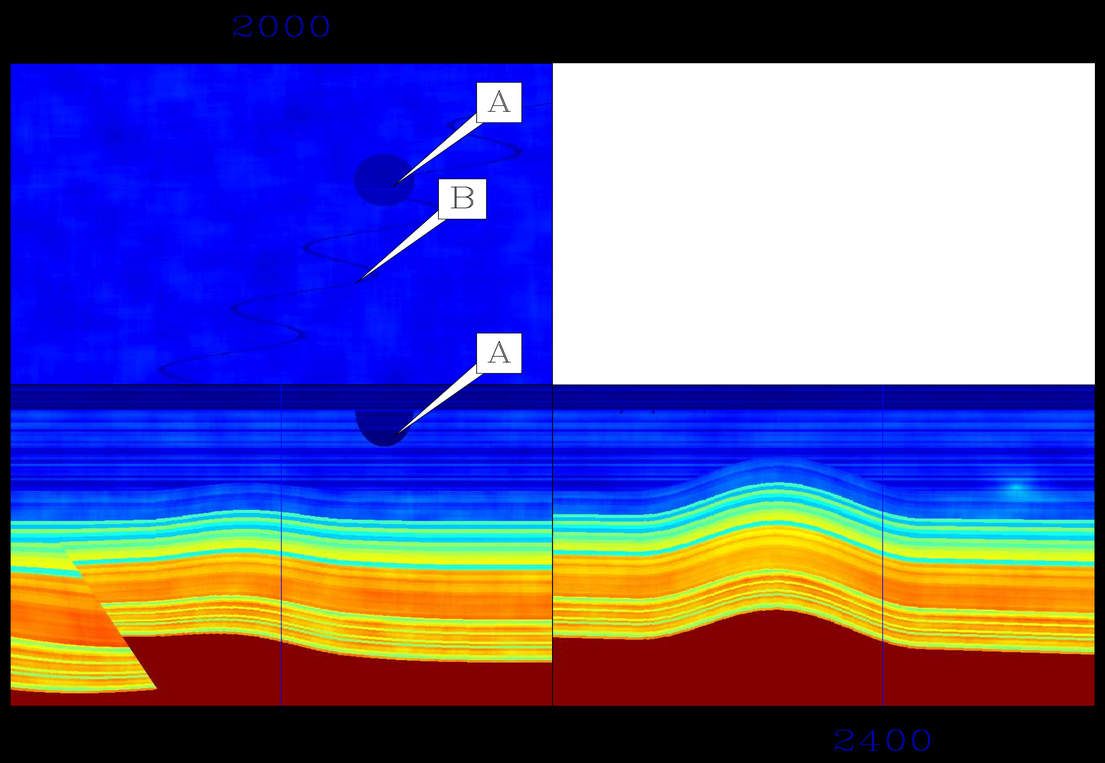
Erosion

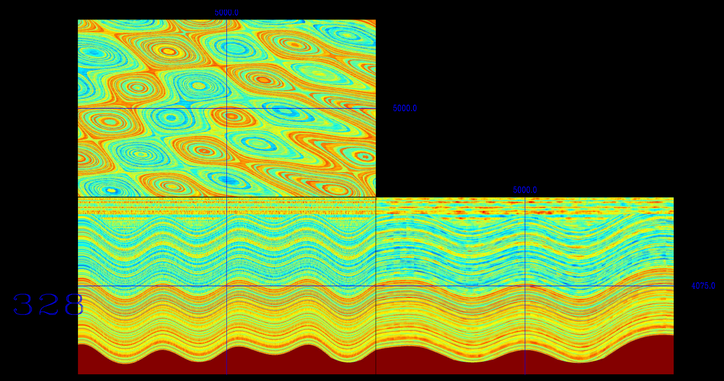
Event Types

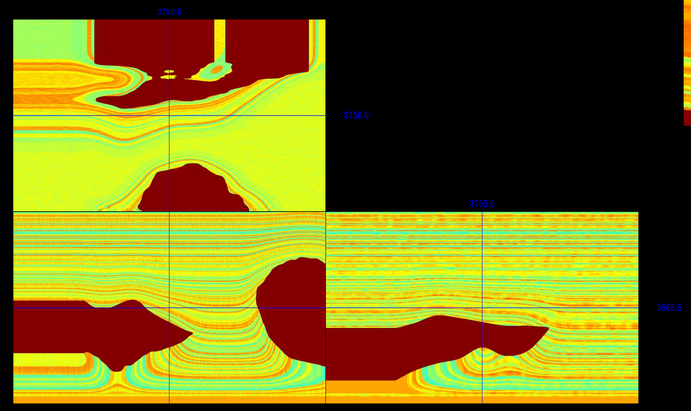






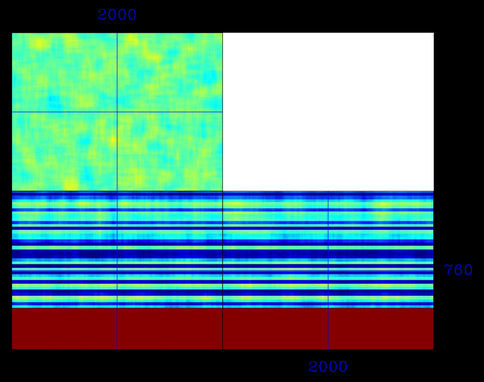


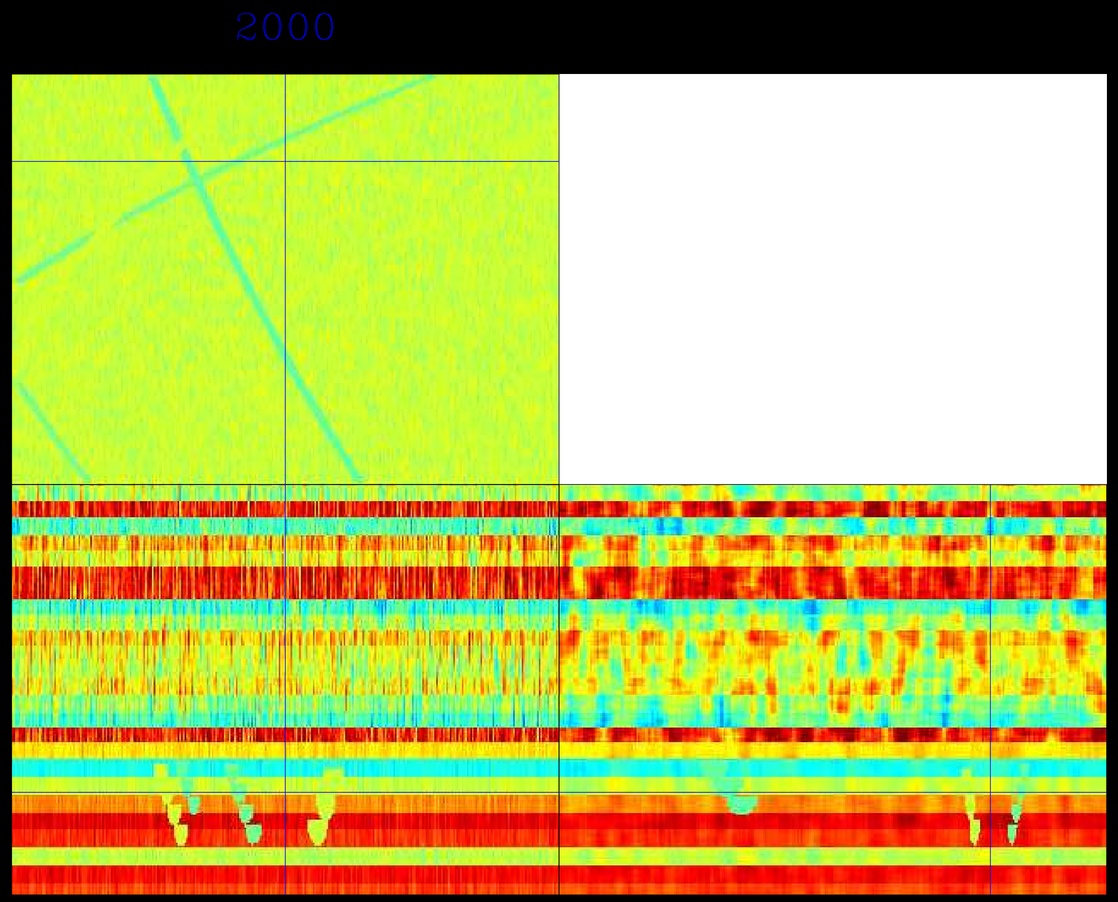


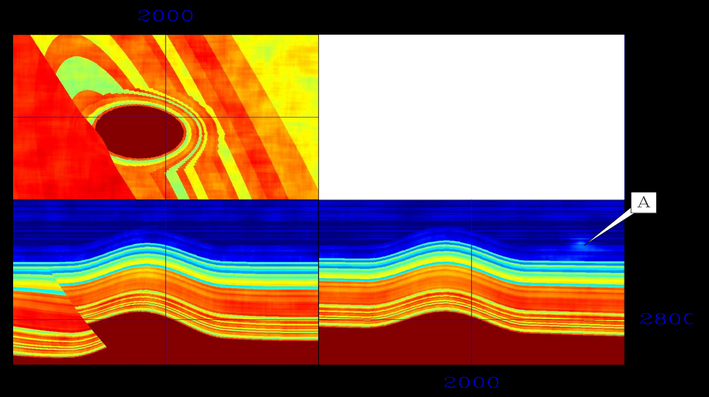


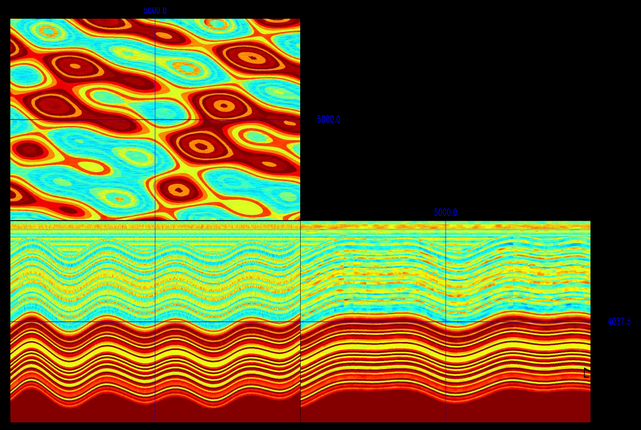
Erosion

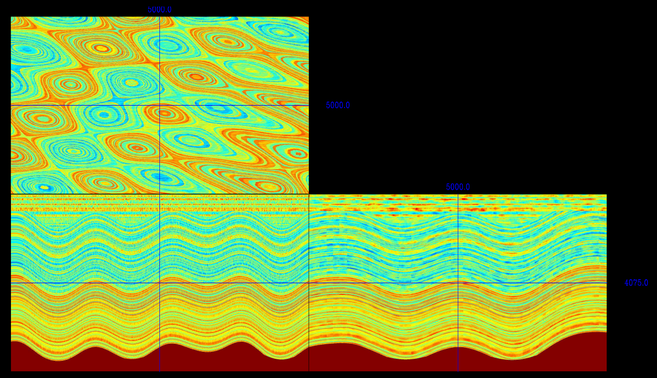
Event Types

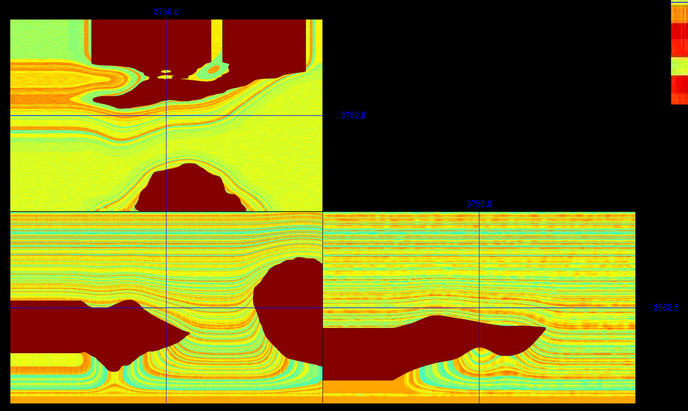




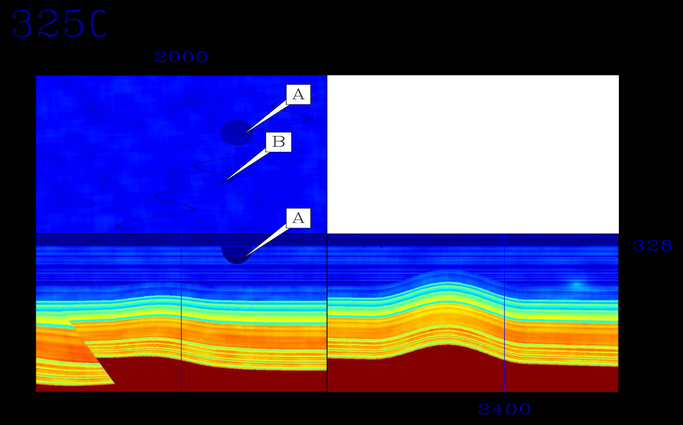




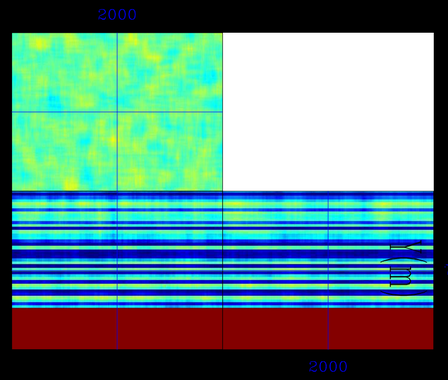


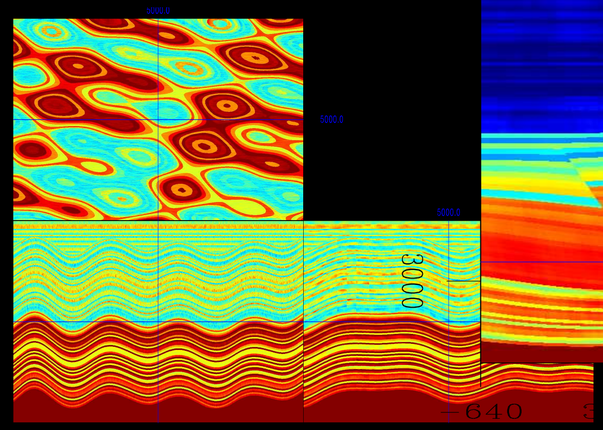


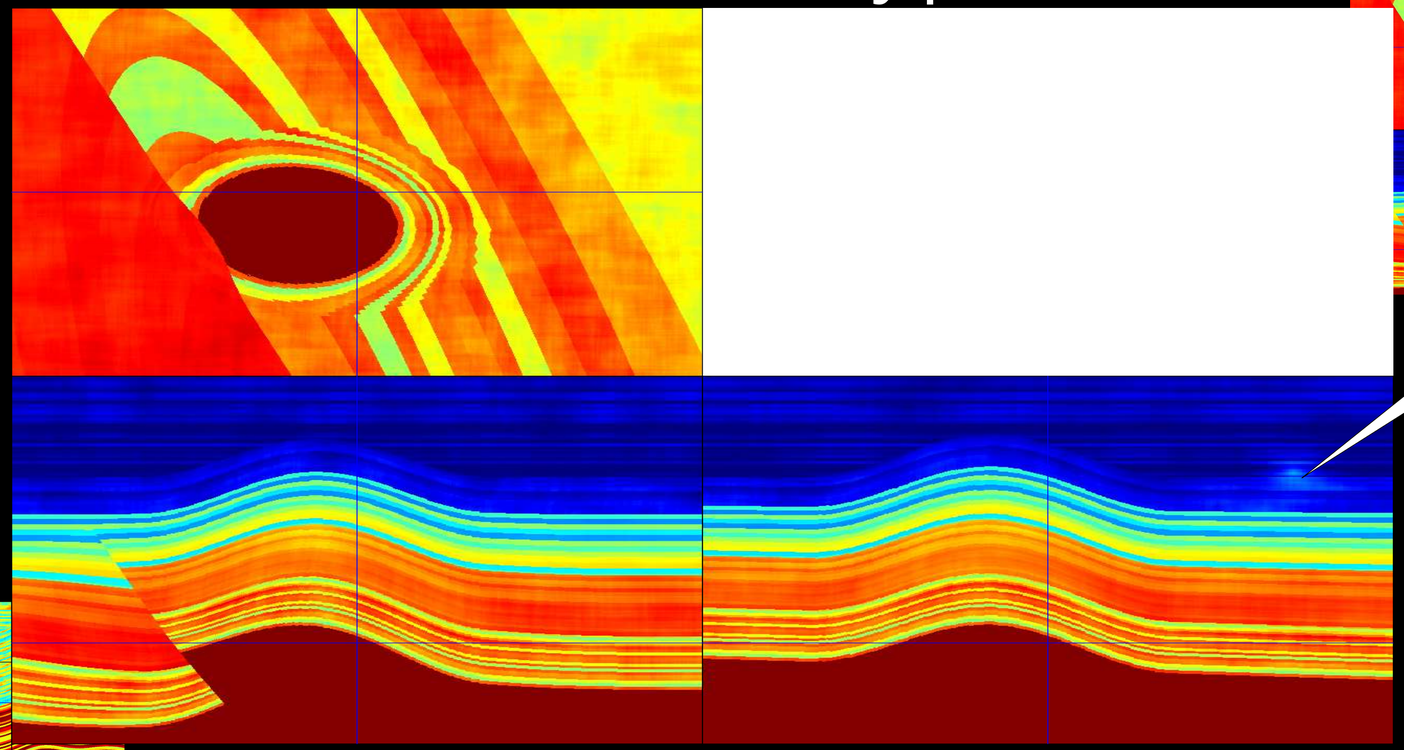
River channels

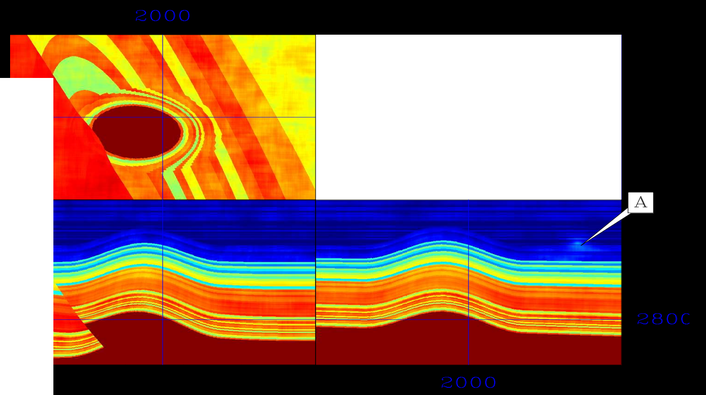


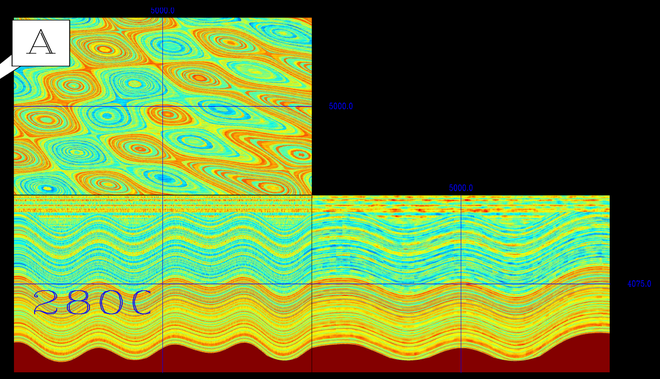
Event Types



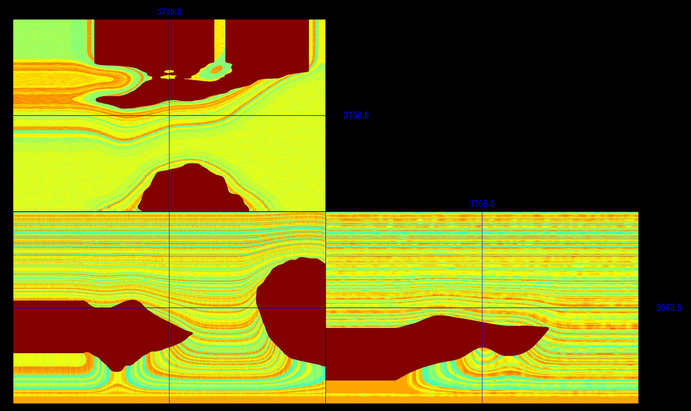


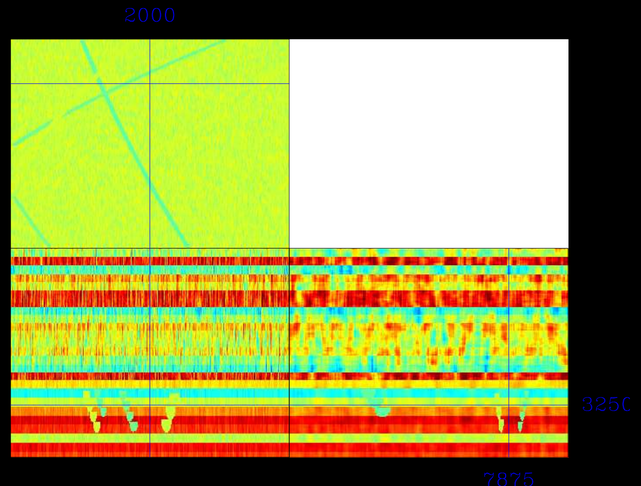


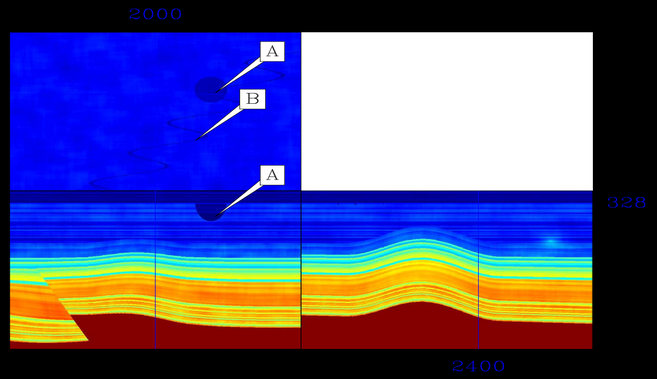




Gaussian anomalies







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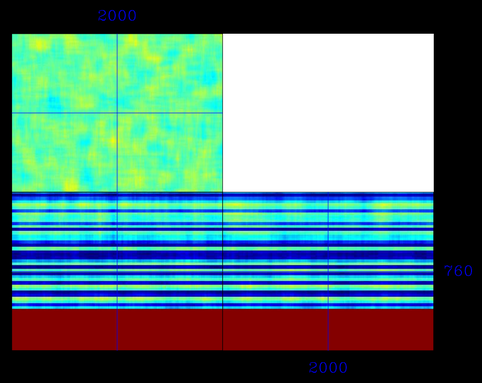
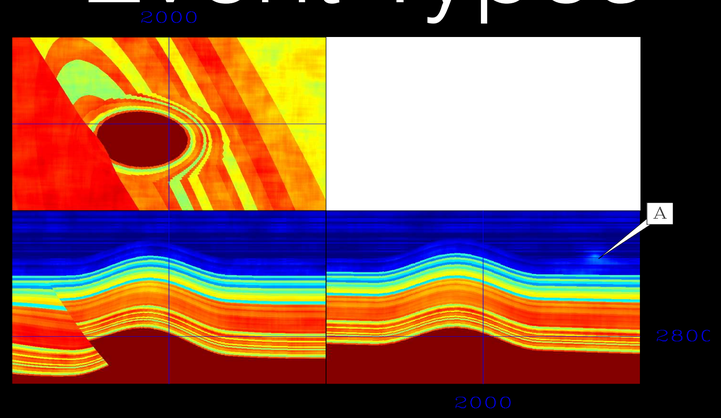
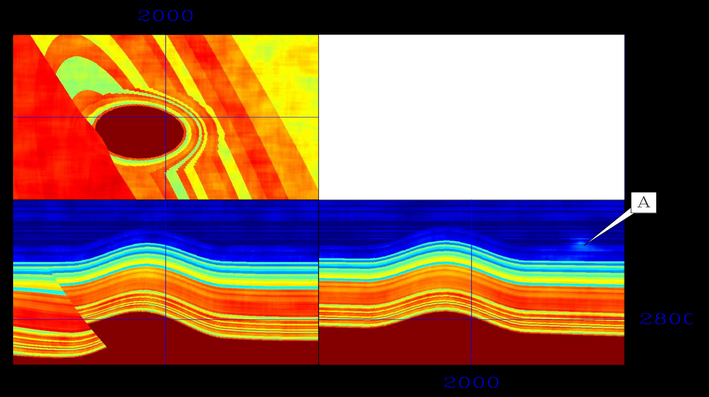
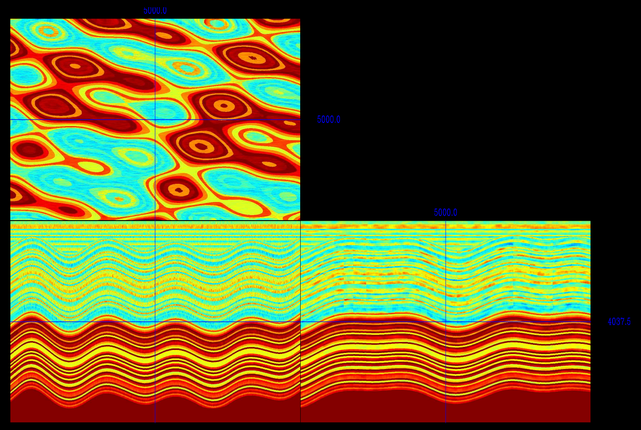
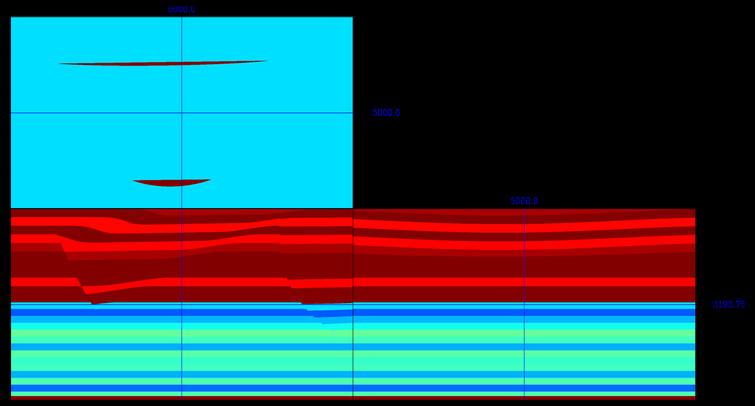
Event Types

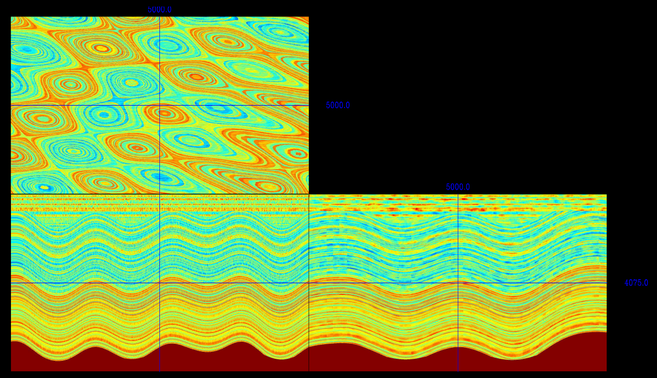


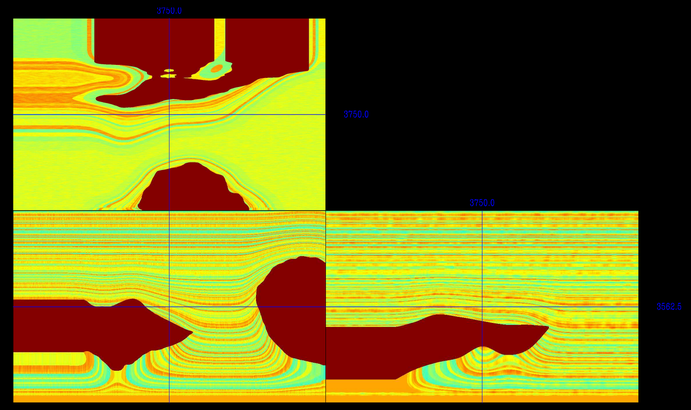


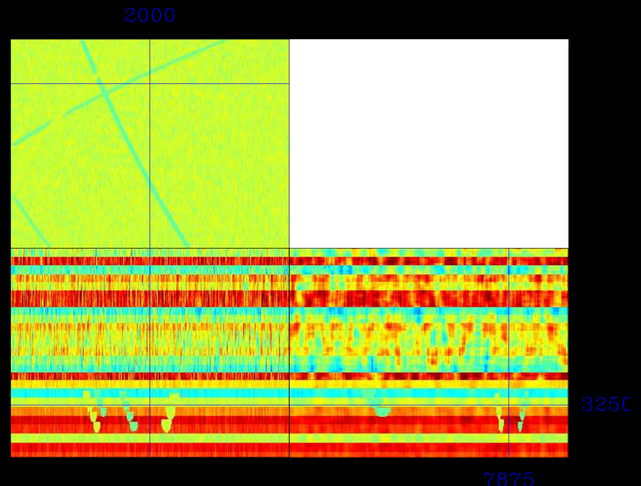


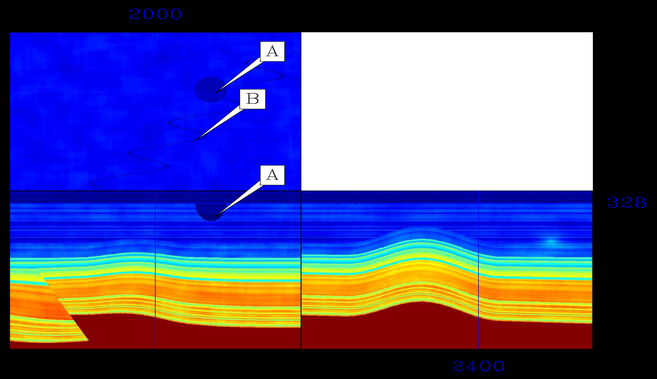












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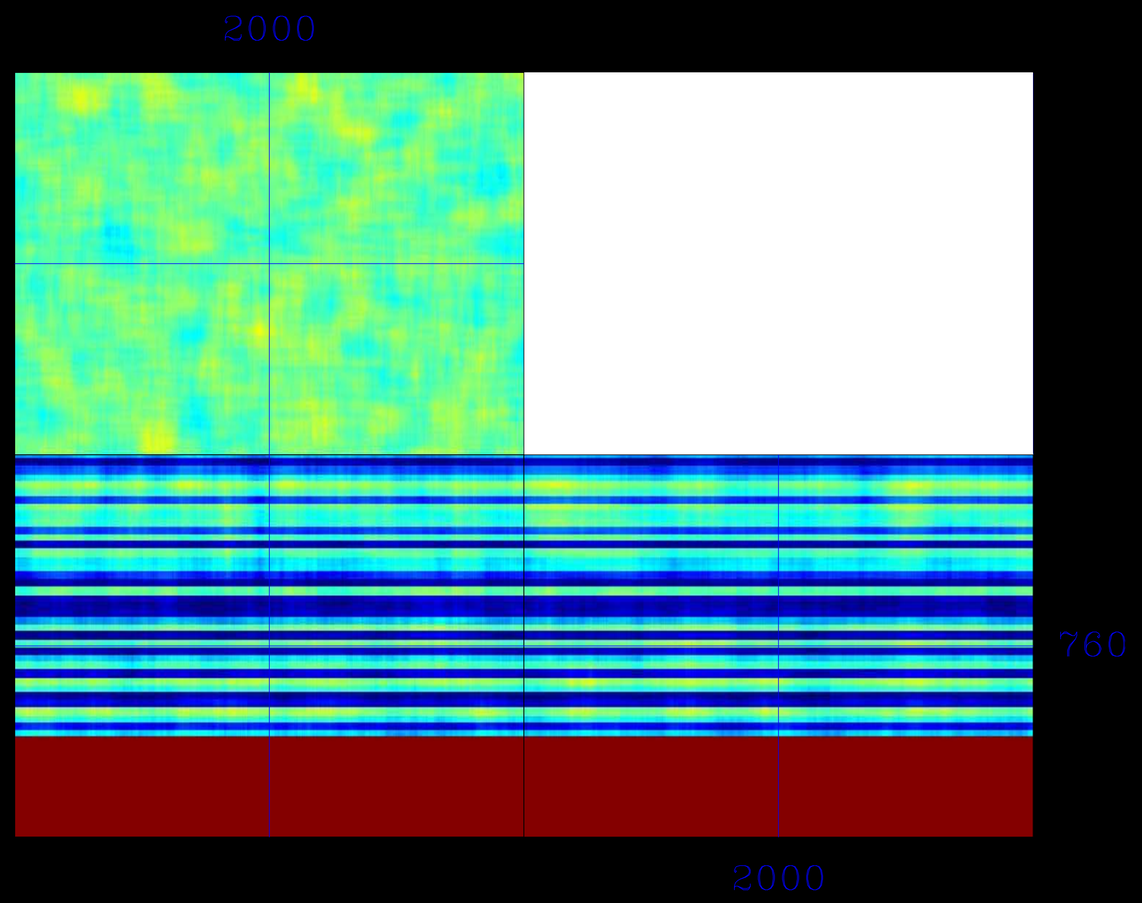
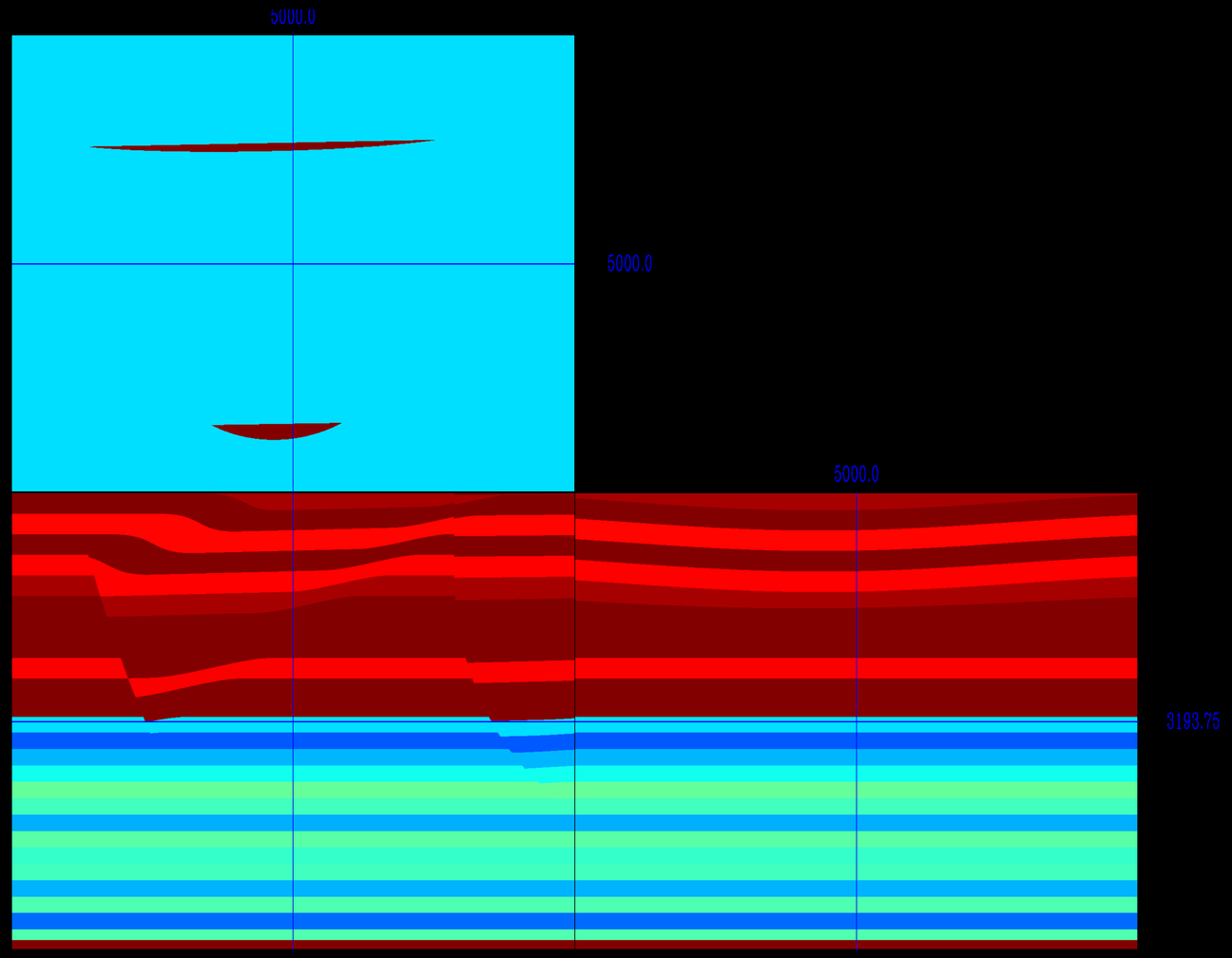
Deposition



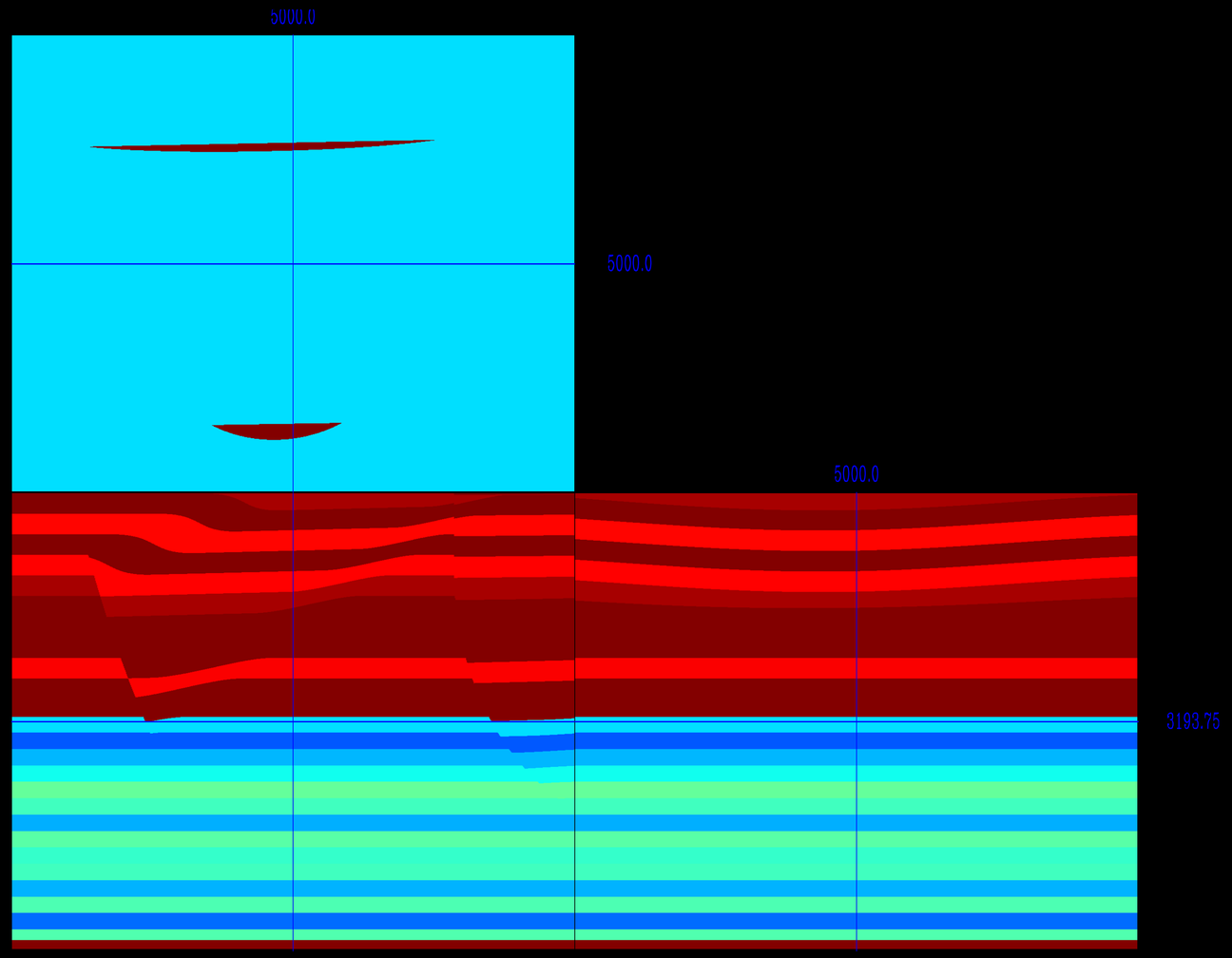
Deposition

- Specify layer base value
- Interbed layer thickness range and variation
- X-Y variation

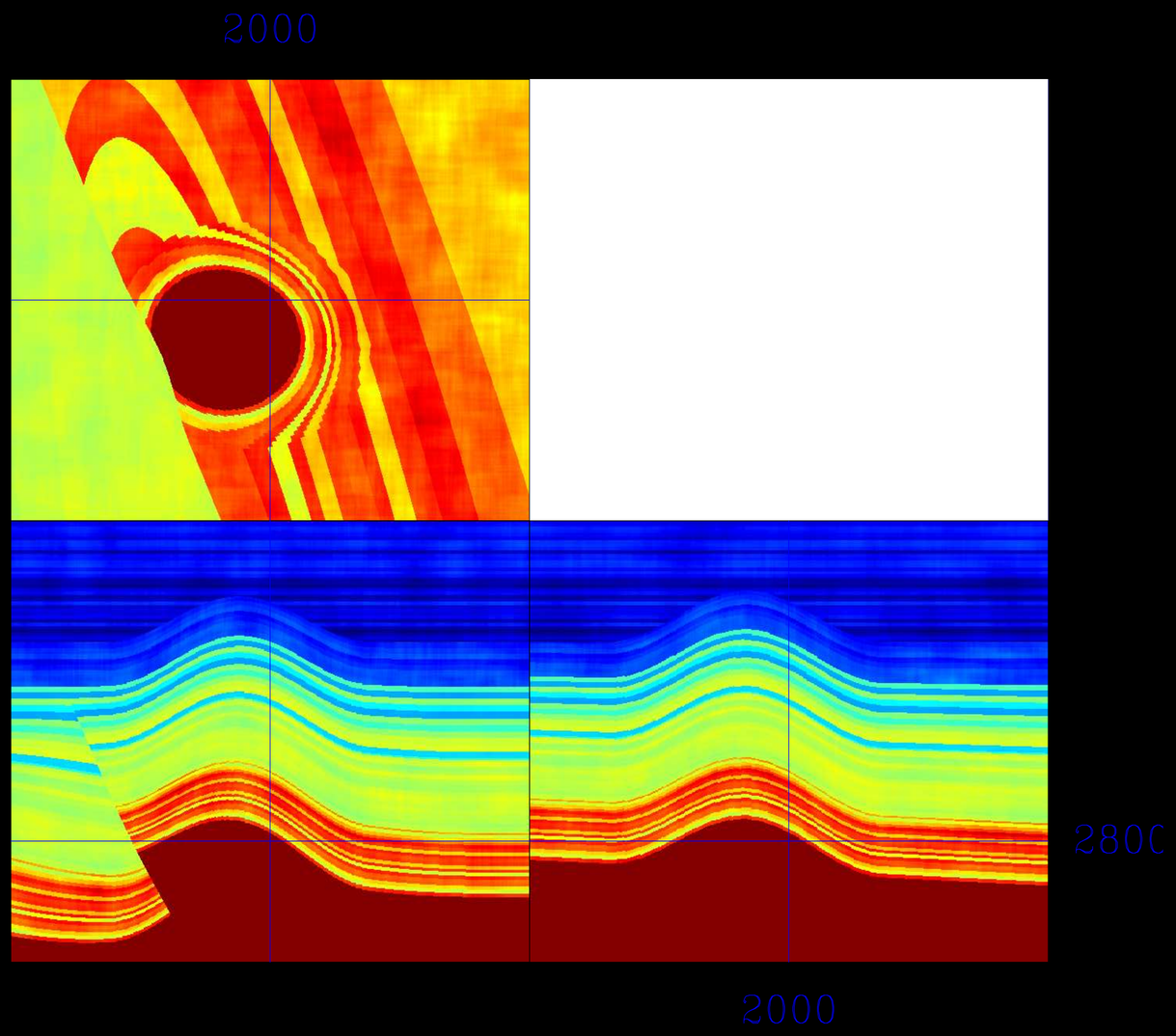
Faulting



Faulting

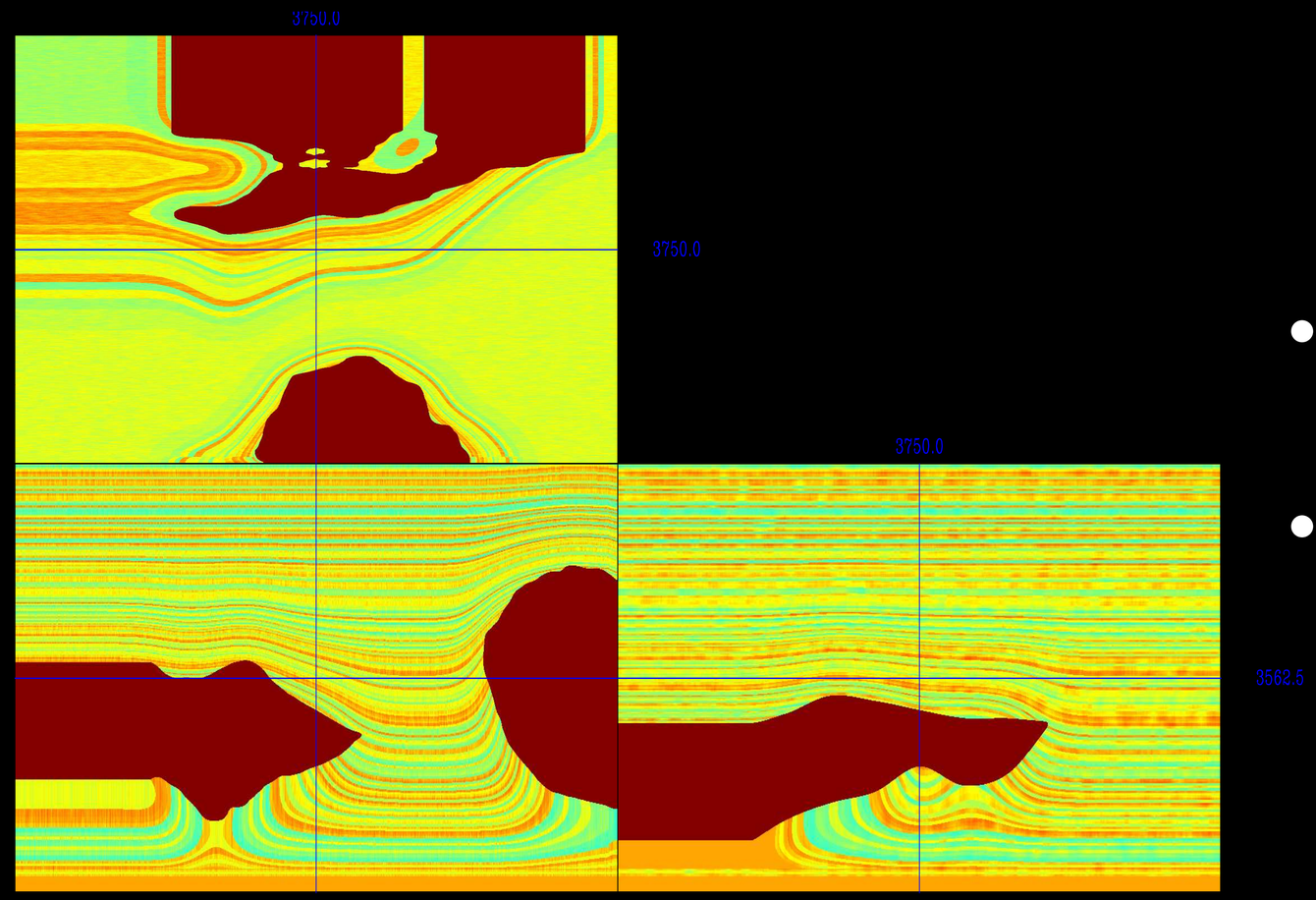


Uplift



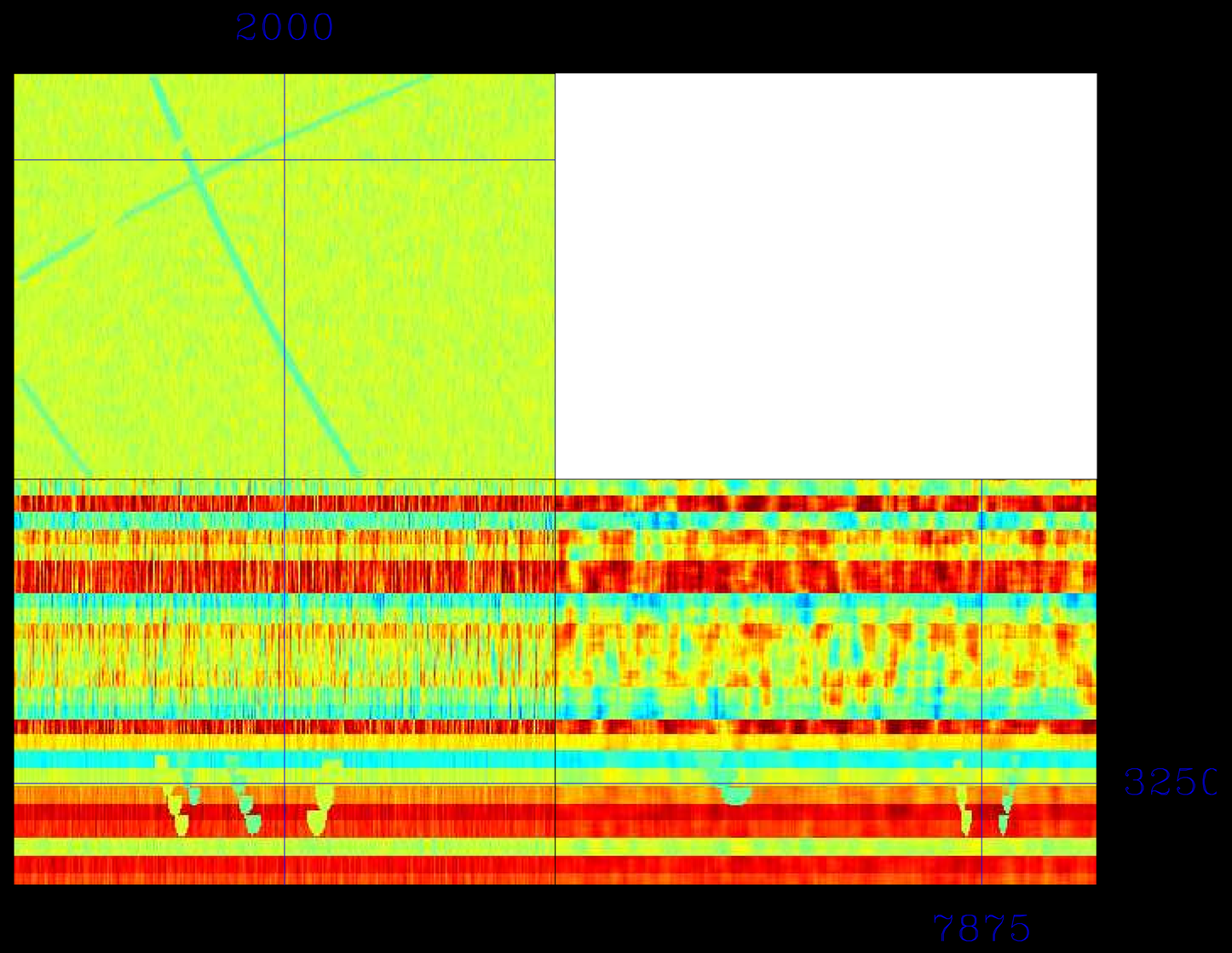
- Specify location and maximum uplift
- Die off along major axis and minor axis
- Rotation of axes

Emplacement



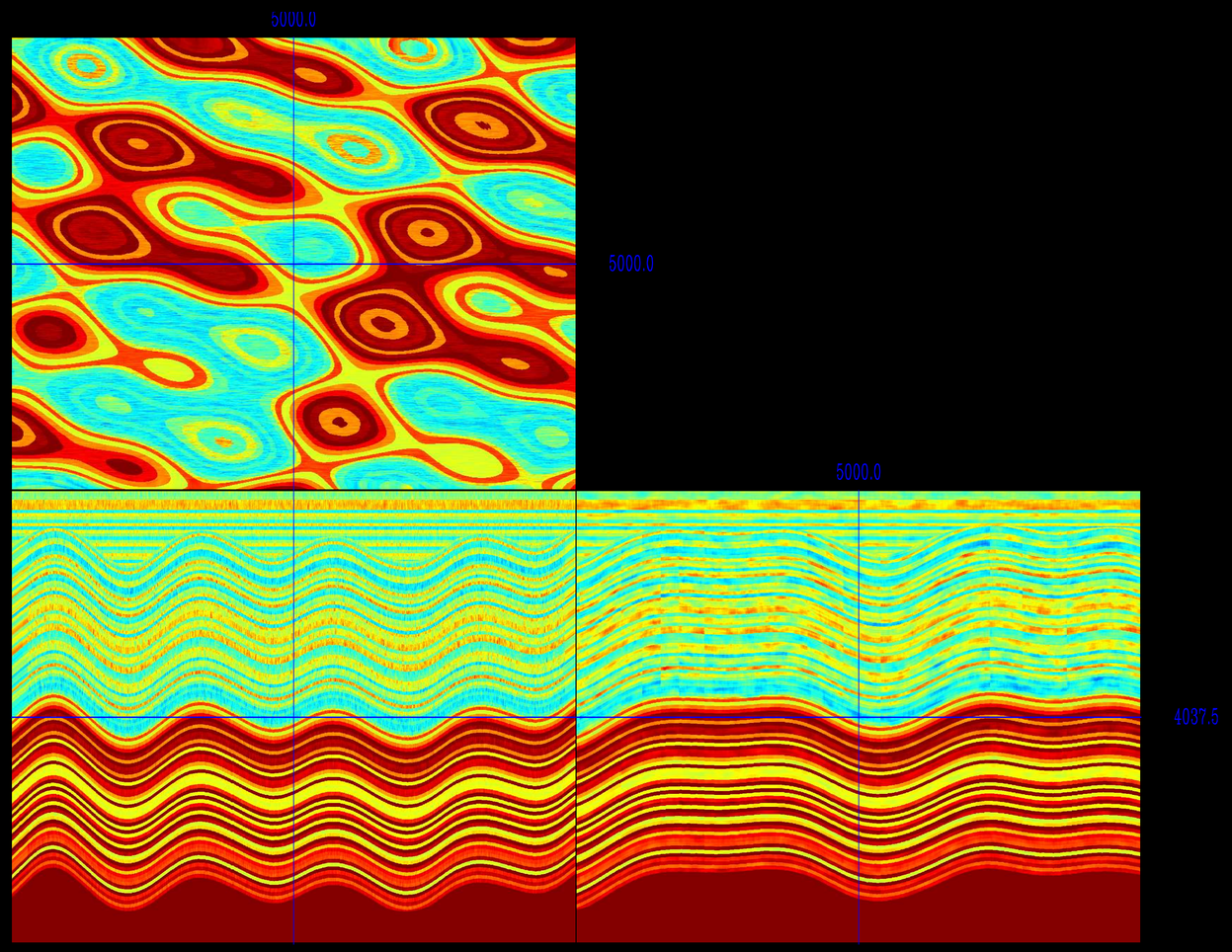
- File containing the body to emplace
- Whether or not to conform around the emplaced body

River channels



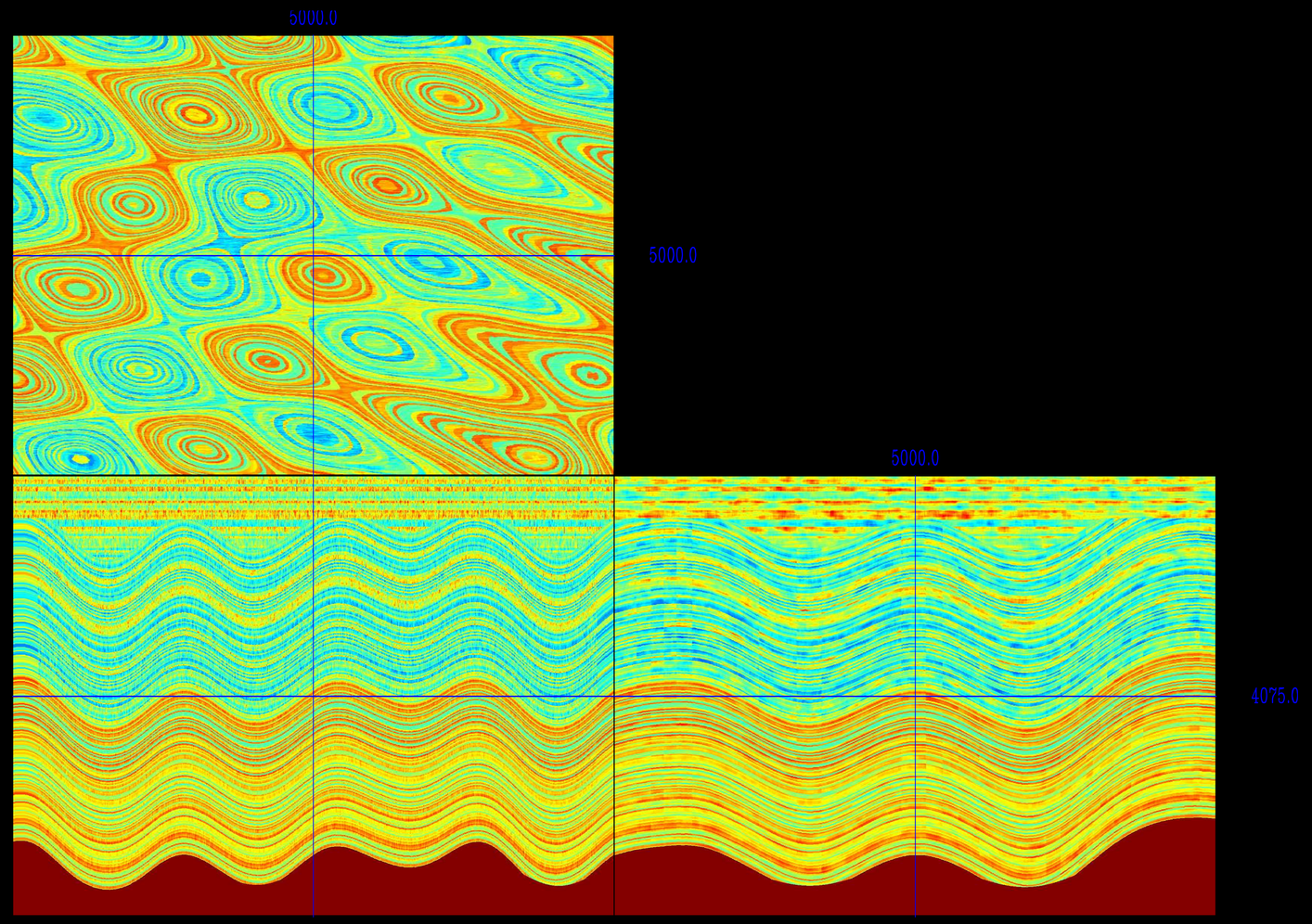
- Specify length, starting point and angle
- Number of different channels that of been cut over time
- Fill property value

Compression



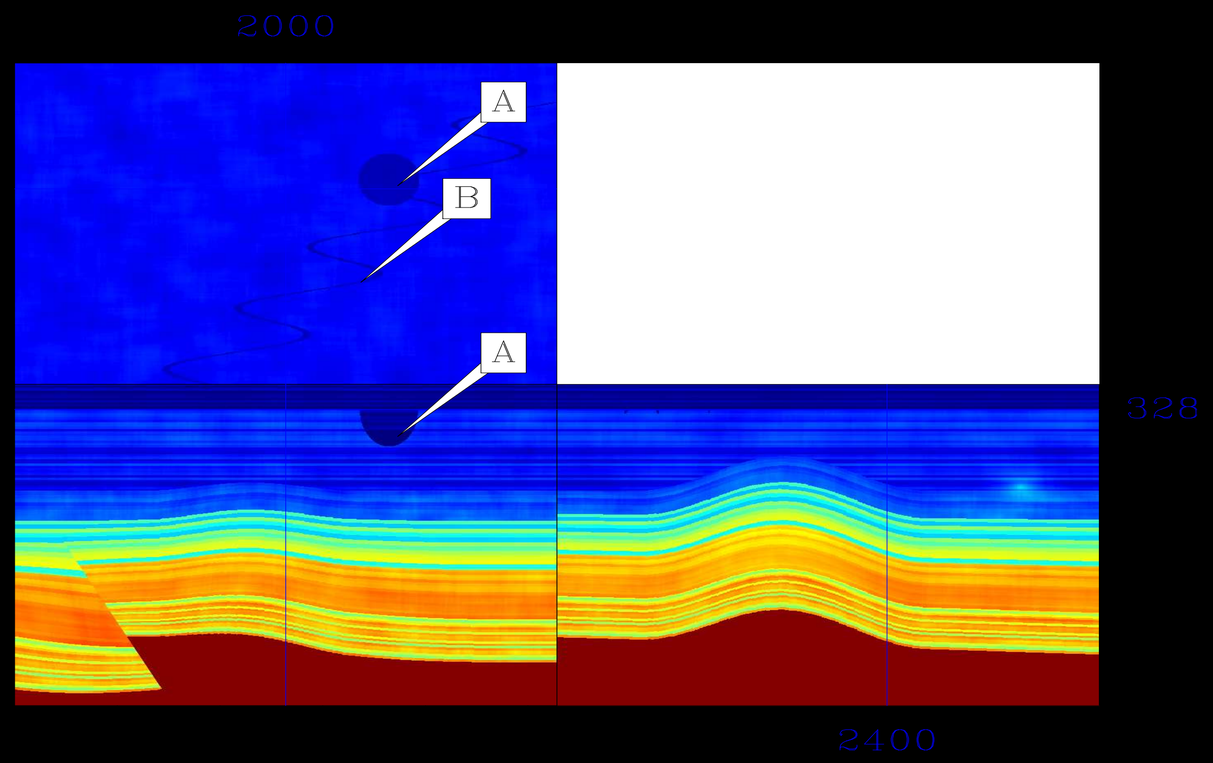
- Maximum movement
- Angle
- Major and minor die off
- Period of repetition
- Randomness of repetition

Erosion



- Depth to erode model

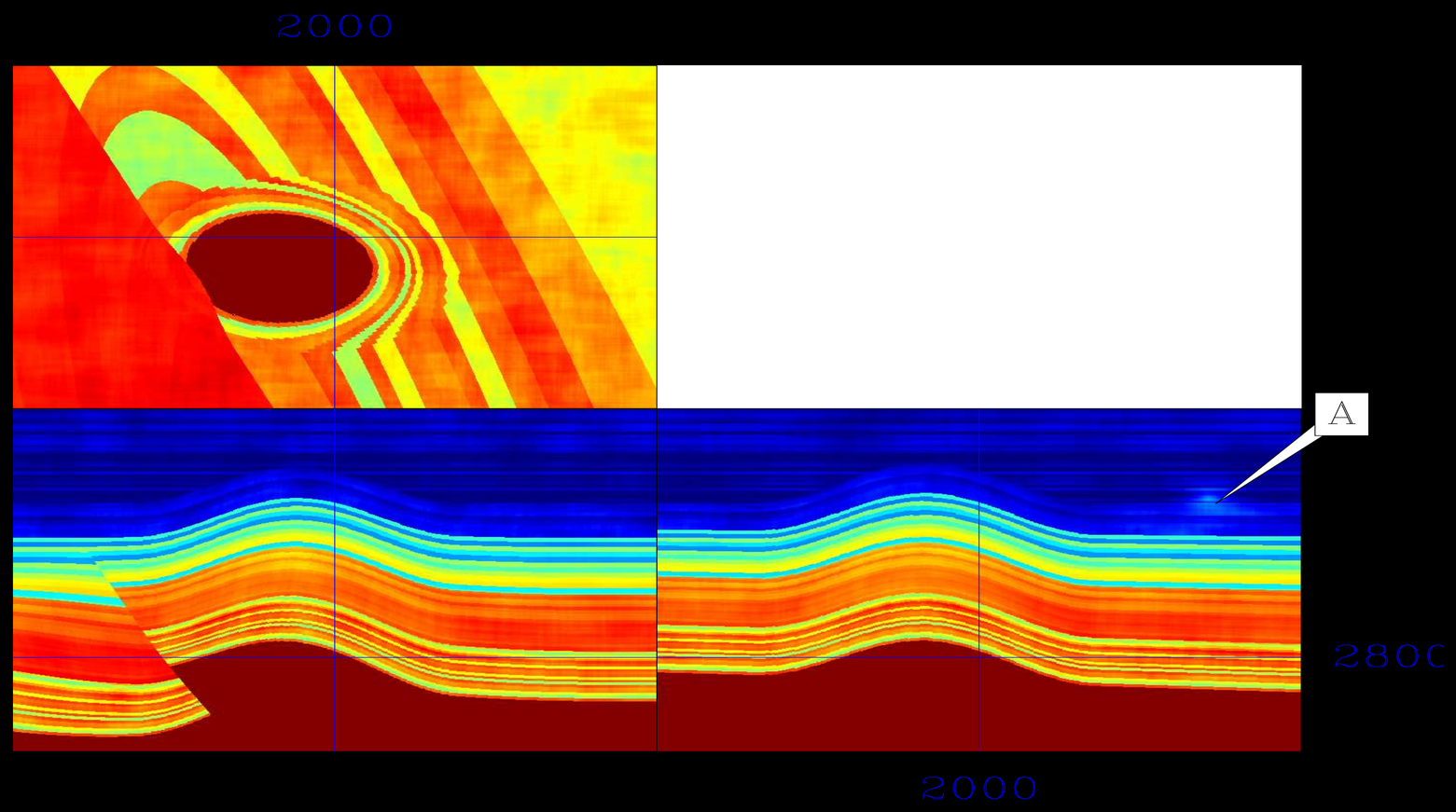
Erosion #2



Erosion

- Location
- Maximum depth
- Radius
- Fill level
  - Fill property value

Gaussian anomalies



- Specify location
- Width
- Deviation

Accesability

thick_2=1
event2=deposit
prop_2=4920.023988
dev_pos_2=0.550740
ev_layer_2=0.151379
layer_2=22.555732

event3=fault_p
begz_3=0.175283
begx_3=0.231708
begy_3=0.244294
dz_3=751.529498
daz_3=500.000000
eltaTheta_3=4.398077
perp_die_3=0.705760
heta_die_3=2.073728
dist_die_3=1.240765
heta_shift_3=0.586028

dev_pos_4=0.713095
dev_layer_4=0.276416
layer_4=26.301962

thick_5=80
event5=deposit
prop_5=4009.160190
dev_pos_5=0.481866
dev_layer_5=0.098720
layer_5=51.617865

thick_6=1
event6=deposit
prop_6=3941.424200
dev_pos_6=0.637447
dev_layer_6=0.227765

event7=fault_p
begz_7=0.142912
begx_7=0.130640
begy_7=0.331192
dz_7=1413.482459
daz_7=500.000000
deltaTheta_7=33.716849
perp_die_7=0.535767
theta_die_7=23.172812
dist_die_7=1.219660
theta_shift_7=2.998515
azimuth_7=24.316443
dir_7=1.000000
event8=fault_p
begz_8=0.136065
begx_8=0.534460
begy_8=0.760631
dz_8=1599.001314

Scripting

- Let randomness be your friend specify the range of acceptable parameters

```
myDefaults=Geomodel.defaults()
myDefaults.change_param_ranges("deposit",["thick:80:80","dev_pos:.
4:.8","dev_layer:.05:.29","layer:11:79"])
```

Scripting

- Define model sampling

```
mod=Geomodel.model(myDefaults,12.5,800,0,12.5,800,0,12.5,6000,20,"temp.P")
```

Scripting

- Create a layer and define the geologic events

```
#Layer 1
mod.change_param_ranges("deposit",["prop:4300:4800"])
mod.add_event("deposit")
mod.add_event("fault")
```

Scripting

```
#layer3
mod.new_layer()
mod.change_param_ranges("deposit",["prop:2800:3400"])
mod.add_event("deposit")
for i in range(4):  mod.add_event("fault")
for i in range(2):  mod.add_event("river")
mod.add_event("squish")
mod.add_event("unconformity")
```

Conclusions

- Event based modeling approaches allow tailoring of model complexity
- Simplified physics can be used to build pseudo-realistic models
- Wraping parameterization complexity within python simplifies the model building process