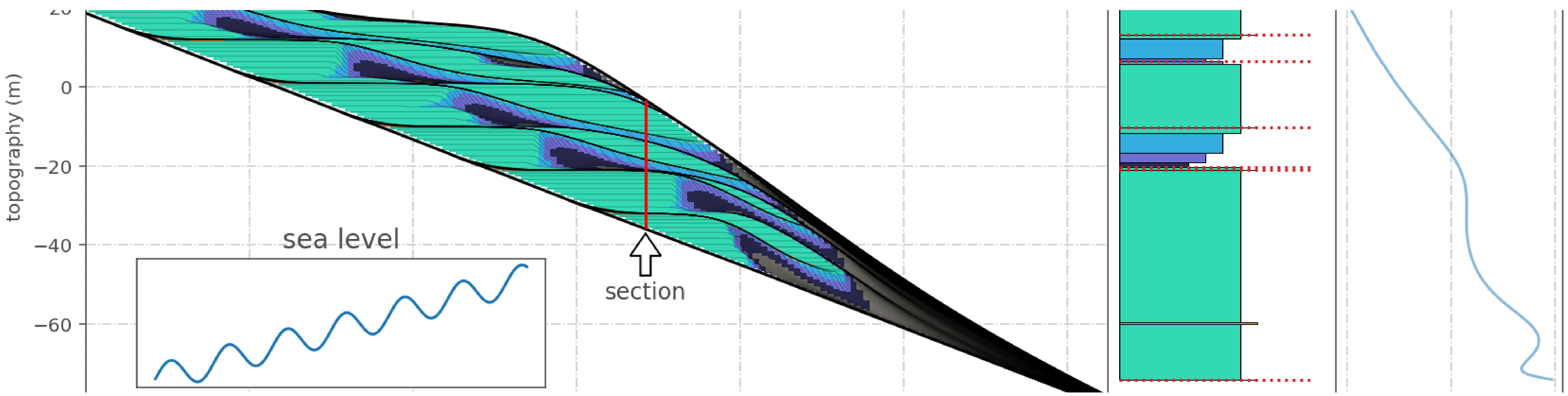
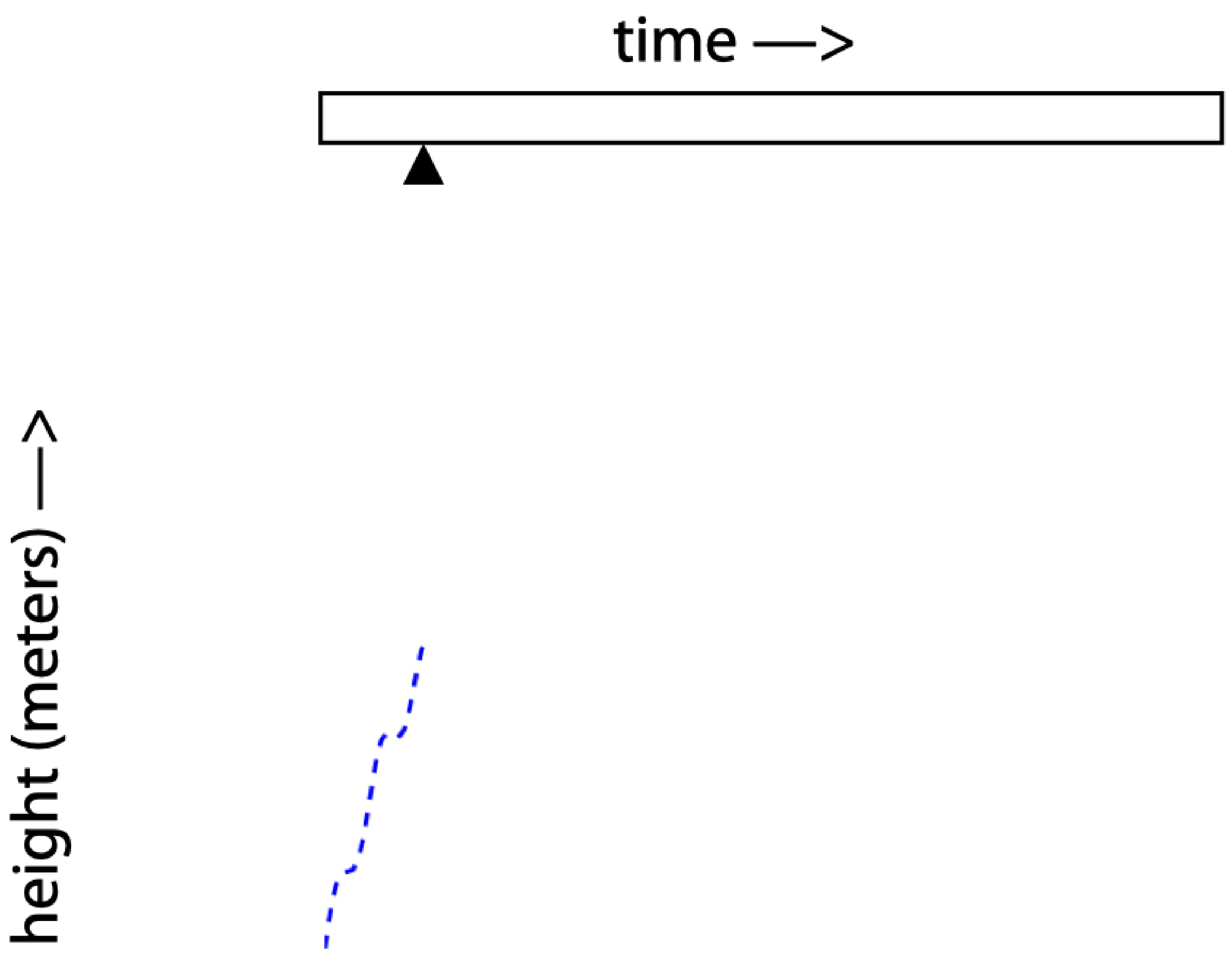


Lecture 8: Stratigraphic time part I

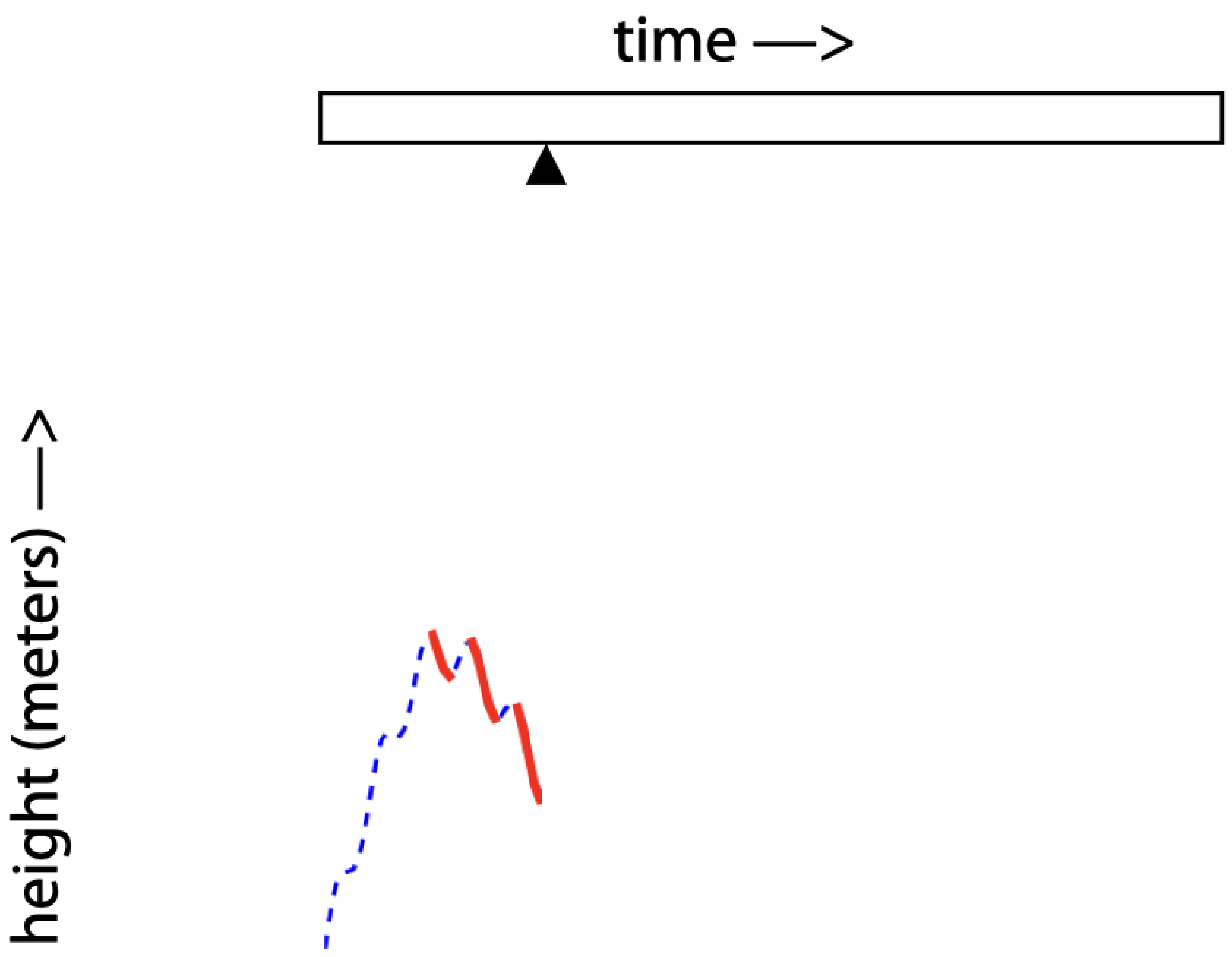
1. Gross vs. net fluxes
    A. erosion and hiatus
    B. how to build a rock record
2. Correlative surfaces
    A. Chronostratigraphy (Wheeler diagrams)
3. Time in the rock record
    A. Sadler effect

We acknowledge and respect the ləkʷəŋən peoples on whose traditional territory the university stands and the Songhees, Esquimalt and W̱SÁNEĆ peoples whose historical relationships with the land continue to this day.

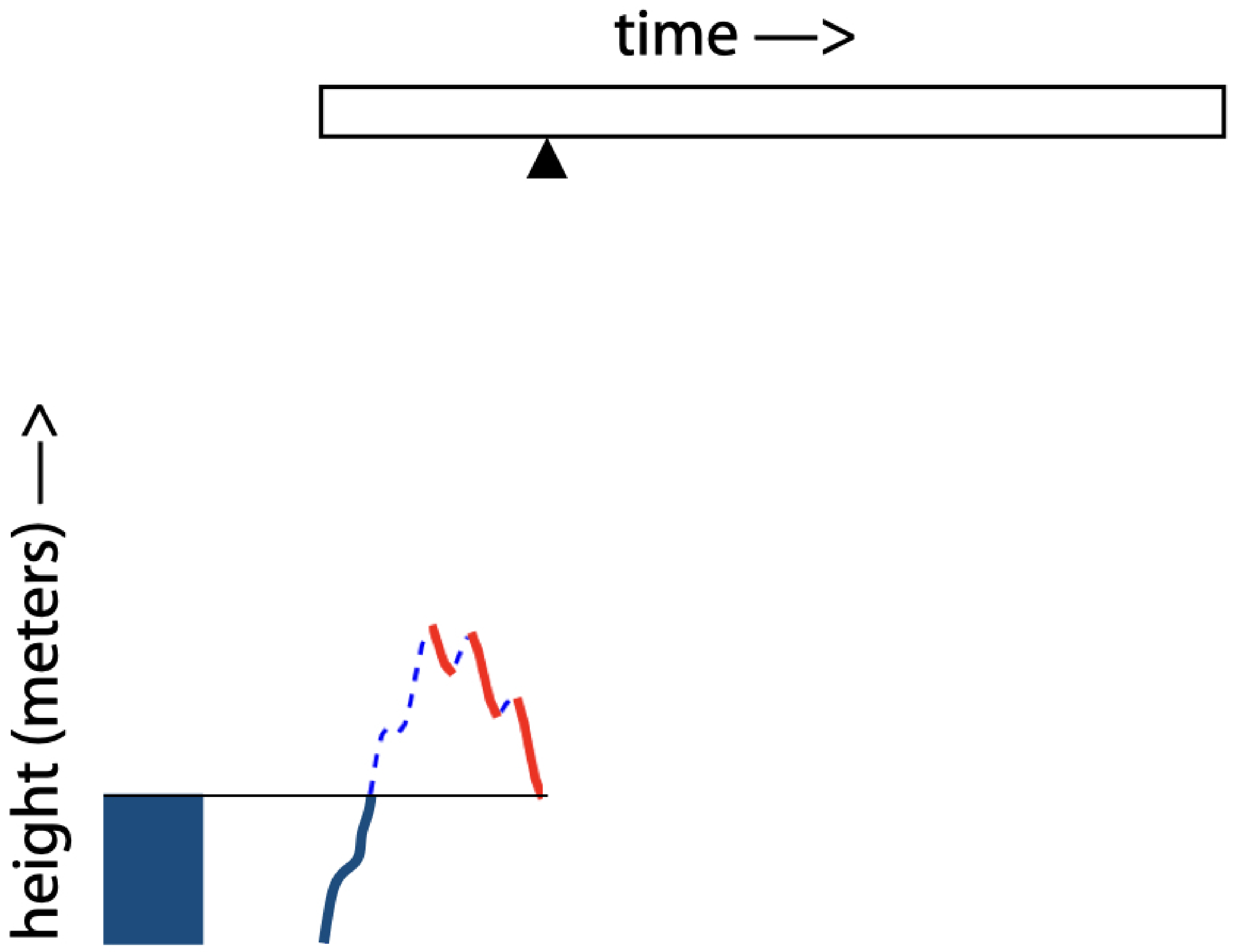
Gross and net sedimentation



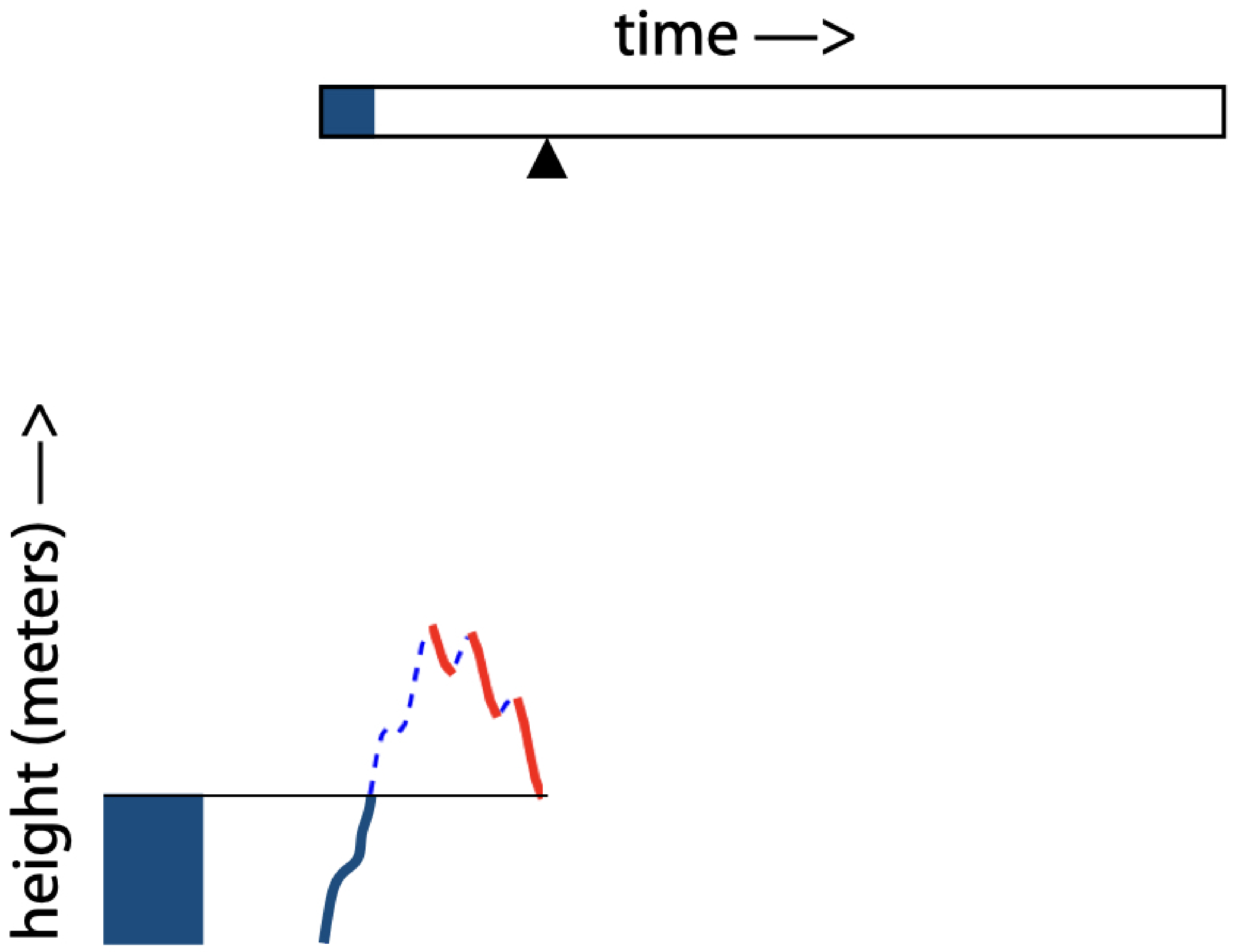
Gross and net sedimentation



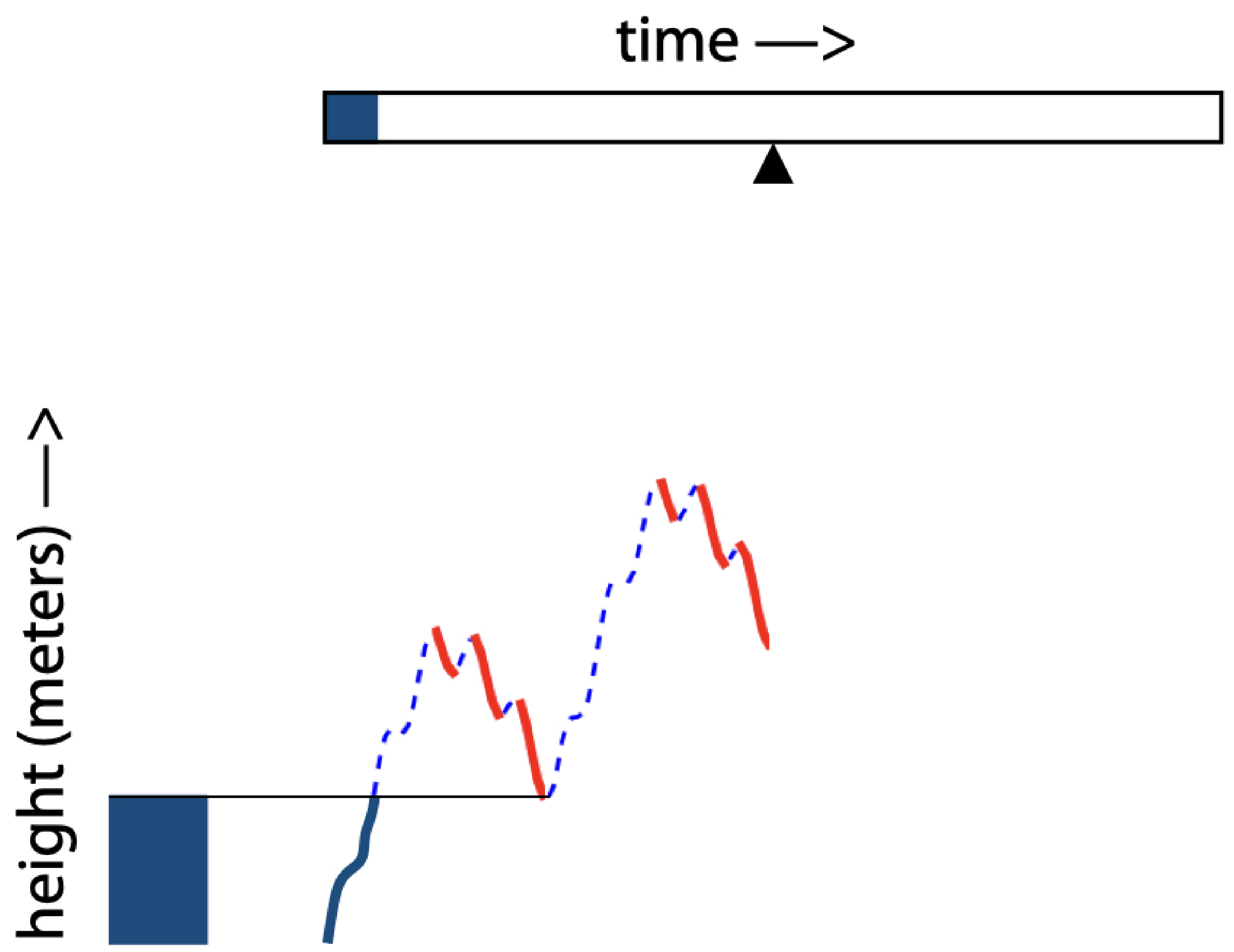
Gross and net sedimentation



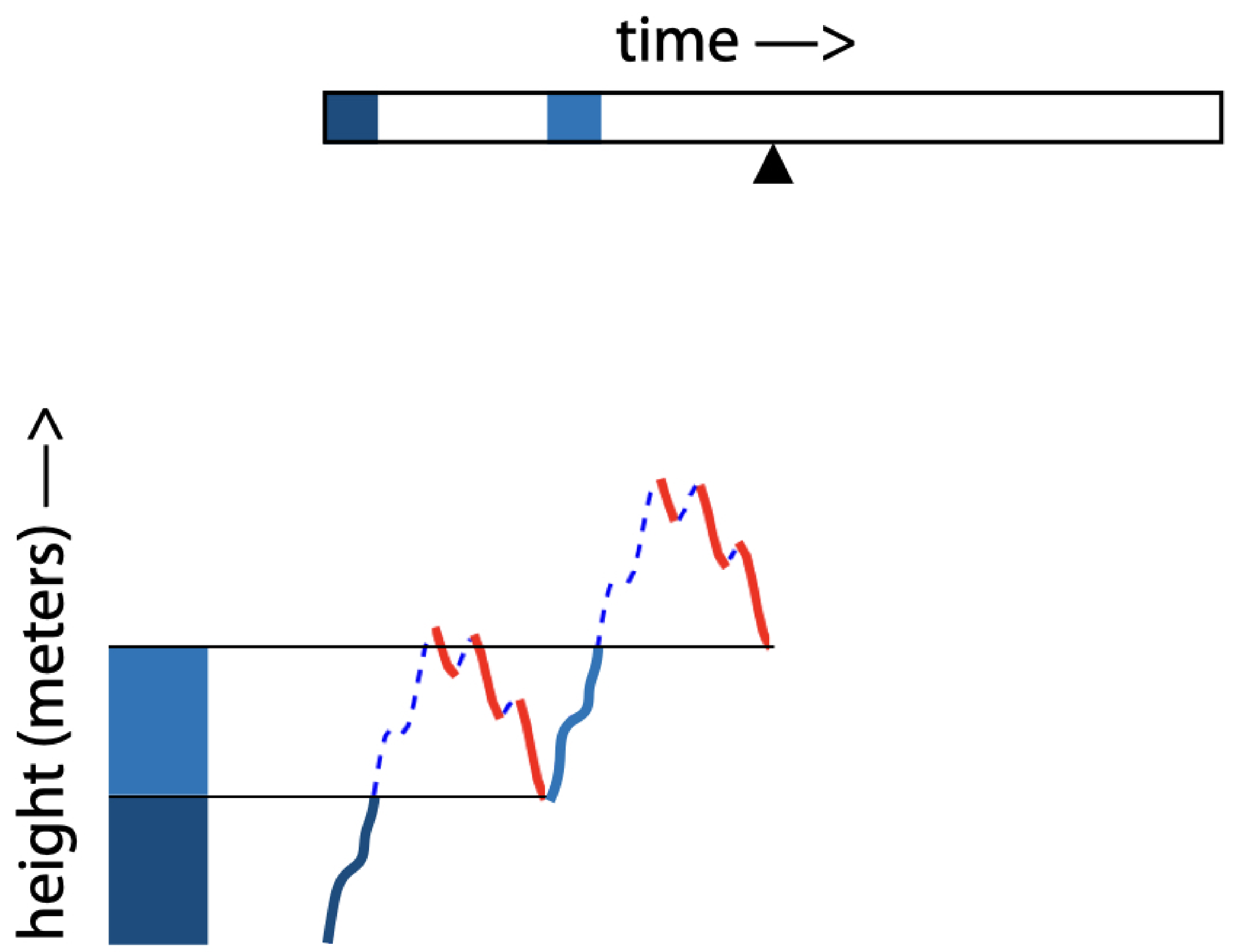
Gross and net sedimentation



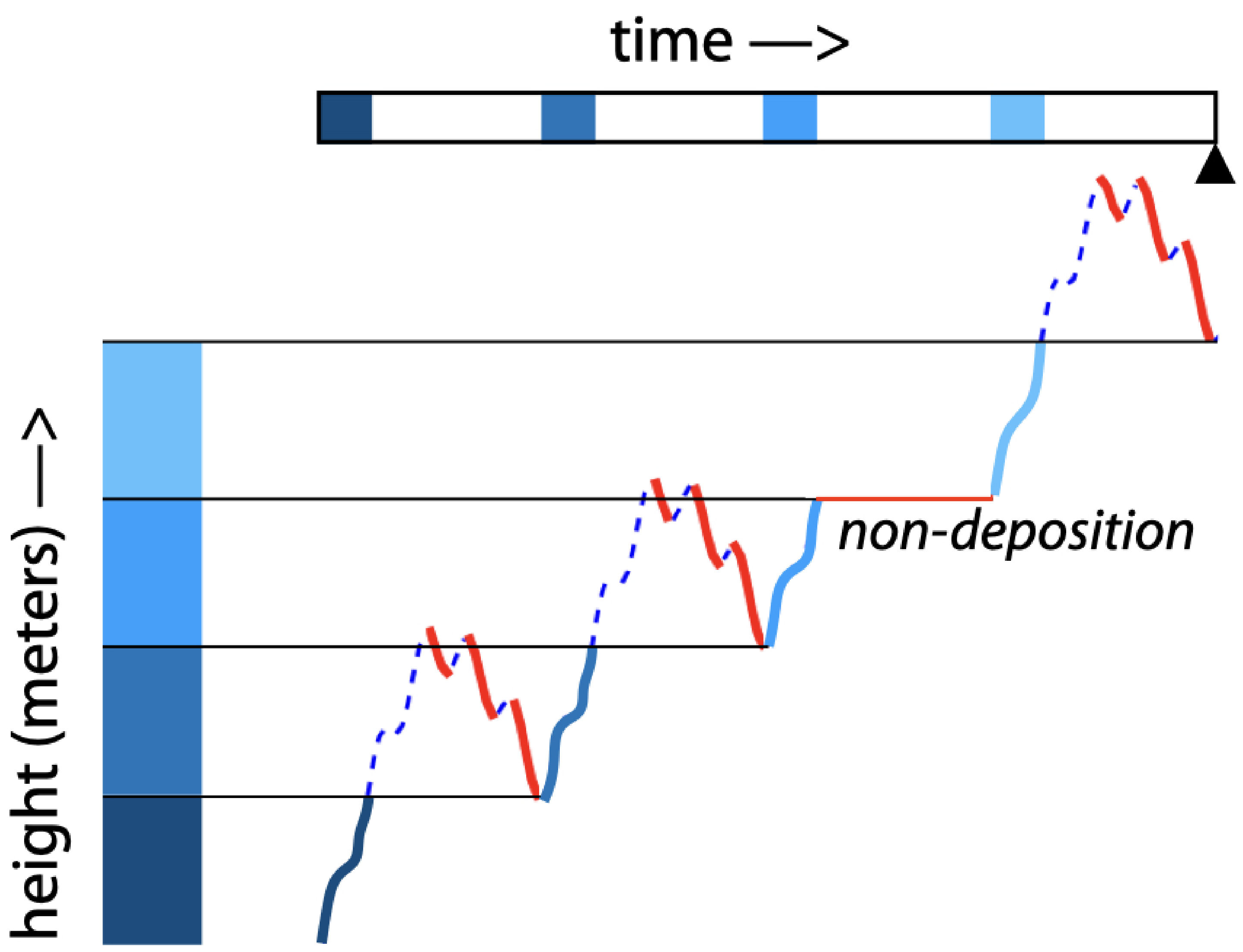
Gross and net sedimentation



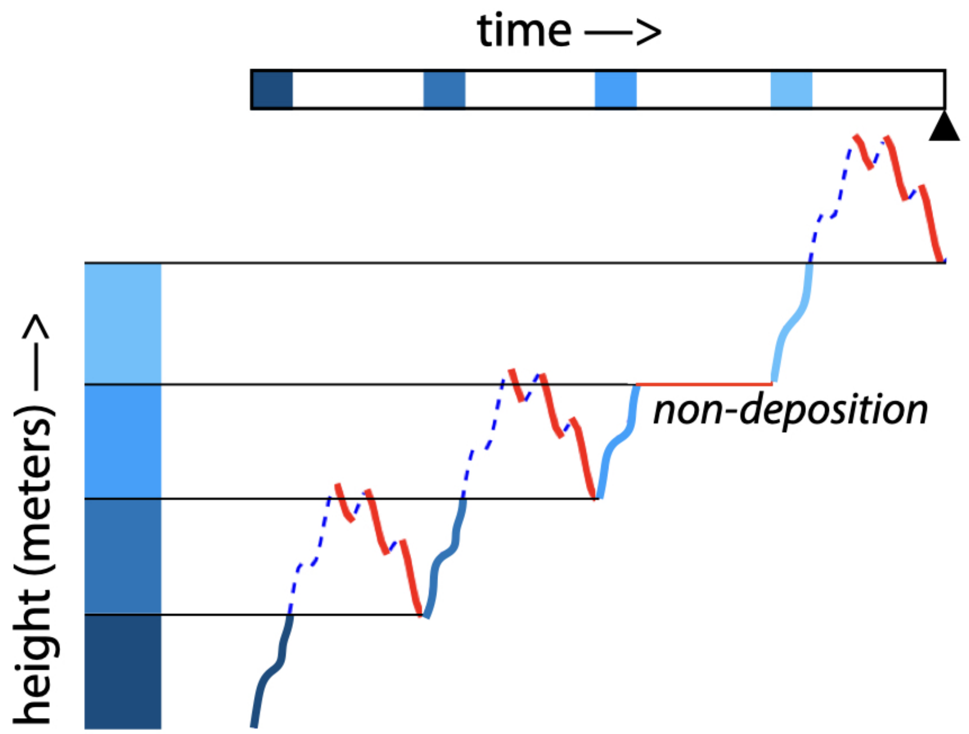
Gross and net sedimentation



Gross and net sedimentation

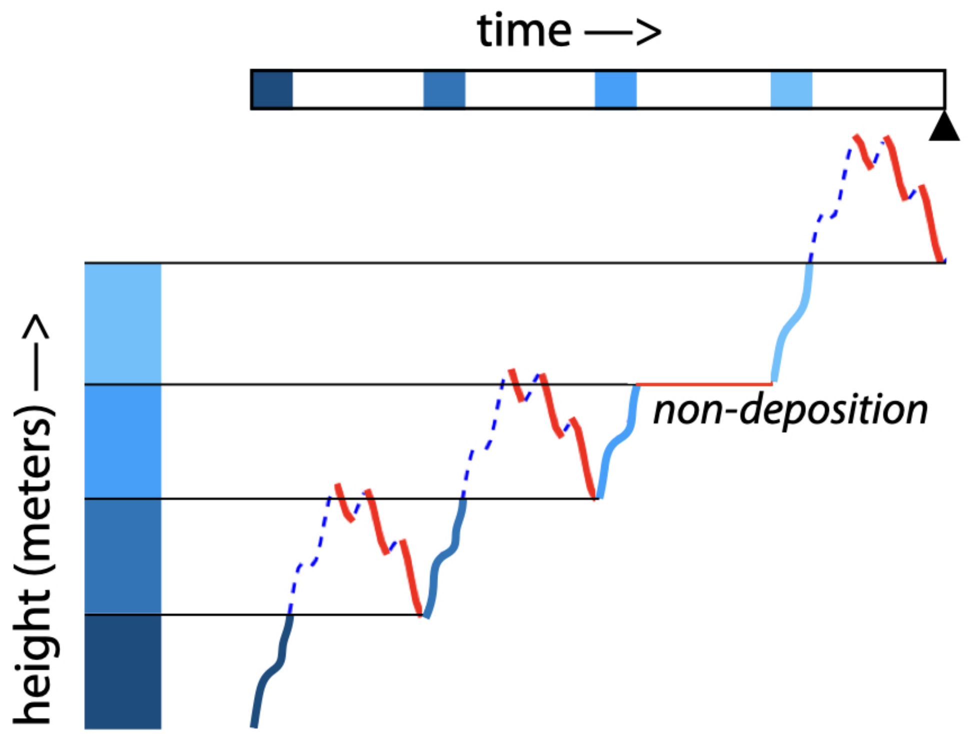


Gross and net sedimentation



net sedimentary record is full of **gaps:** both **erosive surfaces** and **hiatuses**.

Gross and net sedimentation



net sedimentary record is full of **gaps:** both **erosive surfaces** and **hiatuses**.

How much time is represented by sedimentary rock?

How to build the net rock record

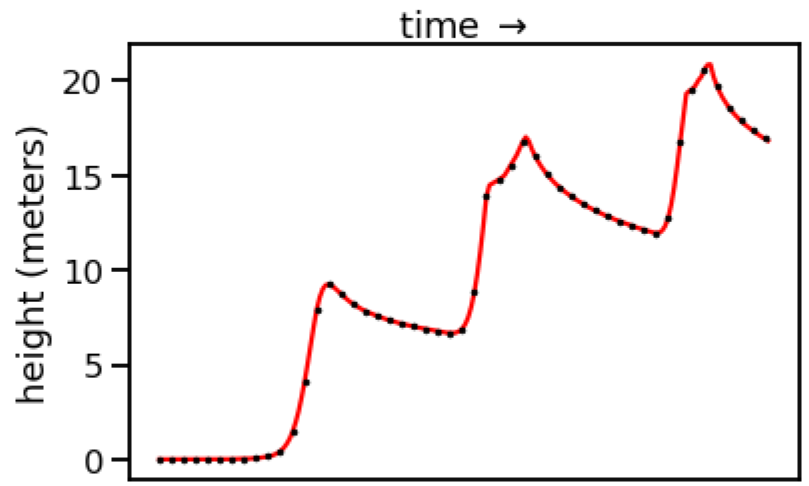
In [2]:

```
import csv
import numpy as np
from matplotlib import pyplot as plt
import seaborn as sns
sns.set_context('talk')
%matplotlib inline

#empty lists for data
model_topo=[]

#open the data file
with open("model_results.csv","r") as fid:
    data = csv.reader(fid, delimiter=",")

    #reads the data in line-by-line
    for row in data:
        model_topo.append([float(r) for r in row[1:]])

#convert to list of numpy arrays
model_topo=[np.array(t) for t in model_topo]

#define as change from inital conditions
model_topo=[t-model_topo[0] for t in model_topo]
```

How to build the net rock record

In [3]:

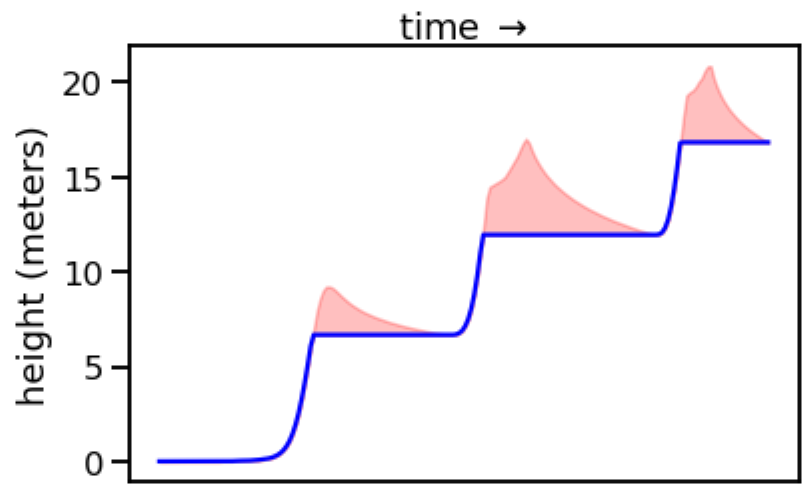
```
#pull topographic evolution from one spot in the basin
section=[t[454] for t in model_topo]

plt.plot(section,'-',color='r')
plt.plot(np.arange(len(section))[0::4],section[0::4],'.',markersize=5,color='k')

plt.gca().set_xticks([])
plt.gca().set_xlabel(r'time $\rightarrow$')
plt.gca().set_ylabel('height (meters)')
plt.gca().xaxis.set_label_position('top')
```



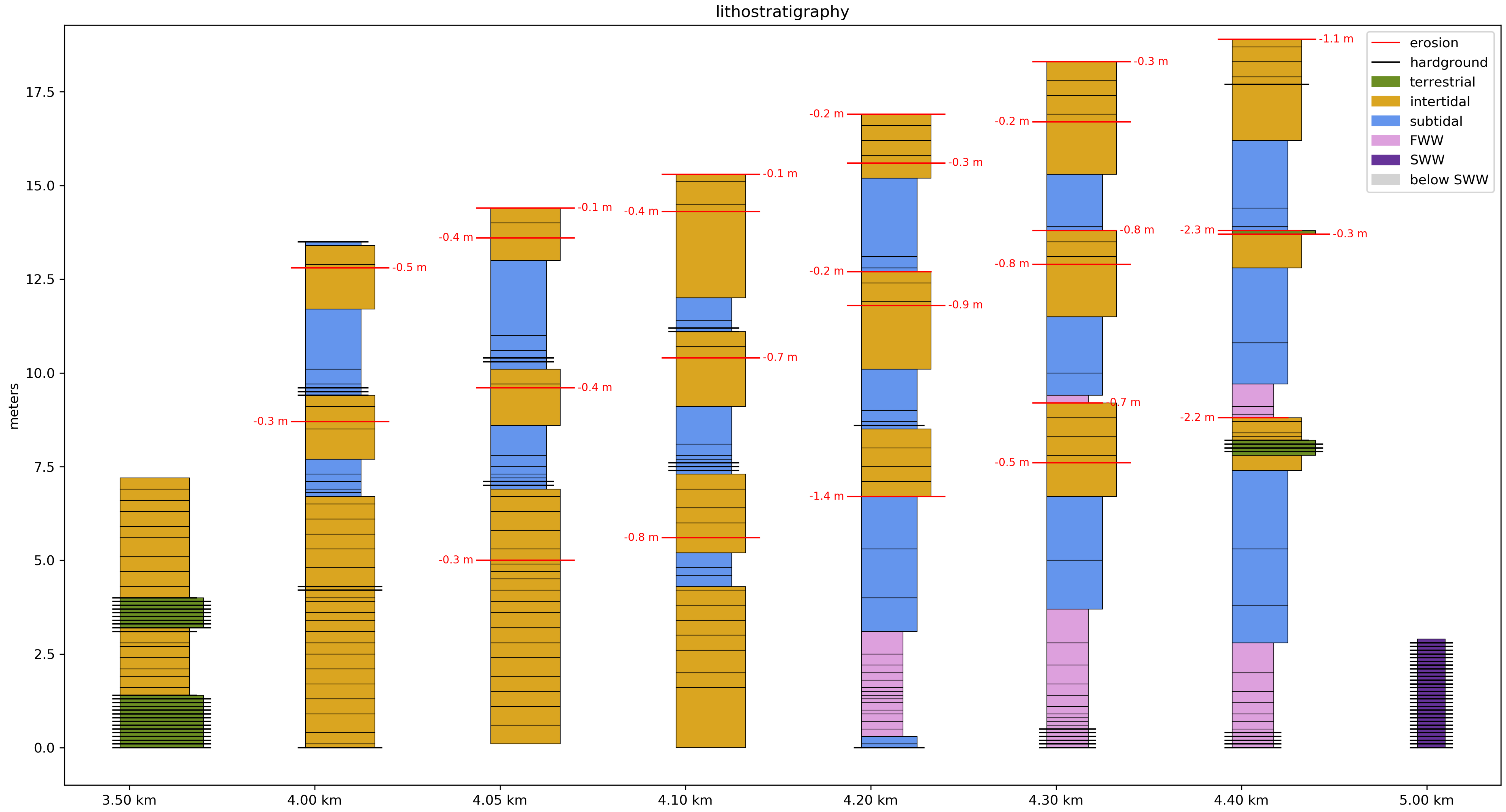
How to build the net rock record

In [3]:

```
net=np.flipud(section) #flip this stratigraphy upside down to examine youngest to oldest
for i,s in enumerate(net): #count through time slices starting at the youngest
    if i!=len(net)-1: #if we're not at the end
        #look "down section" - was this layer eroded?
        # --> if height had decreased, then yes
        if s<net[i+1]: #s is height of current timeslice, net[i+1] is heigh of previous timeslice
            net[i+1]=s #create new record of net sedimentation
#make stratigraphy younging upwards again
net=np.flipud(net)
plt.plot(net,color='b')
plt.fill_between(np.arange(len(section)),section,net,color='r',alpha=0.25)
plt.gca().set_xticks([])
plt.gca().set_xlabel(r'time $\rightarrow$')
plt.gca().set_ylabel('height (meters)')
plt.gca().xaxis.set_label_position('top')
```



How to build the net rock record

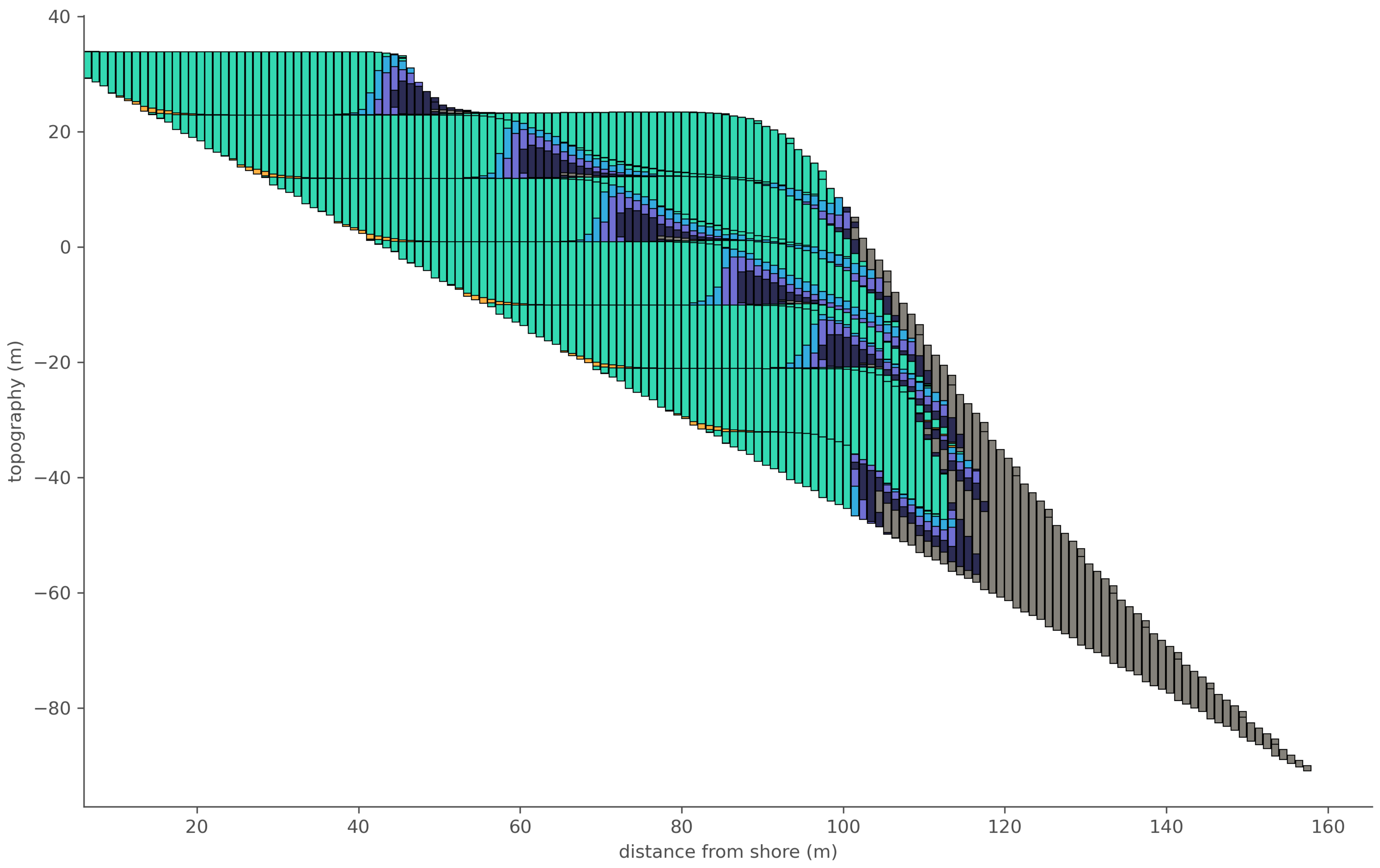


Coastline position and erosion and hiatus

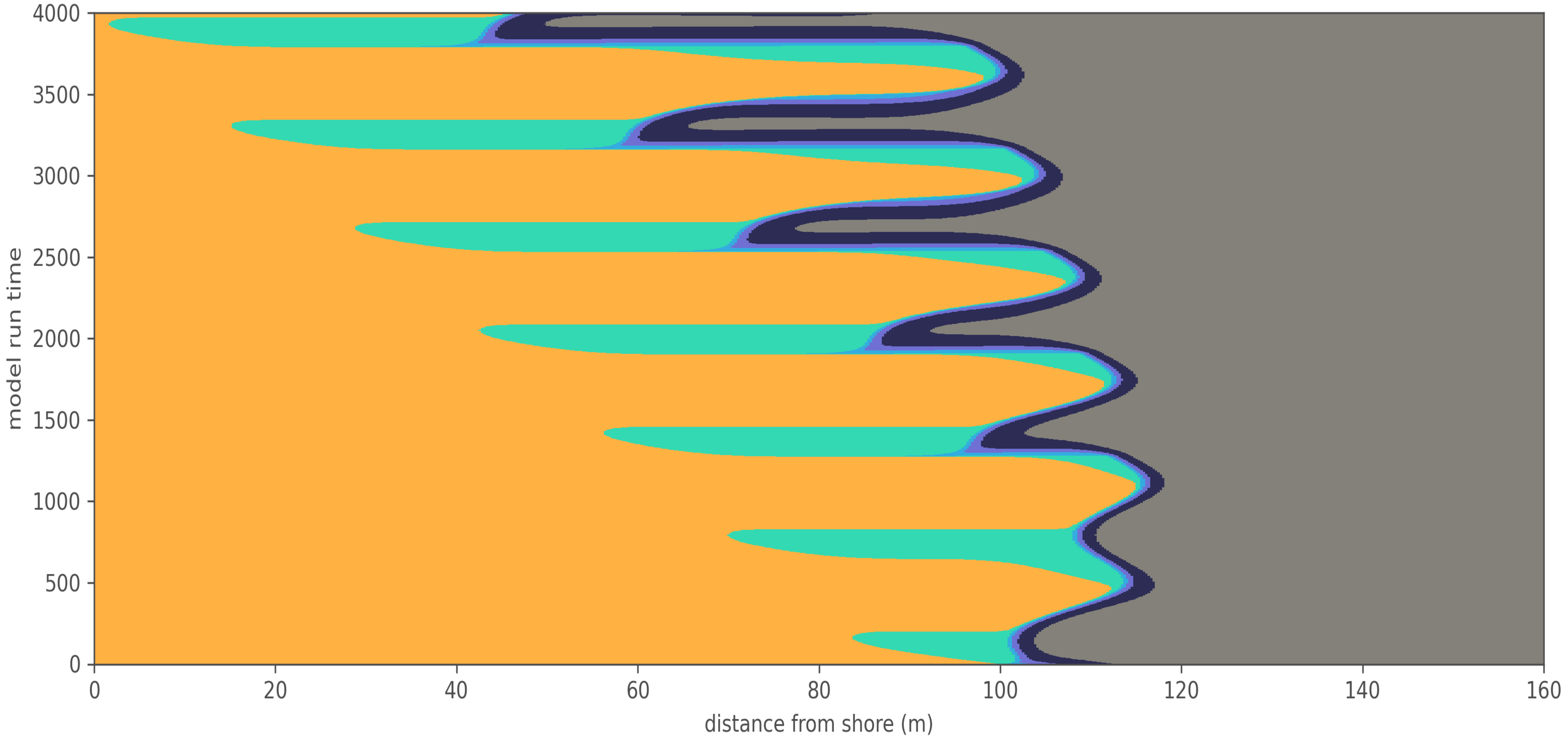
We will look at a set of model runs to better understand the relationship of the coastline position to **erosion** and **hiatus** (and **time**). First, let's review the controls on coastline position:

- Coastline progrades/regresses/moves seaward when: $\frac{sed}{dt} > \frac{space}{dt}$
- Coastline retrogrades/transgresses/moves landward when: $\frac{sed}{dt} < \frac{space}{dt}$
- Coastline aggrades/stays in the same location landward when: $\frac{sed}{dt} \approx \frac{space}{dt}$

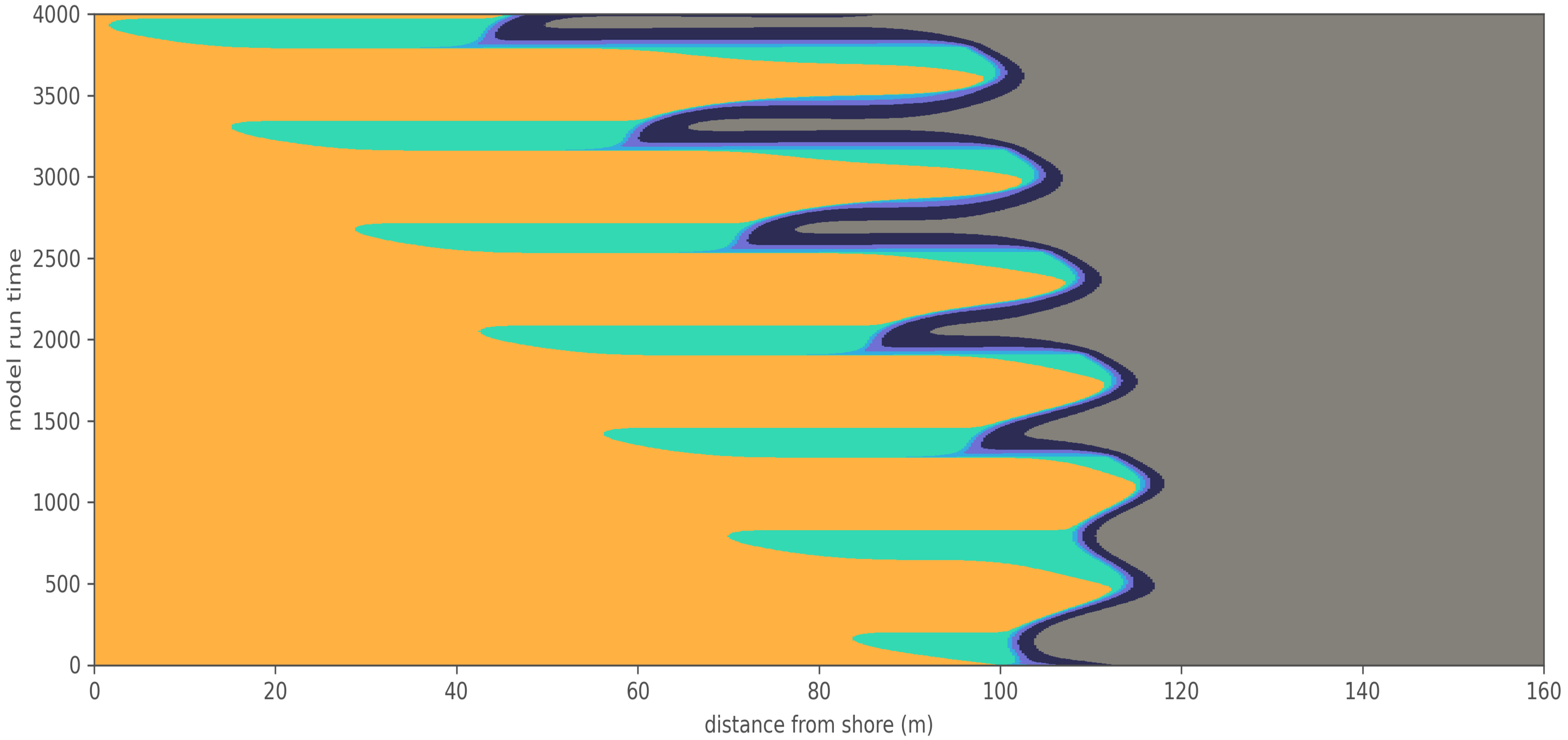
Simple sea level cycles: stratigraphic columns



Simple sea level cycles: time vs topography

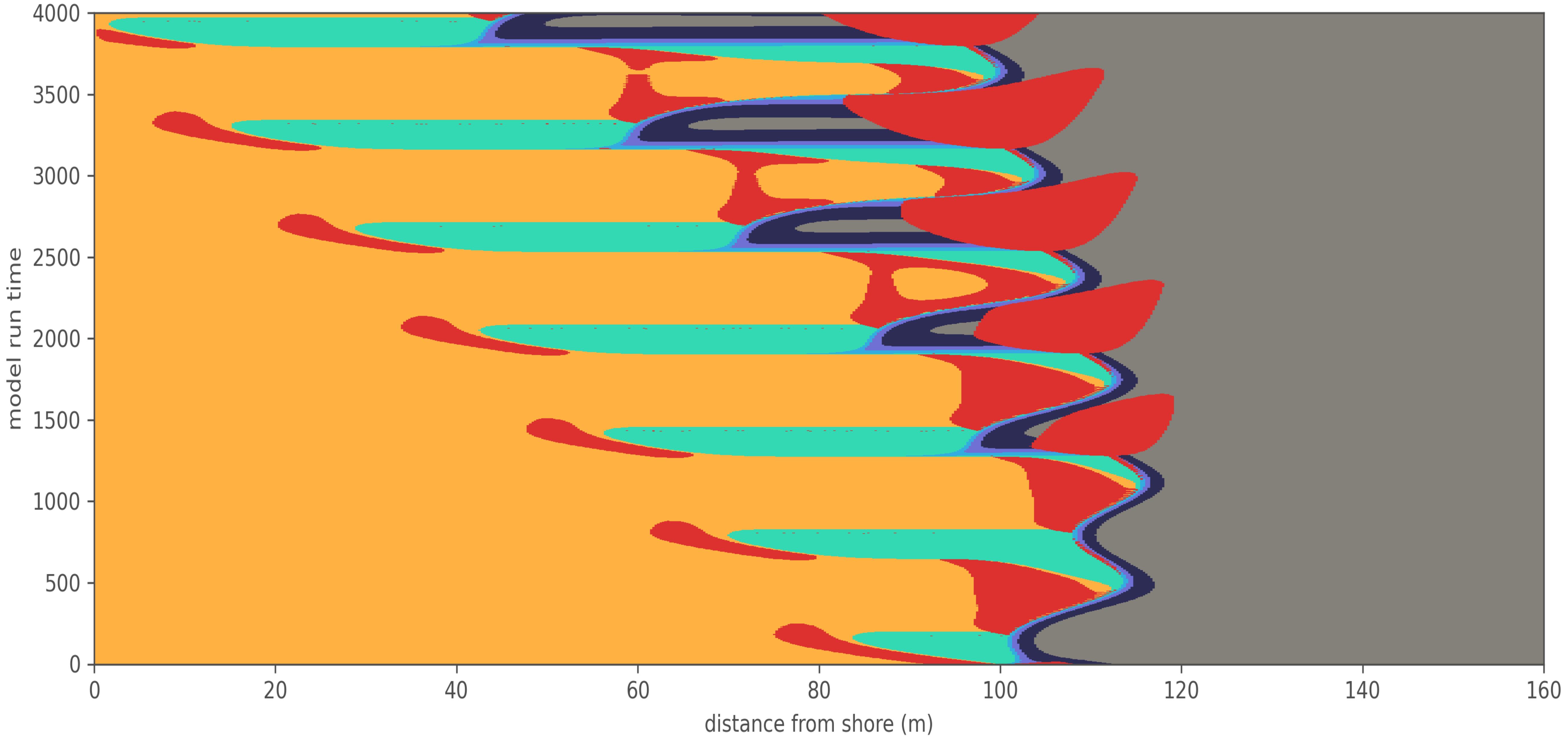


Simple sea level cycles: time vs topography

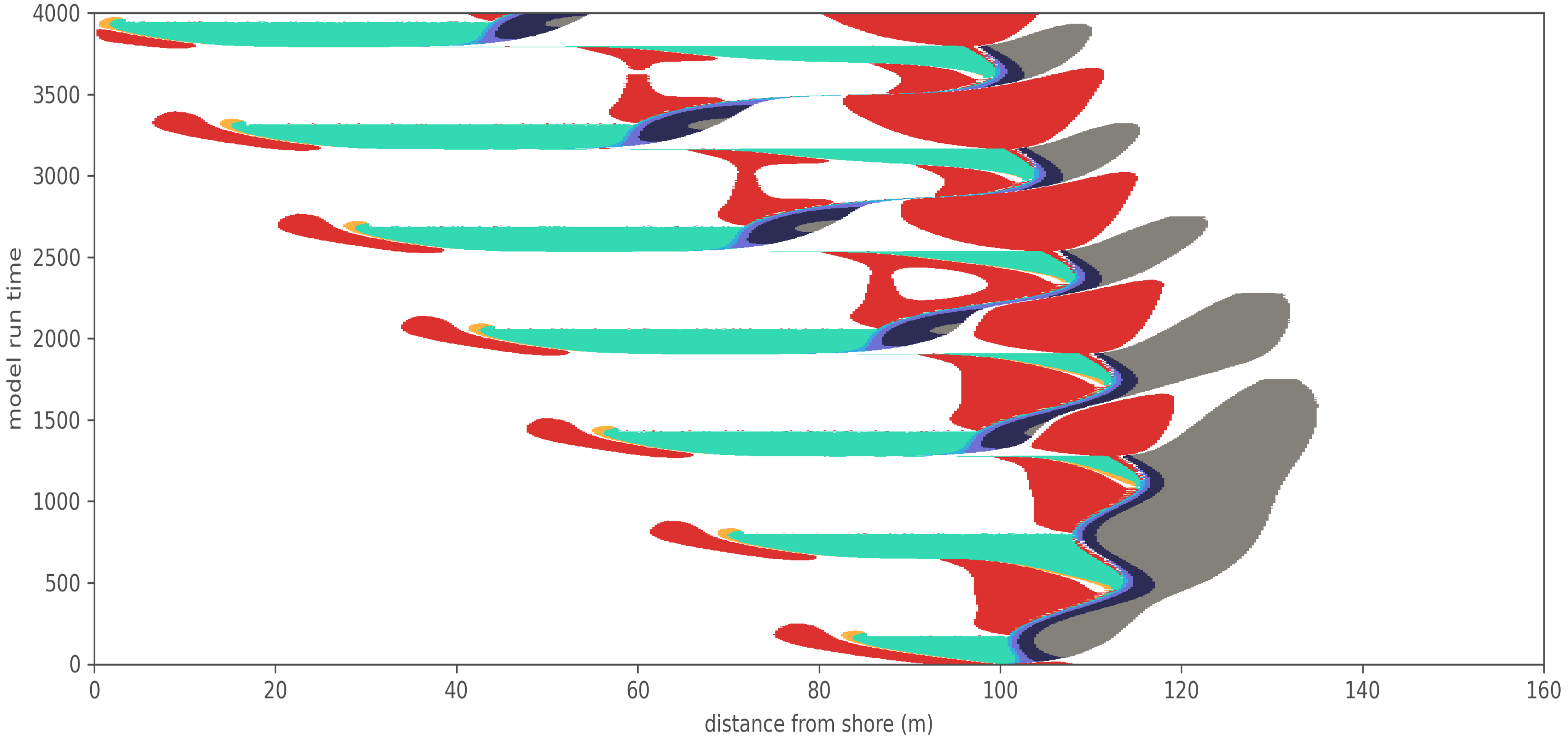


Where do you get erosion? Where is erosion rate maximized? What about non-deposition? *(annotate/draw on your handout)*

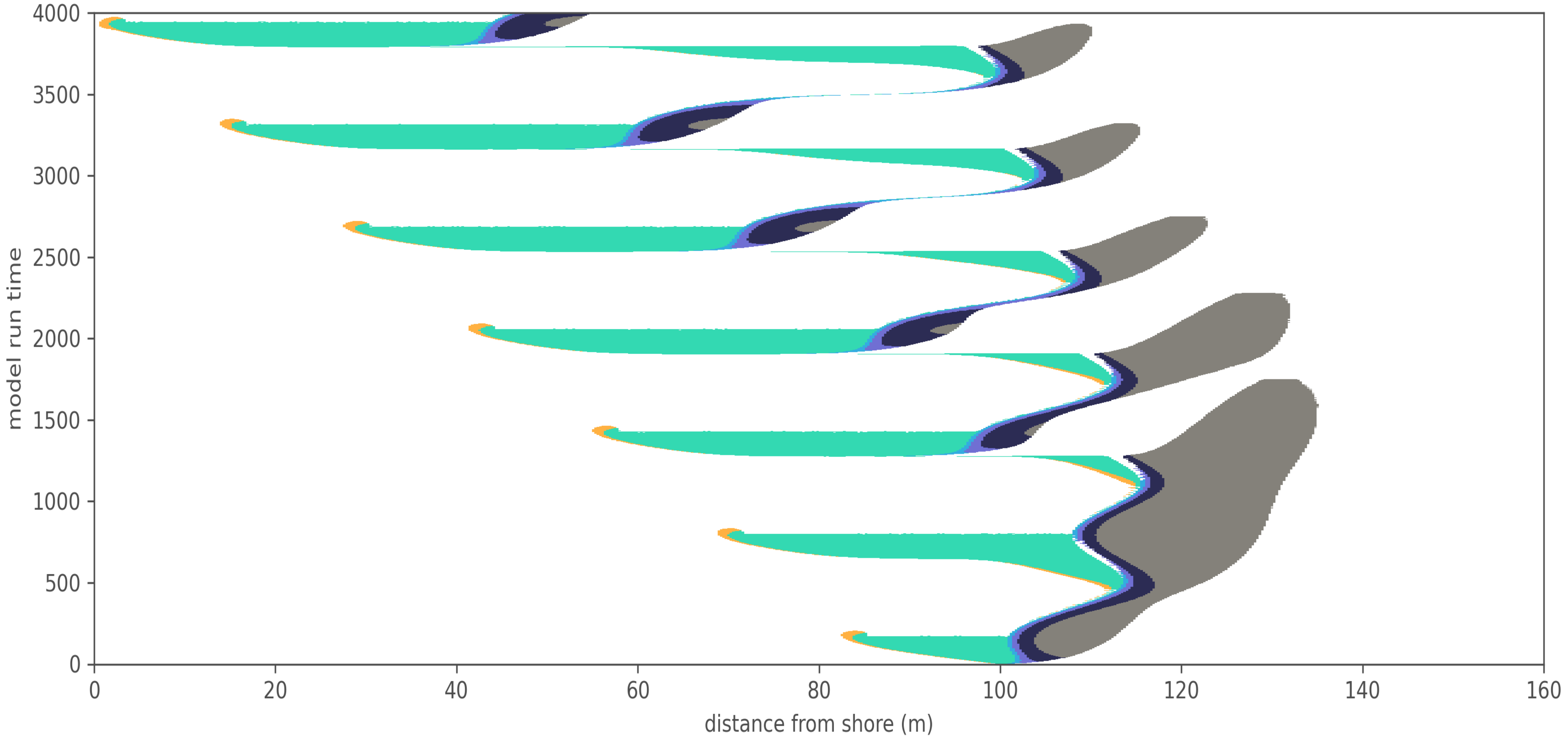
Simple sea level cycles: time vs topography (erosion)



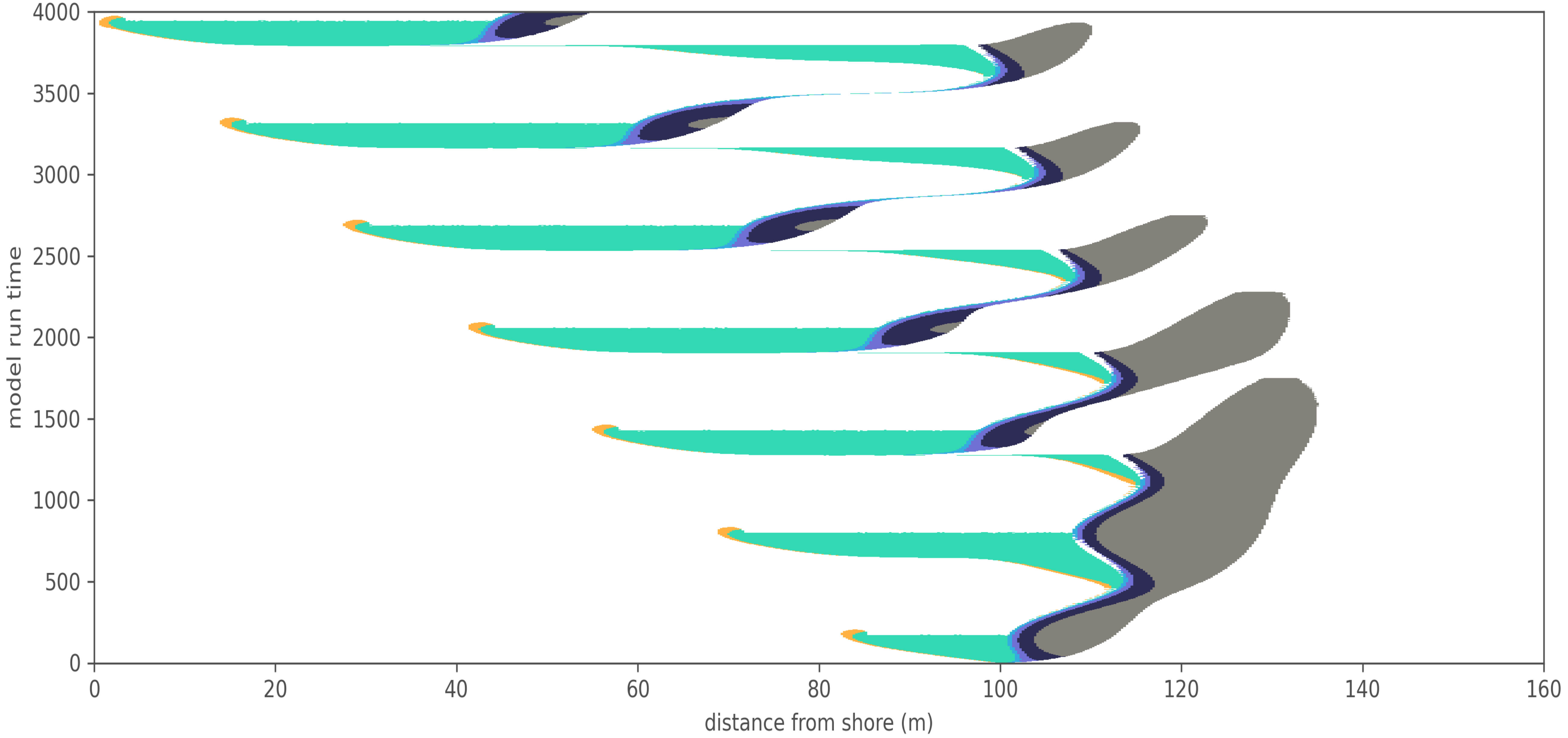
Simple sea level cycles: time vs topography (erosion and hiatus)



Simple sea level cycles: *Wheeler* diagram

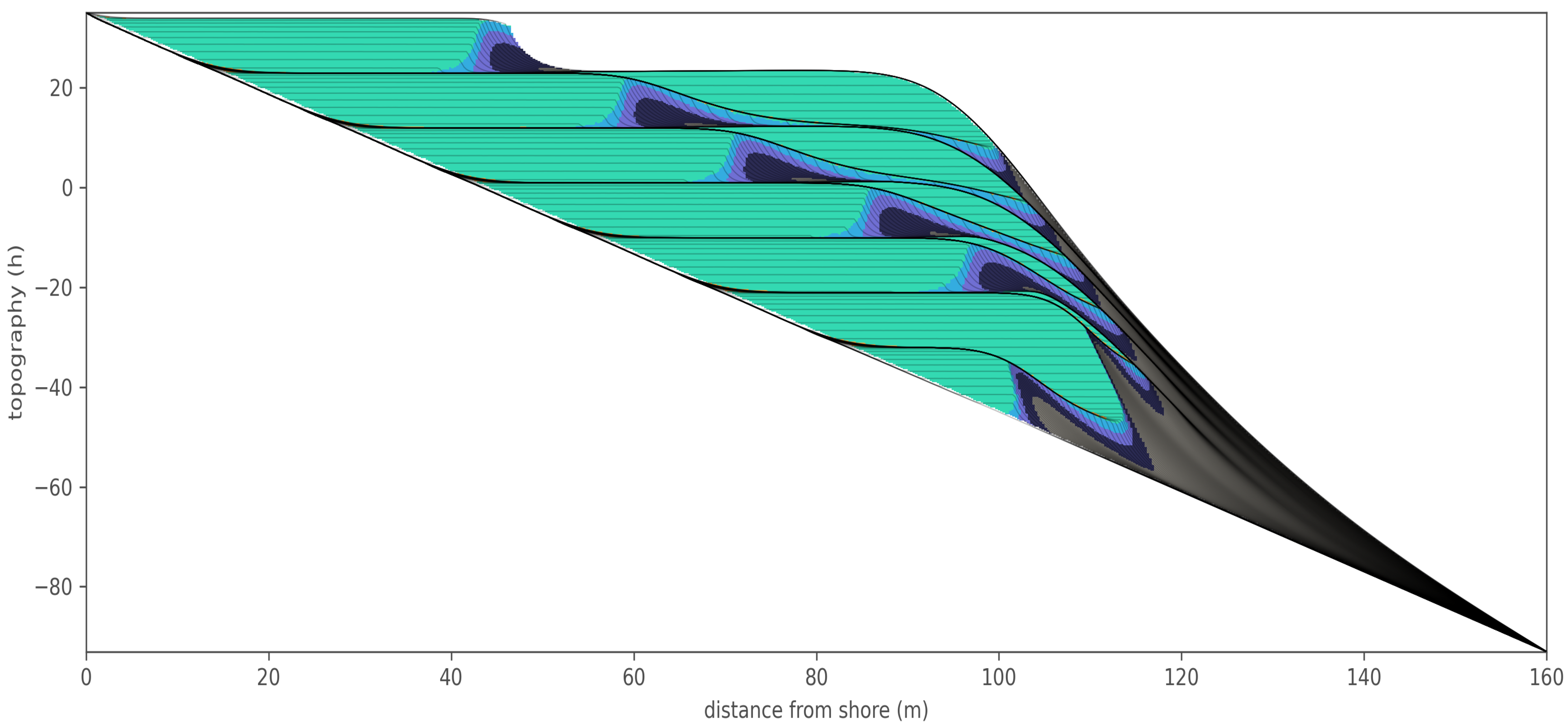


Simple sea level cycles: *Wheeler* diagram

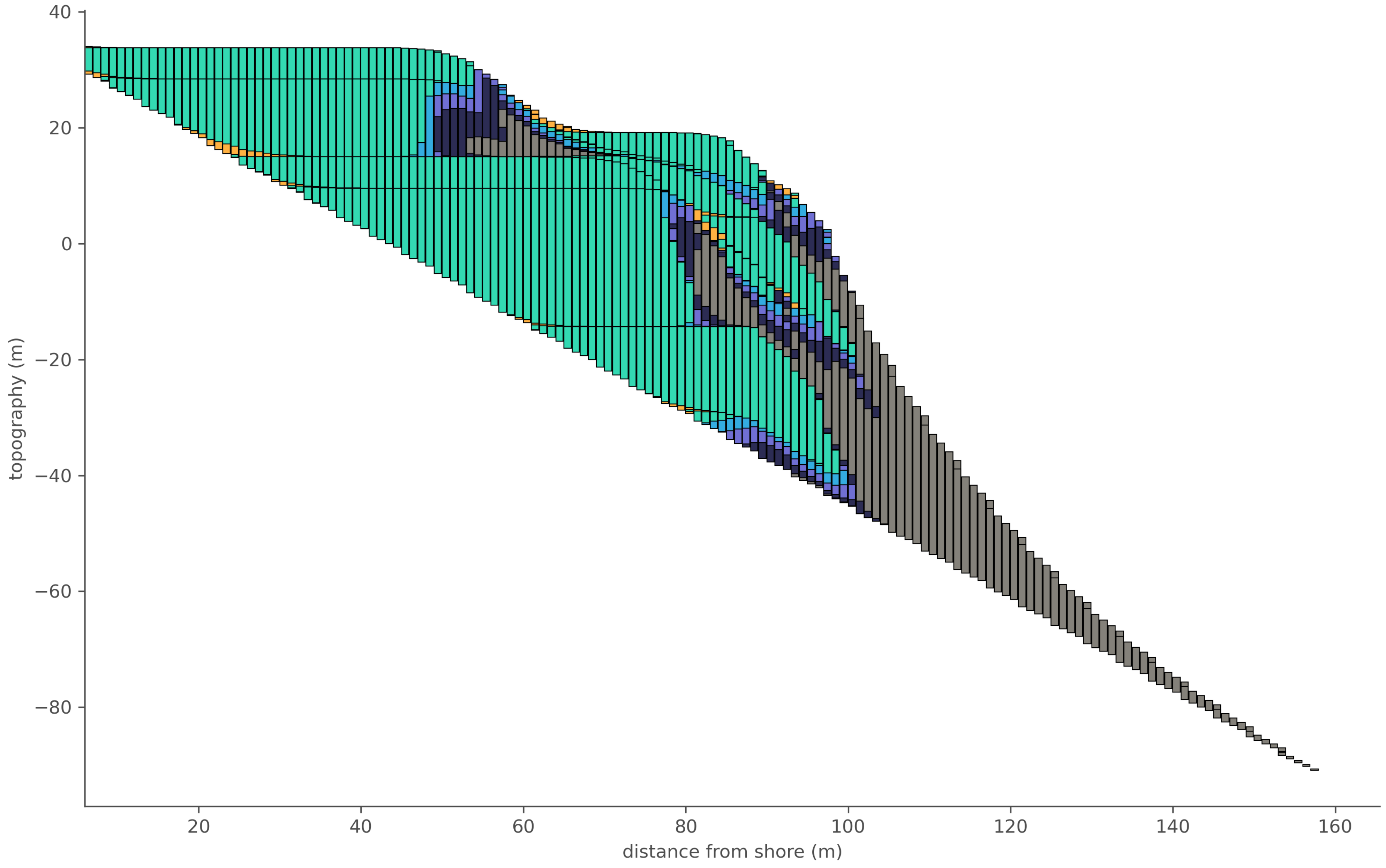


Note: not all positive deposition is significant. Discuss where you think the thickest sediments (highest sedimentation rates) are.

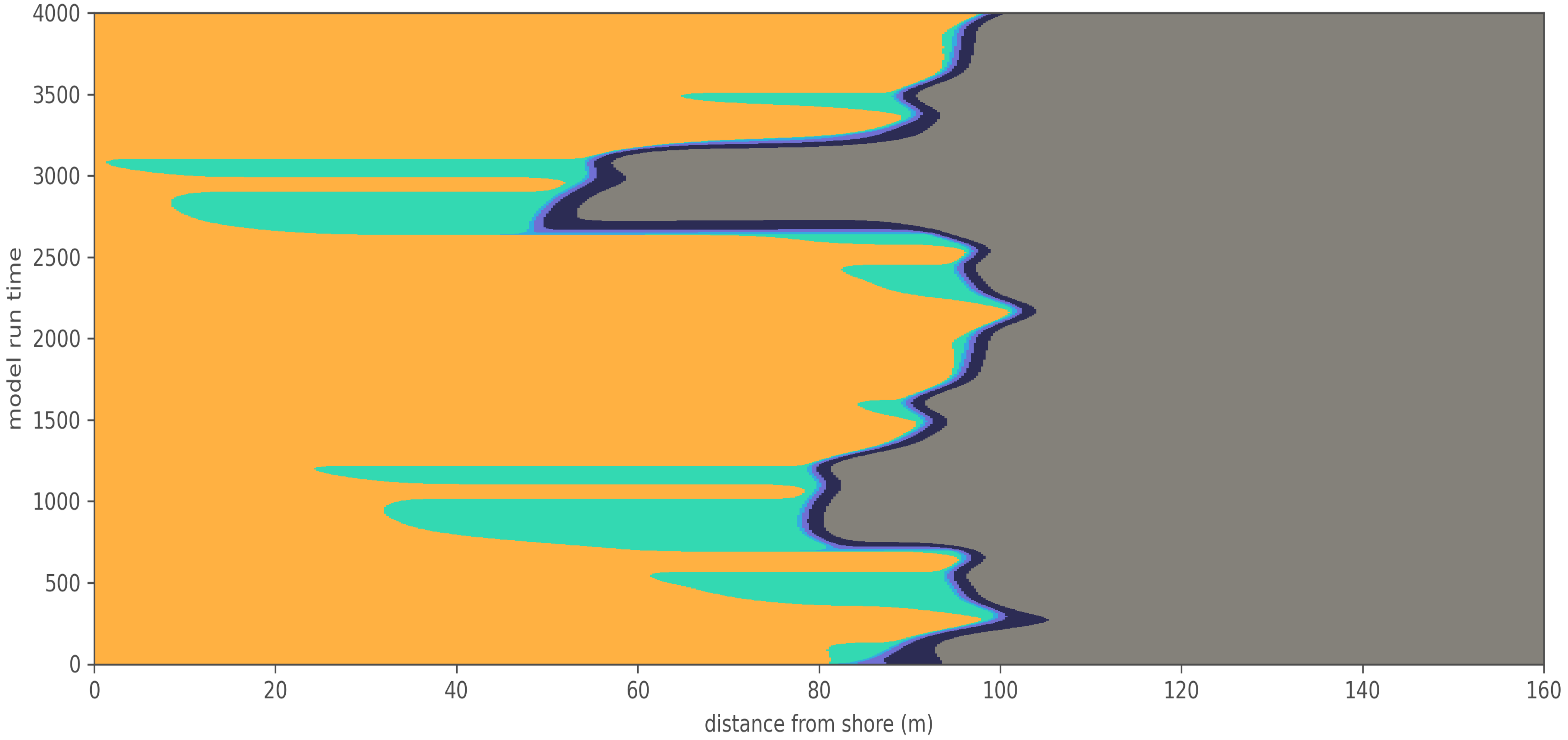
Simple sea level cycles: stratigraphic profile



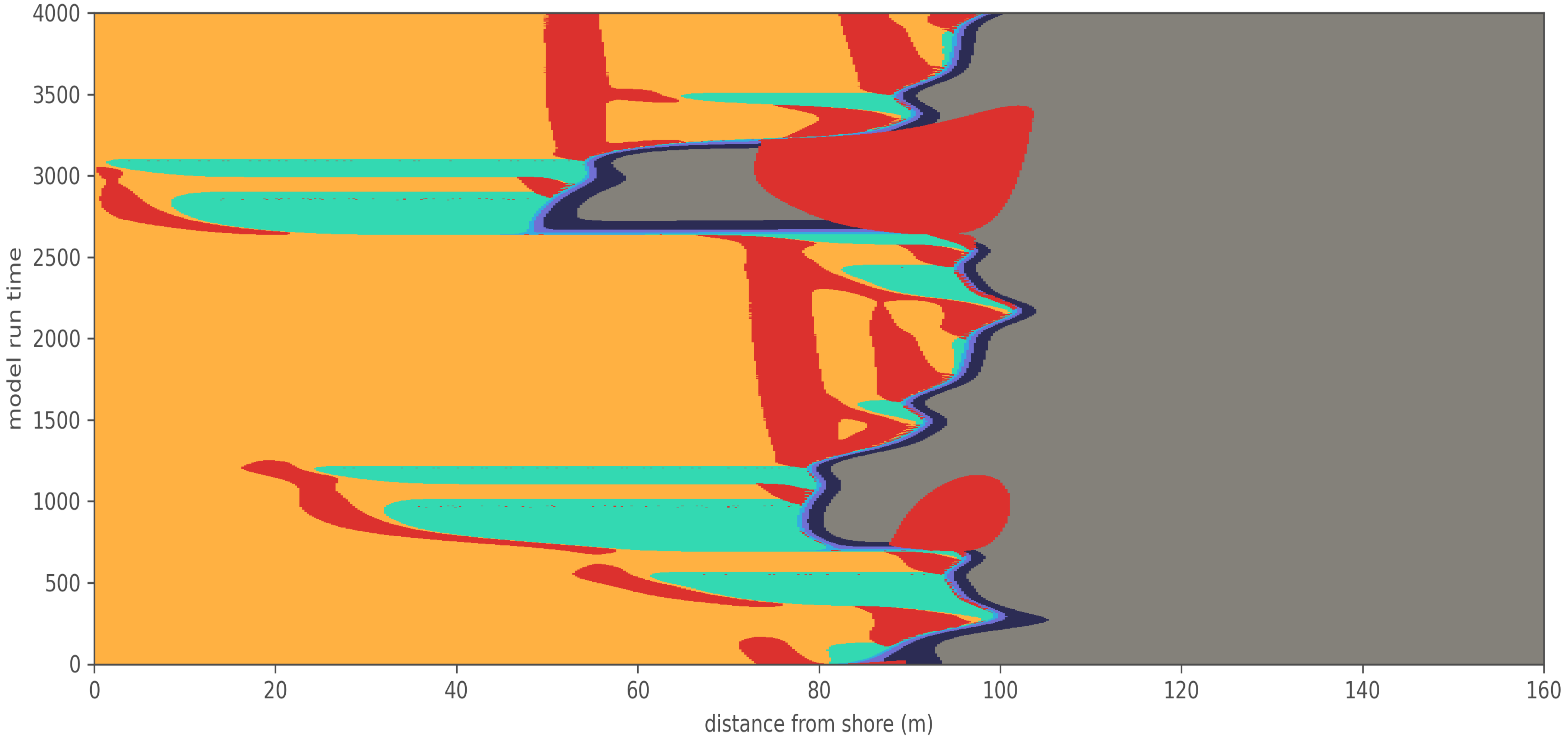
Class example 1: stratigraphic columns



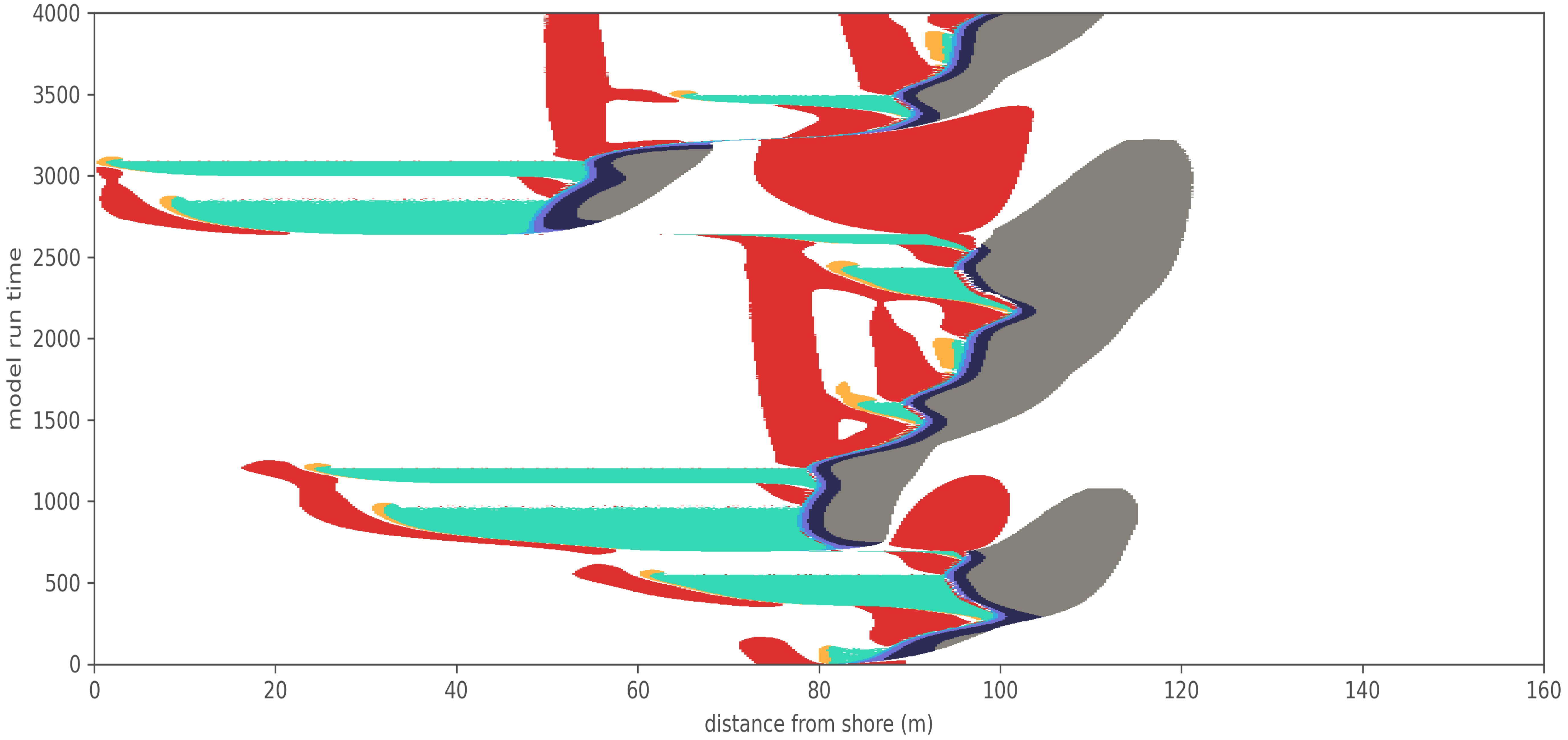
Class example 1: time vs topography



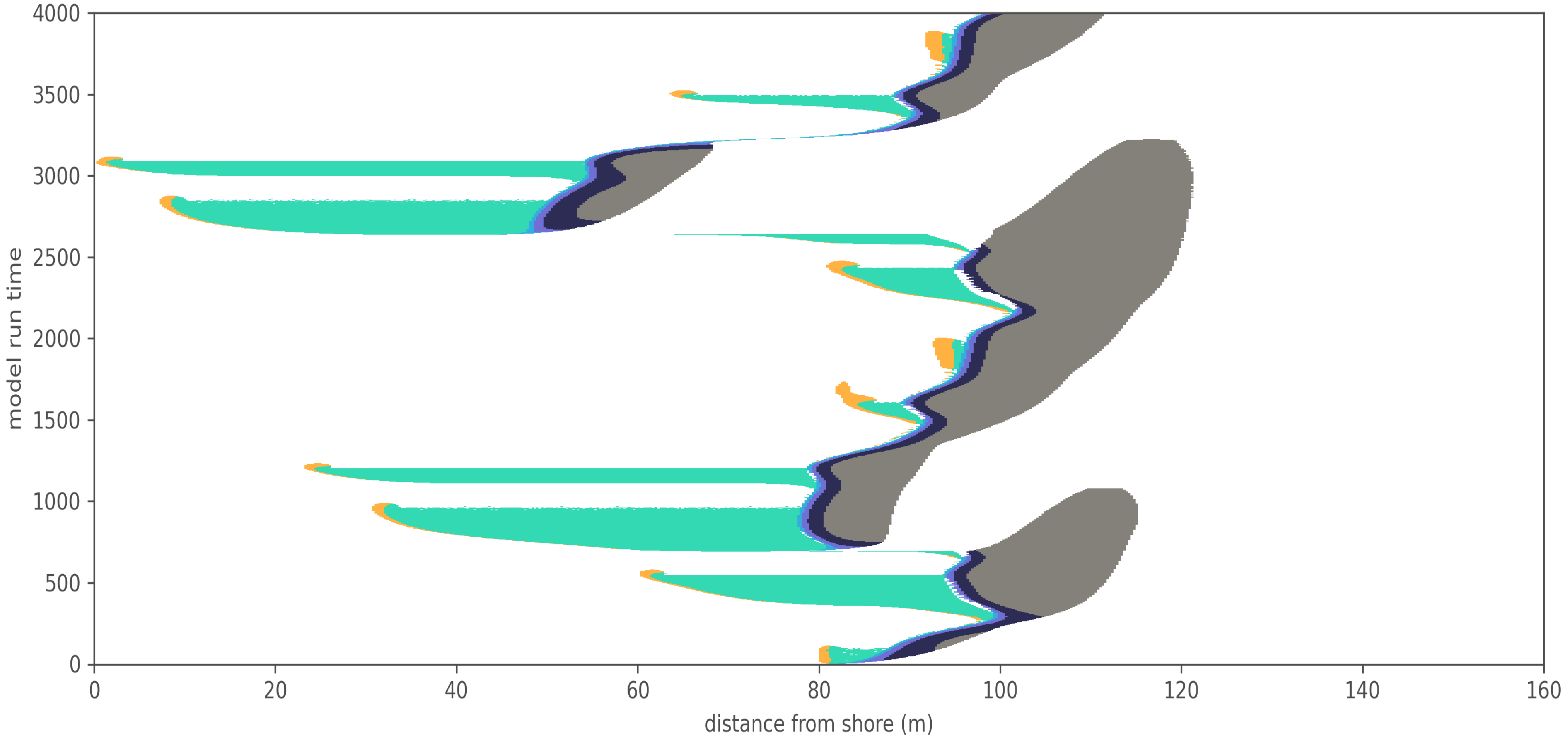
Class example 1: time vs topography (erosion)



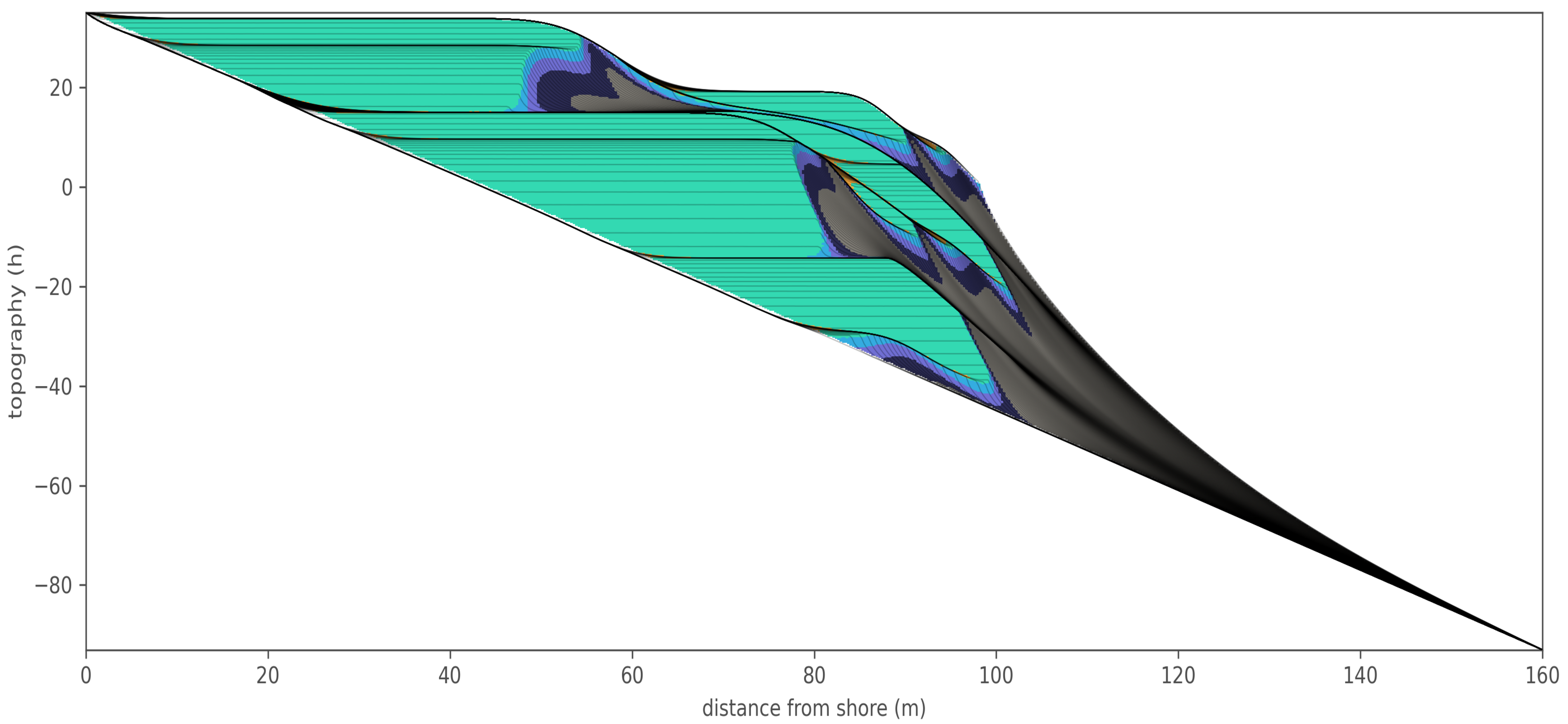
Class example 1: time vs topography (erosion and hiatus)



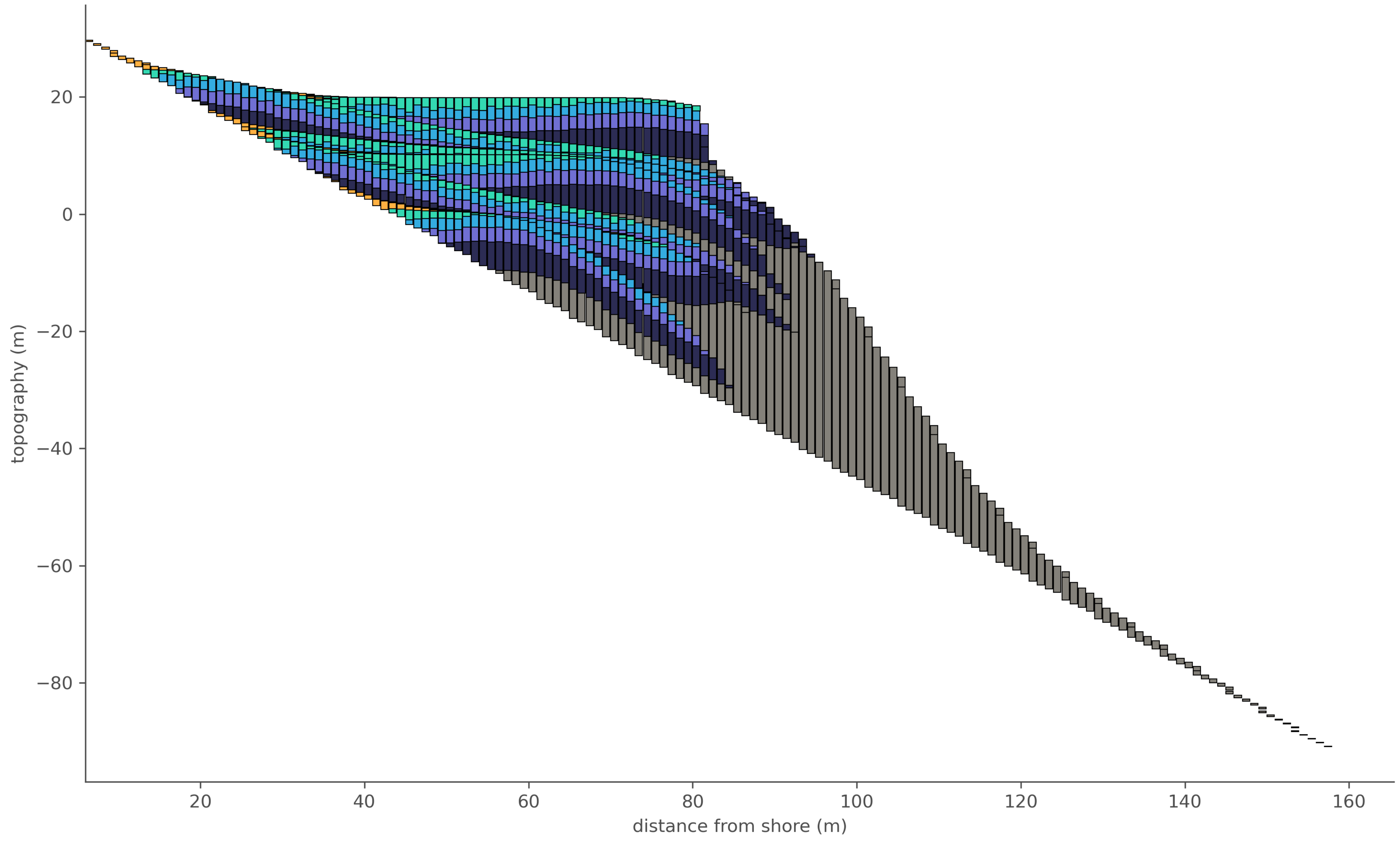
Class example 1: *Wheeler* diagram



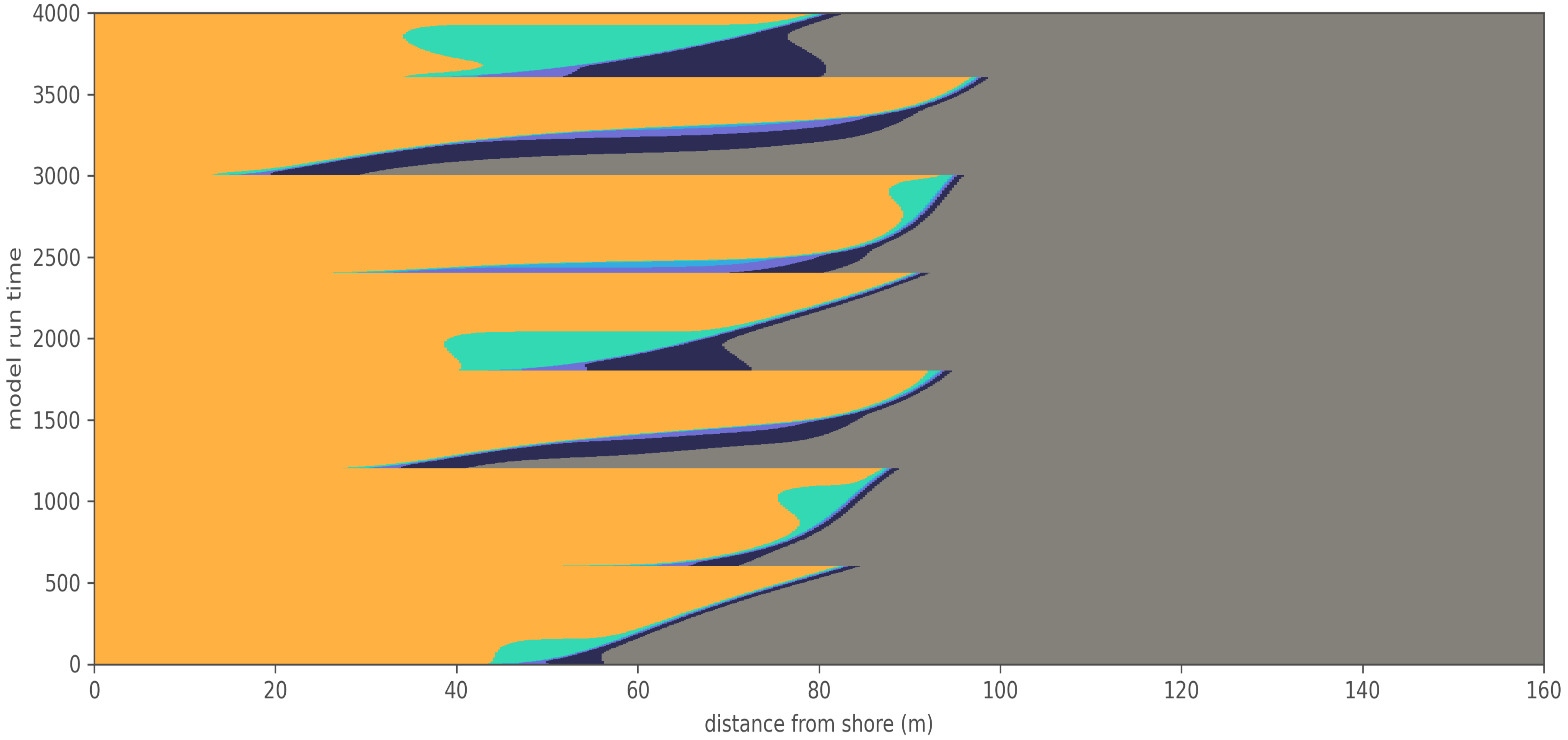
Class example 1: stratigraphic profile



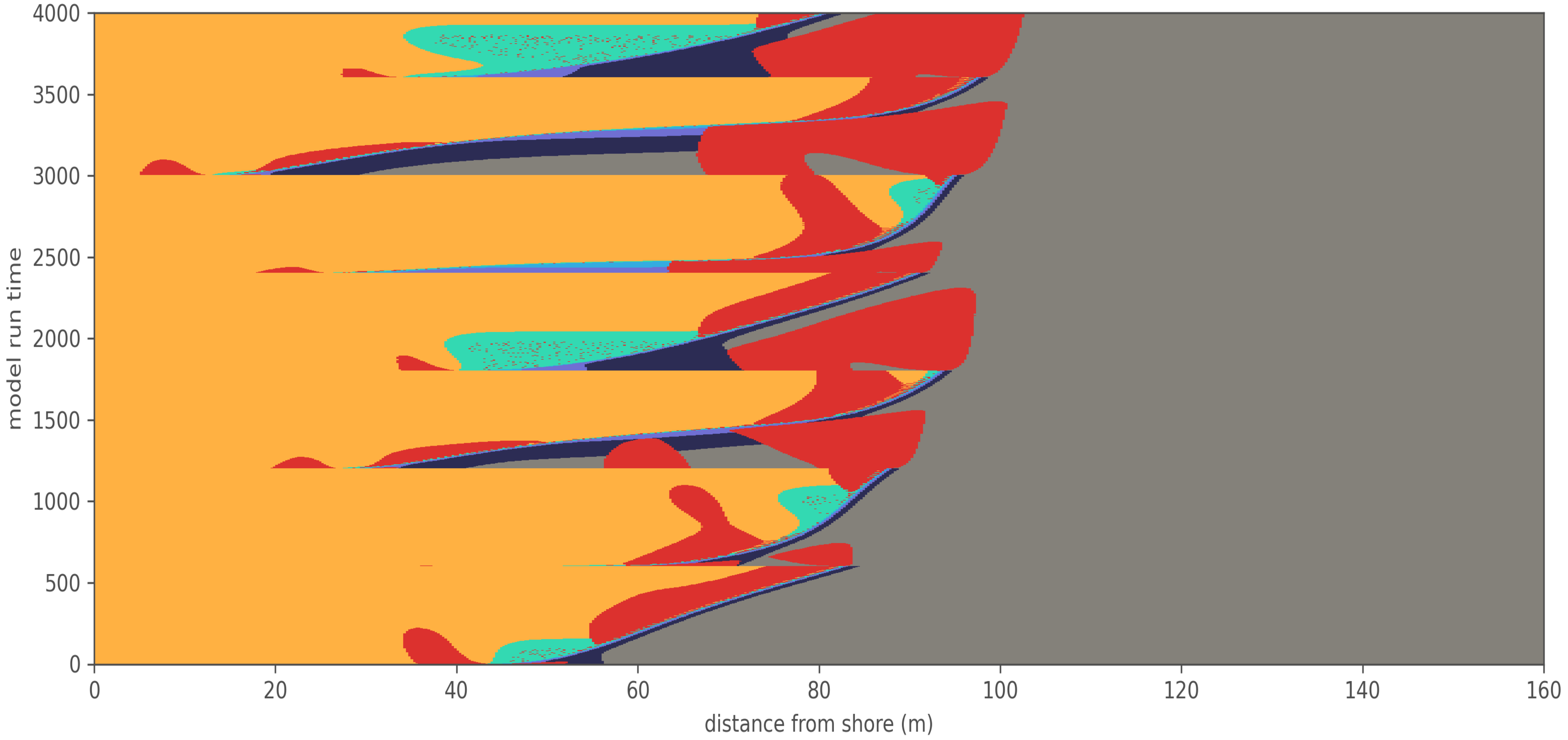
Class example 2: stratigraphic columns



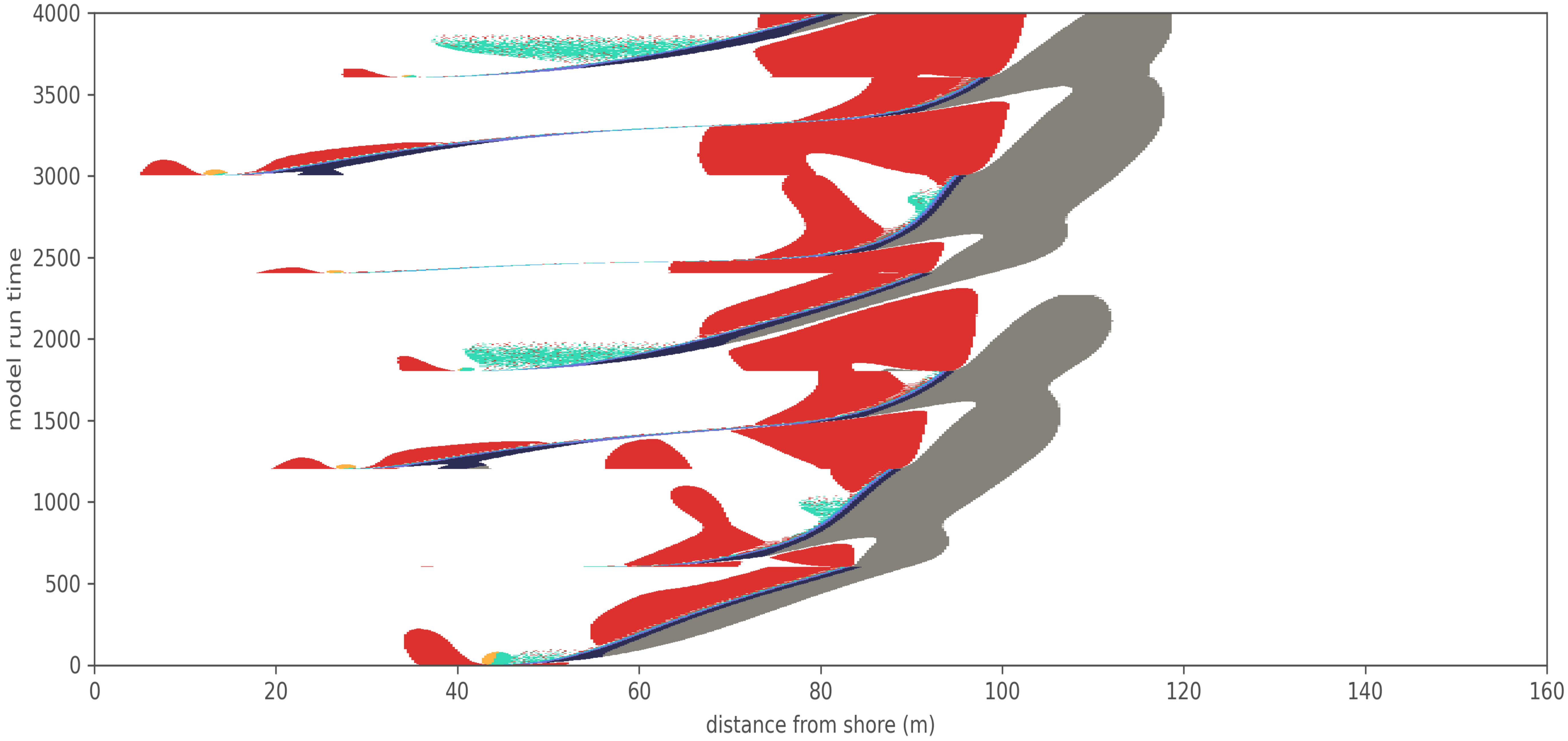
Class example 2: time vs topography



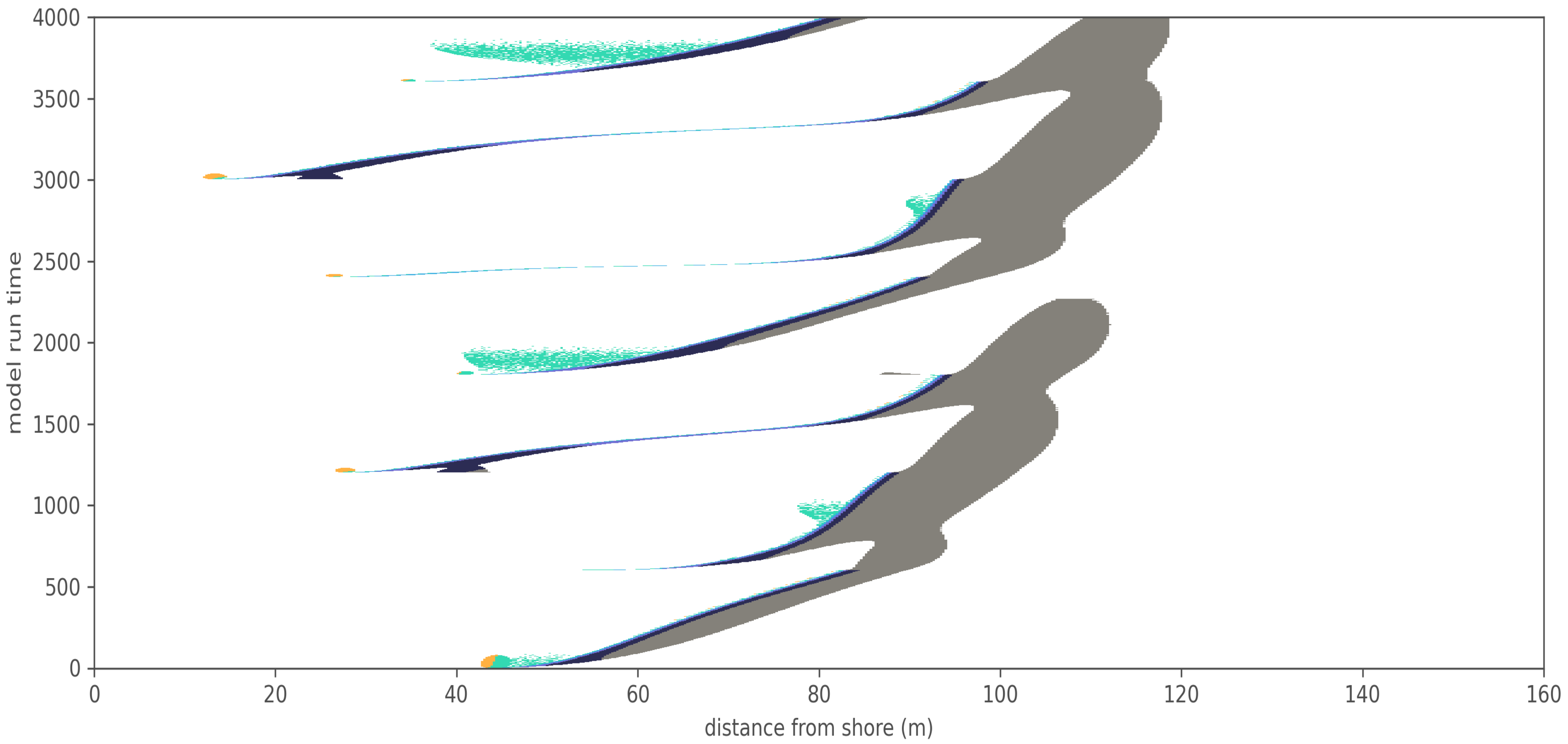
Class example 2: time vs topography (erosion)



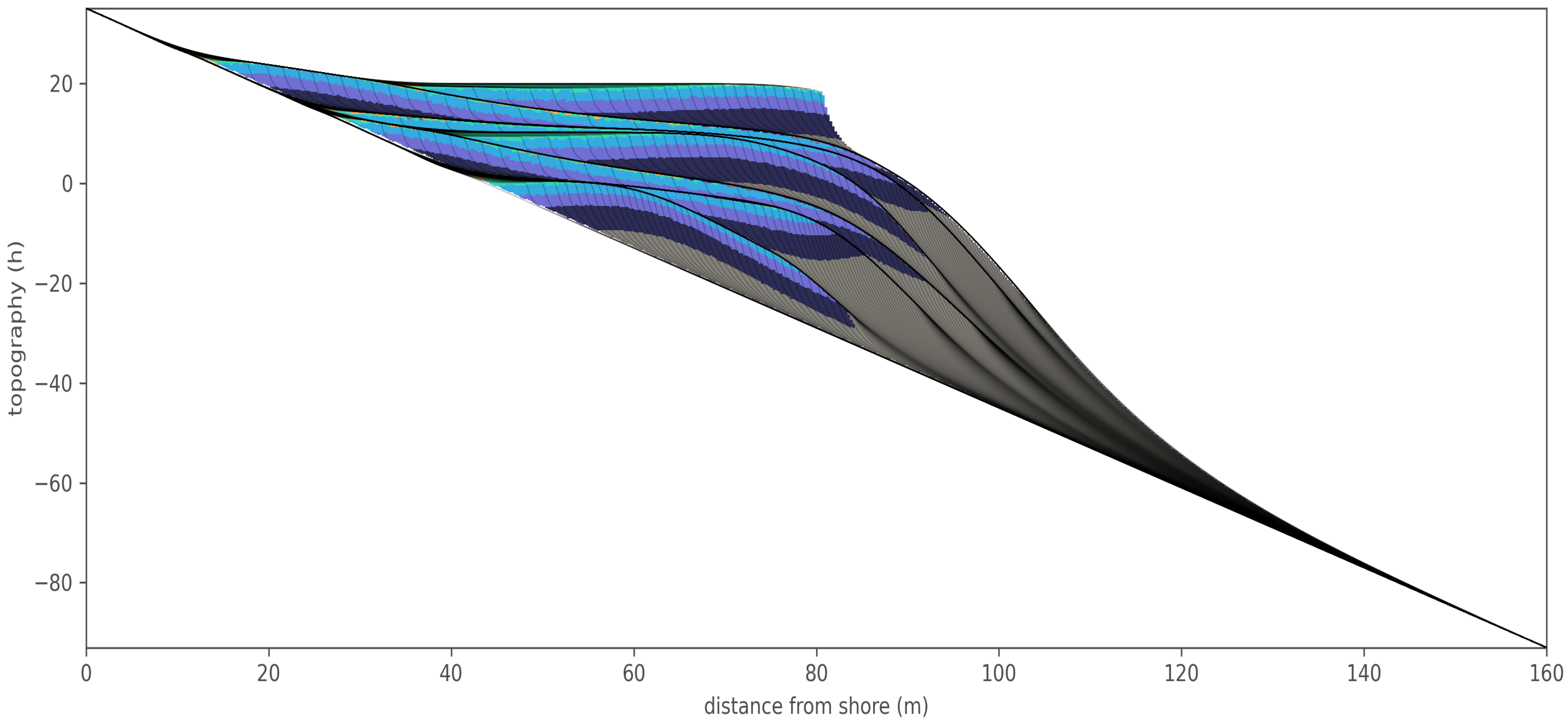
Class example 2: time vs topography (erosion and hiatus)



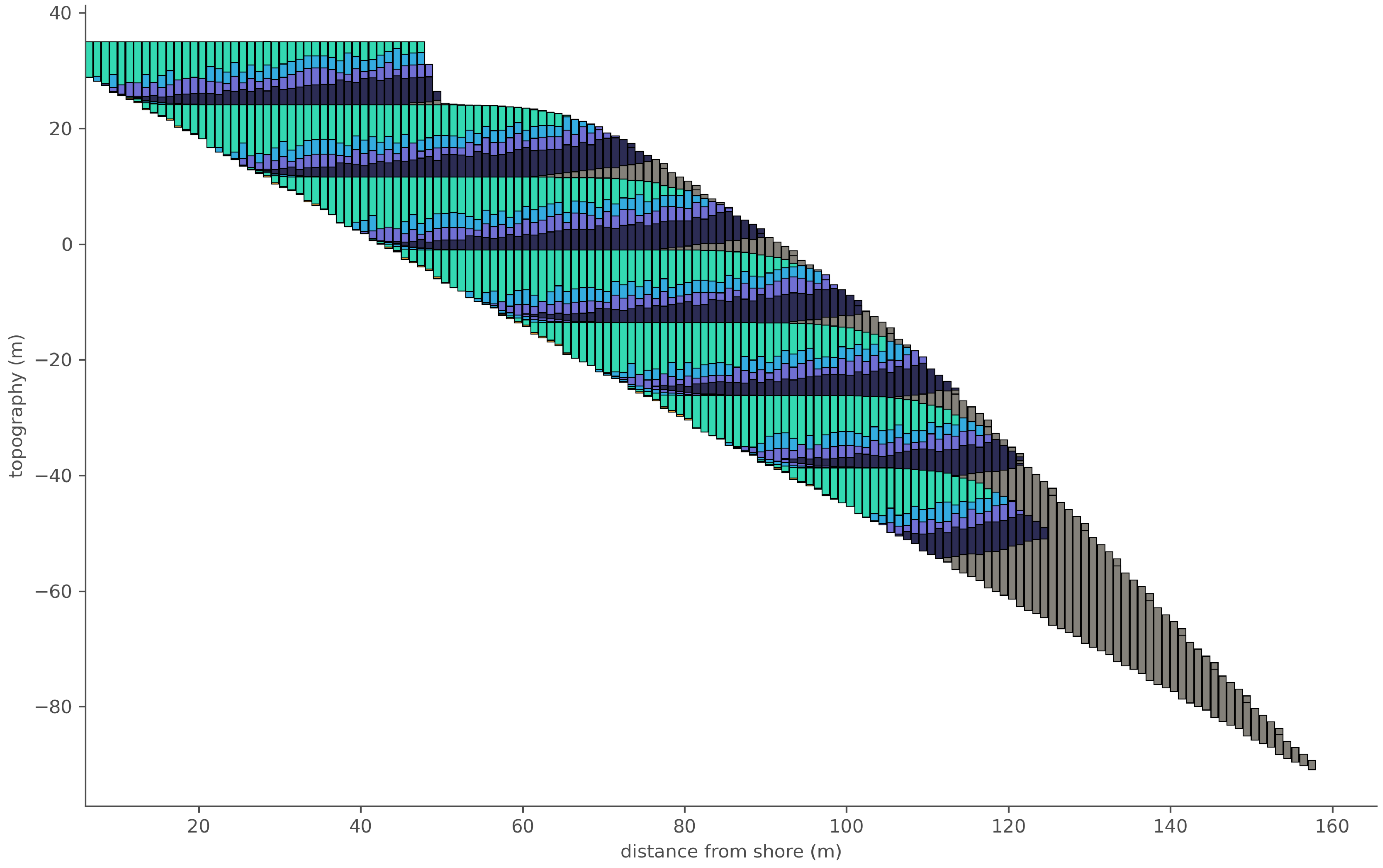
Class example 2: *Wheeler* diagram



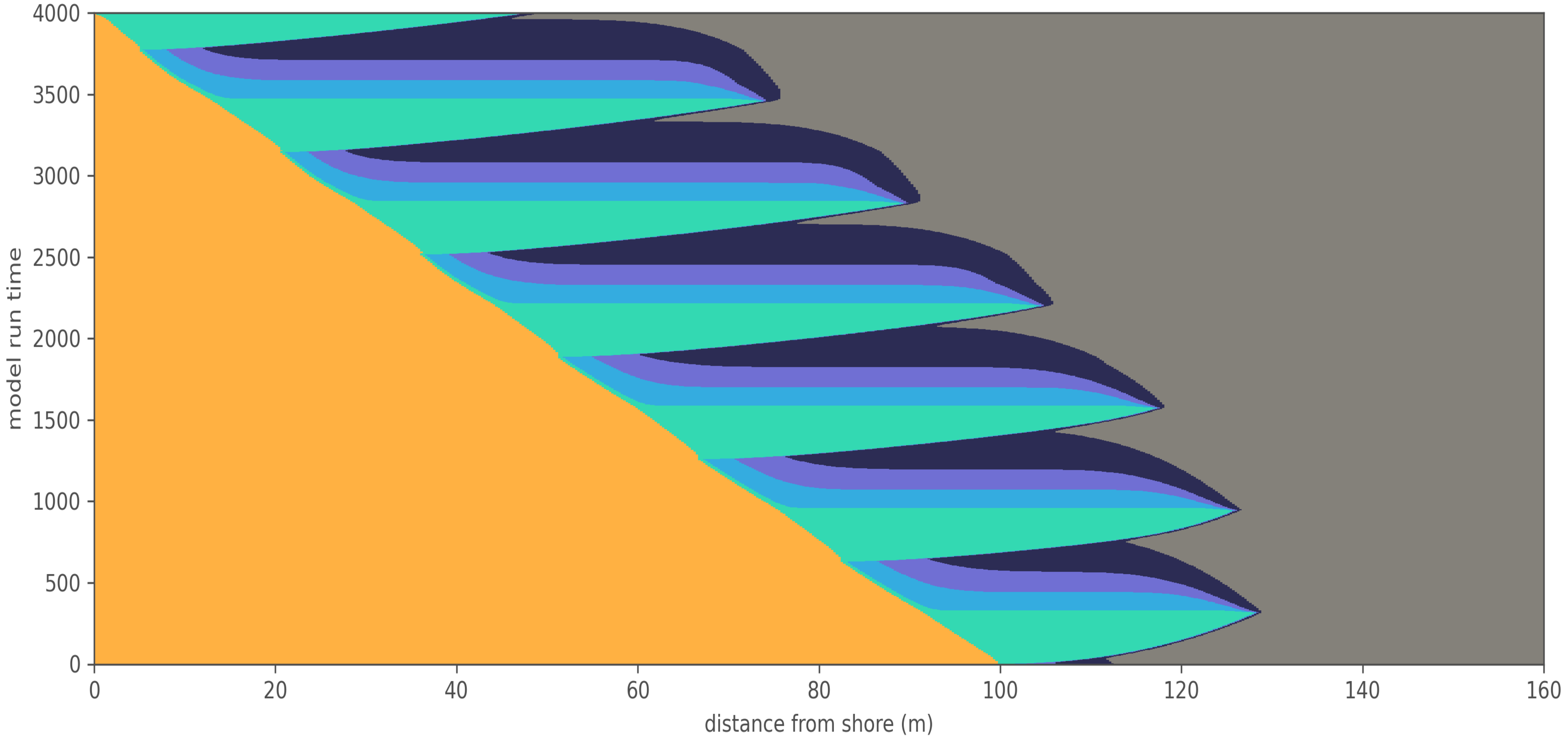
Class example 2: stratigraphic profile



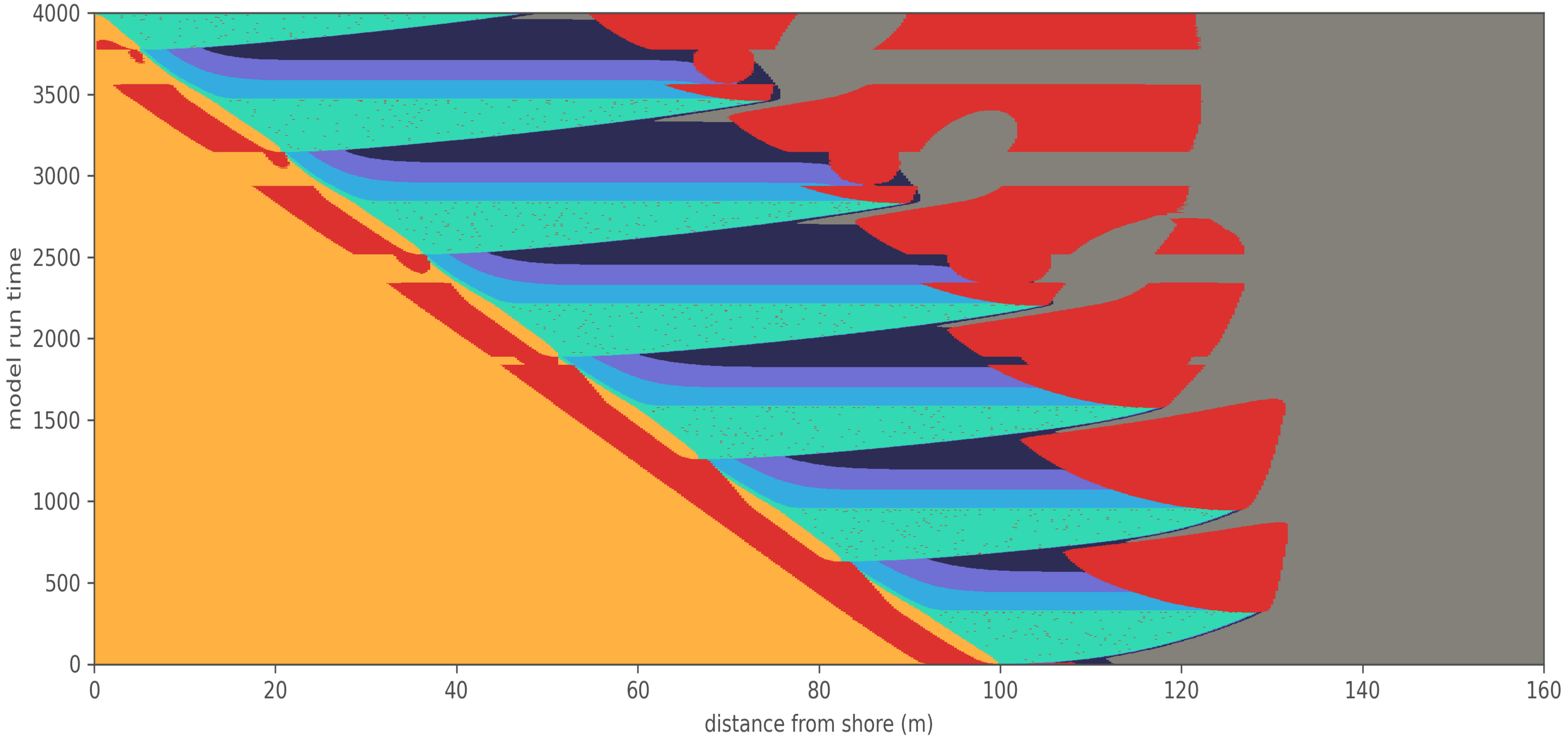
On/Off sediment supply with constant subsidence: time vs topography



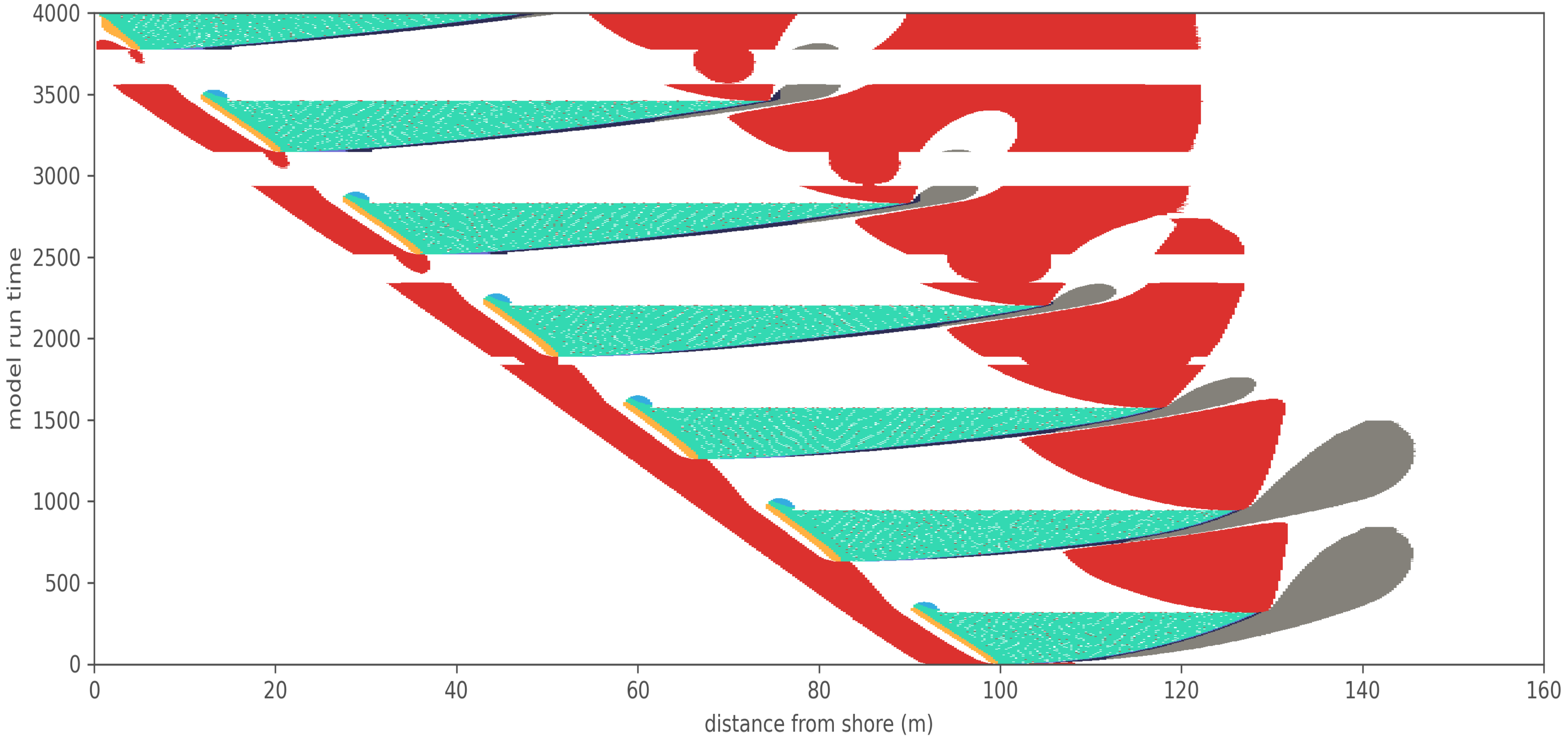
On/Off sediment supply with constant subsidence: time vs topography



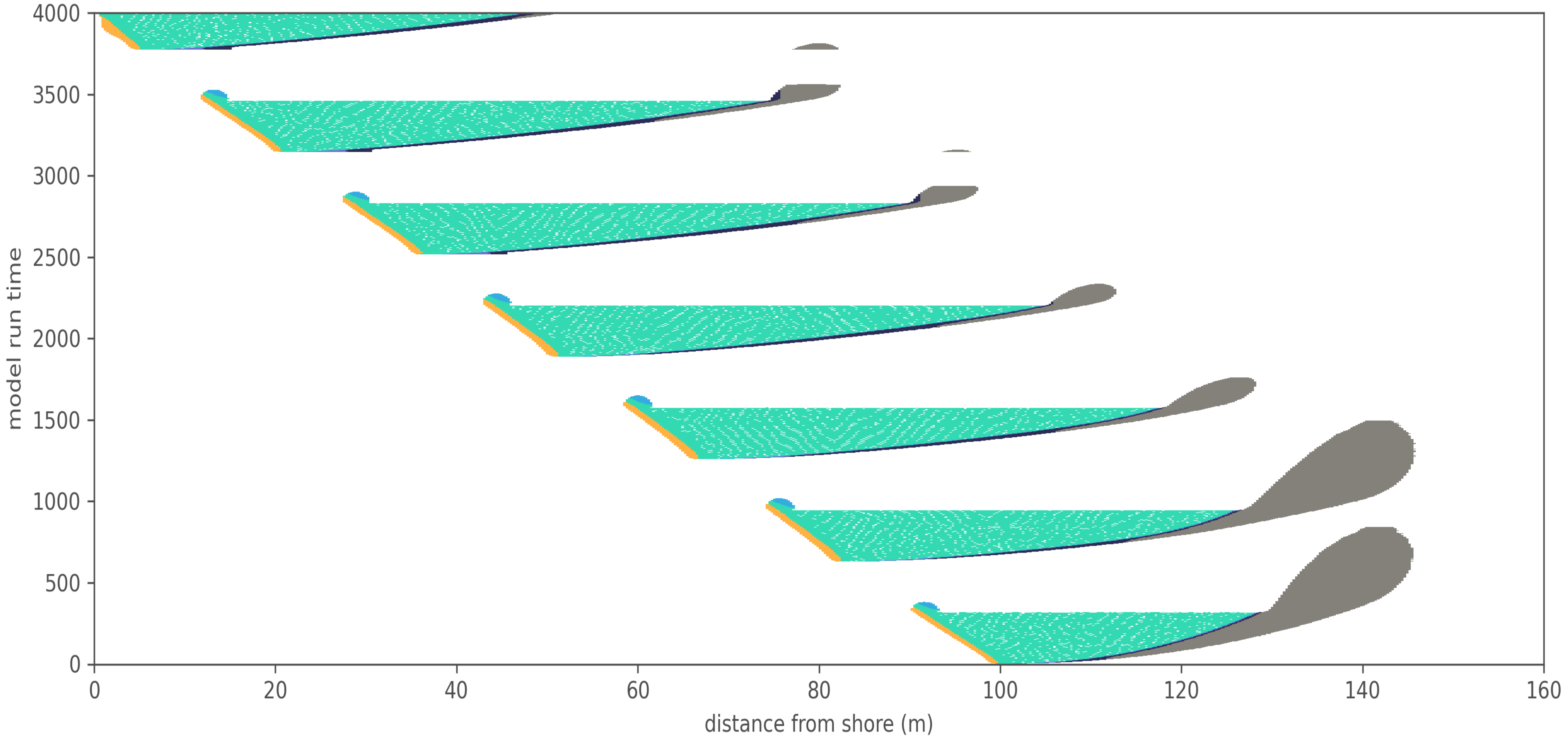
On/Off sediment supply with constant subsidence: time vs topography (erosion)



On/Off sediment supply with constant subsidence: time vs topography (erosion and hiatus)



On/Off sediment supply with constant subsidence: *Wheeler* diagram



On/Off sediment supply with constant subsidence: stratigraphic profile