Miocene Transitional Carbonates: Facies, Stratigraphic Architecture, and Early Diagenesis of a Fault-Block Carbonate Platform in Sardinia (Central Mediterranean Sea)*

By

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Abstract

Transitional carbonates present characteristics in between classic photozoan and heterozoan carbonates. Models that represent these systems are poorly developed. A sedimentological, stratigraphical, and early diagenetic model for a Miocene (Burdigalian) carbonate platform located on a fault-bound topographic high in Sardinia is presented. The setting offers outstanding exposures that allow LIDAR and 3D geometrical reconstructions. The platform contains two depositional sequences separated by a major erosional unconformity and several high frequency sequences reflecting the occurrence of higher-order base-level fluctuations. The platform evolves from a ramp to a steep-flanked platform. The geometrical turnover goes along with a change of the carbonate factories from warm-temperate to tropical. The warm-temperate ramp of the lower sequence contains small patch reefs and beaches, longshore bars and outer ramp bioclastic, and red algal packstones to rudstones. In the lower part of the second sequence, a belt of submarine dunes separated platform-interior from deeper water bioclastic deposits. Dunes were locally stabilized by coralline algal bindstones. In the upper part of this sequence, the depositional system consisted of an extensive reef flat with a marked slope break formed by coralline algal bindstones and rhodolithic clinoforms beds dipping up to 27°. Steepening of the depositional relief of the carbonate platform is gradual and linked to (1) the inception of coralline algal bindstones and (2) increasing amounts of early diagenetic cementation. This study presents a further example for the close relation between carbonate factory and depositional geometries.

Miocene transitional carbonates:

facies, stratigraphic architecture and early diagenesis of a fault-block carbonate platform in Sardinia (Central Mediterranean Sea)

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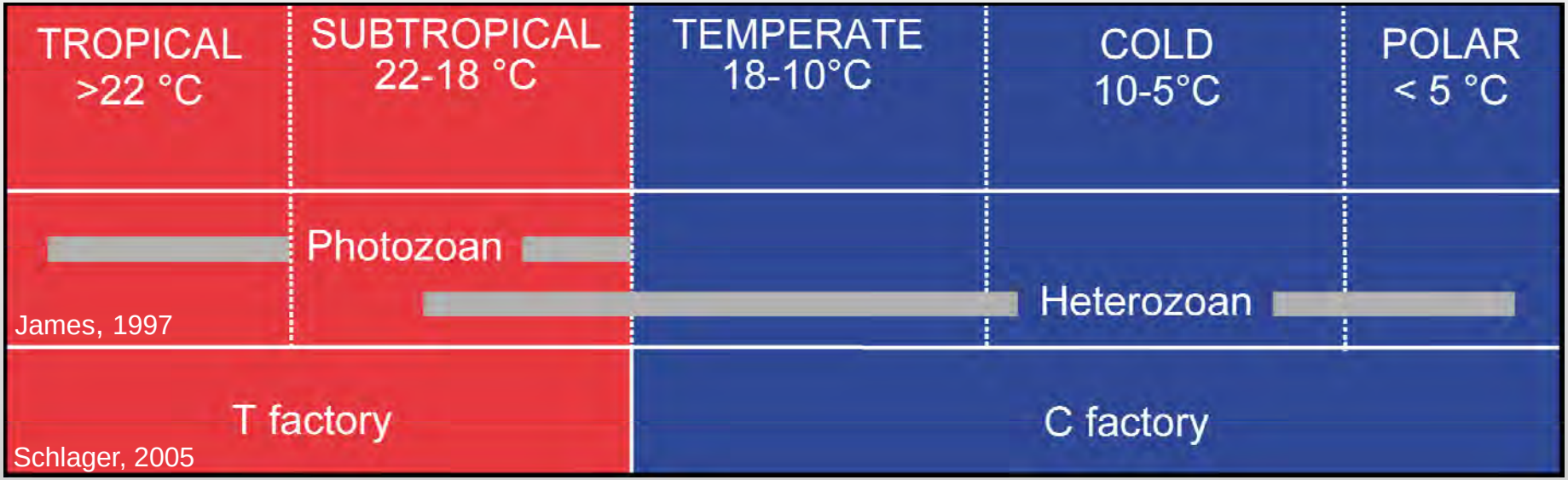
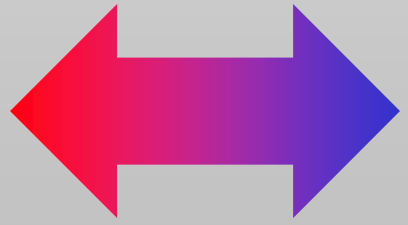
rimmed platform

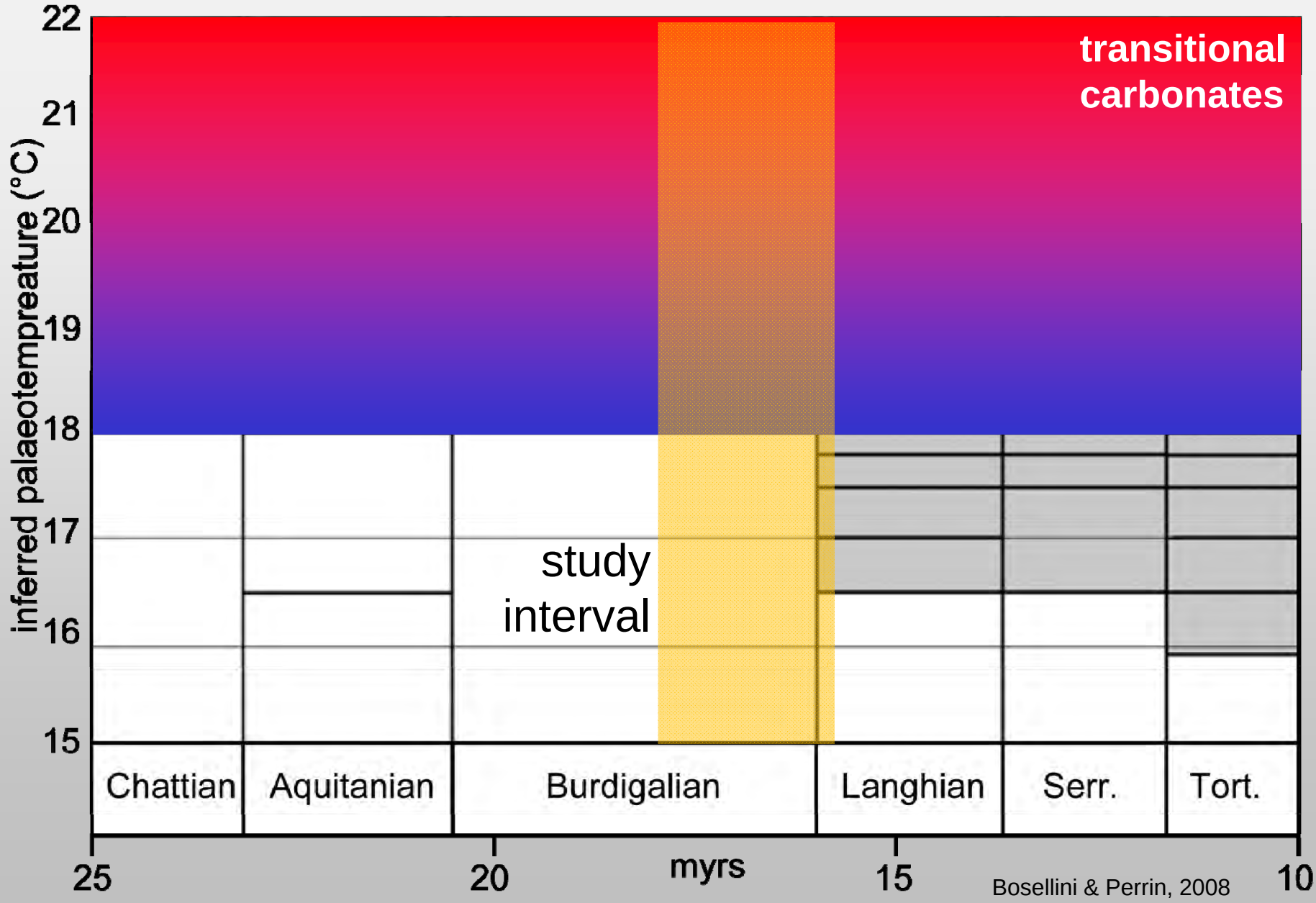

ramp


TROPICAL
>22 °C
SUBTROPICAL
22-18 °C
TEMPERATE
18-10°C
COLD
10-5°C
POLAR
< 5 °C
Photozoan
Heterozoan
James, 1997
T factory
C factory
Schlager, 2005



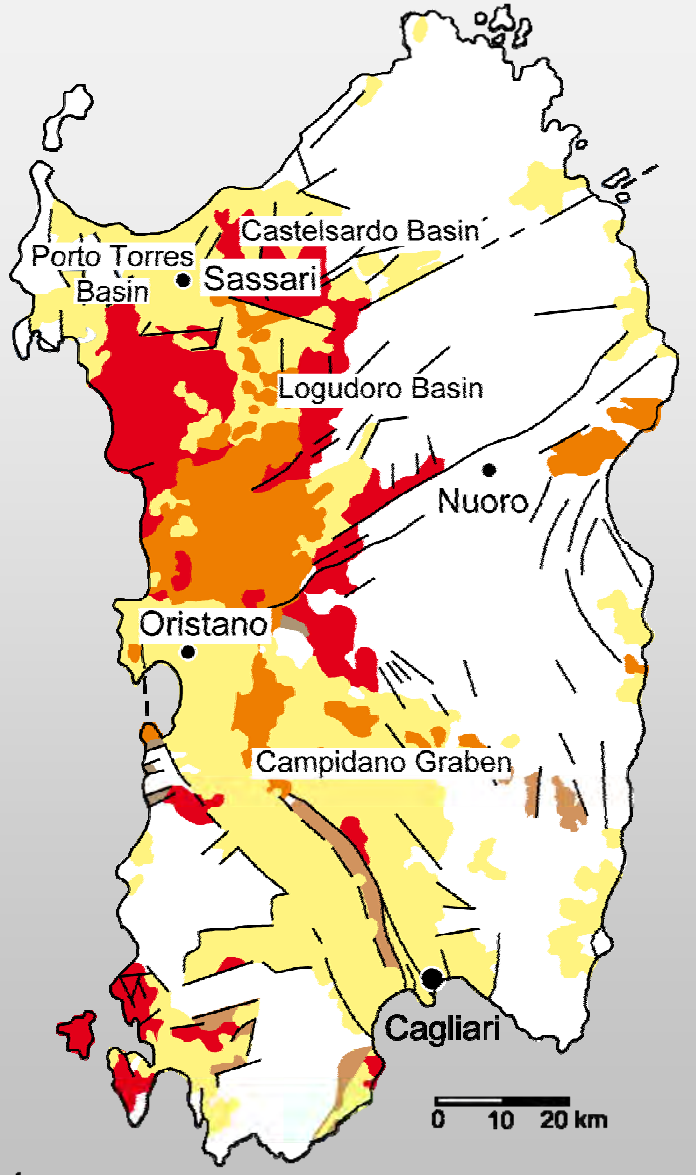
transition

Miocene water temperatures in the Mediterranean Sea, based on coral associations



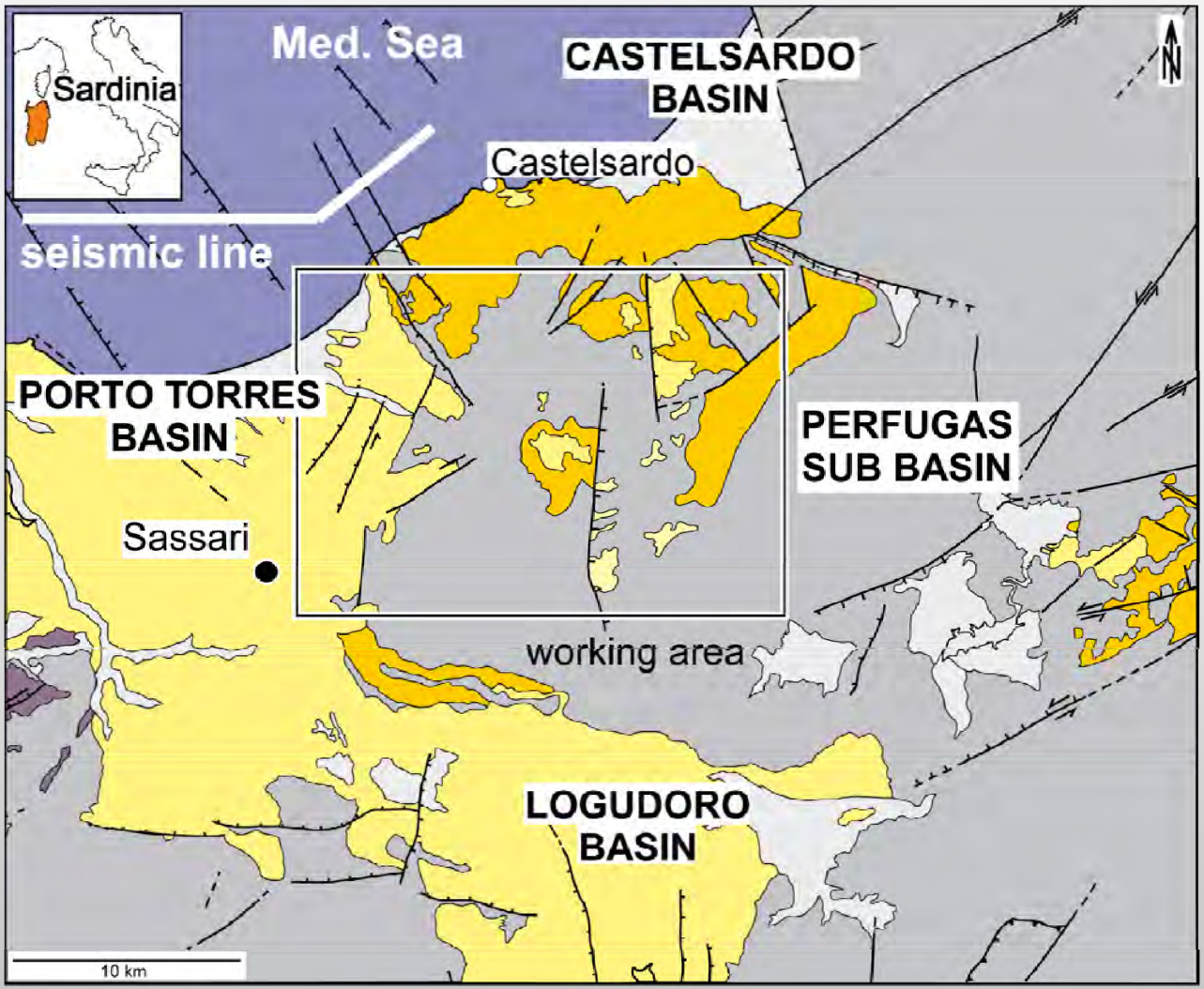
Bosellini & Perrin, 2008

Geological setting: central Mediterranean Sea

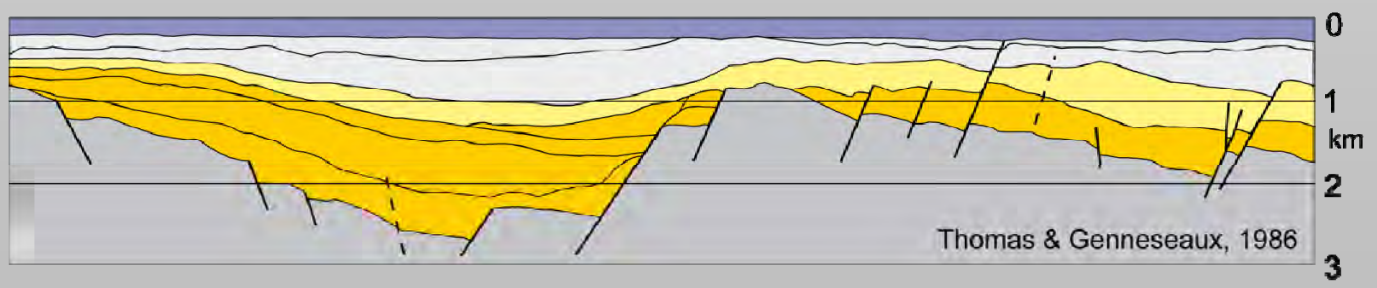


Paleogene | Palaeozoic, Mesozoic | Oligo-Miocene volcanics | Plio-Quarternary volcanics | Neogene

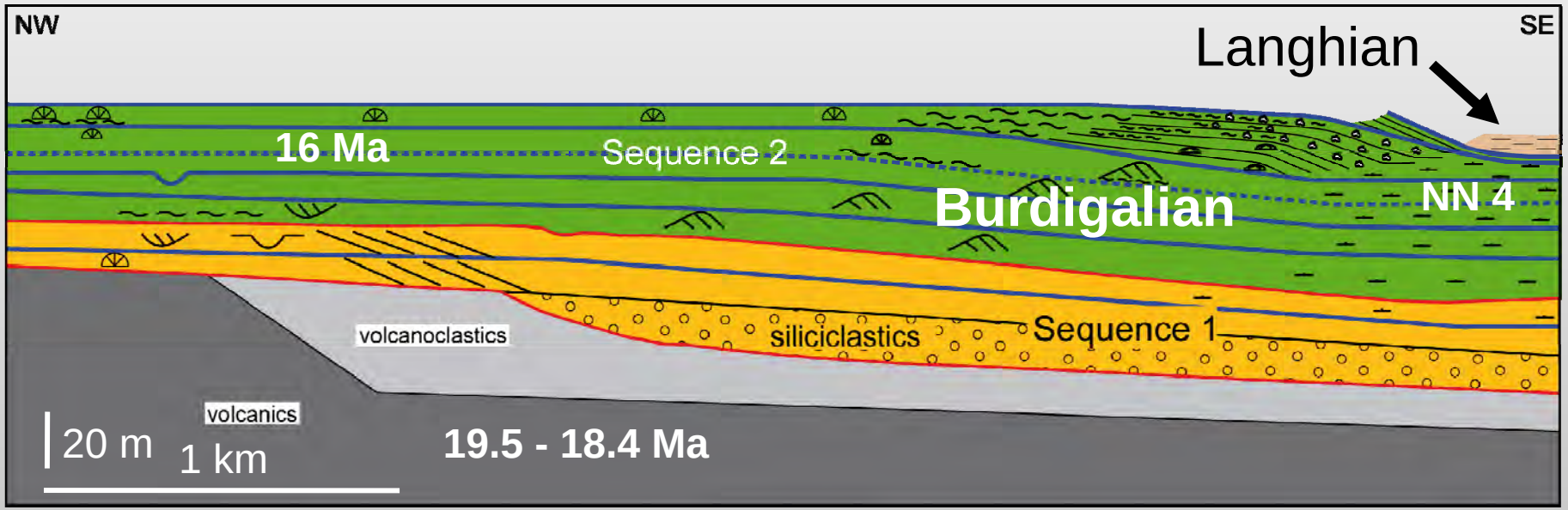
Geological setting



Basement
Palaeogene to Neogene
Middle Miocene
Upper Miocene and younger



Stratigraphy of the Sedini Carbonate Platform



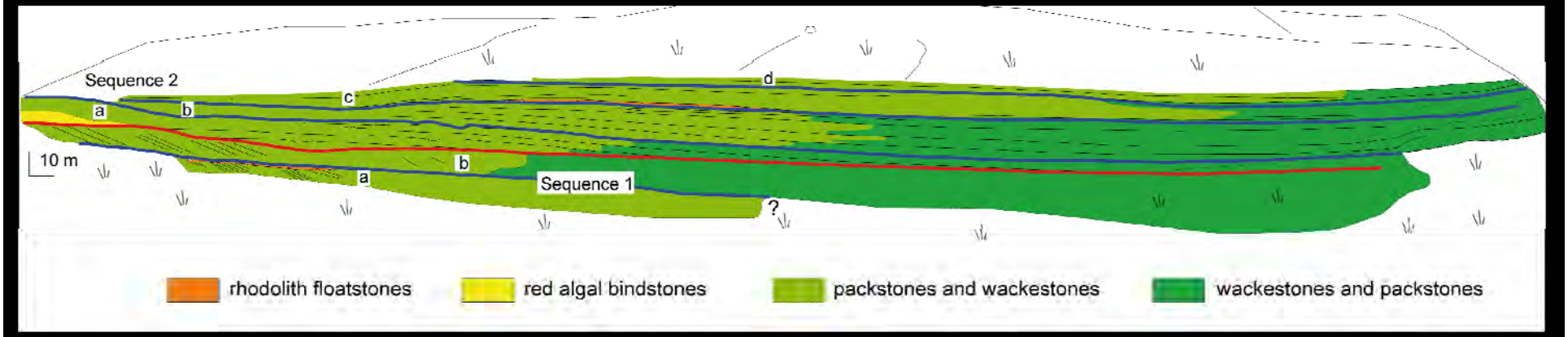
coral reefs

red-algal bindstones

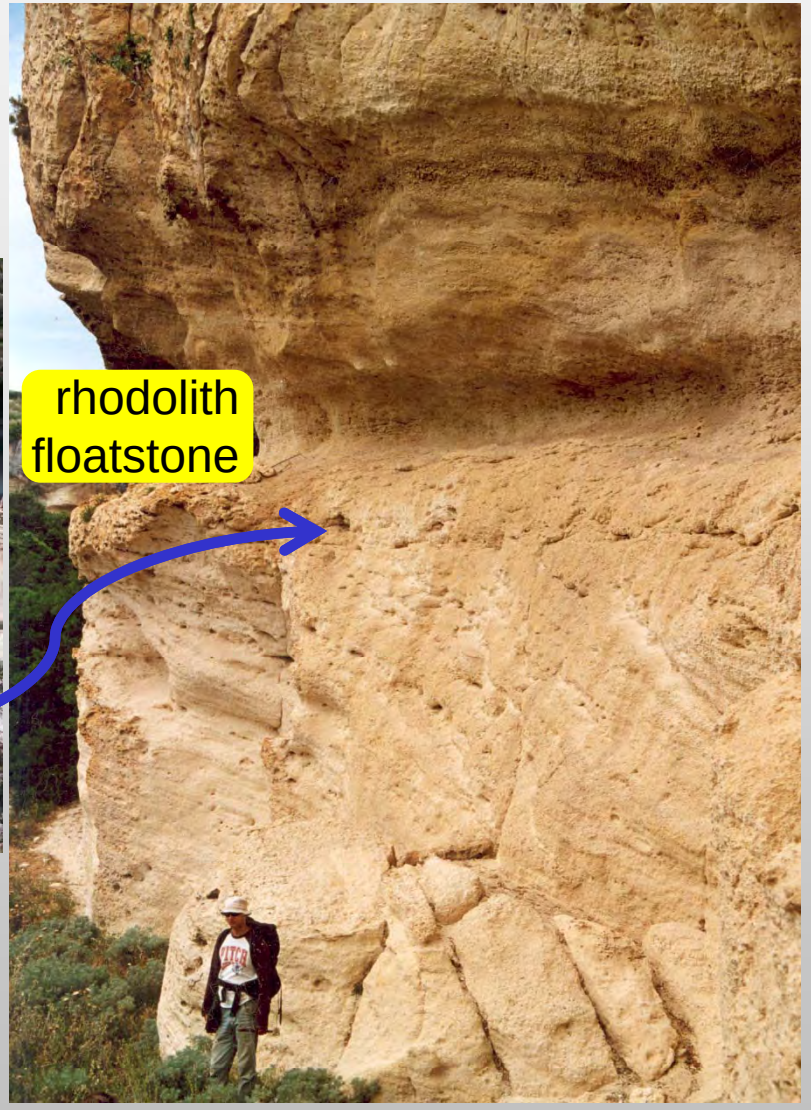
large-scale planar / convex cross beds

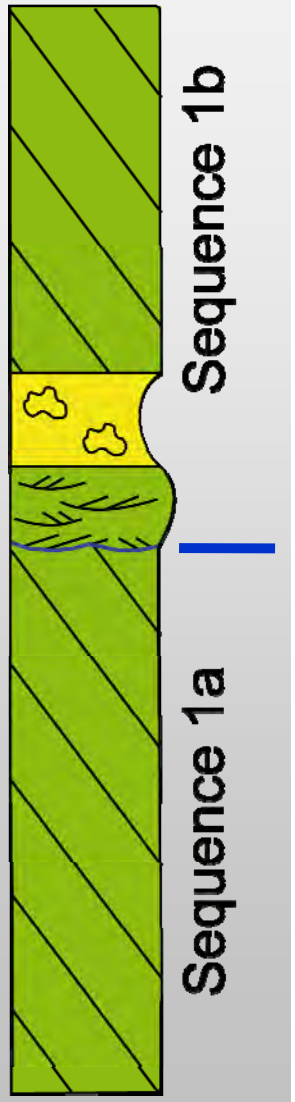
platform geometry and stratigraphy

platform slope **platform margin** **inner platform**



platform geometry and stratigraphy

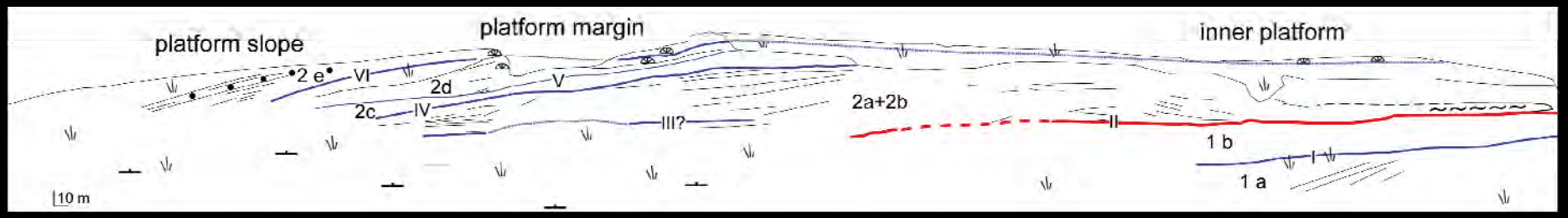


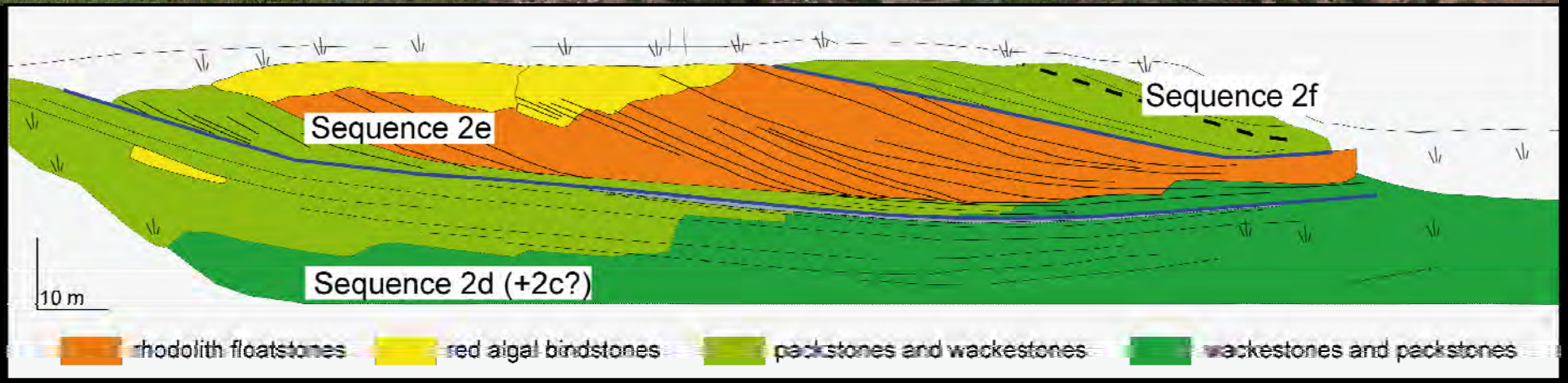


platform geometry and stratigraphy

Miocene transitional carbonates, central Mediterranean Sea

platform geometry and stratigraphy

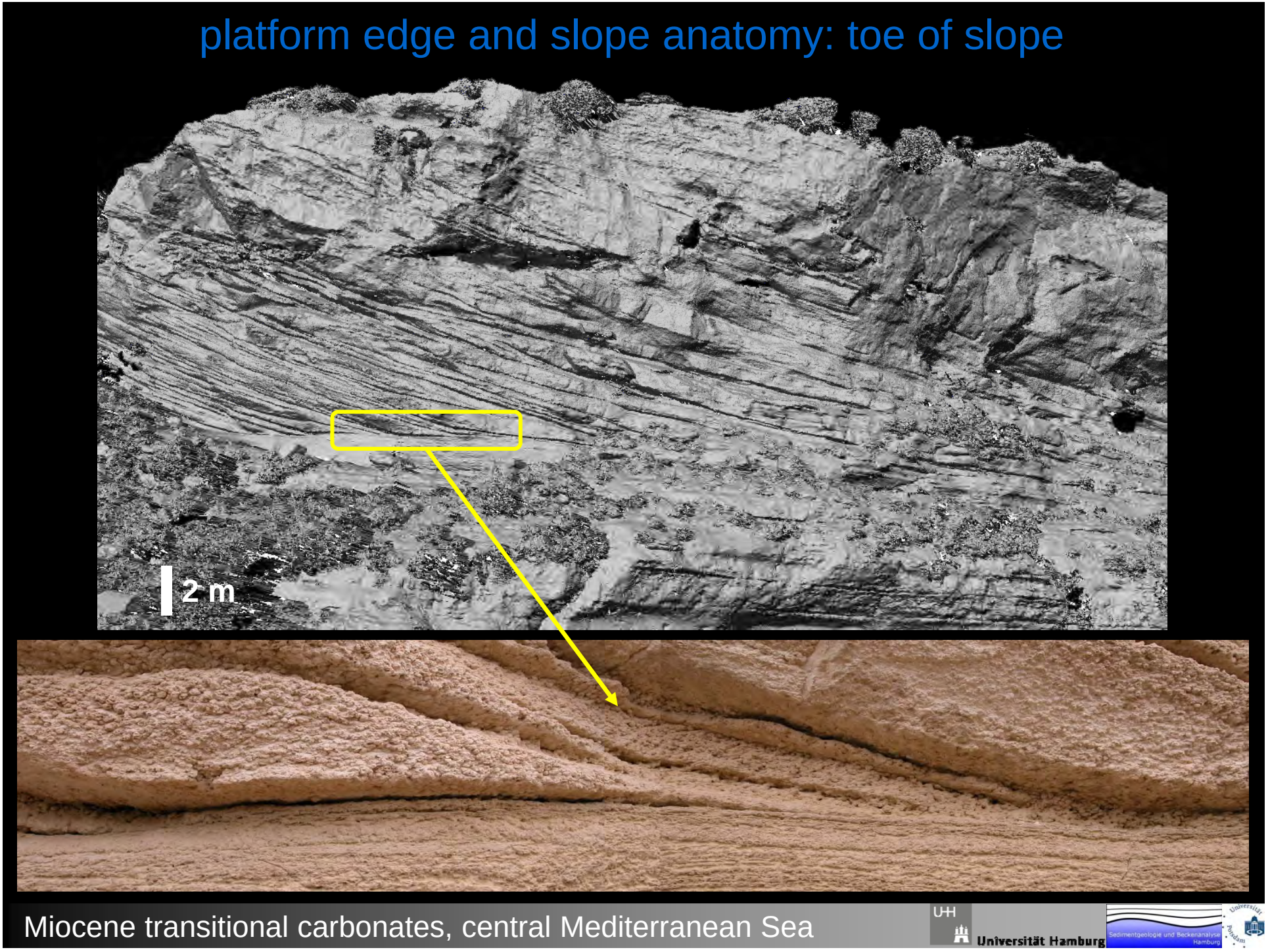




platform edge and slope anatomy

Miocene transitional carbonates, central Mediterranean Sea

platform edge and slope anatomy: toe of slope



Miocene transitional carbonates, central Mediterranean Sea

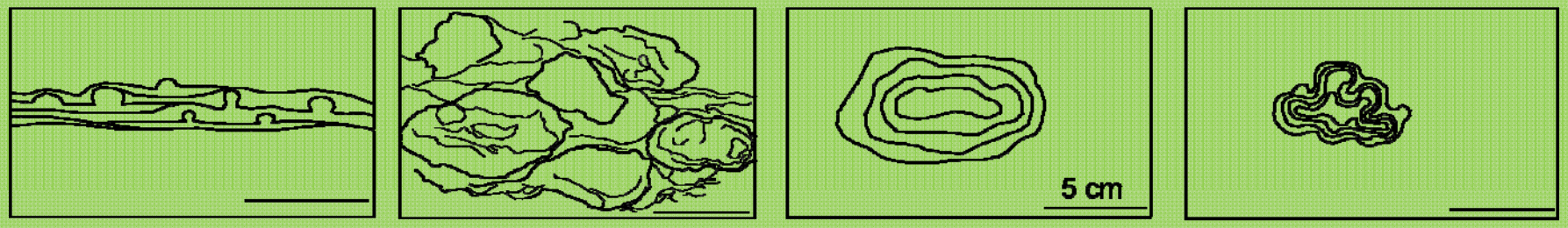
platform edge and slope anatomy: slope

Miocene transitional carbonates, central Mediterranean Sea

platform edge and slope anatomy: platform edge

Miocene transitional carbonates, central Mediterranean Sea

slope zonation: red-algal associations



Robust to delicate framework

Rhodoliths fused by subsequent coralline algal encrustation

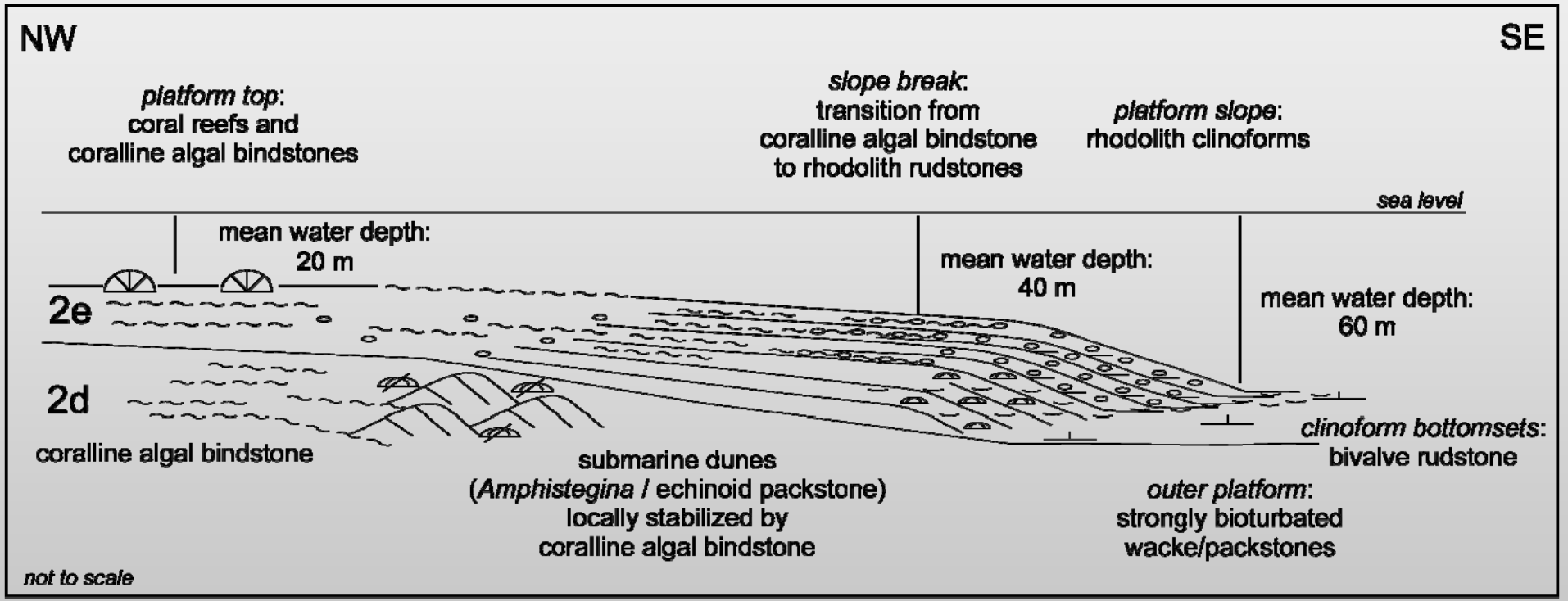
Laminar concentric rhodolith morphology

Increasing radial rhodolith morphology

Lithology	*Coralline algal bindstones*					*Transitional lithology*		*Rhodolith rudstones*									*Distal clinoforms rudstones*
sample	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**
Lithophyllum sp.	■	■	■	■	■		■	■									
Sporolithon sp.	■	■		■			■		■	■	■	■		■	■		
Mastophoroids		■															
Melobesioids						■		■	■	■		■		■			
Lithoporella sp.						■											
Mesophyllum sp.								■									
Spongites sp.								■									
Neogoniolithon sp.												■					
Hydrolithon sp.												■					

downslope

platform and slope palaeobathymetry



geometrical turnover and change of carbonate factory

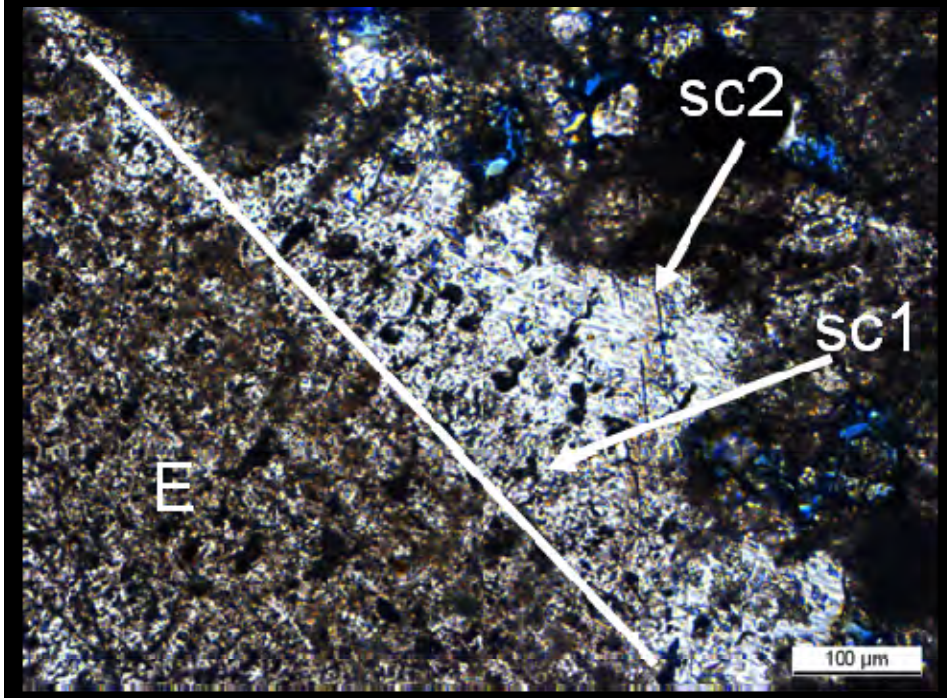
Sequence 1:
heterozoan-dominated carbonate factory

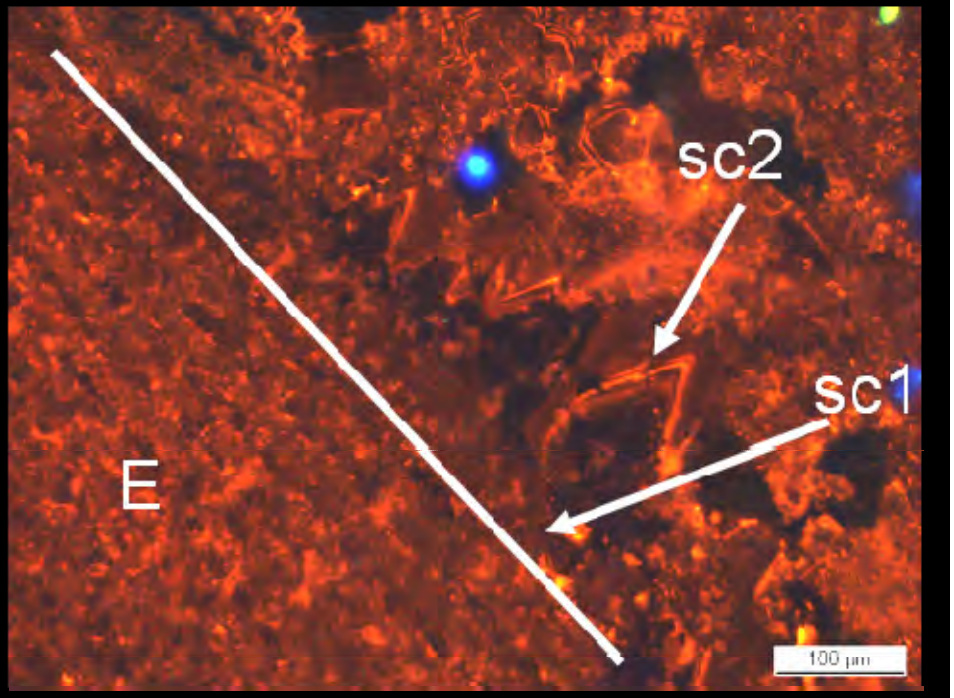
red-algal floatstone - rudstone

Sequence 2:
photozoan-dominated carbonate factory

coral framestone

geometrical turnover and changes in cementation

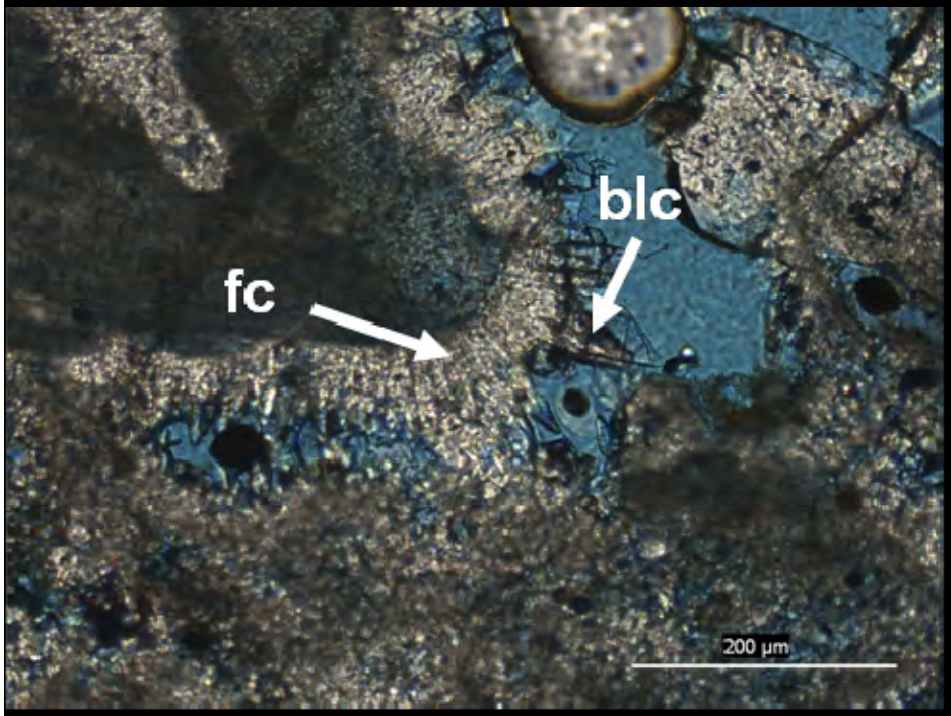


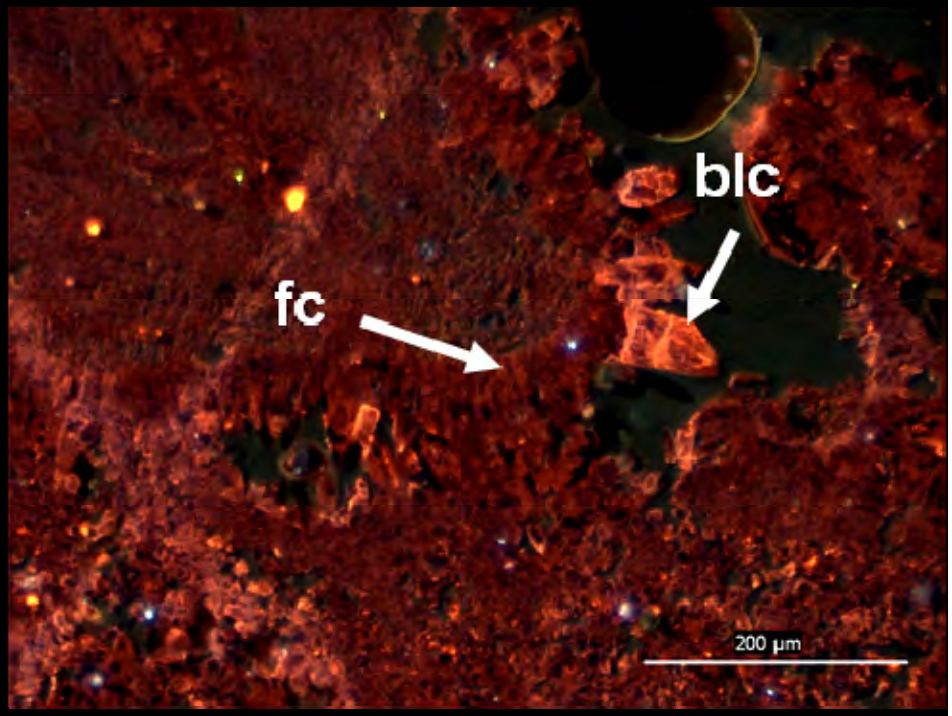


Sequence 1:

syntaxial inclusion-rich (sc1) and inclusion-poor (sc2).

geometrical turnover and changes in cementation

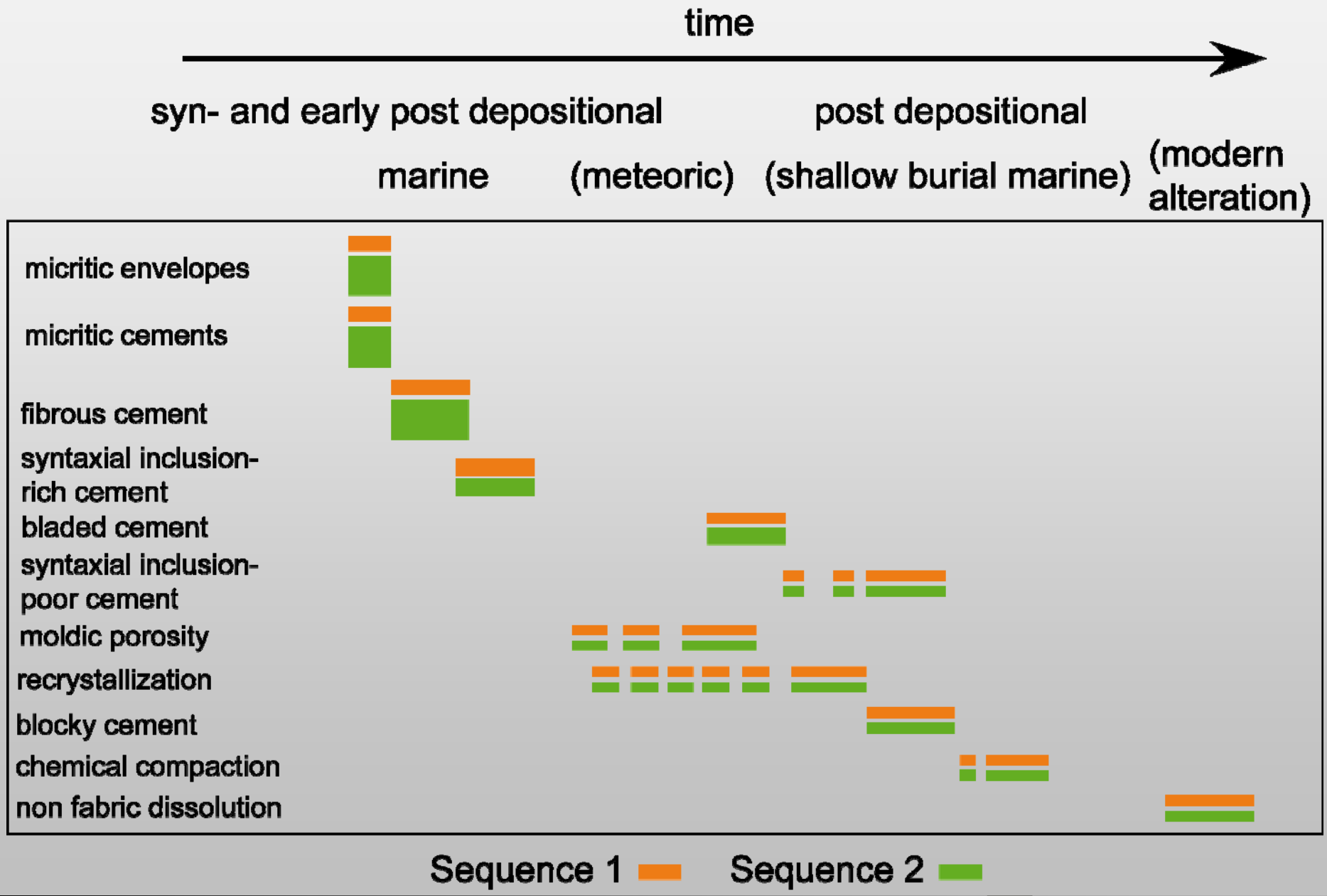




Sequence 2:

fibrous cement (fc) and bladed cement (blc)

paragenetic sequence



geometrical turnover and occurrence of red-algal bindstones

red-algal bindstone

red-algal bindstone with *Isognomon*

Main results

- transitional carbonates with a turnover from a ramp to steep-flanked platform;
- turnover goes along with a change of the carbonate factories from warm-temperate to tropical;
- platform edge lies not at sea level, but in a water depth of around 40 m; platform-interior reefs occur at 20 m
- steepening of the depositional relief of the carbonate platform is gradual and linked to

  (1) the inception of coralline algal bindstones and

  (2) increasing amounts of early diagenetic cementation;

- further example for the close relation between carbonate factory and depositional geometries;