The Messinian Salinity Crisis: A Perspective for Reservoir Exploration in the Mediterranean and Adjacent Basins*

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Abstract

The distinction between peripheral and central Mediterranean basins has constituted a crucial advance in the knowledge of the scenario of the Messinian Salinity Crisis, both from the viewpoints of paleogeographic and factual reconstructions within an accurate chronostratigraphic frame. The evidence around the Mediterranean Basin and adjacent basins (such as the Paratethys) of fluvial valleys cut during the peak of the Messinian Salinity Crisis allowed to point out thick clastic deposits within the Mediterranean central basins as a consequence of the sea-level drawdown (ca. 1500 m) prior to the deposition of evaporites (including halite) during the earliest phase of reflooding by Atlantic marine waters. These outstanding variations in sea level resulted in important paleogeographic changes such as intra-basin disconnections-connections, lake or river captures, tectonic responses, etc. which controlled transport and location of deposition of coarse sediments.

After the complete marine reflooding in the peripheral areas, the Messinian valleys were filled by terrigenous deposits, including coarse blocks caused by debris flows, then Gilbert-type fan delta prograding systems. The related reference surfaces (Messinian Erosional Surface, marine-continental transition, abandonment surface) are useful for quantifying subsequent vertical tectonic movements. The resulting integrated scenario of the Messinian Salinity Crisis evidences common features to the Mediterranean region sensu lato but emphasizes regional differences due to geodynamic and paleogeographic specificities.

Selected References

Bache, F., S-M. Popescu, M. Rabineau, C. Gorini, J-P. Suc, G. Caluzon, J.L. Olivet, J.L. Rubino, M.C. Melinte-Dobrinescu, F. Estrada, L. Londeix, R. Armijo, B. Meyer, L. Jolivet, G. Jouannic, E. Leroux, D. Aslanian, J. Baztan, A.T. Dos Reis, N. Dumurdzanov, I. Zagorchev, V. Lesic, D. Tomic, N. Cagatay, G. Ucarkus, and Z. Cakir, 2012, A two-step process for the reflooding of the Mediterranean Basin after the Messinian salinity crisis: Basin Research, v. 24/2, p. 125-153.

Bertoni, C., and J.A. Cartwright, 2007, Major erosion at the end of the Messinian Salinity Crisis: evidence from the Levant Basin, Eastern Mediterranean: Basin Research, v. 19, p. 1-18.

Bertoni, C., and J.A. Cartwright, 2007, Clastic bodies at the base of the late Messinian evaporites of the Levant region, Eastern Mediterranean, in C. Schreiber, (ed.), Evaporite Deposits: Geological Society of London Special publication, v. 285, p. 37-52.

Clauzon, G., J-P. Suc, F. Gautier, A. Berger, and M-F. Loutre, 1996, Alternate interpretation of the Messinian salinity crisis; controversy resolved?: Geology, v. 24/4, p. 363-366.

Gautier, F., G. Caluzon, J-P. Suc, J. Cravatte, and D. Violanti, 1994, Age and duration of the Messinian salinity crisis: Earth Sciences and Planets: v. 318/8, p. 1103-1109.

Krijgsman, W., C.G. Langereis, W.J. Zachariasse, M. Boccaletti, G. Moratti, R. Gelati, S. Iaccarino, G. Papani, and G. Villa, 1999, Late Neogene evolution of the Taza-Guercif Basin (Rifian Corridor, Moracco) and implications for the Messinian salinity crisis, *in* E.J. Rohling, (ed.), Fifth decade of Mediterranean paleoclimate and sapropel studies: Marine Geology, v. 153/1-4, . 147-160.

Manzi, M.S.D., K.A.A. Hein, N. King, and R.J. Durrheim, 2013, Neoarchaean tectonic history of the Witwatersrand Basin and Ventersdorp Supergroup; new constraints from high-resolution 3D Seismic reflection data: Tectonophysics, v. 590, p. 94-105.

Savoye, B., and D.J.W. Piper, 1991, The Messinian event on the margin of the Mediterranean Sea in the Nice area, southern France: Marine Geology, v. 97/3-4, p. 279-304.

The Messinian Salinity Crisis, a perspective for reservoir exploration in the Mediterranean and adjacent basins

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AAPG European Regional Conference, Barcelona, 2013

Because of huge changes in Mediterranean sea level, the time-interval 6 – 5 Ma encompassing the Messinian Salinity Crisis is an unique case study for clastic production and deposition

The detailed chronology of the Messinian Salinity Crisis proposed by Bache *et al*. (2012, *Basin Research,* 24) provides new perspectives for a comprehensive view of time and space distribution of clastics

Ma

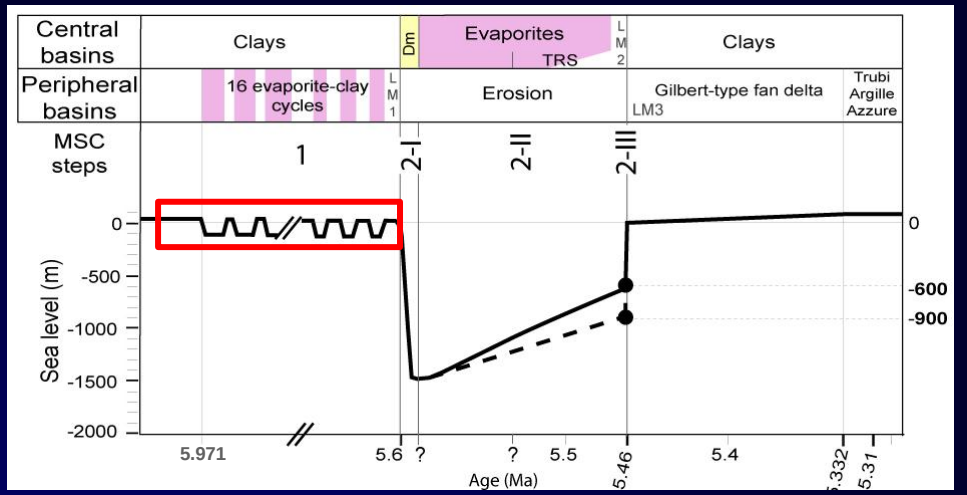
5.600

Gypsum

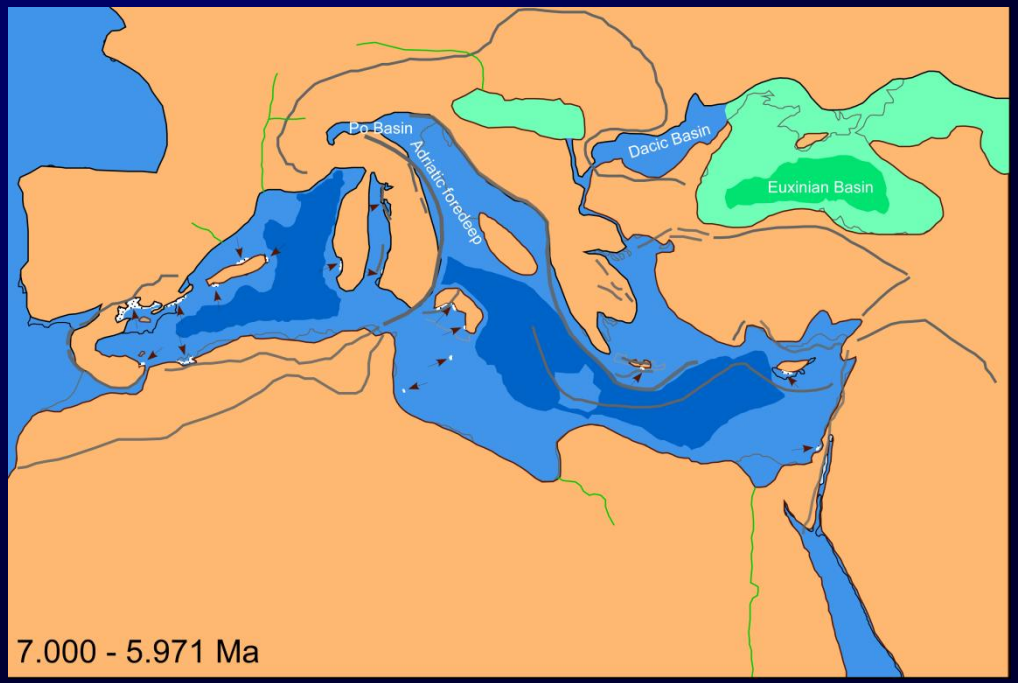
5.971

Marine sediments

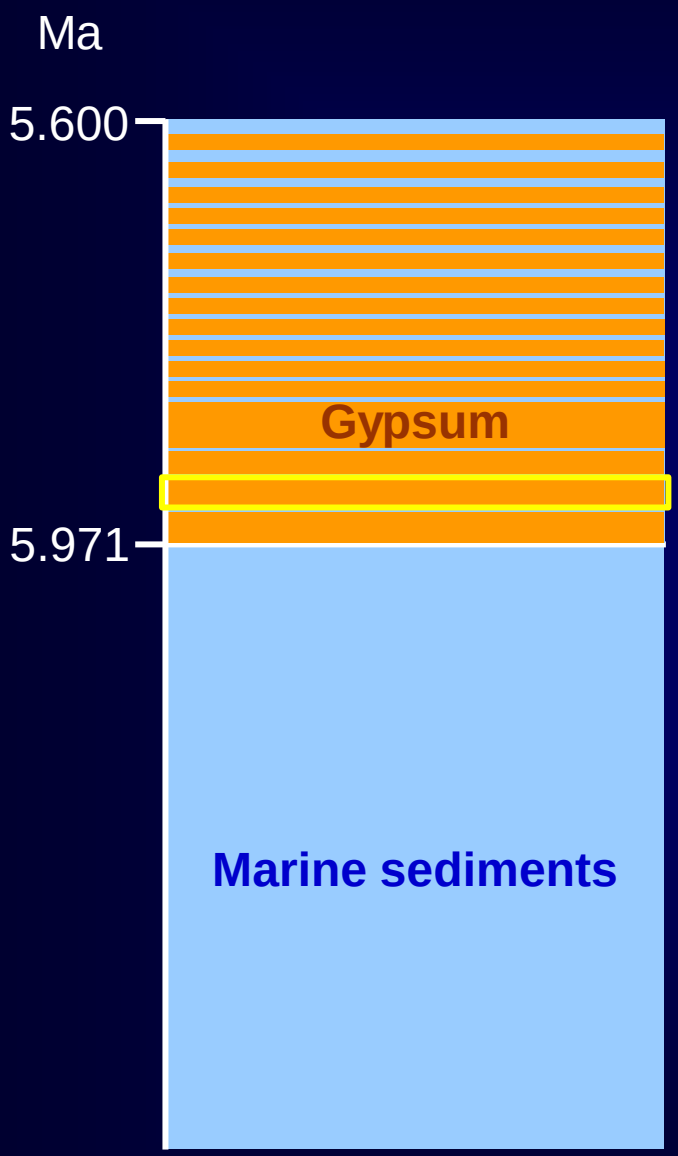
Peripheral basins



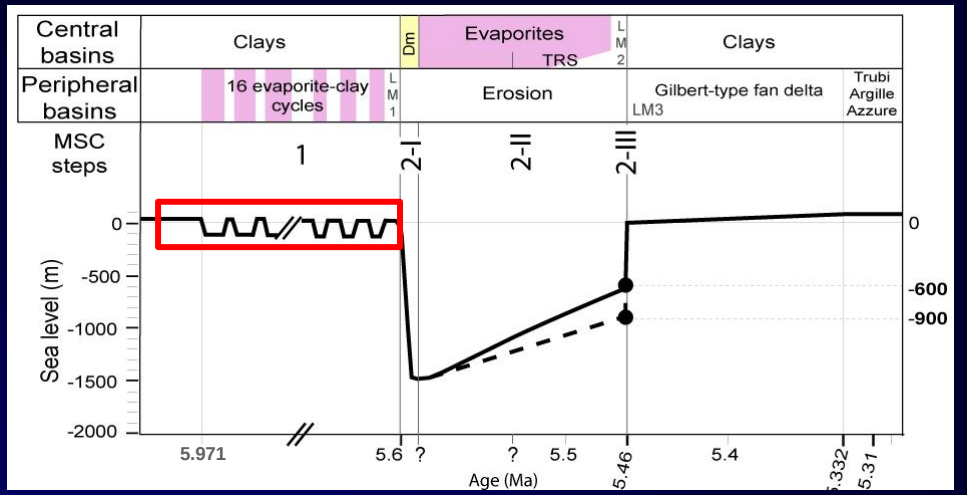
Bache *et al.*, 2012, submitted



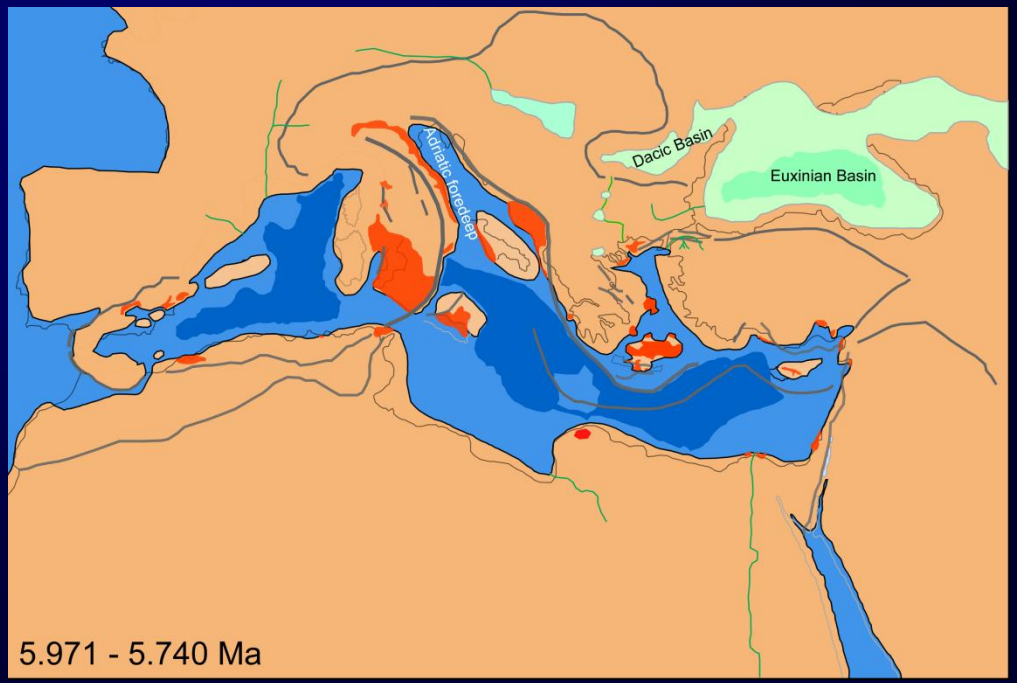
Gautier *et al.*, 1994; Clauzon *et al.*, 1996; Krijgsman et al., 1999; Manzi *et al.*, 2013

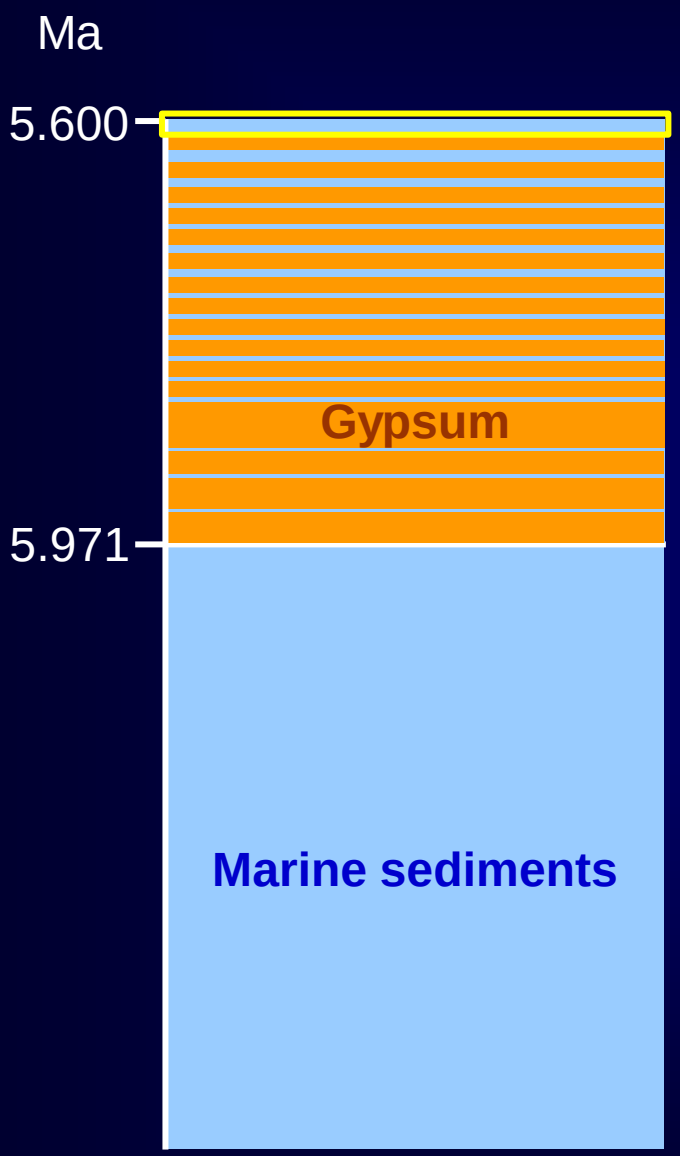


Peripheral basins

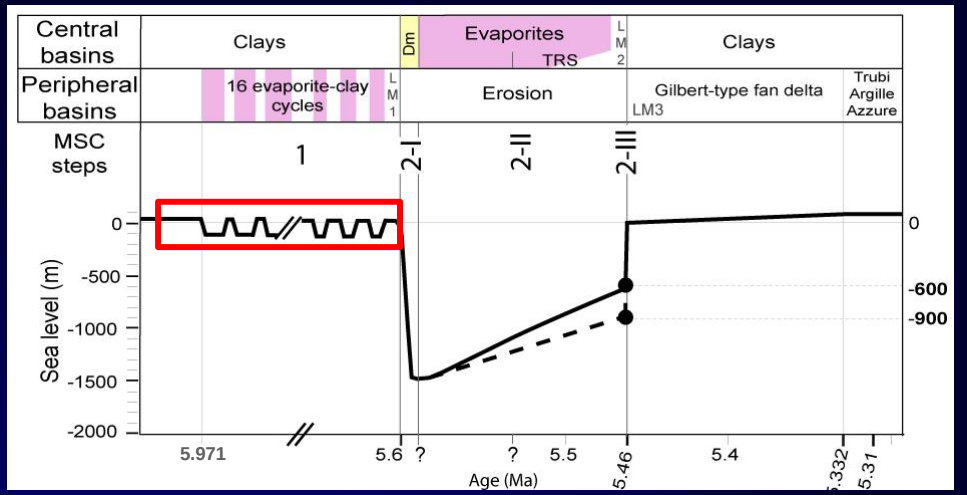


Bache *et al.*, 2012, submitted

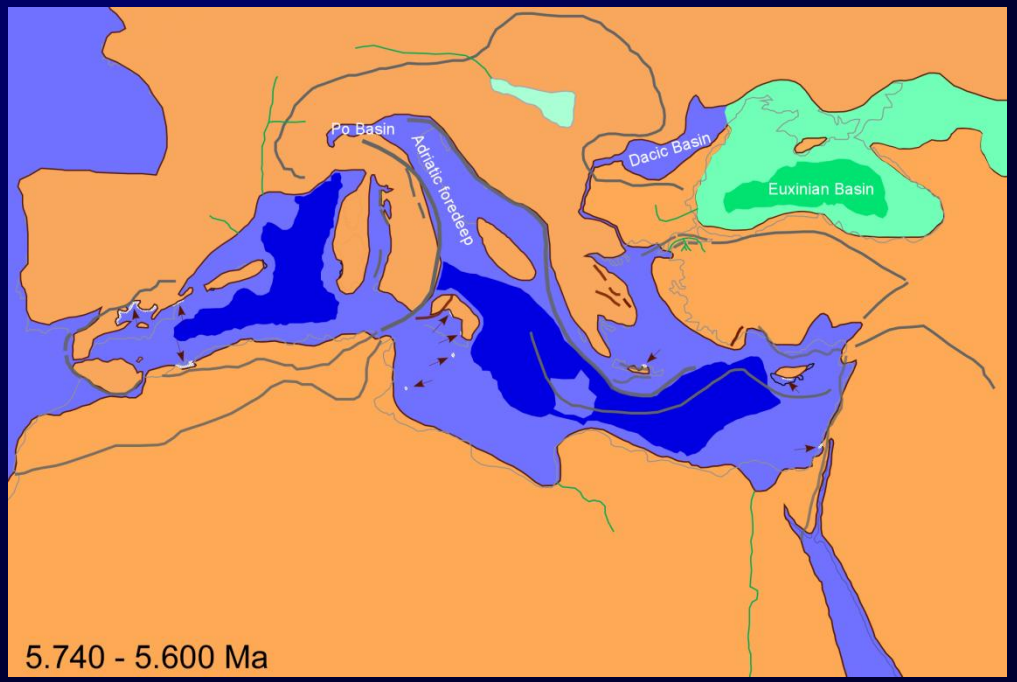




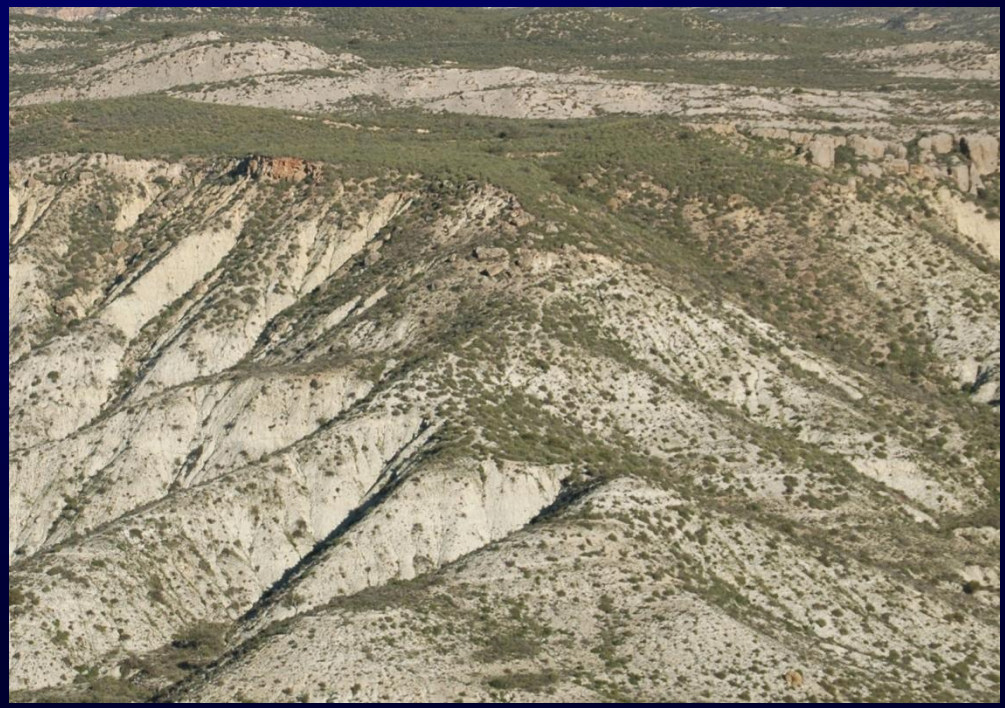
Peripheral basins

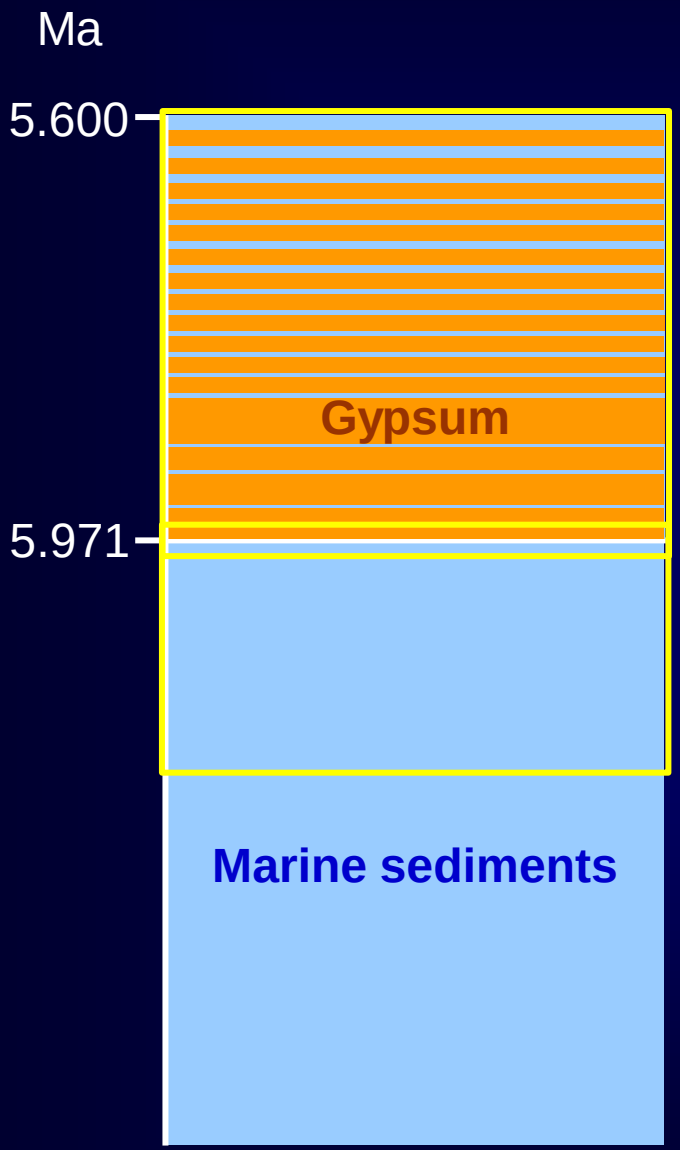


Bache *et al.*, 2012, submitted

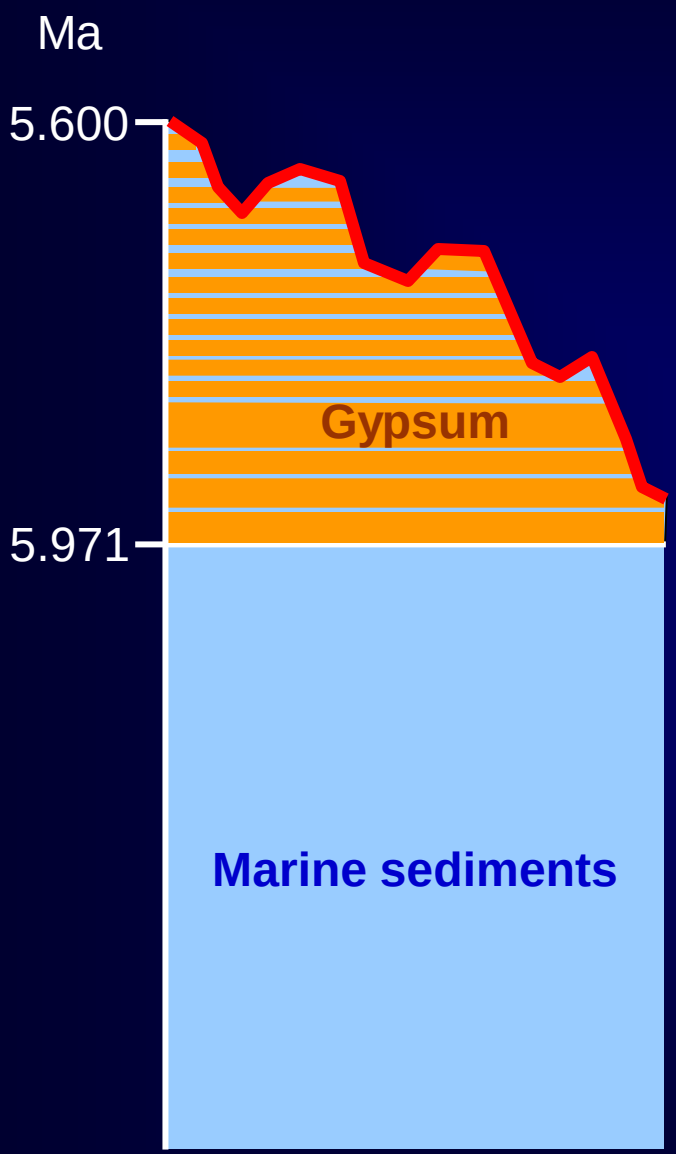


Sorbas (S Spain)

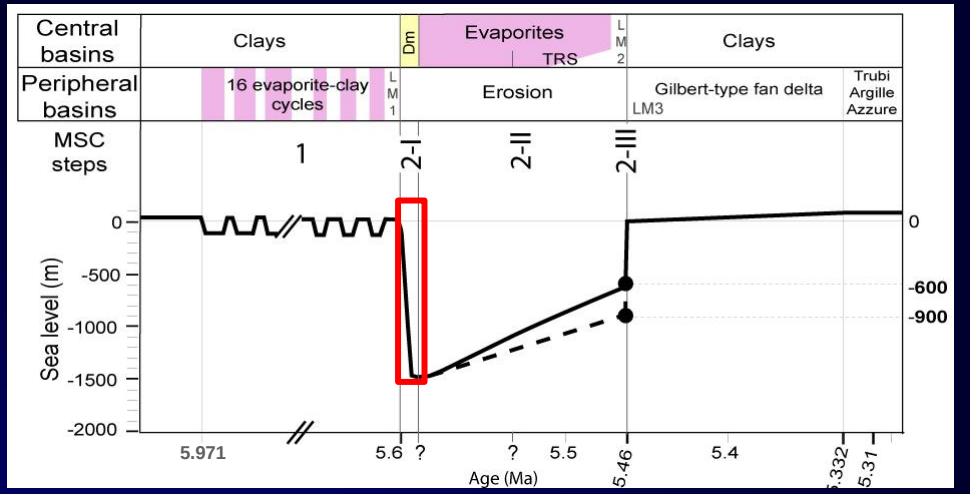




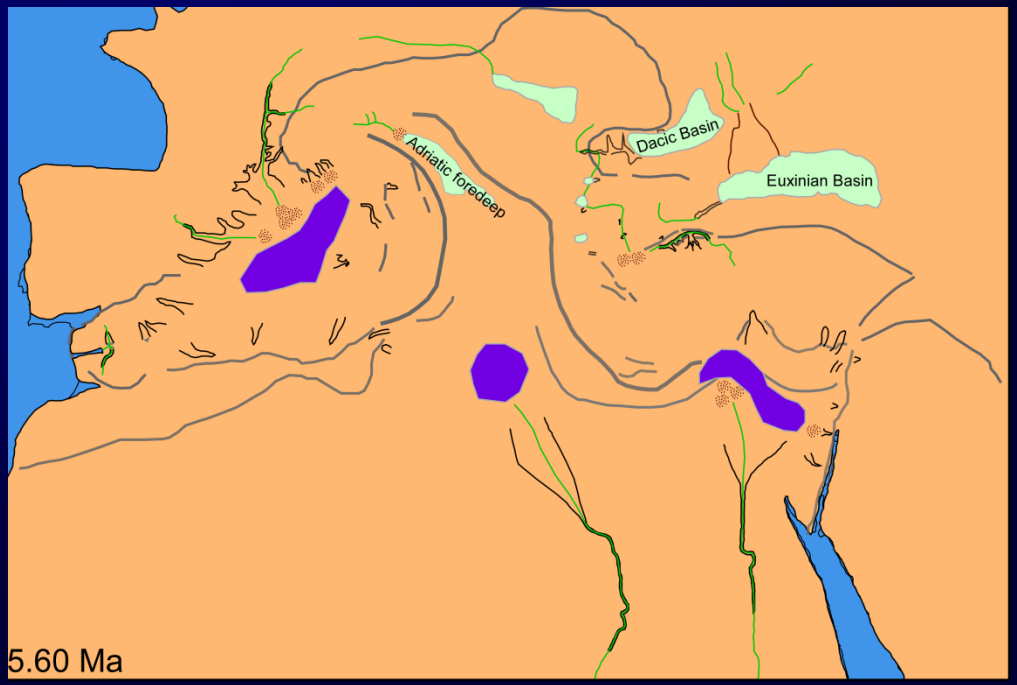
Peripheral basins



Peripheral basins

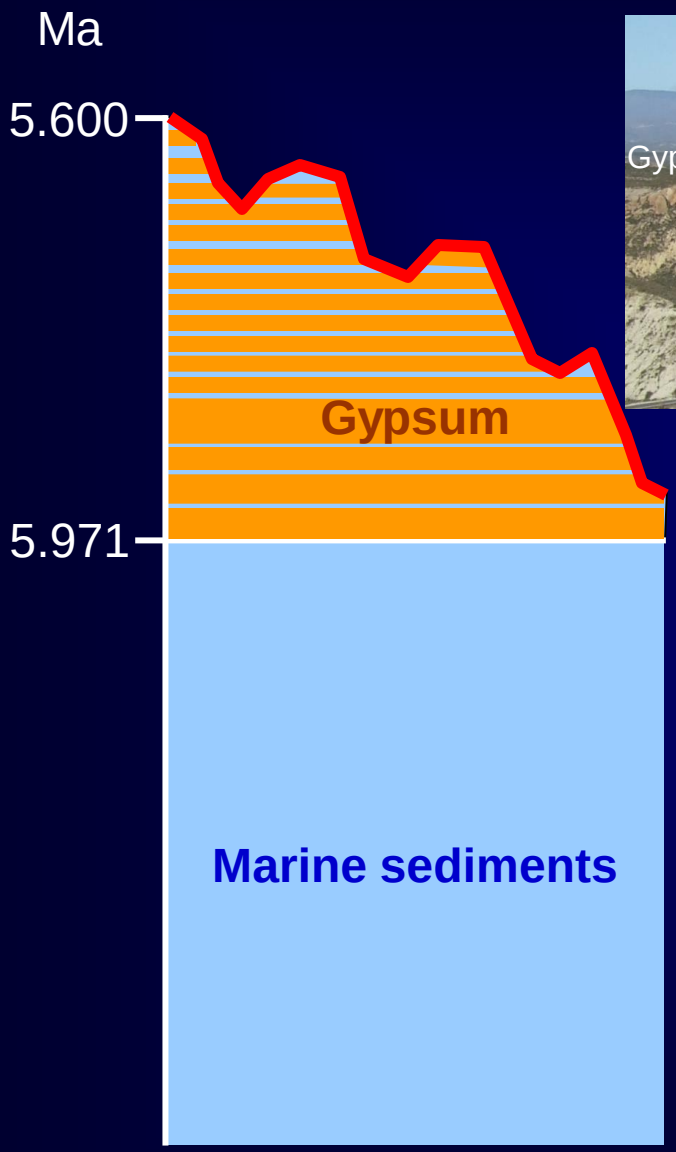


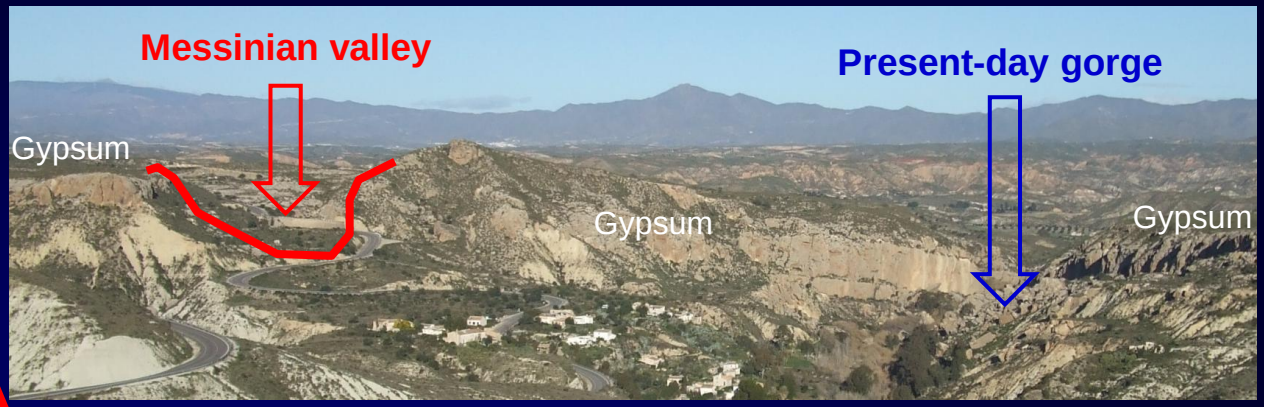
Bache *et al.*, 2012, submitted



Clauzon *et al.*, 1996; CIESM, 2008

Sorbas (S Spain)

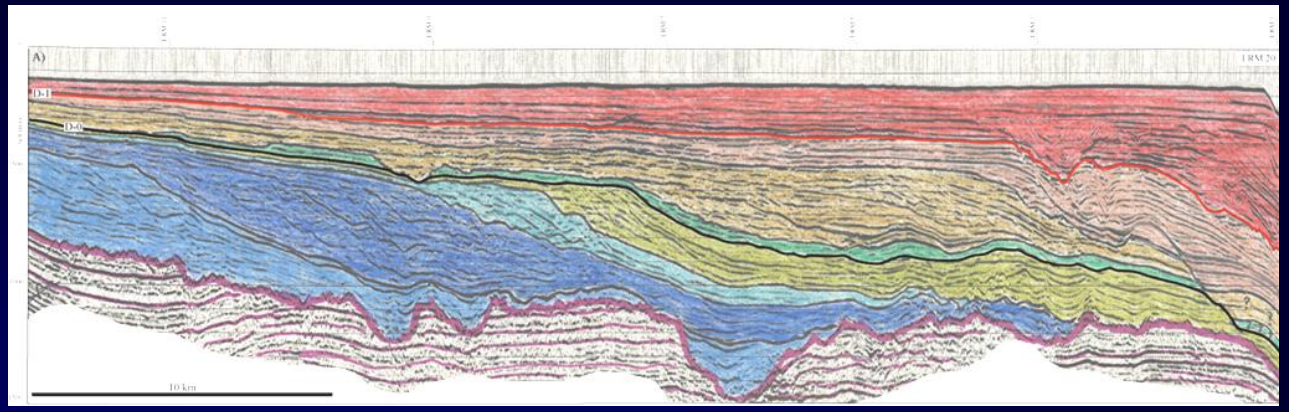




Clauzon *et al*., submitted

Peripheral basins

Gulf of Lions (NW Mediterranean)



Lofi *et al.*, 2005

Ma

5.600

Gypsum

5.971

Marine sediments

Peripheral basins

Messinian Erosional Surface

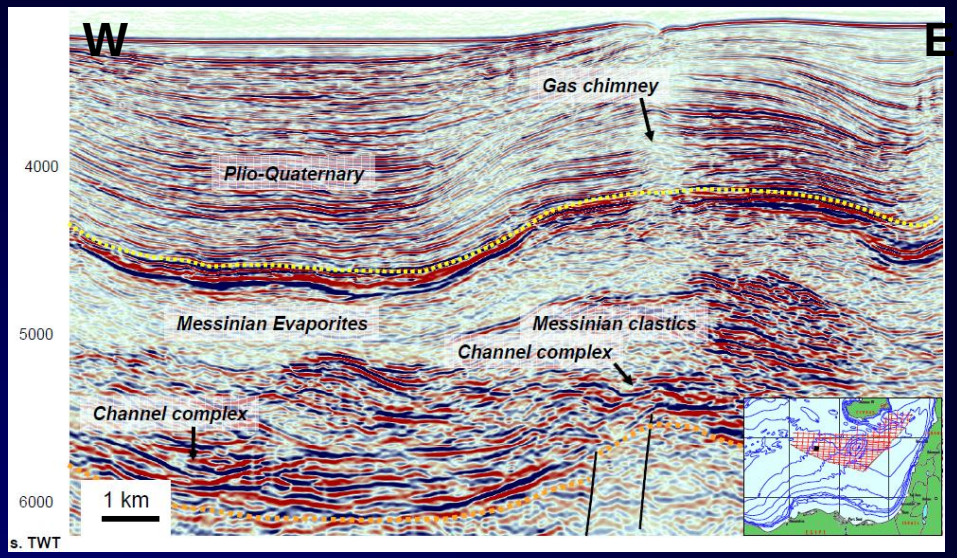
Ma

5.600

Marine sediments

Central basins

SW Cyprus (E Mediterranean)



Montadert *et al*., 2011

Ma

5.600

5.971

Gypsum

Marine sediments

Ma

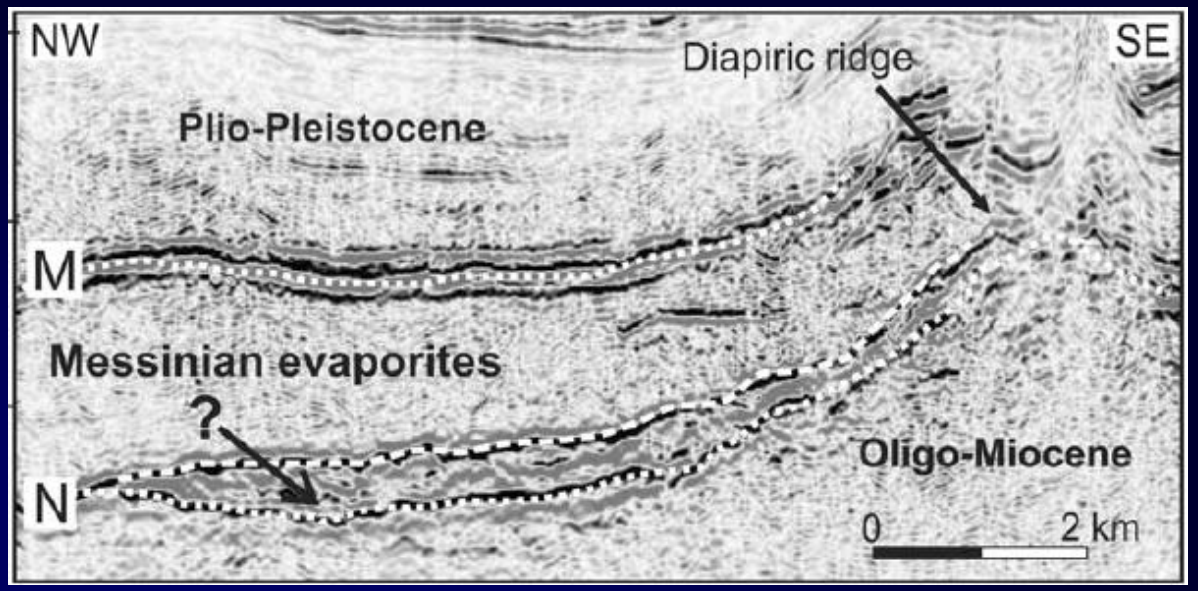
5.600

Marine sediments

Peripheral basins

Central basins

Levantine Basin (E Mediterranean)



Bertoni & Cartwright, 2011

Ma

5.600

5.971

Gypsum

Marine sediments

Ma

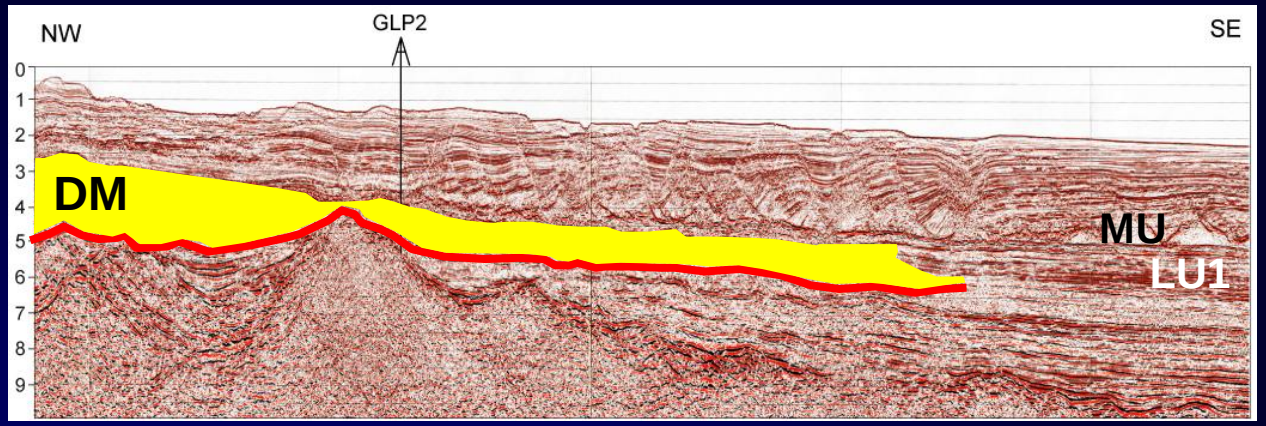
5.600

Marine sediments

Peripheral basins

Central basins

Gulf of Lions (NW Mediterranean)



Bache *et al.*, submitted

Ma

5.600

5.971

Gypsum

Marine sediments

Peripheral basins

Ma

5.600

Marine sediments

Central basins

Liguria (NW Mediterranean)

Savoye & Piper, 1991; Bache *et al*., submitted

Ma

5.600

5.971

Gypsum

Marine sediments

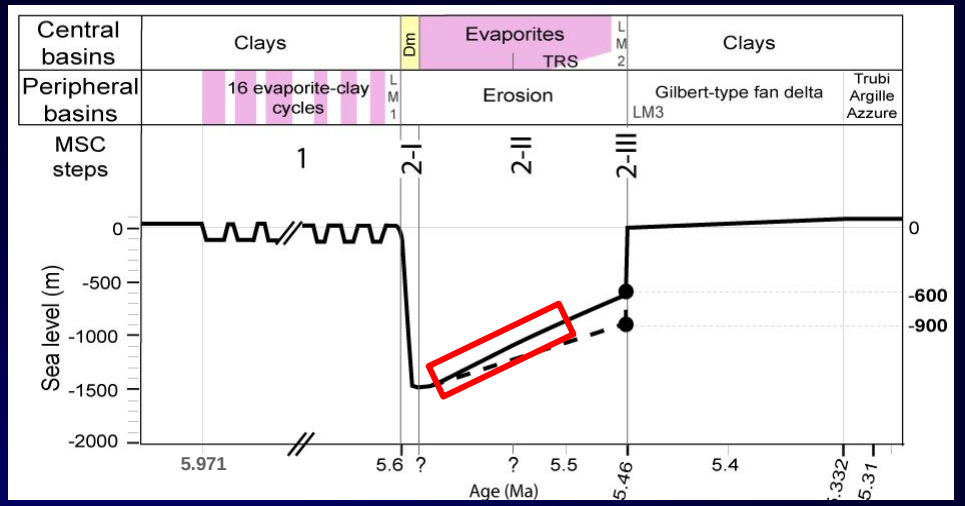
Peripheral basins

Ma

5.600

Marine sediments

Central basins



Bache *et al.*, 2012, submitted

Ma

5.600

5.971

Gypsum

Marine sediments

Peripheral basins

Ma

Evaporites (including halite)

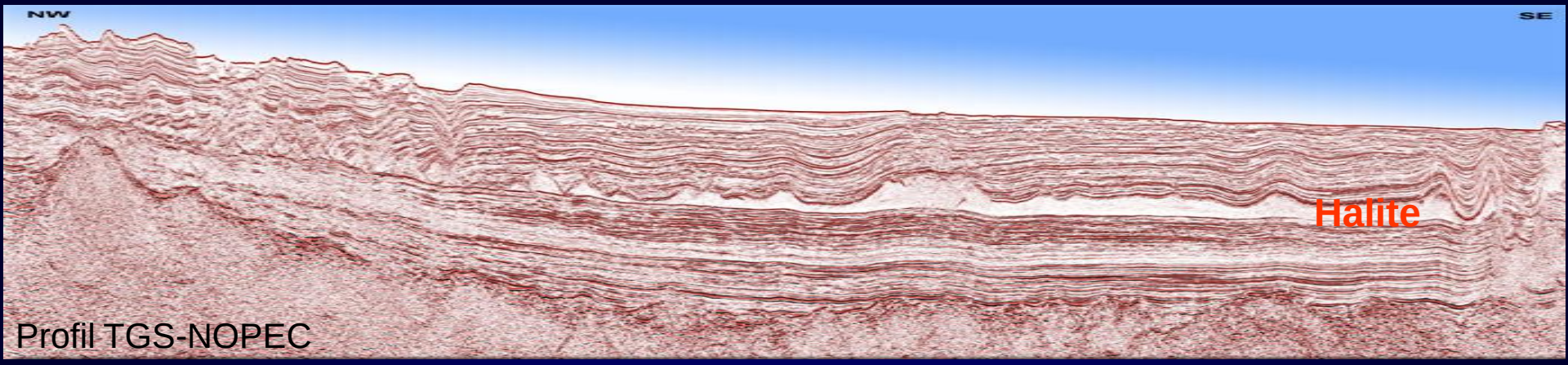
5.580?

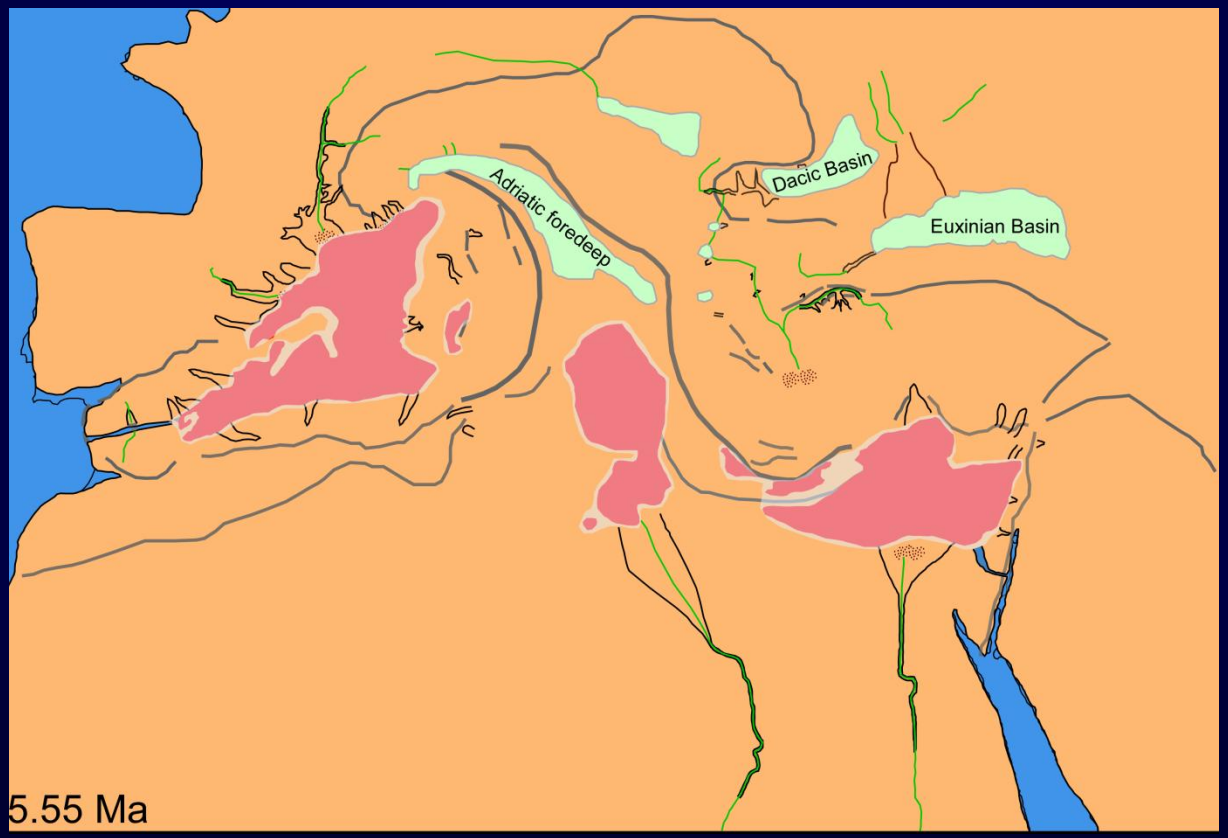
5.600

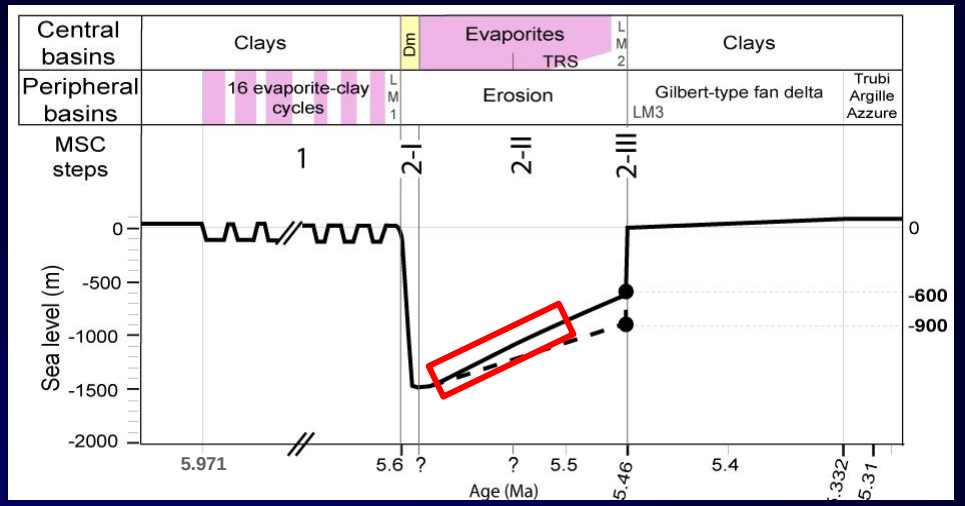
Marine sediments

Central basins

Gulf of Lions (NW Mediterranean)







Bache *et al.*, 2012, submitted

Ma

5.600

5.971

Gypsum

Marine sediments

Clastics?

Ma

Evaporites (including halite)

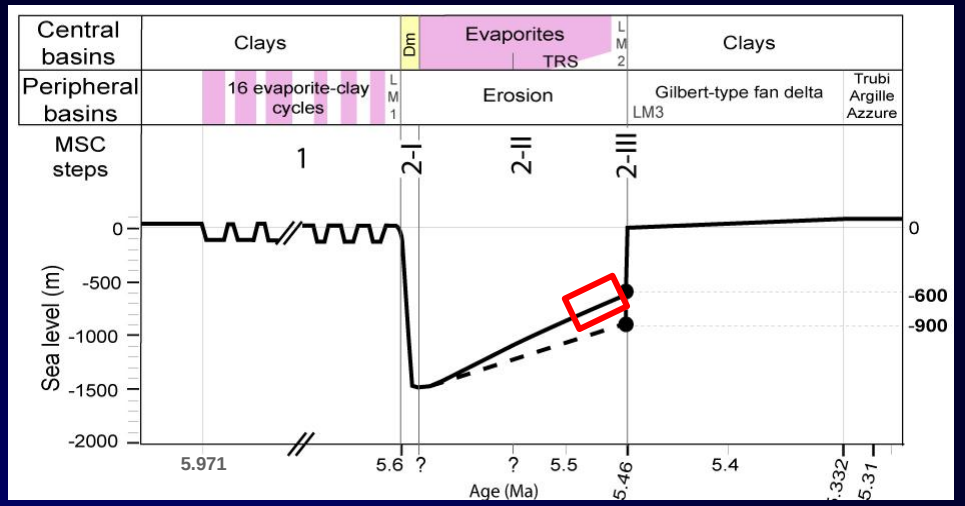
5.580?

5.600

Marine sediments

Peripheral basins

Central basins



Bache *et al.*, 2012, submitted

Ma

5.600

5.971

Gypsum

Marine sediments

Peripheral basins

Sea level

Ma

Wave cut surface

5.500?

Evaporites (including halite)

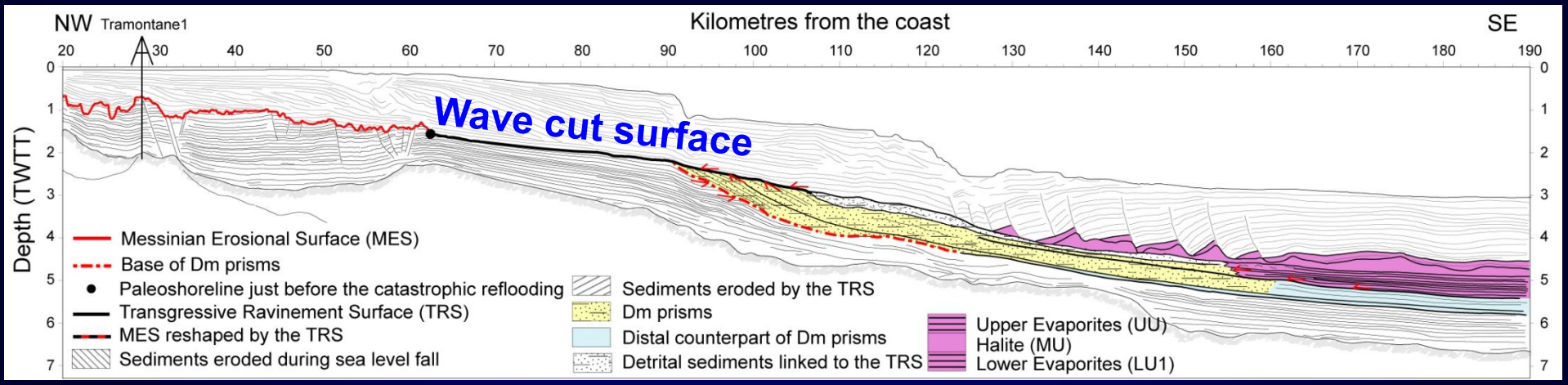
5.580?

5.600

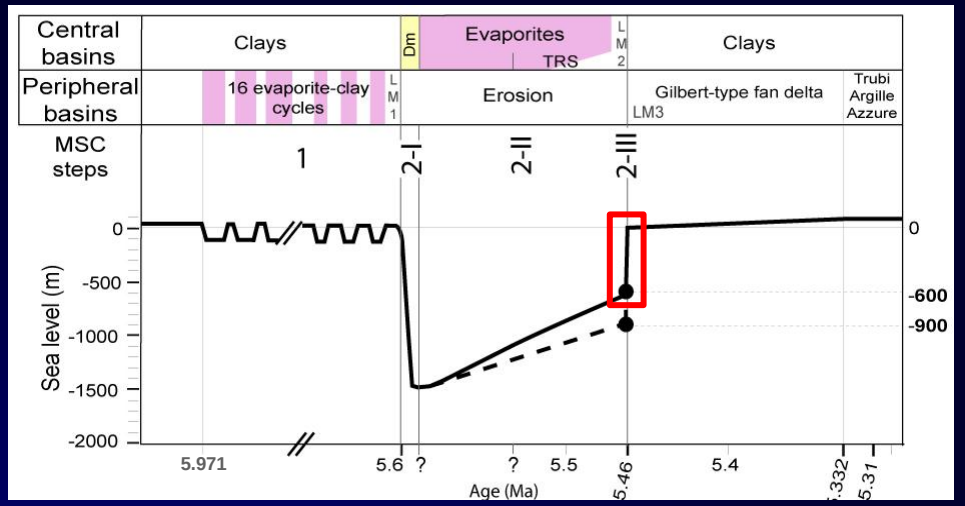
Marine sediments

Central basins

Gulf of Lions (NW Mediterranean)



Bache *et al.*, 2012, submitted



Bache *et al.*, 2012, submitted

Ma

5.600

5.971

Gypsum

Marine sediments

Sea level

Marine sediments

Evaporites (including halite)

Marine sediments

Ma

5.460

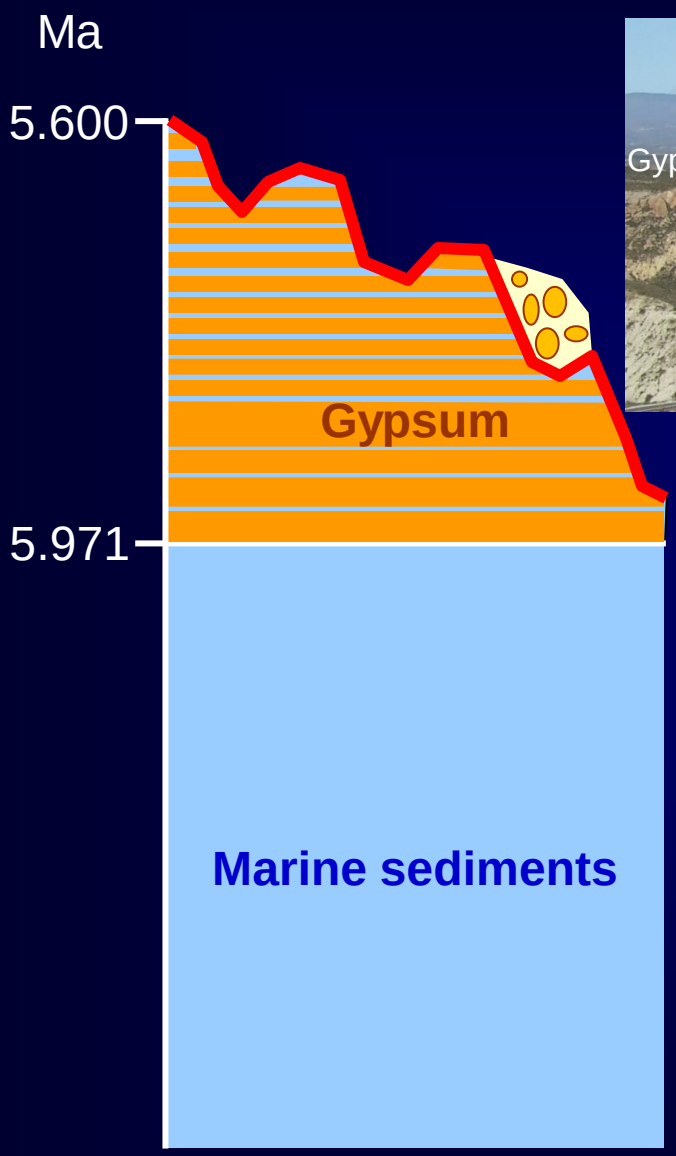
5.580?

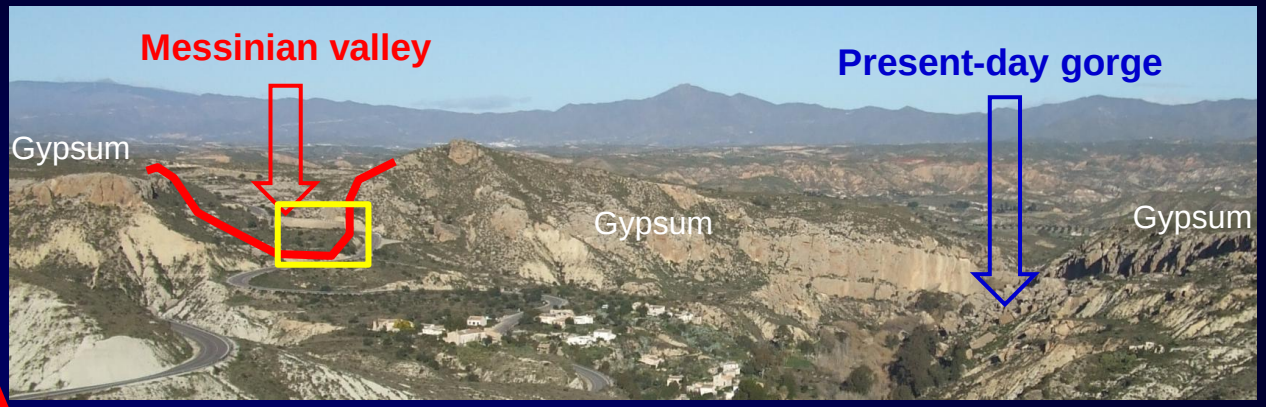
5.600

Peripheral basins

Central basins

Sorbas (S Spain)

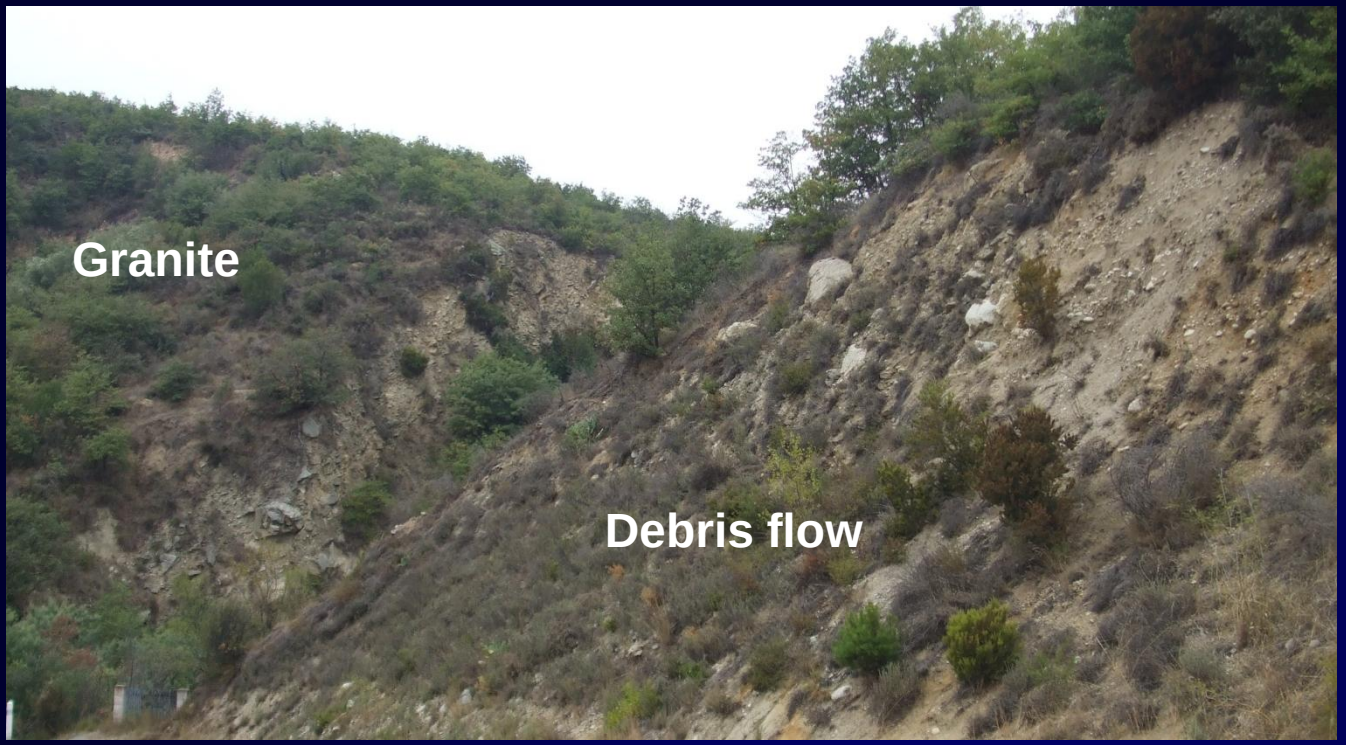


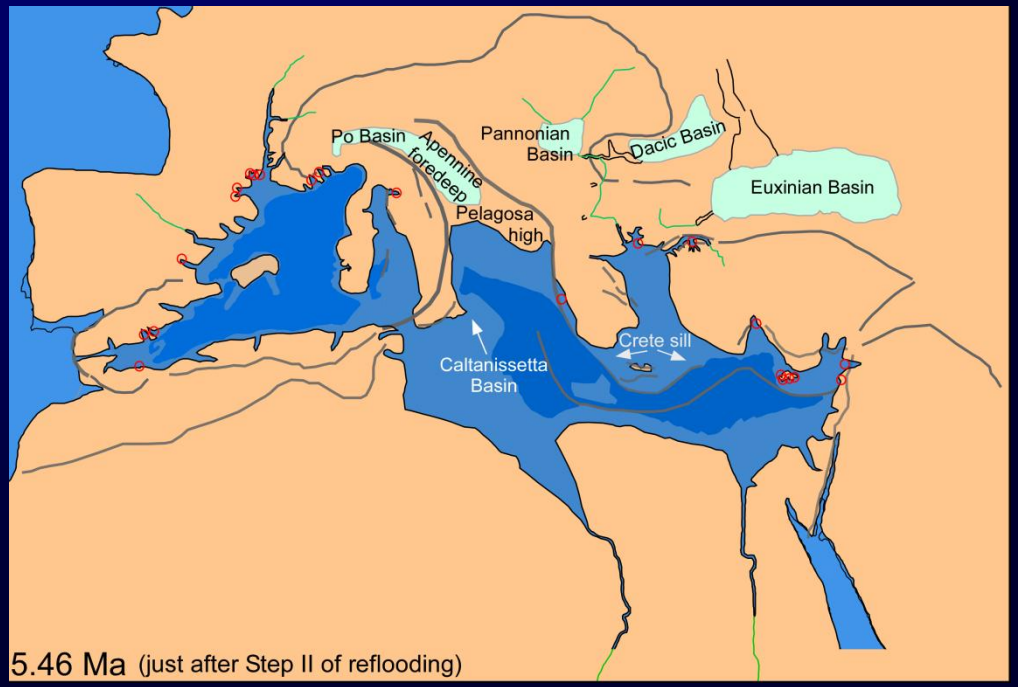


Clauzon *et al*., submitted

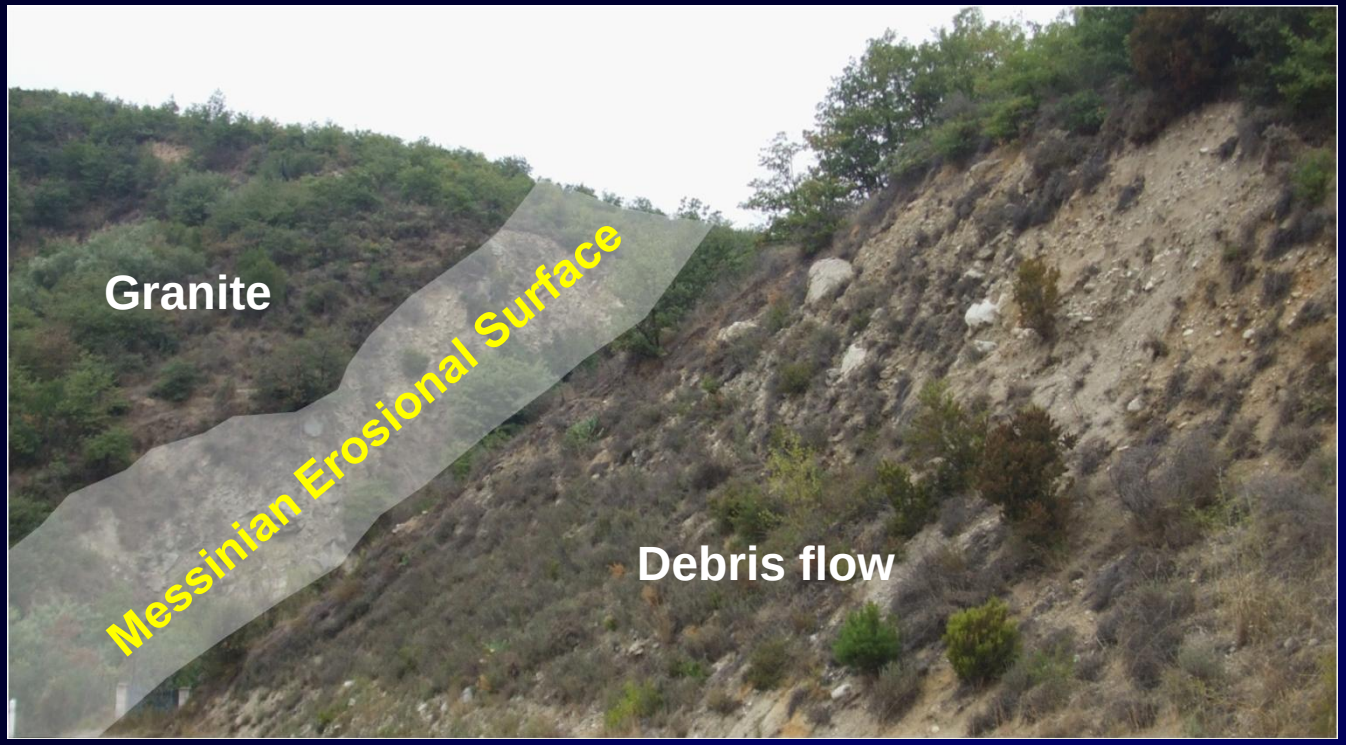
Peripheral basins

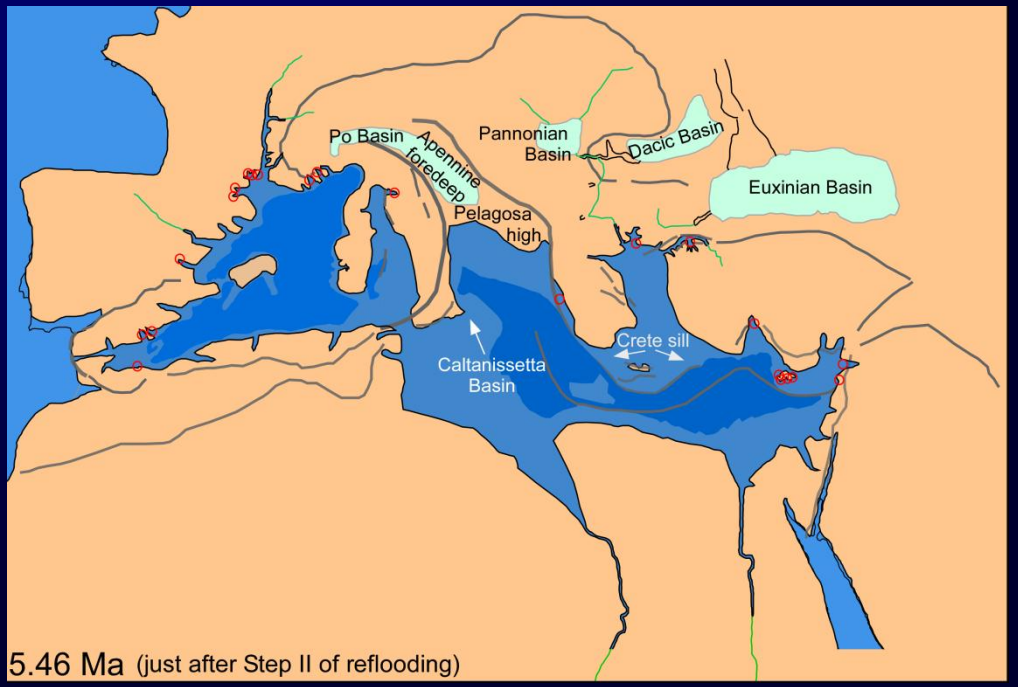
Ille sur Têt (S France)

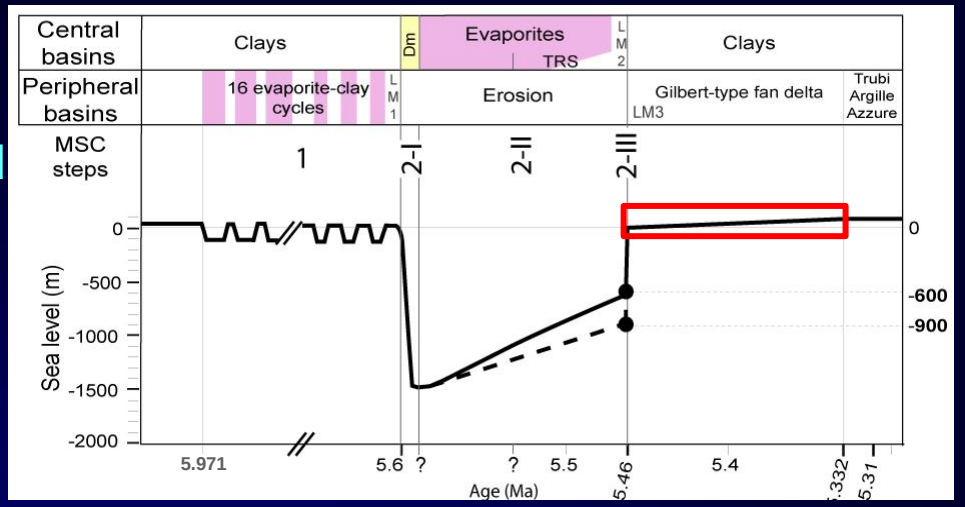




Ille sur Têt (S France)







Bache *et al.*, 2012, submitted

Ma

5.600

5.971

Sea level highstand

Gilbert-type fan delta

Gypsum

Marine sediments

Peripheral basins

Marine sediments

Evaporites (including halite)

Marine sediments

Central basins

Ma

5.460

5.580?

5.600

Ma

Sea level highstand

Gilbert-type fan delta

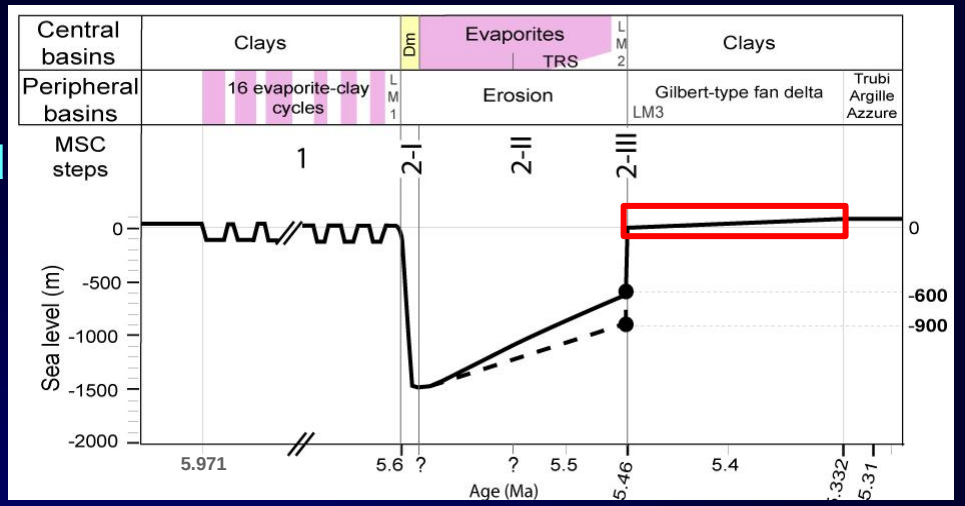
5.600

Gypsum

5.971

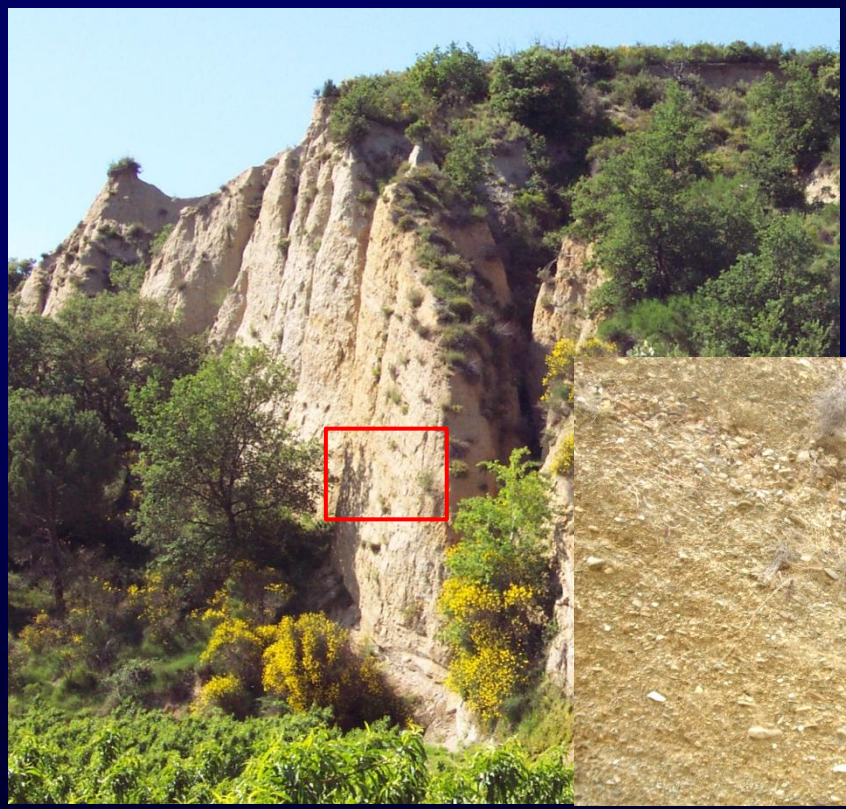
Marine sediments

Peripheral basins



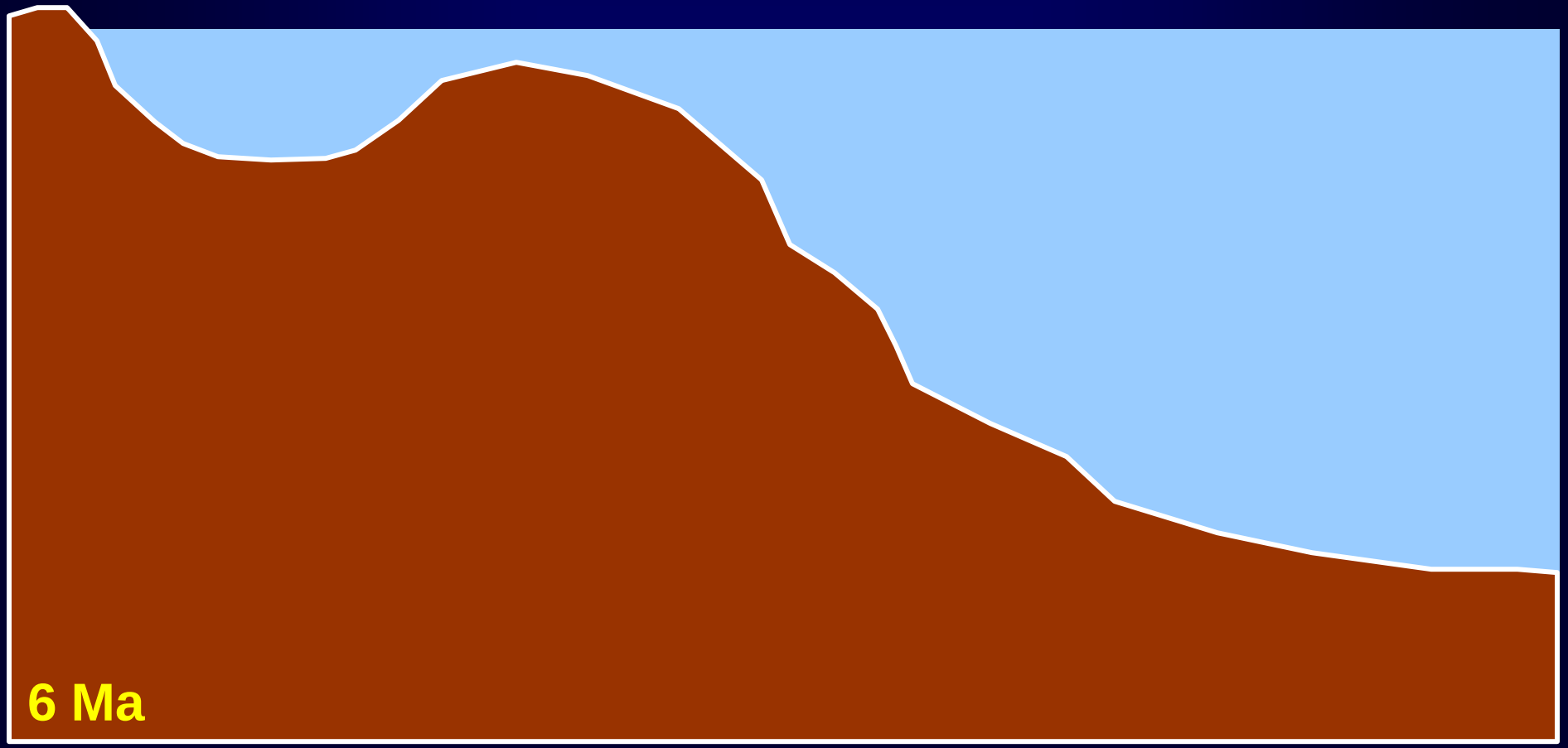
Bache *et al.*, 2012, submitted

Néfiach (S France)



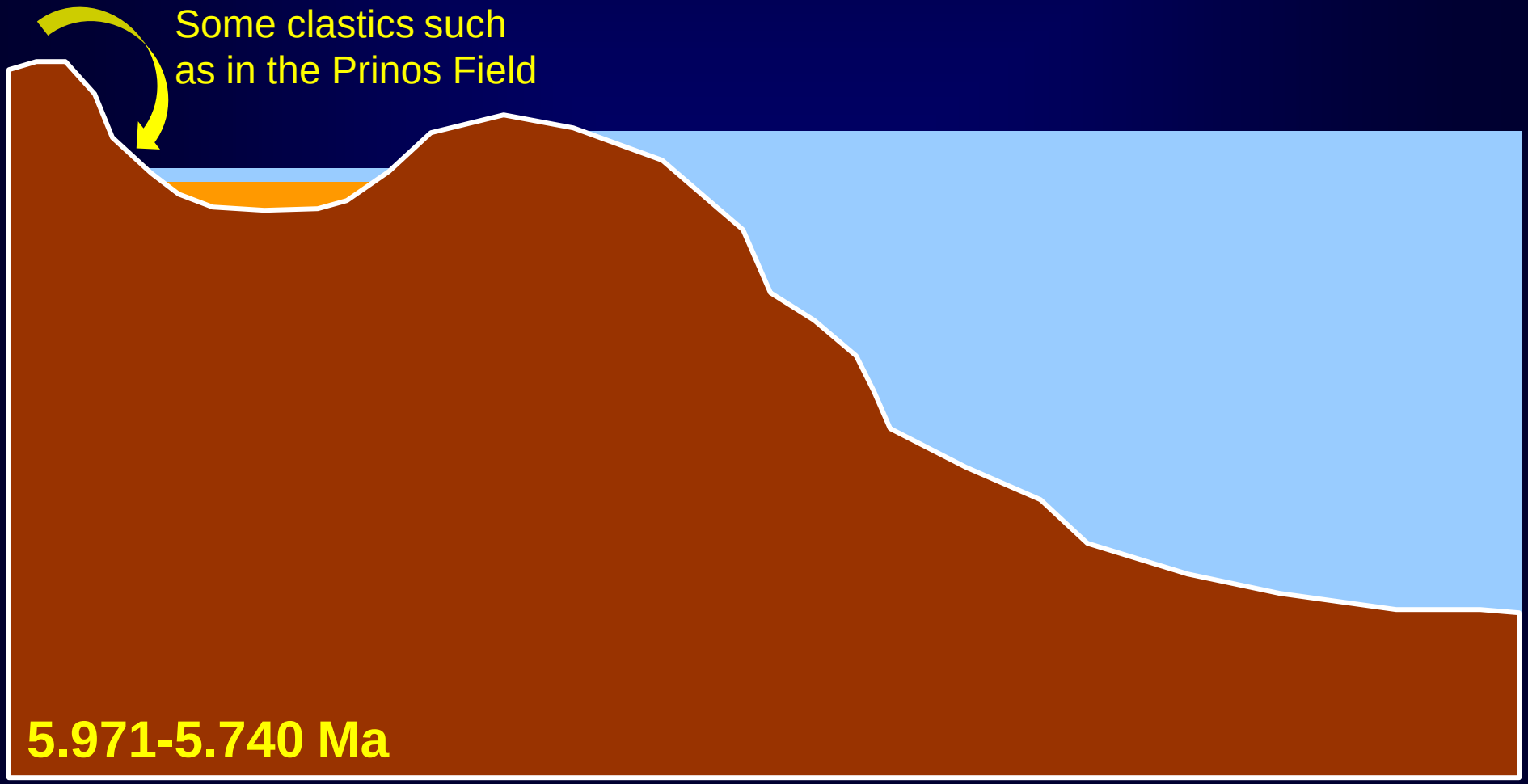
CONCLUSION

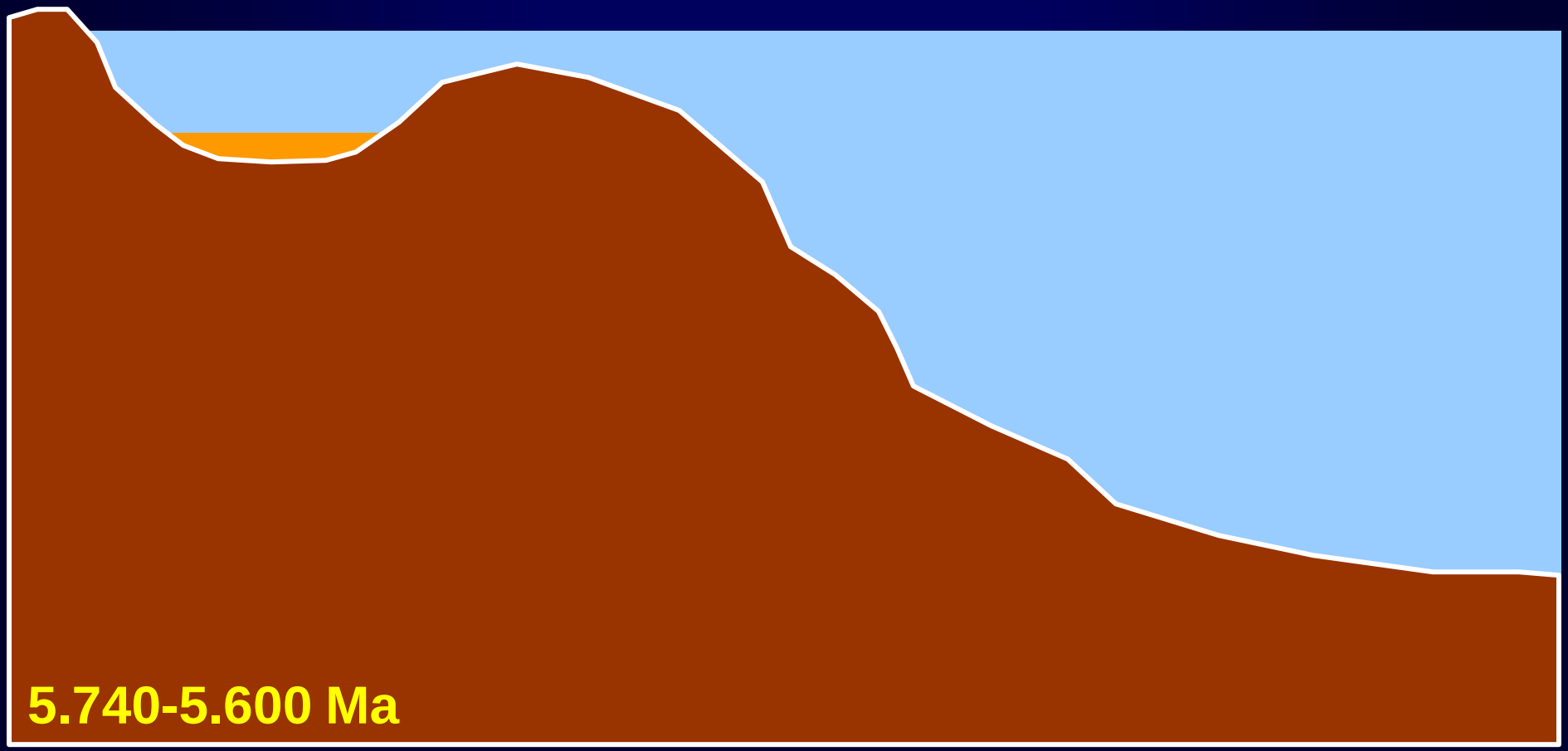
This scenario and its chronology allow to predict location of clastics in the Mediterranean region between 6 and 5 Ma according to sea level



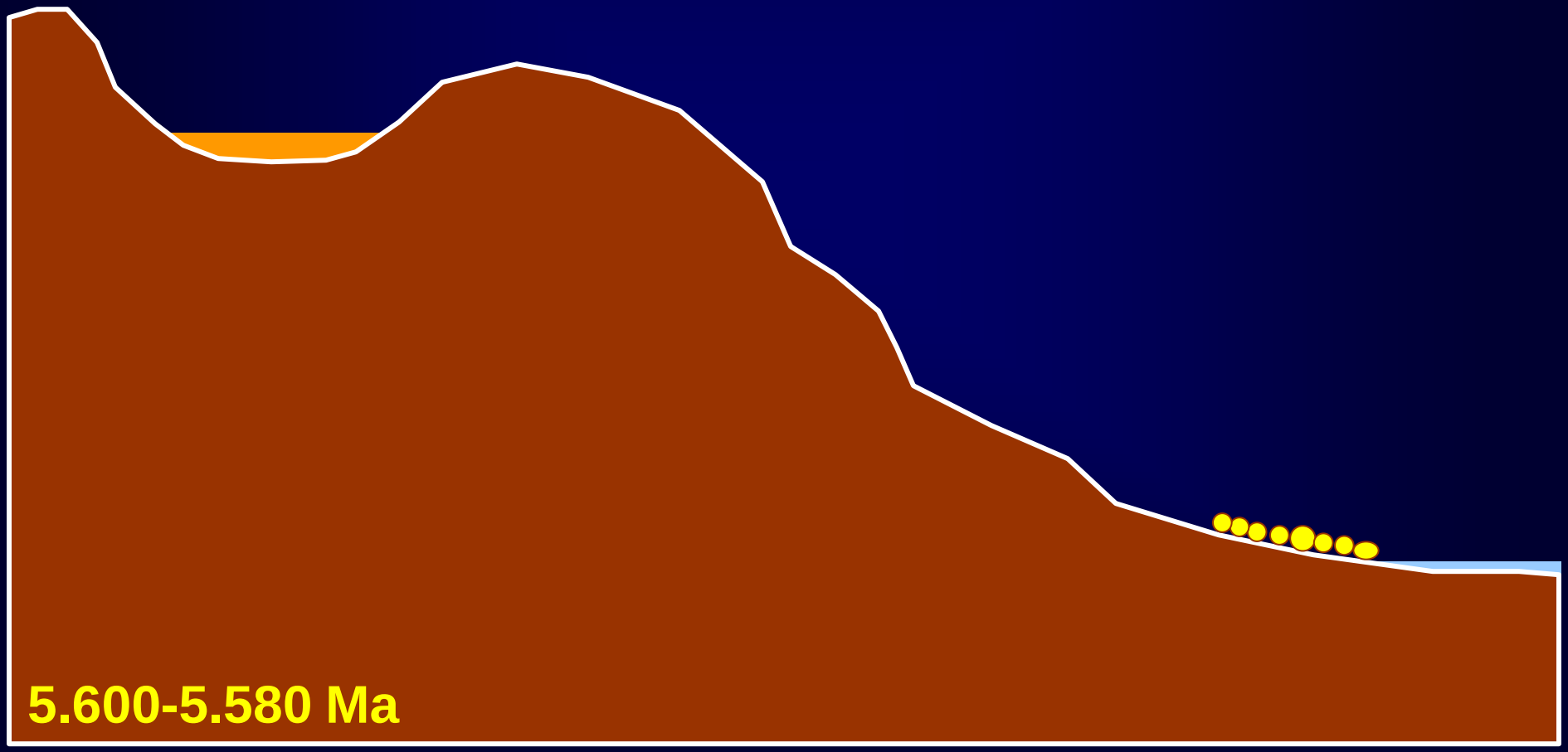
Evaporites deposited in the peripheral basins

The North Aegean Basin received clastics from the Balkans and Carpathians during the minor sea-level falls

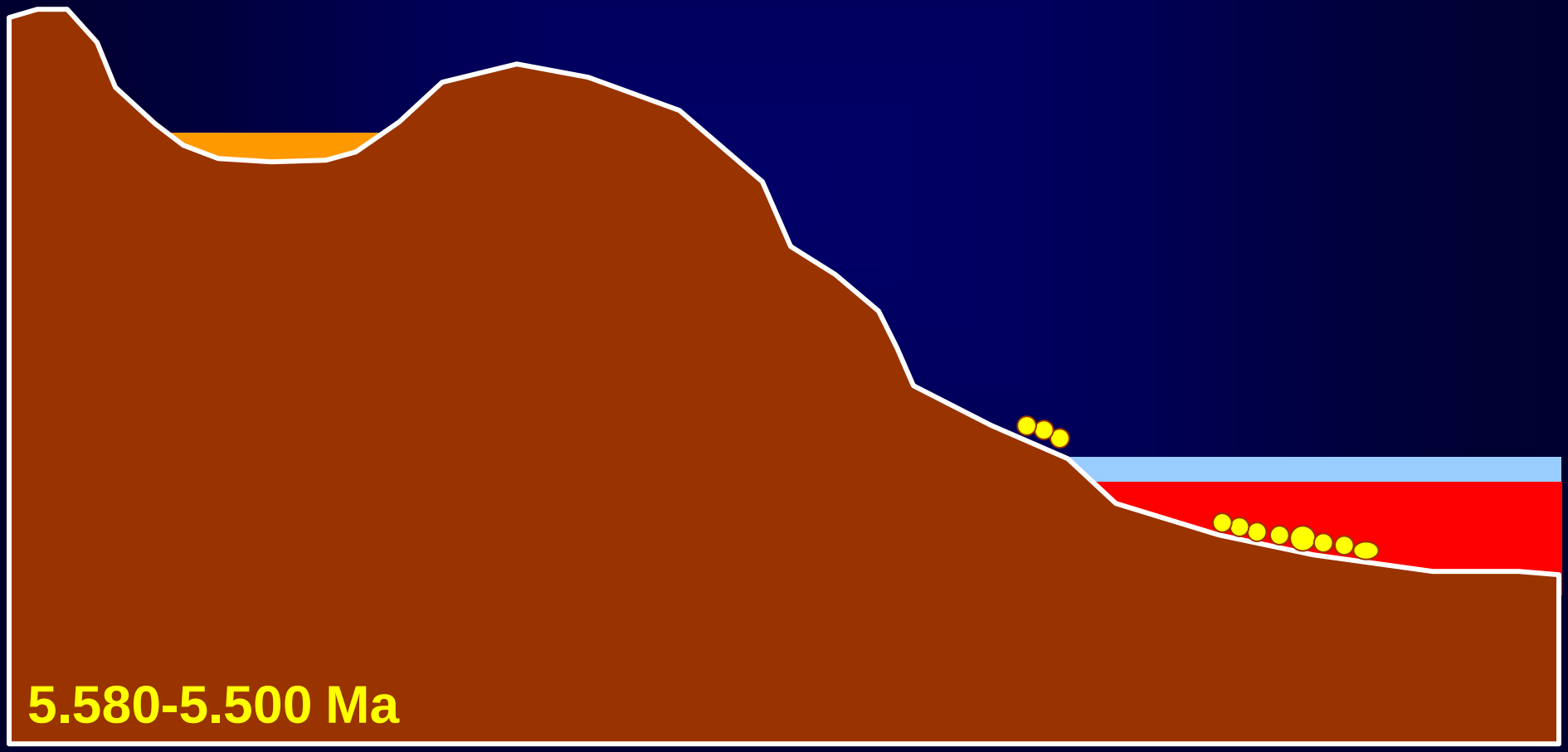



5.740-5.600 Ma

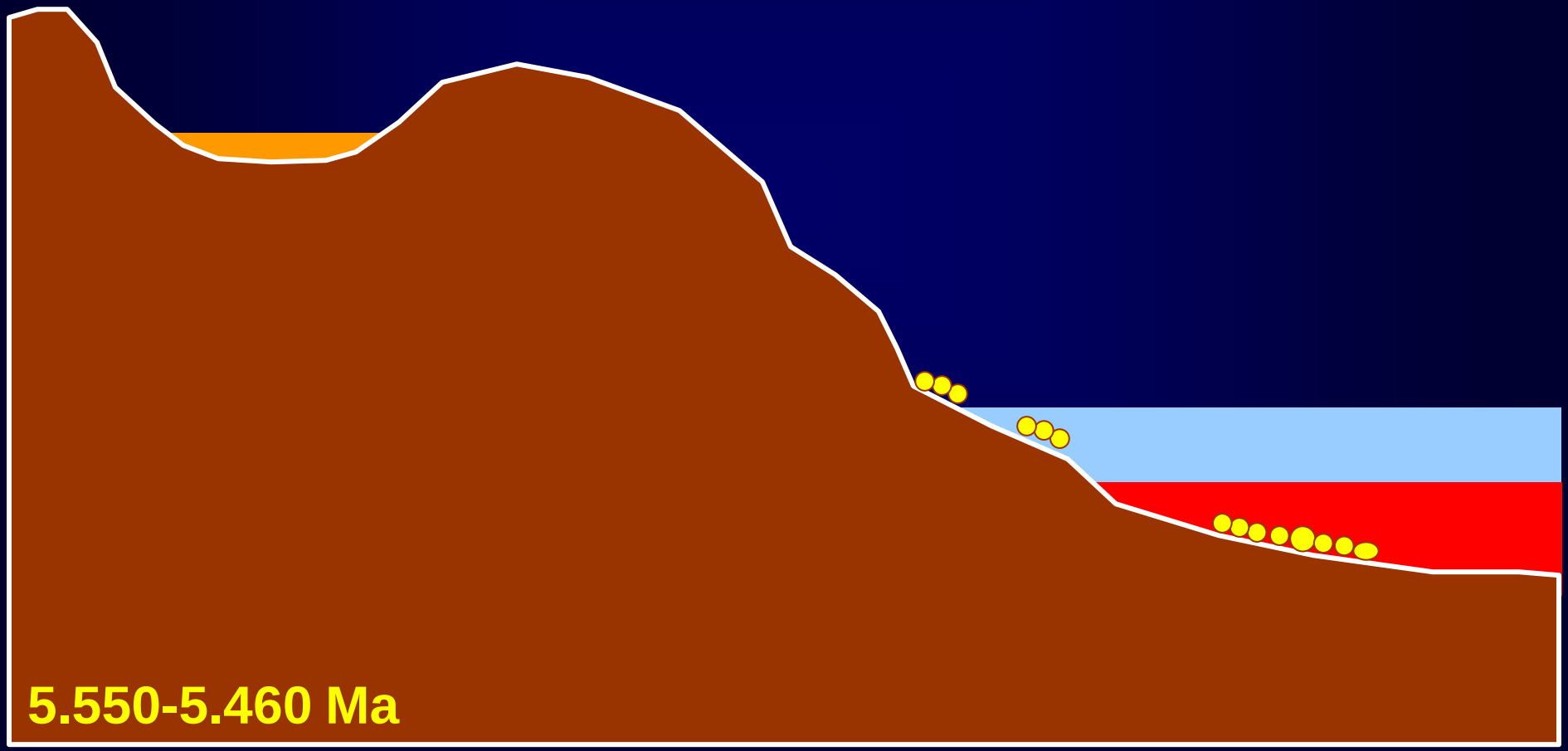
Thick calstics deposited in subaerial conditions within the almost desiccated central basins thanks to intense fluvial input



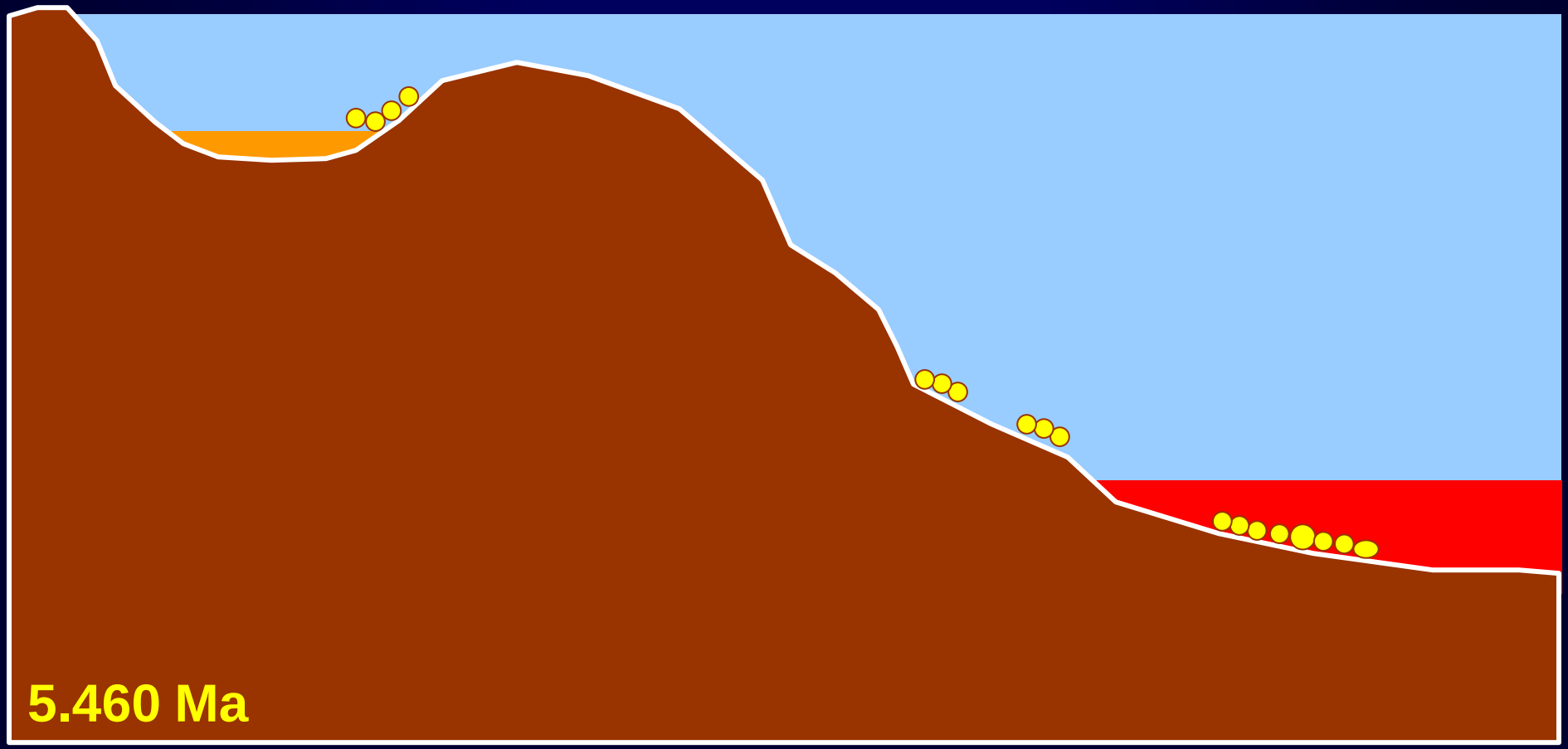
They are overlain by central evaporites while clastics deposited back to the shoreline



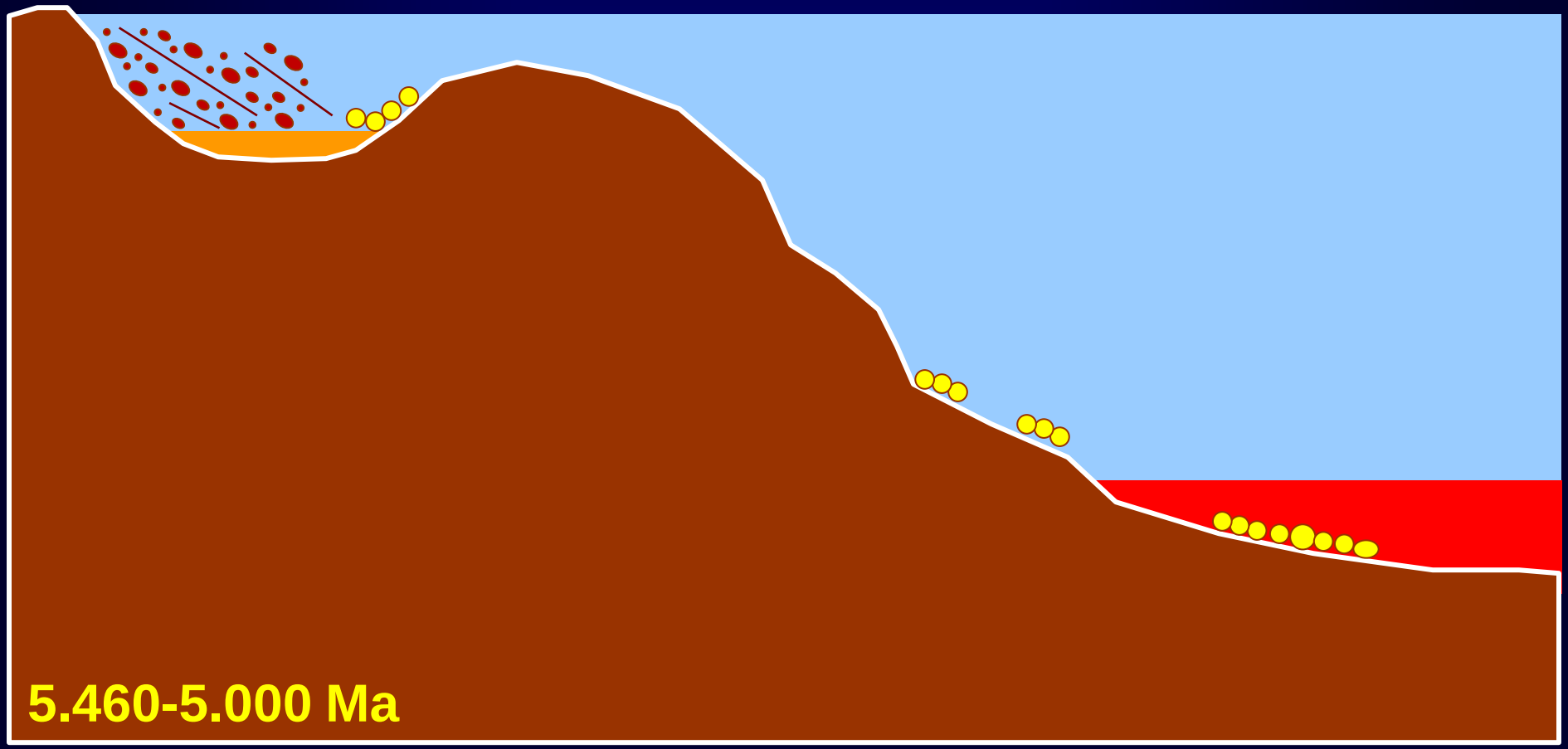
At the beginning of the marine reflooding of the Mediterranean Basin, the slow sea level rise probably caused deposition of clastics following the shifting coastline



The sudden and catastrophic complete reflooding resulted in blocking clastics at the outlet of peripheral basins



Here, they have been then overlain by detrital material of Gilbert-type fan deltas




THANKS