



**Università di Trieste**  
**Corso di Laurea in Geologia**

**Anno accademico 2020 - 2021**

**Geologia Marina**

Parte V

**Modulo 5.3** Golfo di Trieste

Docente

**Martina Busetti**

# ***Il Golfo di Trieste***



**Estensione del Golfo di Trieste secondo Valussi (1973)**

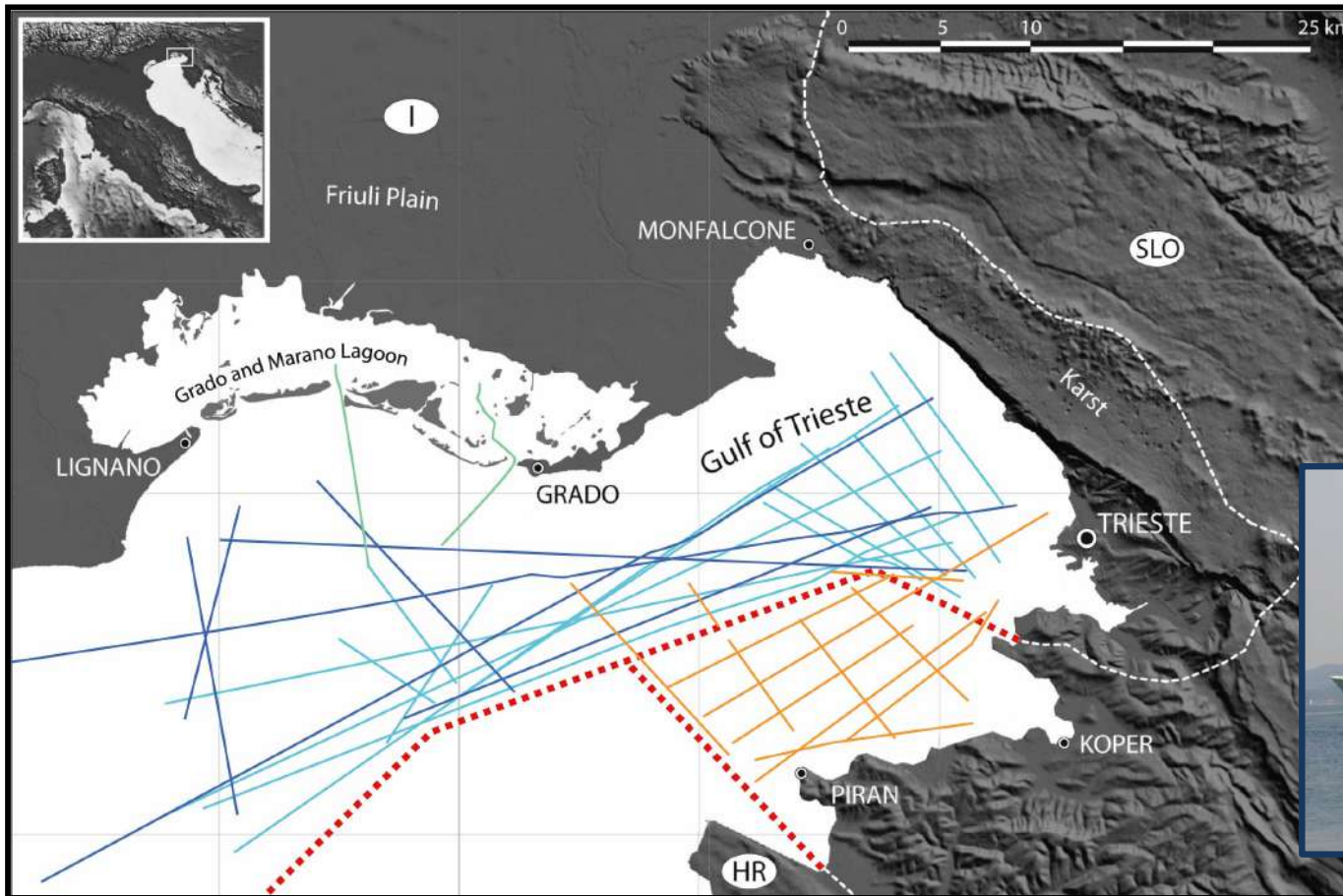


da Dal Cin, 2018 PhD Thesis



Carta geologica compilata da:

Cucchi et al., 1987; Tentor & Tunis 1994; Jurkovšek et al., 1996; Jurkovšek 2008; Nicolich et al., 2006



632 km di profili di  
sismica multicanale  
e Chirp



N/R OGS Explora

220 km nel 2005 - progetto Geotermia

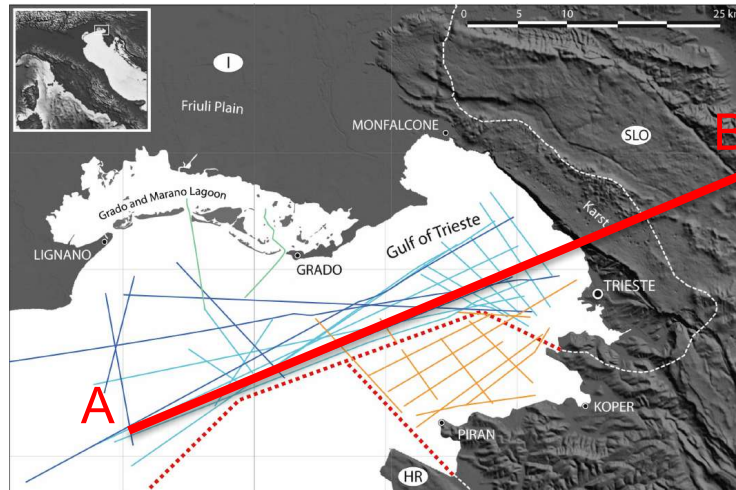
Università di Trieste, OGS, convenzione per la Regione Autonoma Friuli Venezia Giulia

280 km nel 2009 - progetto Golfo Trieste

OGS

132 km nel 2013 - progetto SLOMARTEC

collaborazione OGS, Università di Lubiana e Harpha Sea d.o.o Koper (Slovenia)



**avampaese *dinarico***

**rampa  
frontale**

**Carso**

**B**

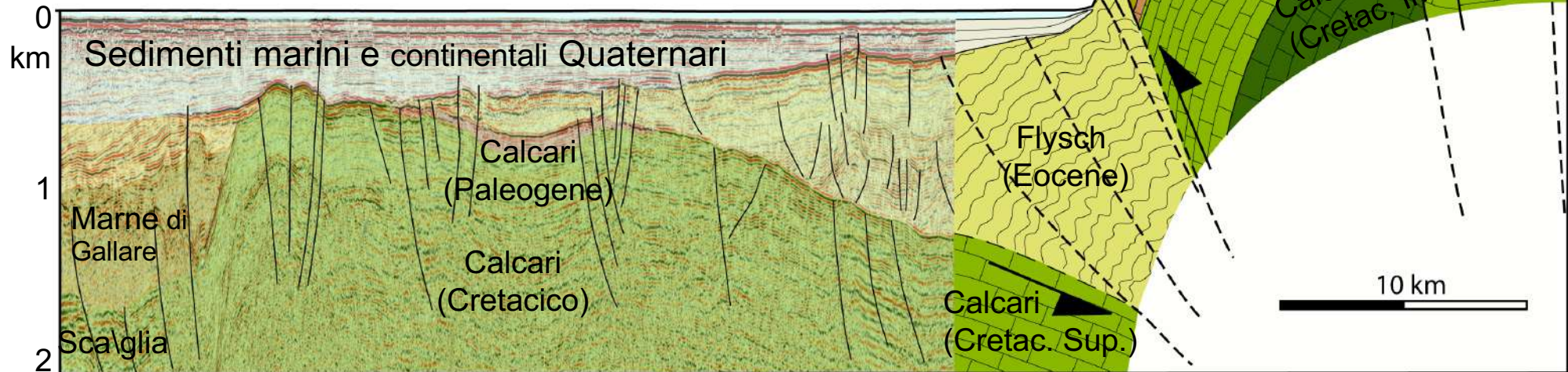
Faglia della Raša

Thrust del Carso Faglia di Divača

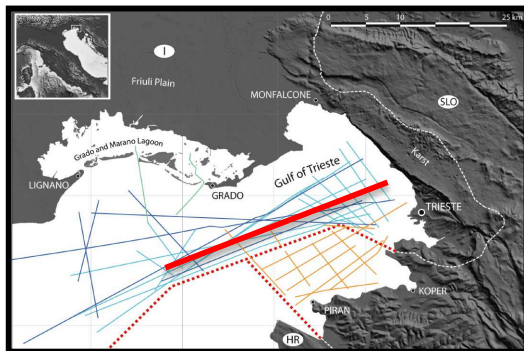
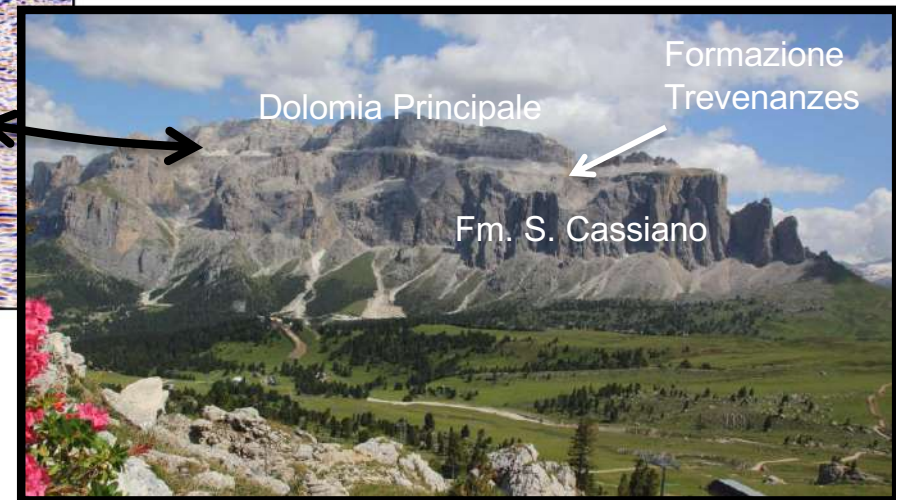
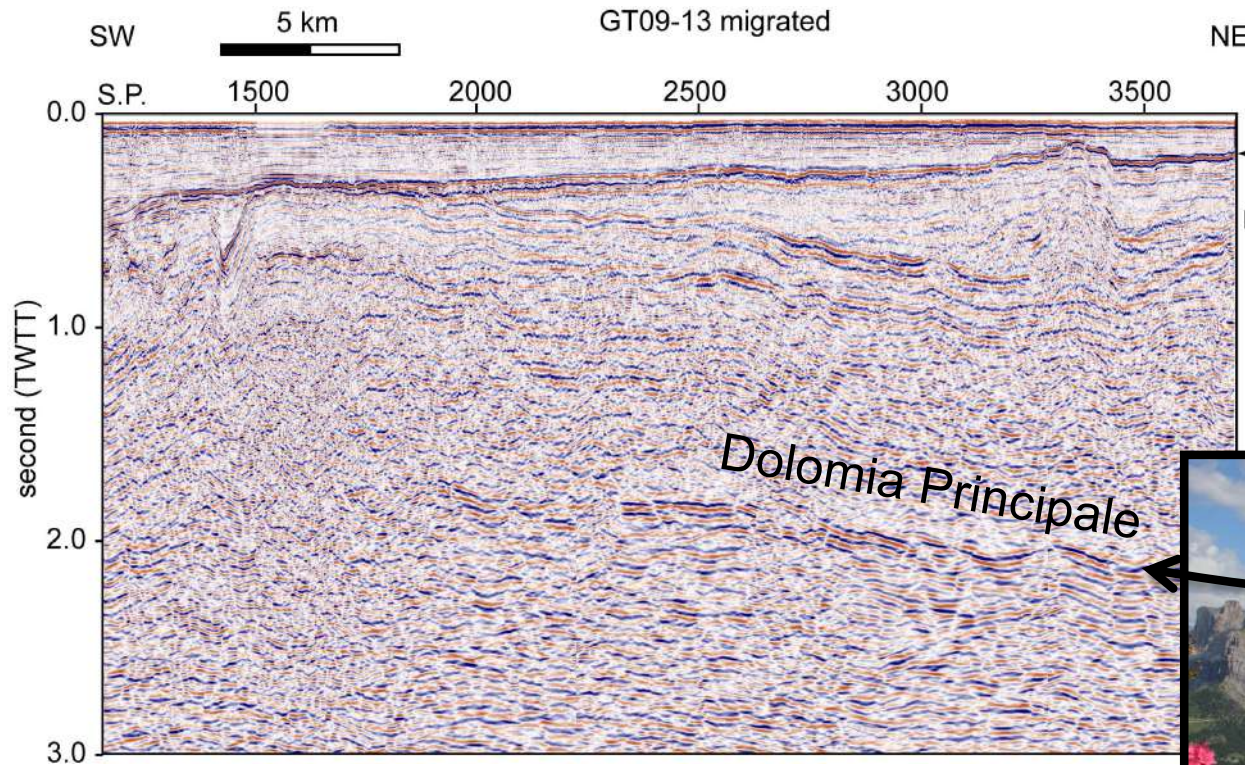
**A**

**rialzo periferico**

**avanfossa**



Sezione geologica a terra da GeoCGT FVG 2011



Nel Golfo di Trieste la base della Dolomia Principale è a 5 – 6 km di profondità

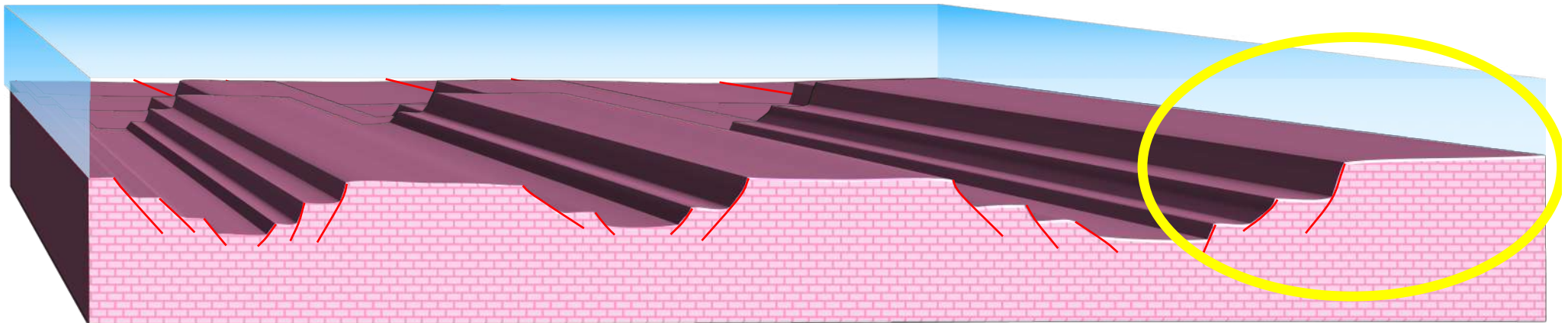
# Isola di Andros (Bahamas)

piana tidale: sedimentazione attuale dei carbonati



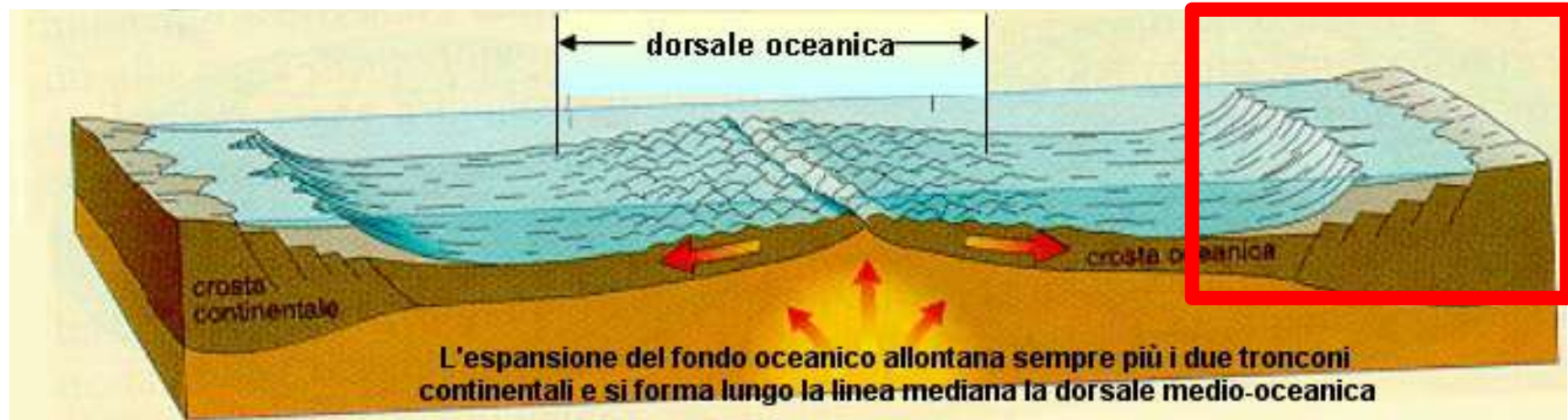


Piattaforma carbonatica della  
**Dolomia Principale**  
del Norico (Triassico Superiore – Mesozoico)  
circa 228-204 Ma

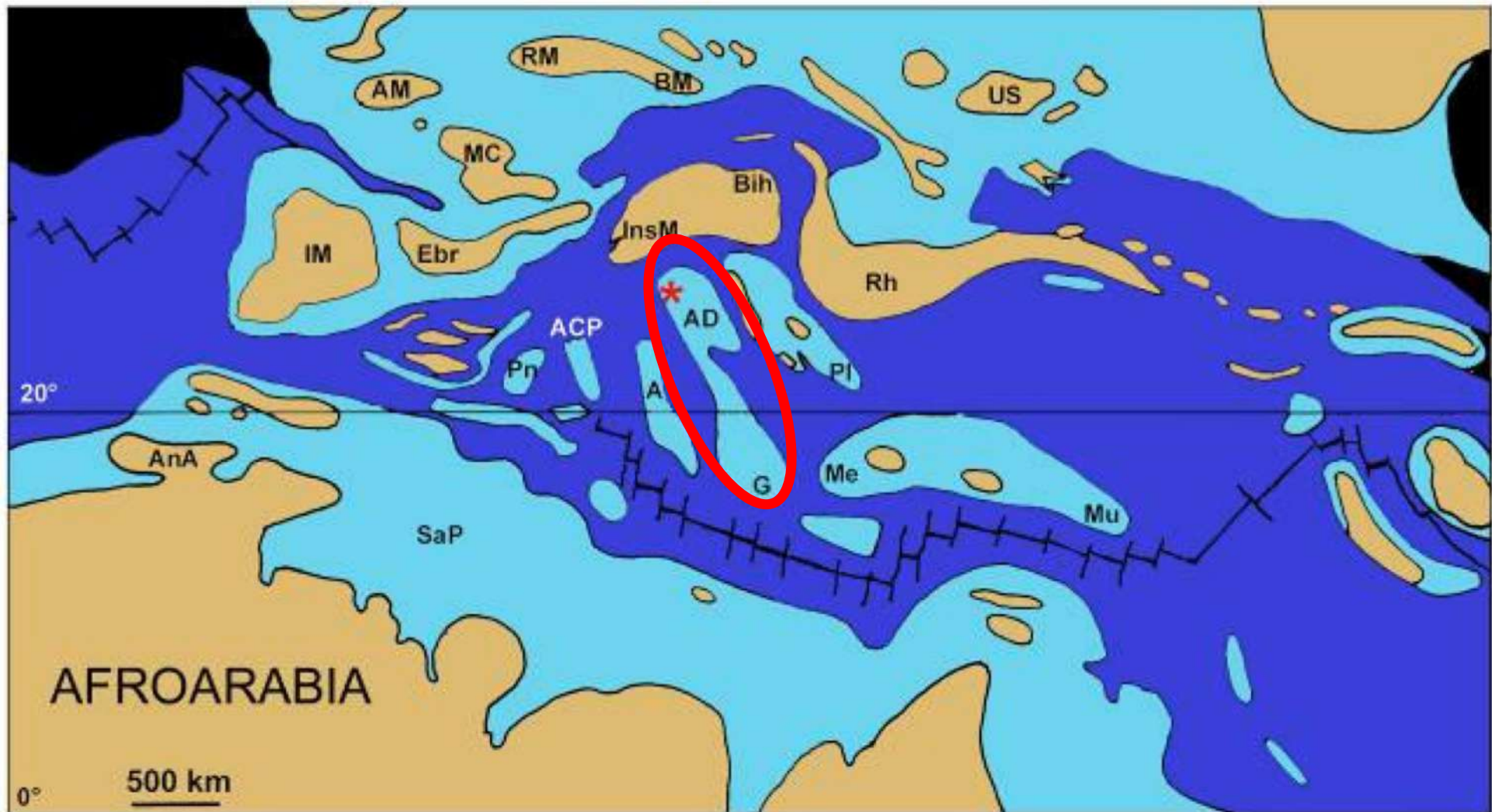


# Mesozoico: margine passivo o divergente

## Il Carso e il Golfo di Trieste

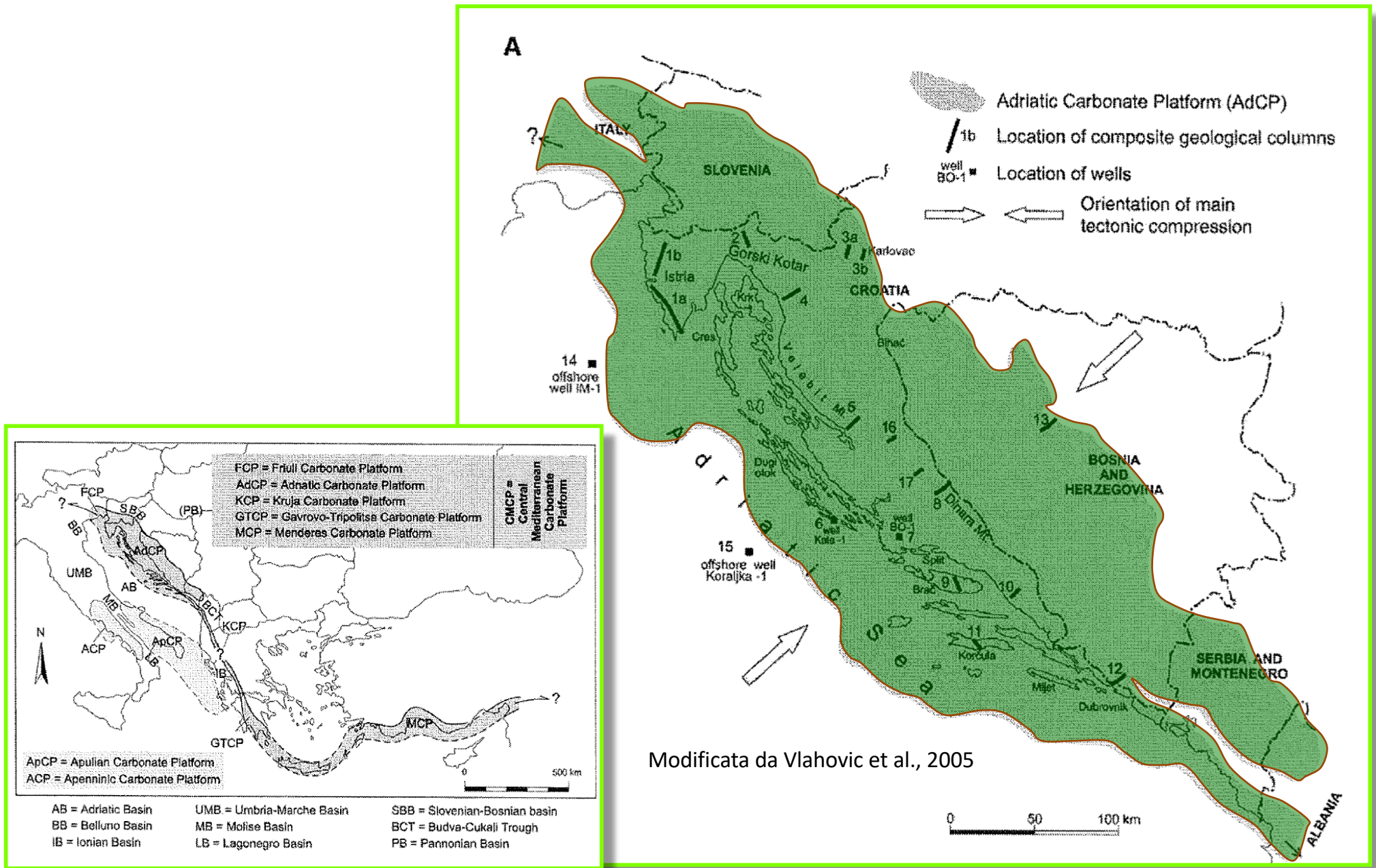


## Mappa paleogeografica della parte centrale dell'Oceano della Tetide 95 milioni di anni fa



Mappa paleogeografica semplificata **della Tetide centrale di 95 milioni di anni fa**, basata su PHILIP et al (2000), modificata e ridisegnata. L'asterisco indica la posizione del Carso. Blu = mare profondo, oceano; azzurro = mare basso; giallo ocra = terre emerse. Abbreviazioni: A = Piattaforma Carbonatica Apula (Puglia e Maiella), ACP = Piattaforma Carbonatica Appenninica, AD = Piattaforma Carbonatica Adriatico-Dinarica, AM = Massiccio Armoricano, AnA = Anti Atlante, Bih = Massiccio di Bihor (Romania), BM = Massiccio Boemo (Repubblica Ceca), Ebr = Massiccio dell'Ebro (Spagna), G = Gavrovo (Bulgaria), IM = Massiccio Iberico (Spagna), InsM = Massiccio Insubrico (Lombardia settentrionale), MC = Massiccio Centrale (Francia), Me = Menderes (Turchia), Mu = Muzurdan (Turchia), PI = zona Pelagoniana, Pn = Panormide (Sicilia), Pr = Provenza (Francia), Rh = Rodope (Bulgaria), RM = Massiccio Renano, SaP = Piattaforma Sahariana, US = Scudo Ucraino.

# La piattaforma carbonatica Mesozoica



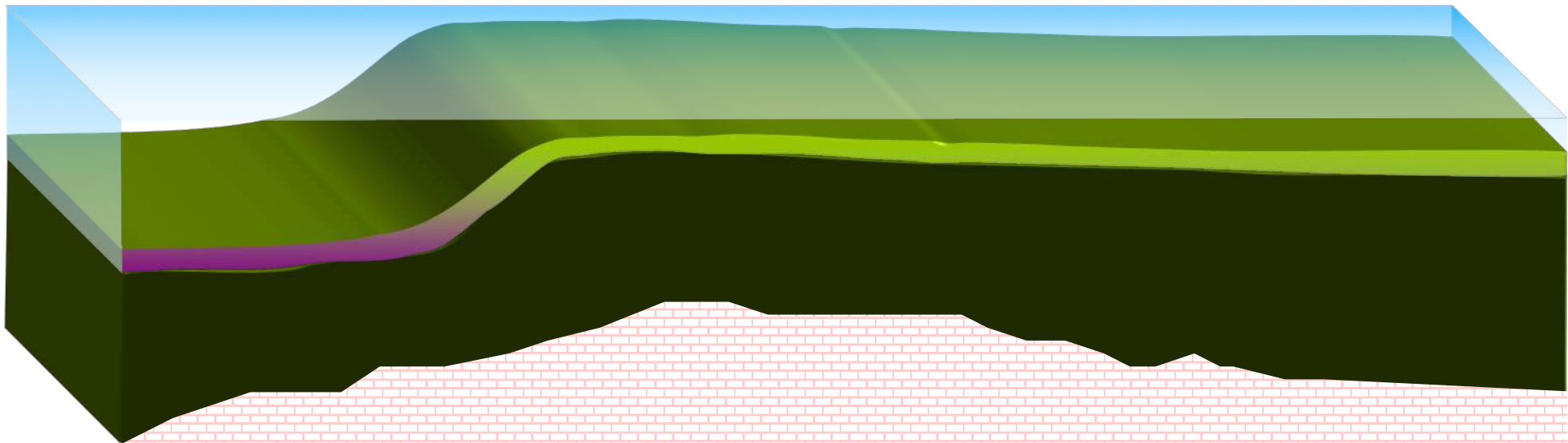


## Formazione della piattaforma carbonatica

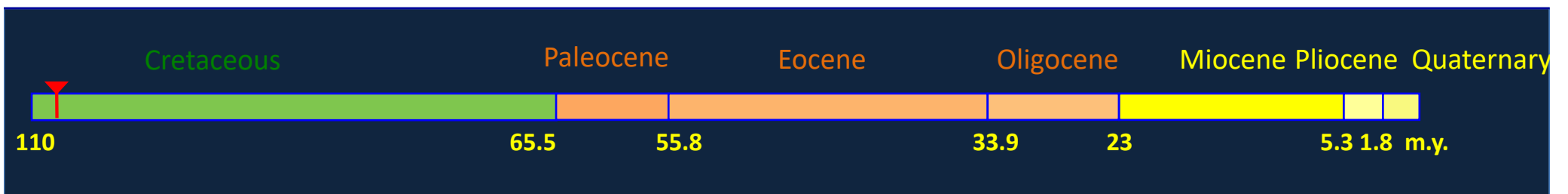
Subsidenza lenta e costante + mare poco profondo

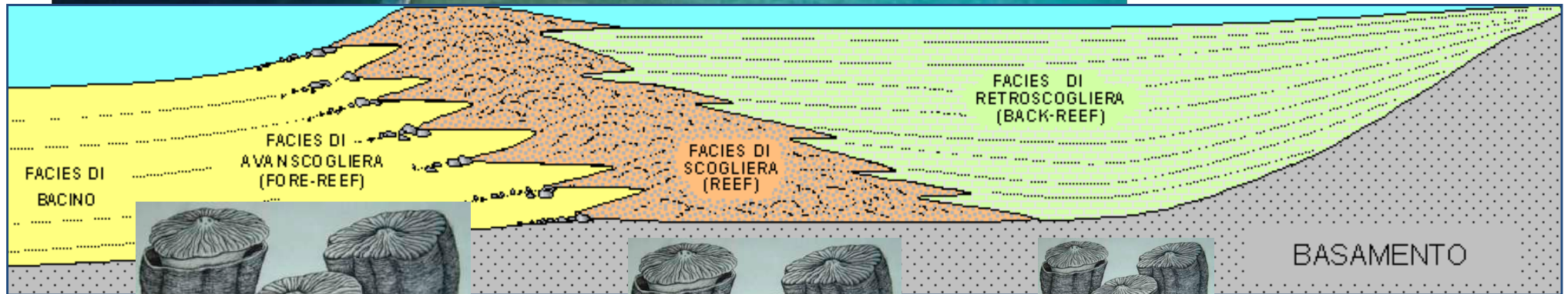


accumulo di sedimenti carbonatici



animazione di F. Zgur (OGS)





Ippuriti grandi + caprine



Ippuriti grandi

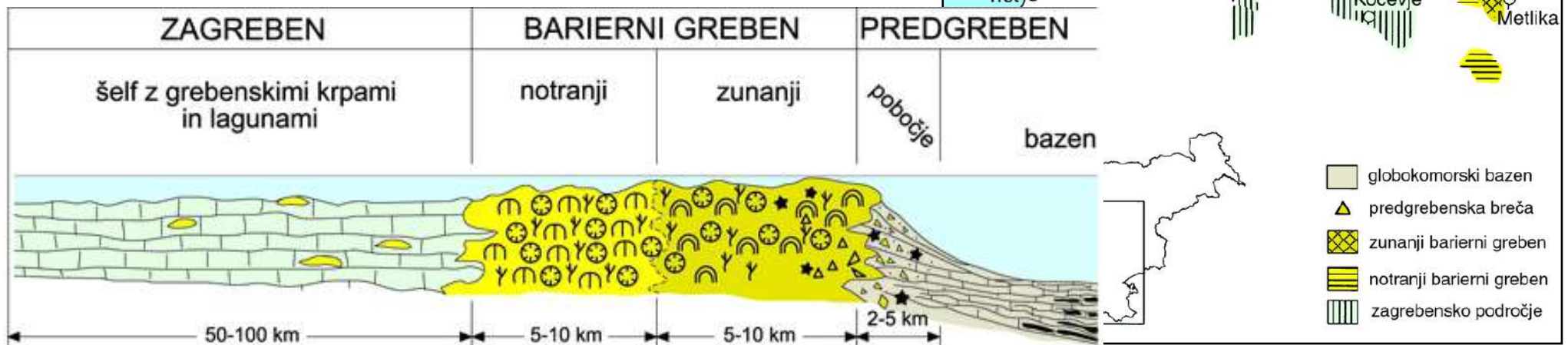
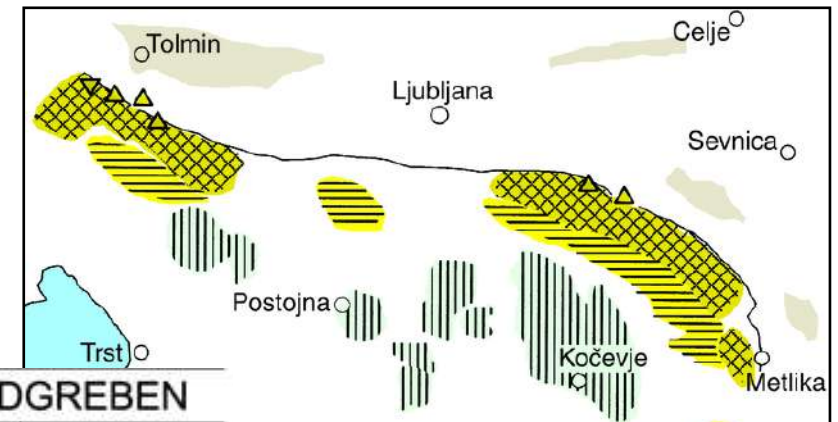
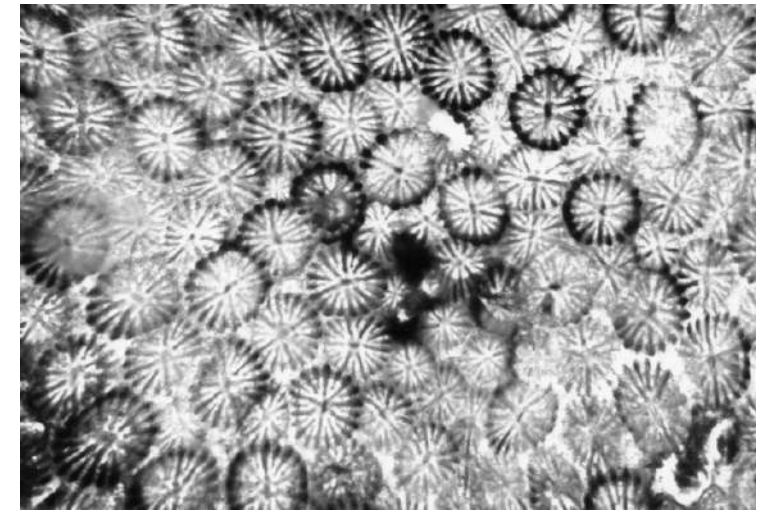


Ippuriti piccole e isolate e radioliti

# I coralli giurassici

151-157 milioni di anni fa

accumulo di 200 metri di carbonati in 6 milioni di anni



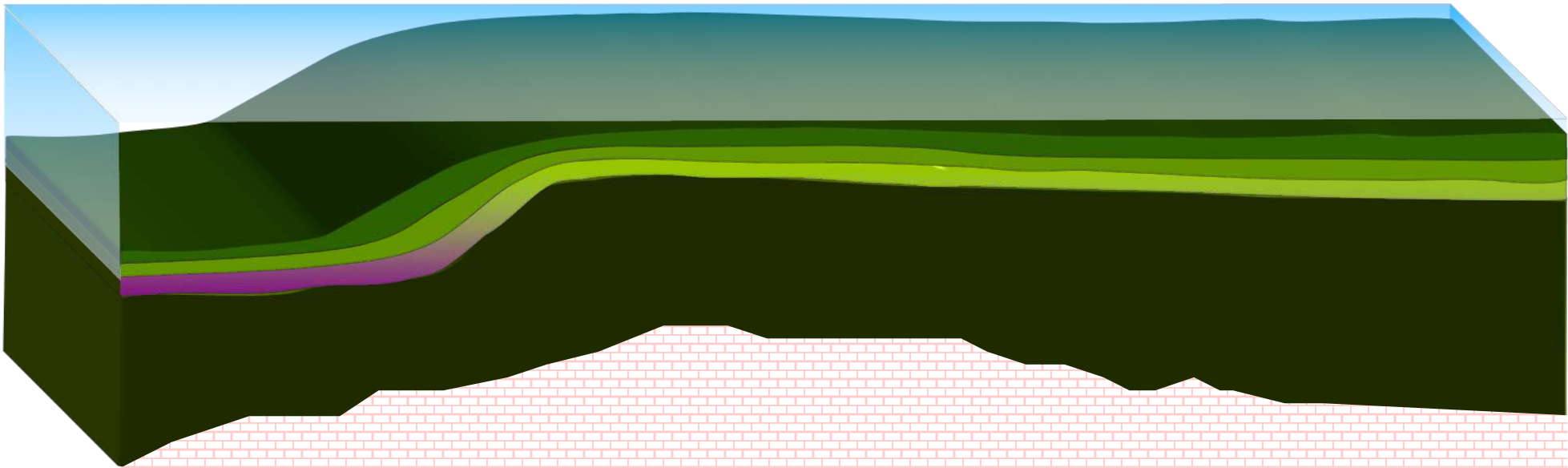


# Continua la crescita della piattaforma carbonatica

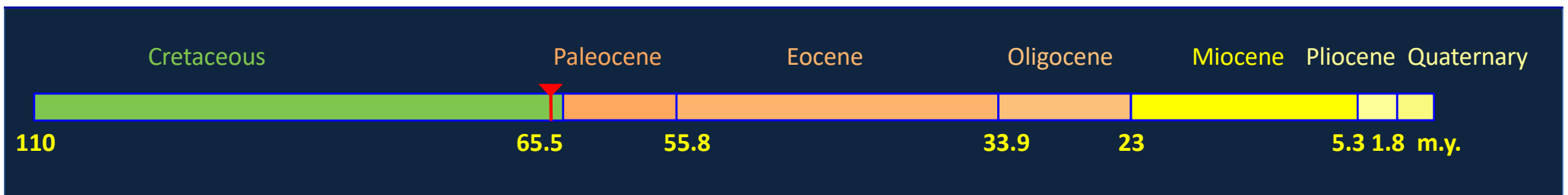
Subsidenza lenta e costante + mare poco profondo



accumulo di sedimenti carbonatici



animazione di F. Zgur (OGS)

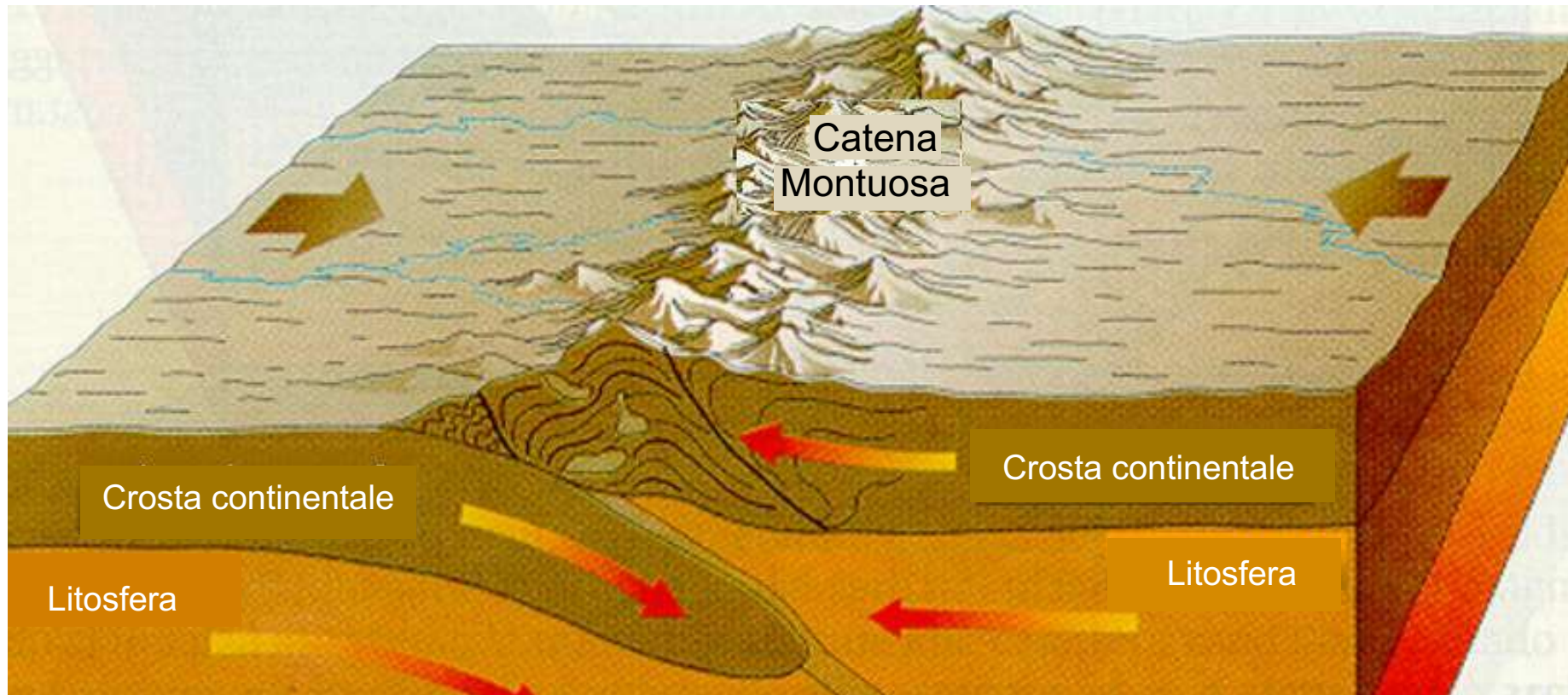


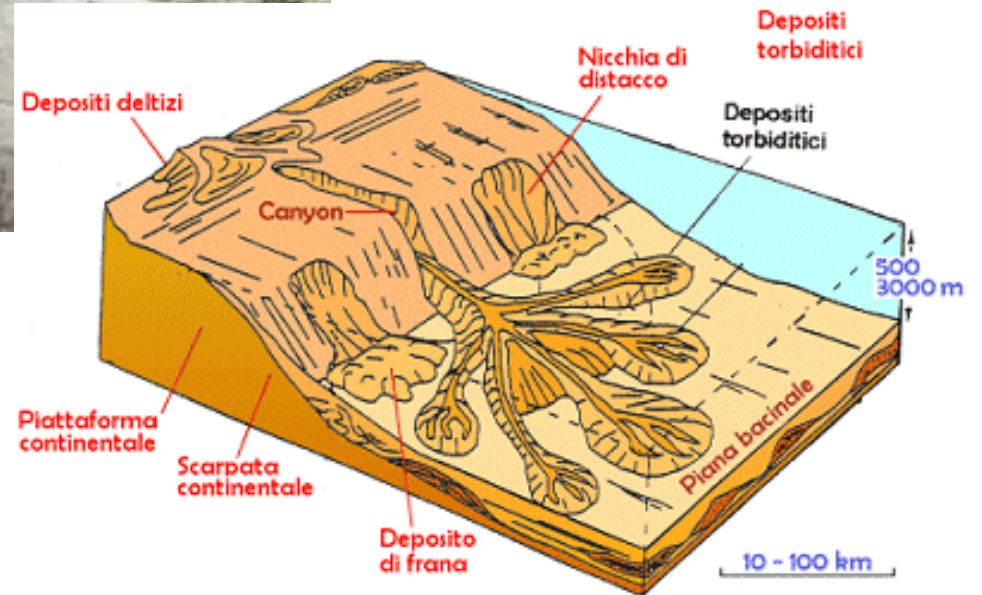
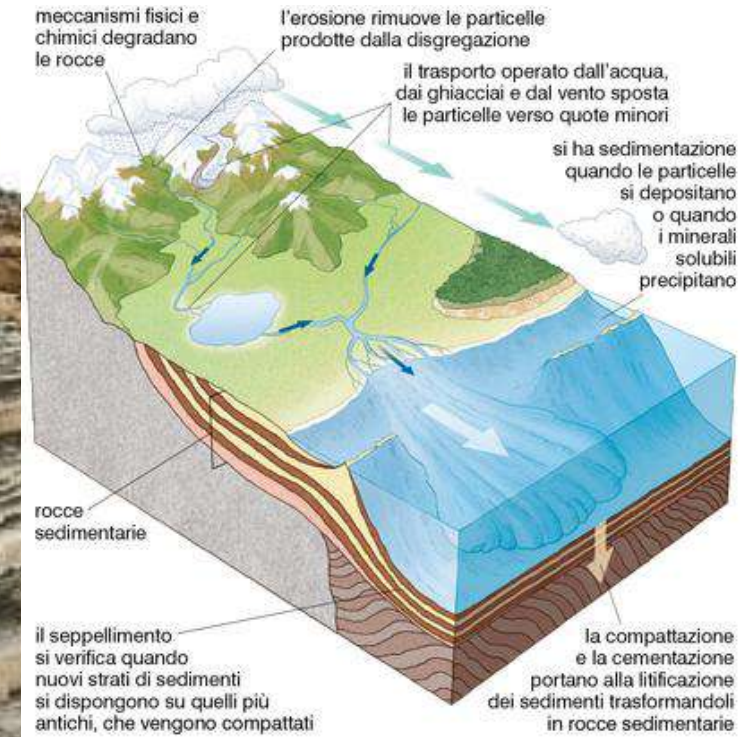
# Antonio - adrosauro del Cretacico Superiore (70-80 milioni d'anni) Sito paleontologico del Villaggio del Pescatore



# Cenozoico: margine attivo o convergente

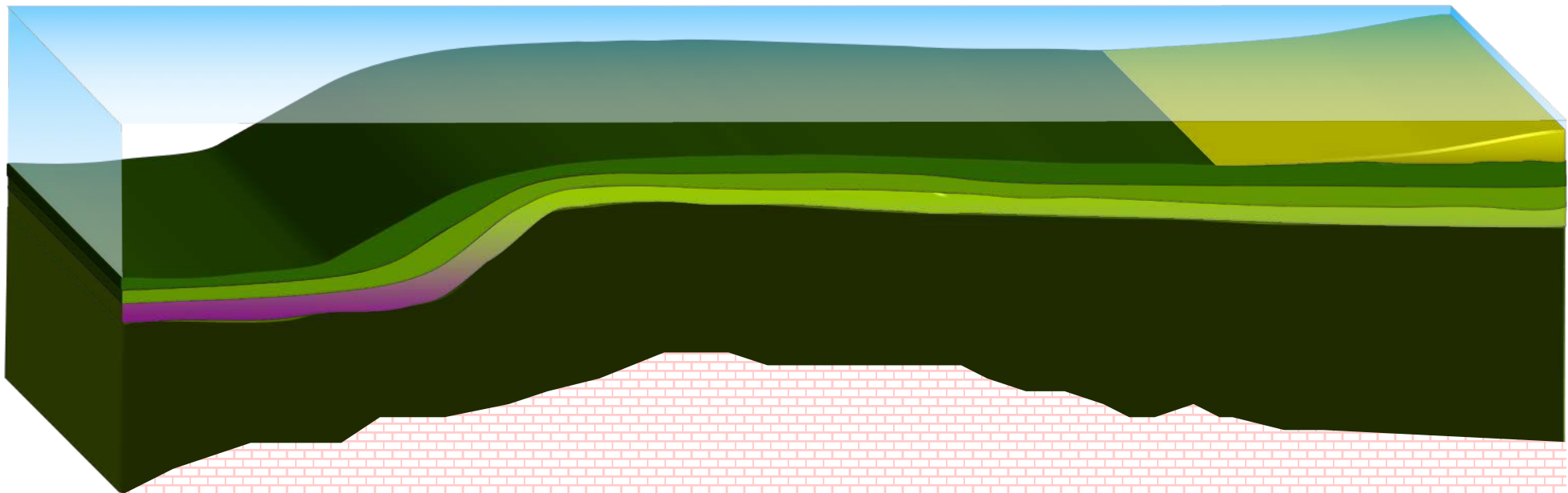
## Formazione delle Dinaridi



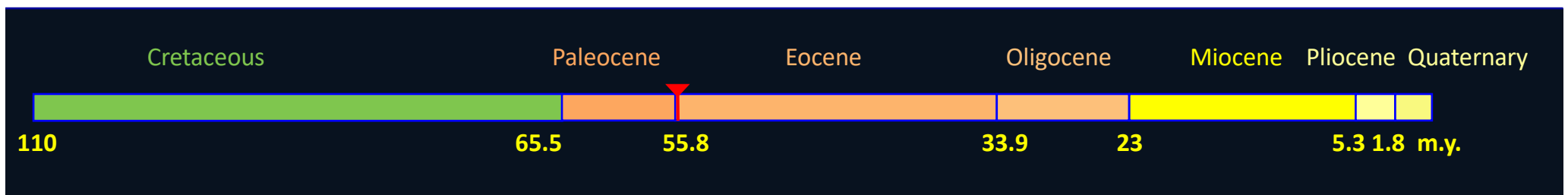


Flysch di Trieste (Eocene inf.– medio)

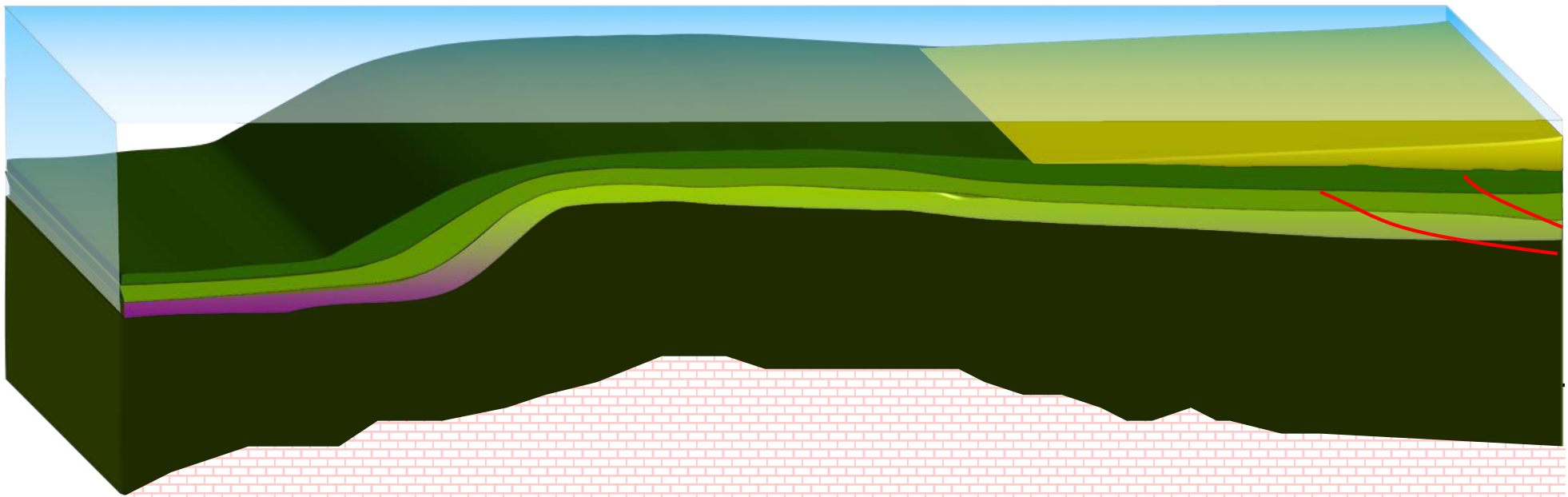
# EOCENE: inizio deposizione del Flysch proveniente dall'erosione della Catena Dinarica Interna (orientale) più antica



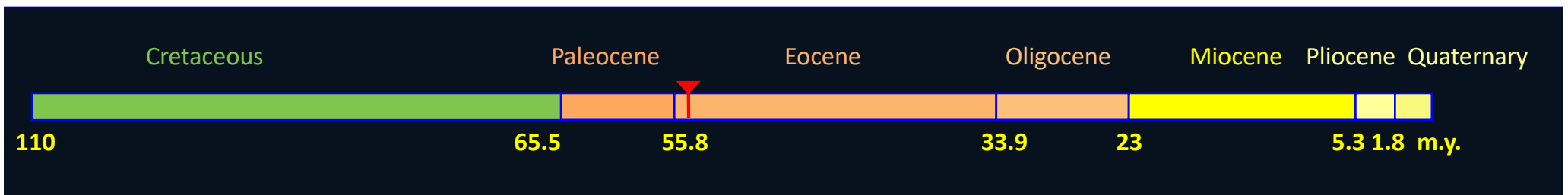
animazione di F. Zgur (OGS)

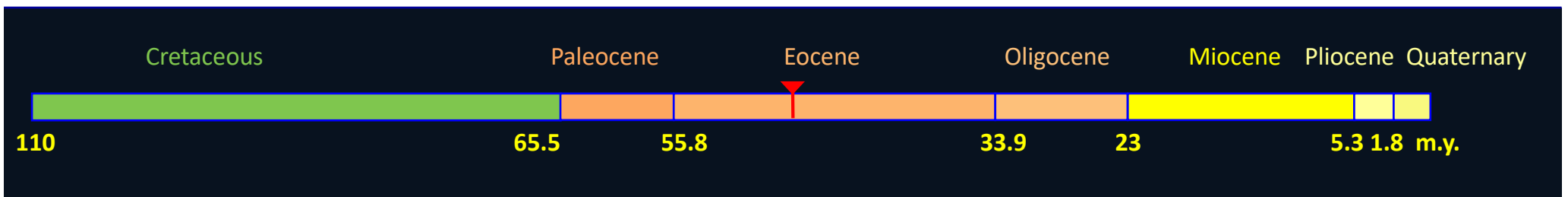
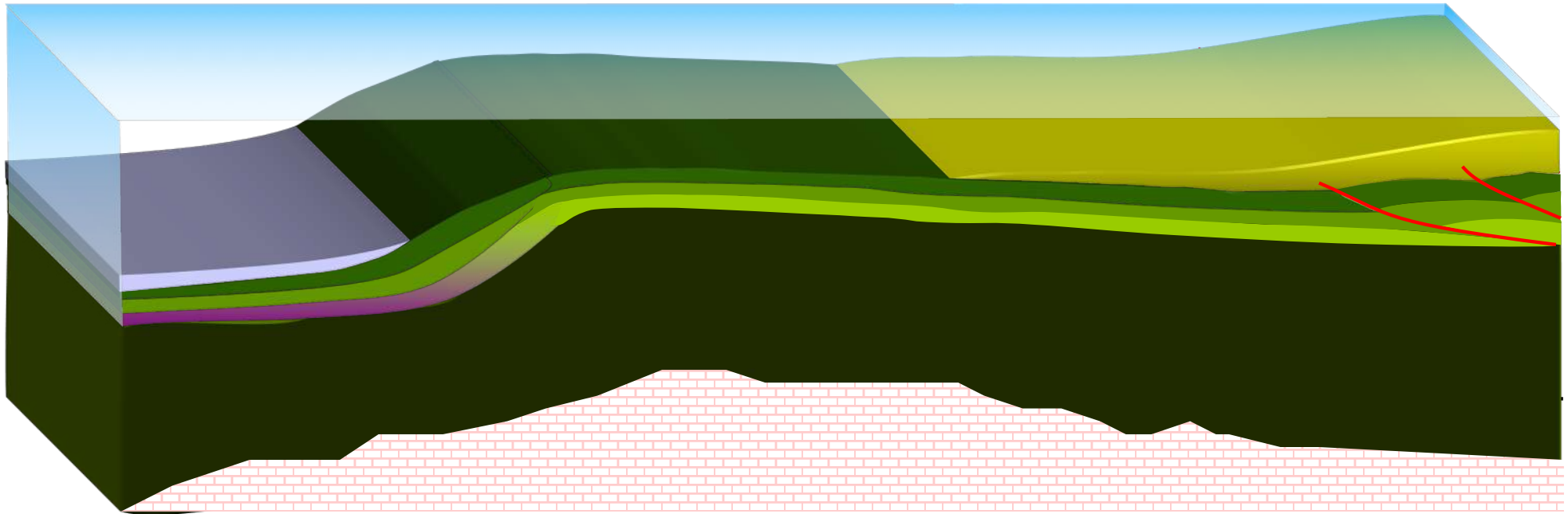


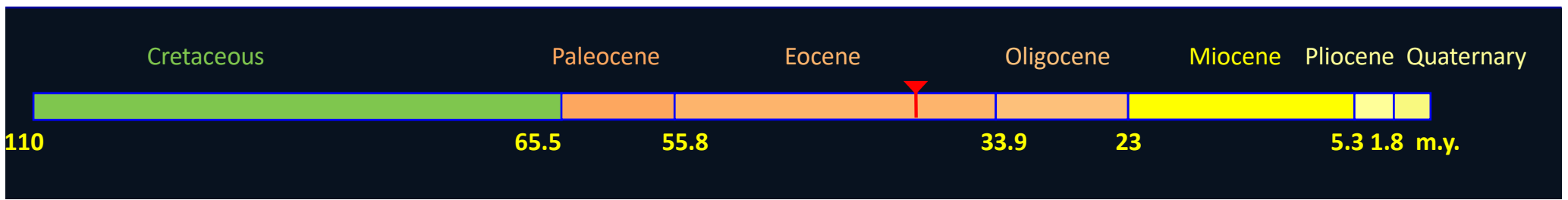
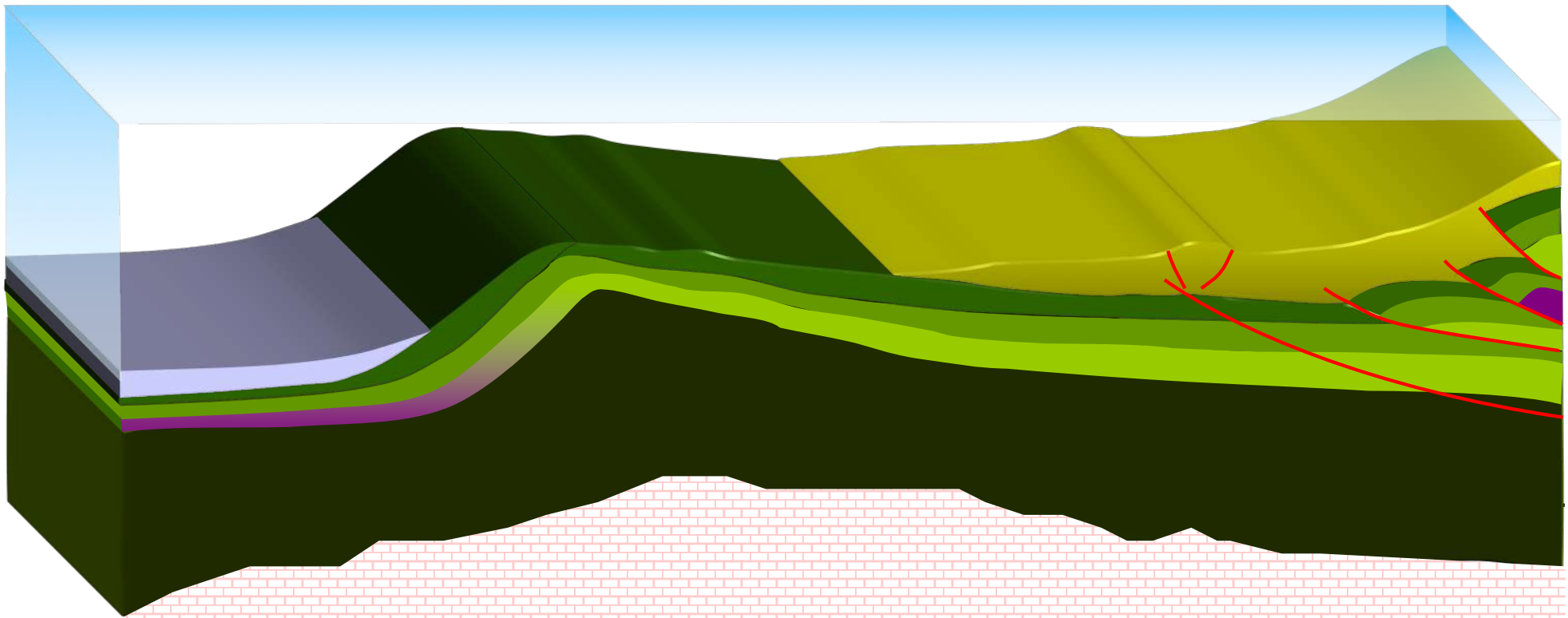
## Progressiva migrazione della deformazione dinarica verso ovest



animazione di F. Zgur (OGS)

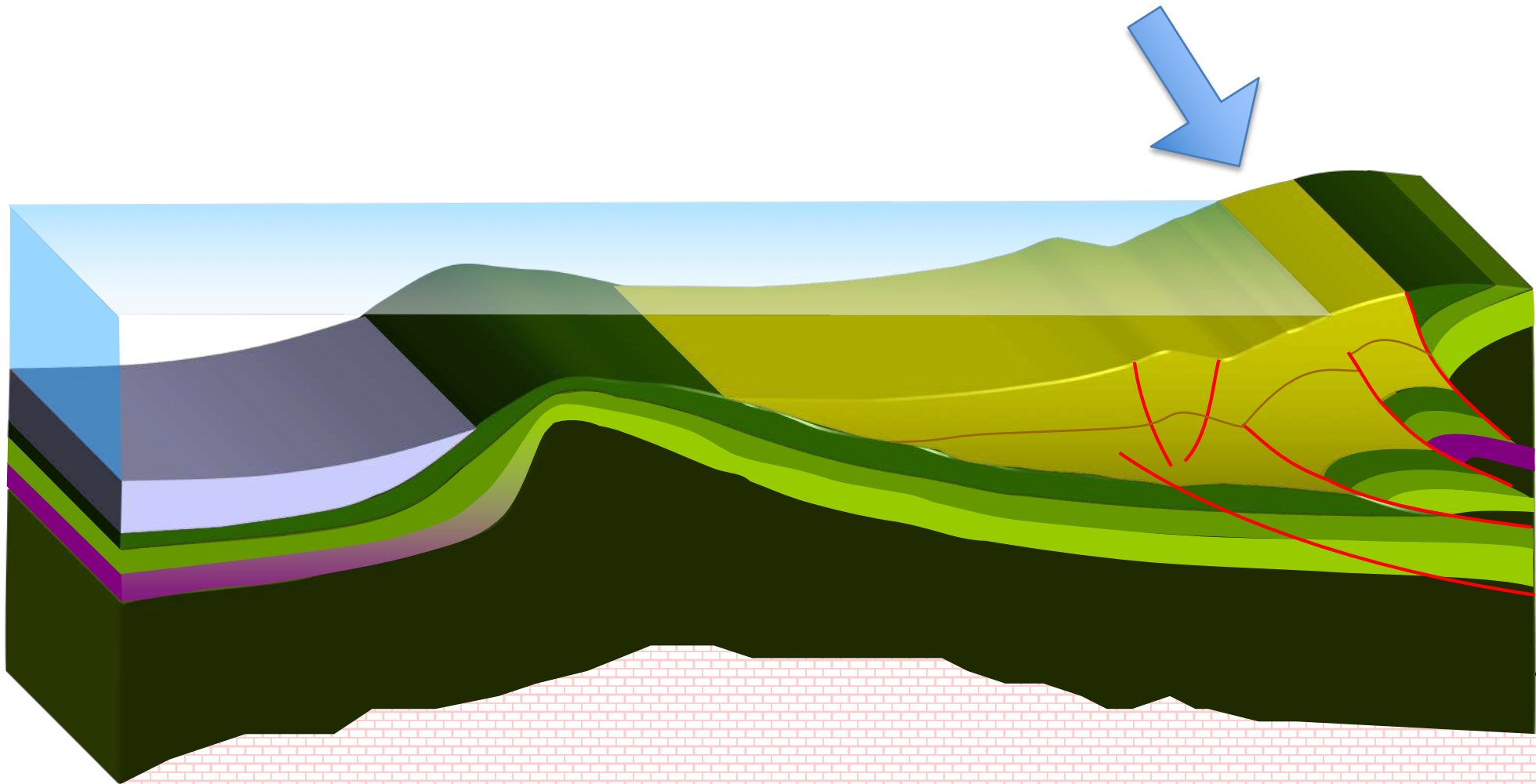




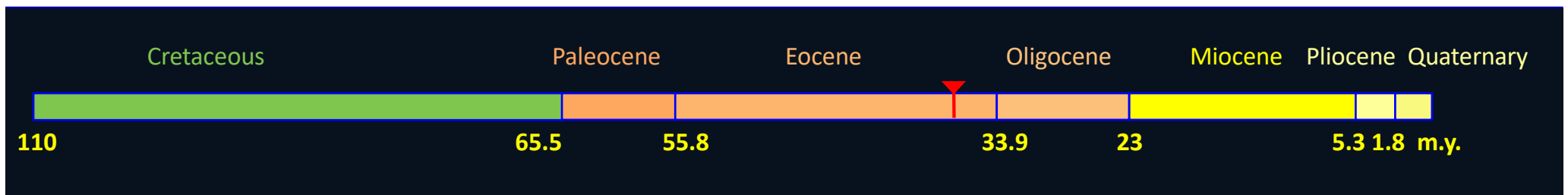




## EOCENE: formazione del Thrust del Carso

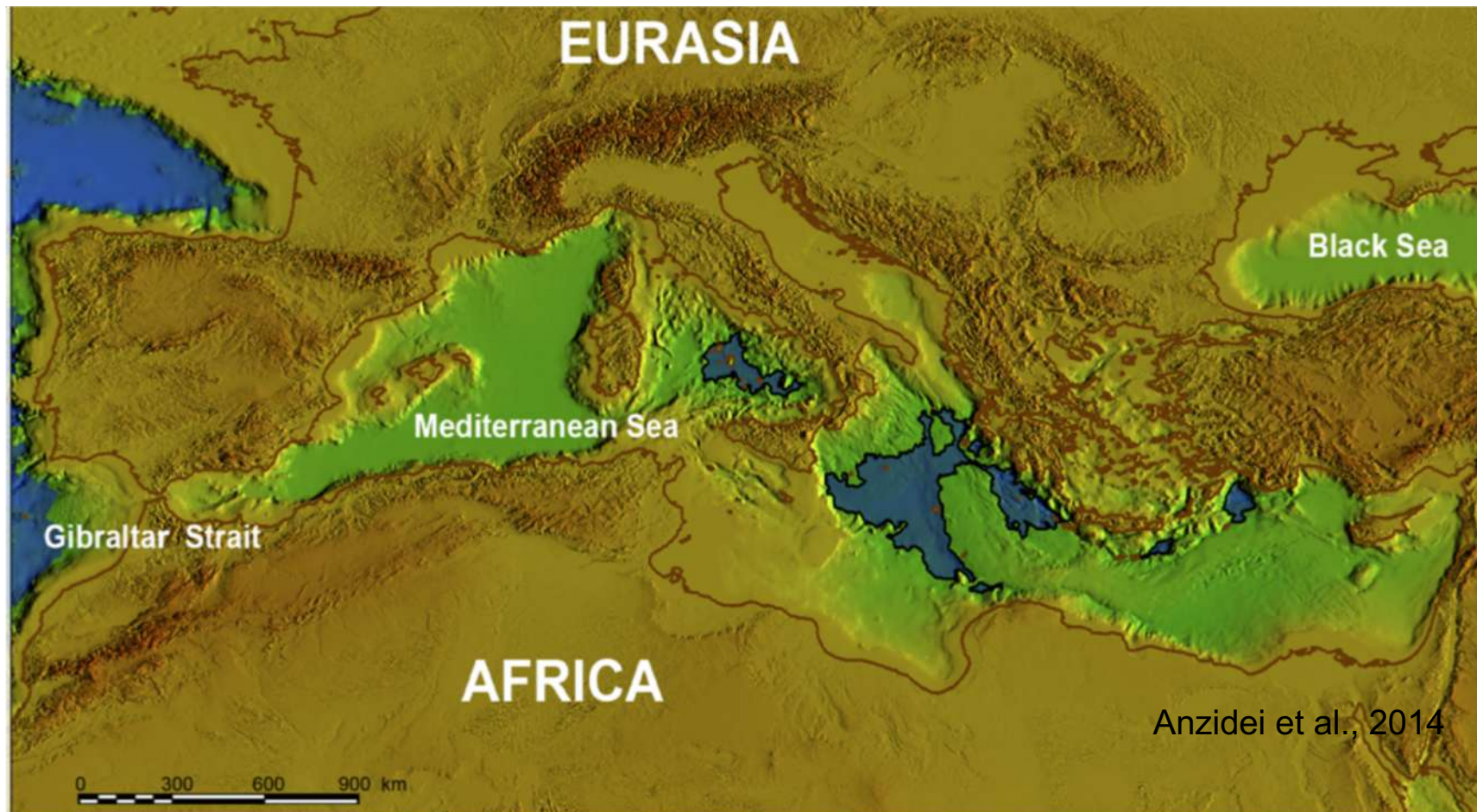


animazione di F. Zgur (OGS)

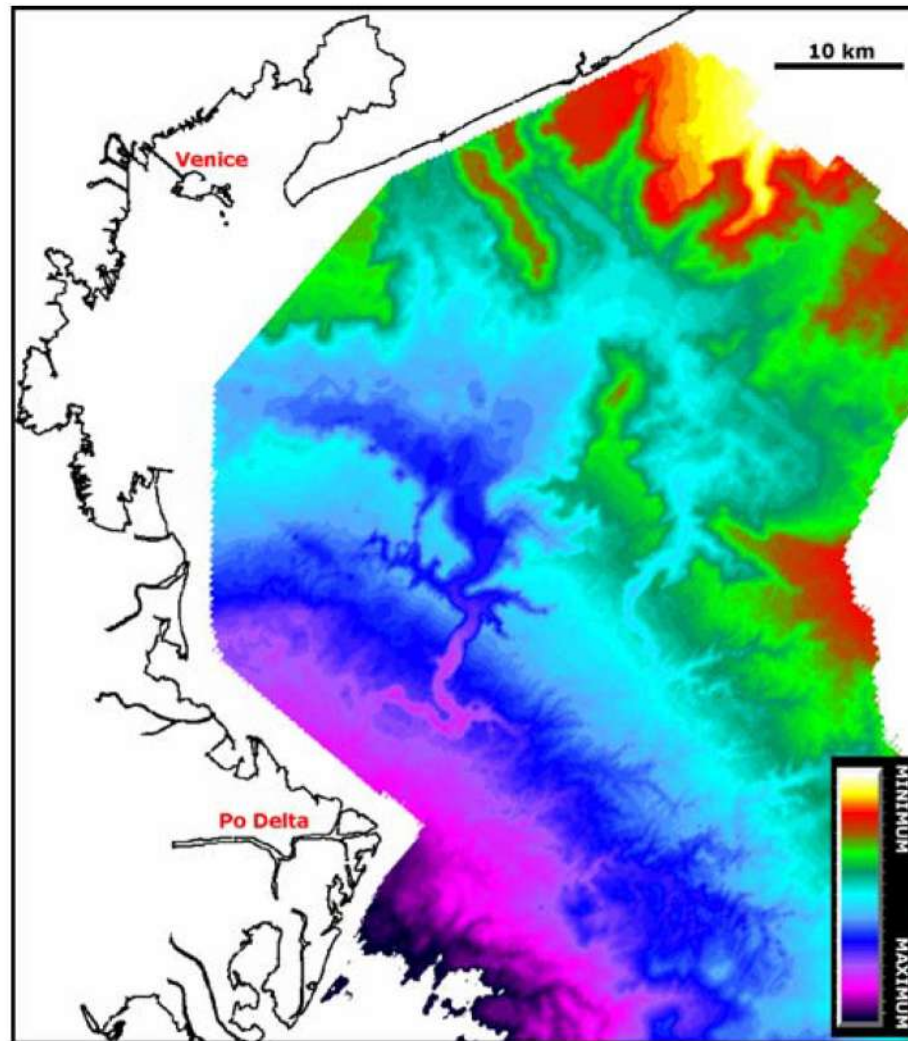


# Paleogeografia del Messiniano - circa 6 milioni di anni fa

- interruzione comunicazione con l'Atlantico
- drammatica diminuzione del livello del mare > il Mediterraneo diventa un lago-mare
- *crisi salina del Messiniano*, nel bacino si depositano spesse sequenze evaporitiche (principalmente sale e gessi)
- nelle zone periferiche si verificano profonde erosioni fluviali.

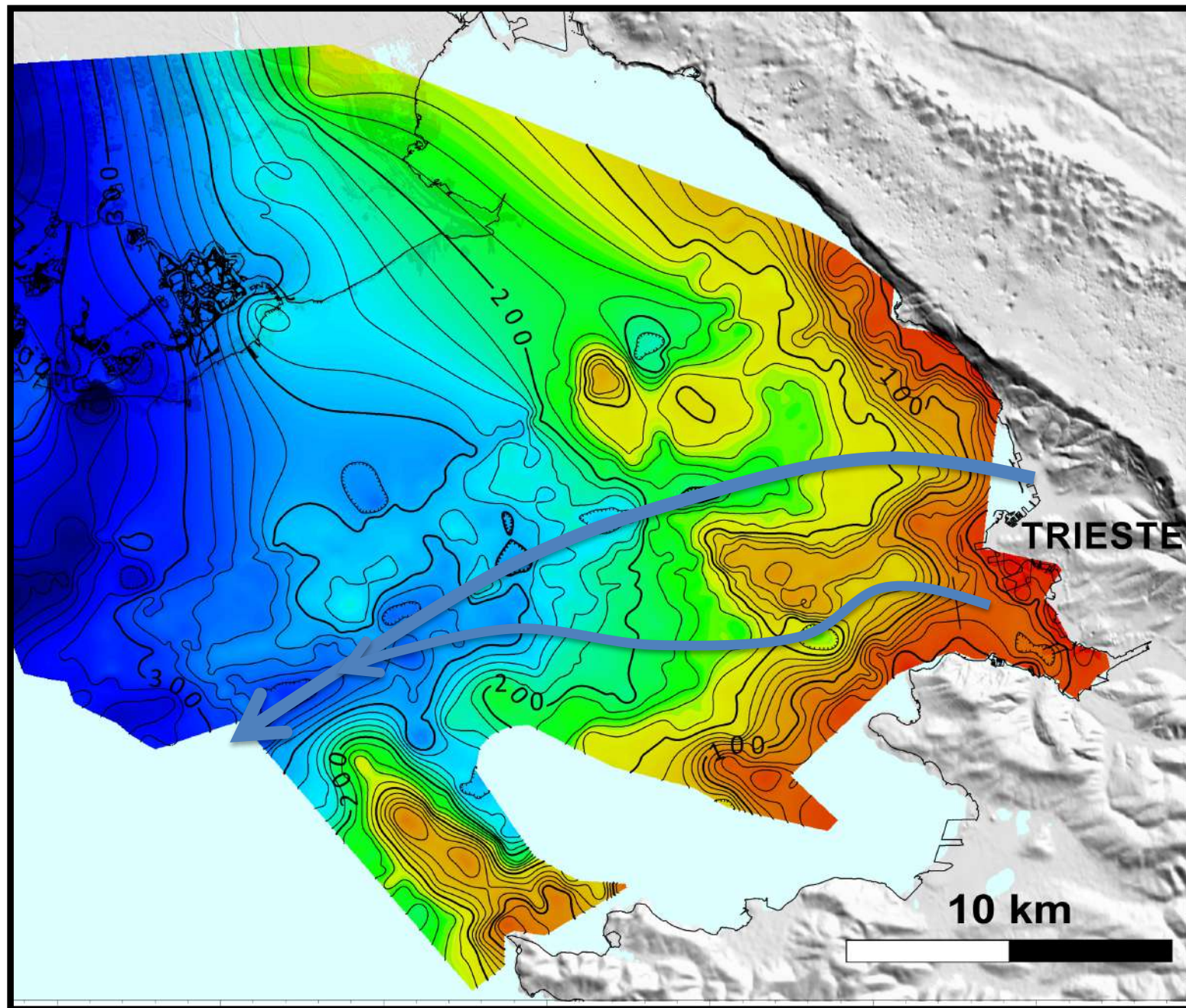


## Mappa della superficie di erosione Messiniana nell'Alto Adriatico da sismica ENI 3D

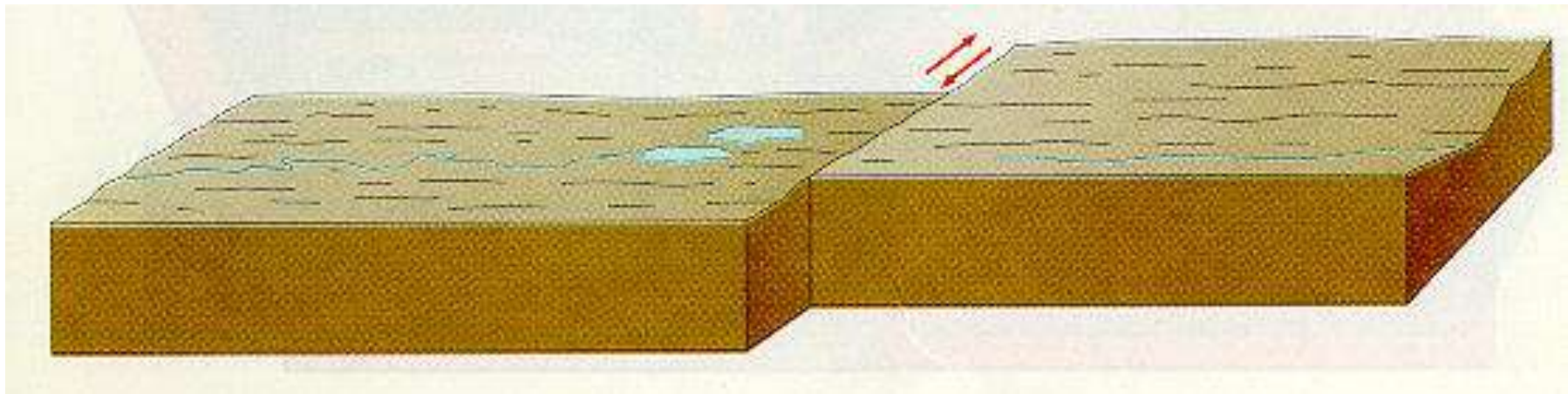


Ghielmi et al., 2009

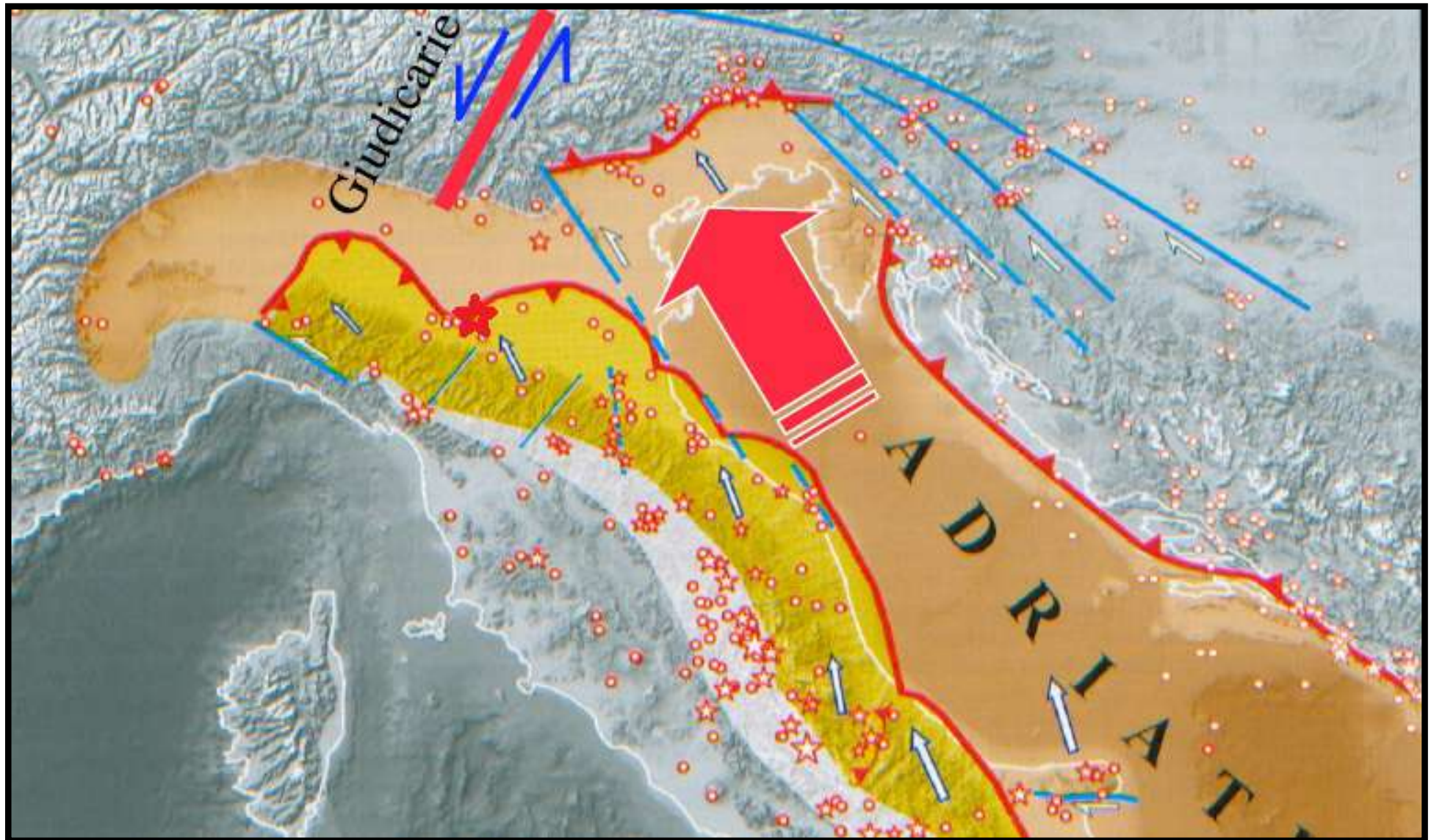
## Mappa in profondità del tetto del flysch

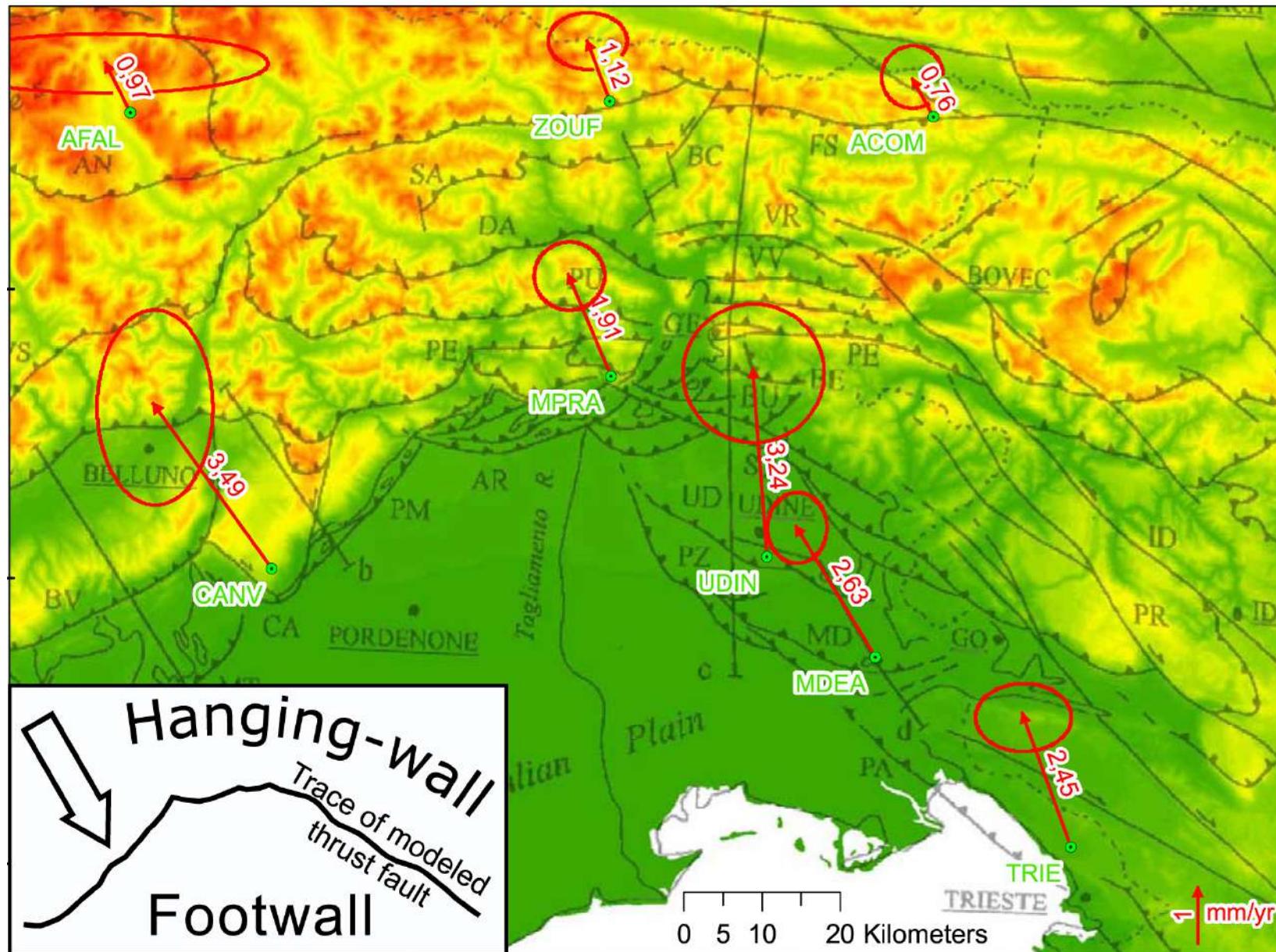


### III fase Il margine trascorrente



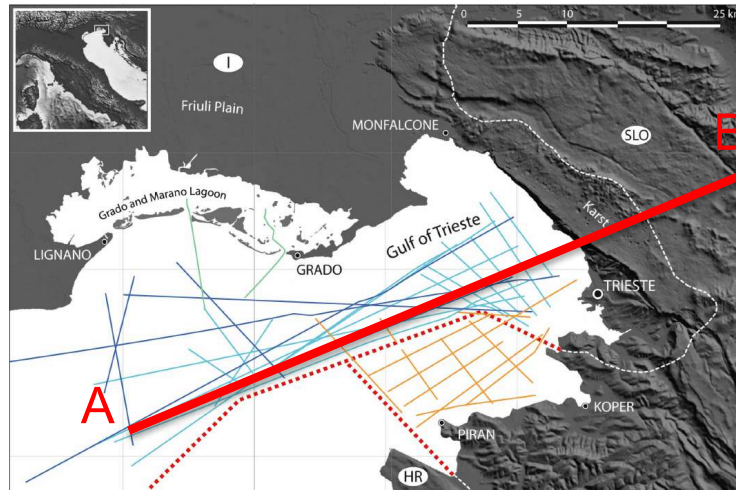
# La Microplacca Adriatica





Bechtold et al., JGR, 2009

movimenti in millimetri all' anno



### avampaese *dinarico*

### rampa frontale

### Carso

**B**

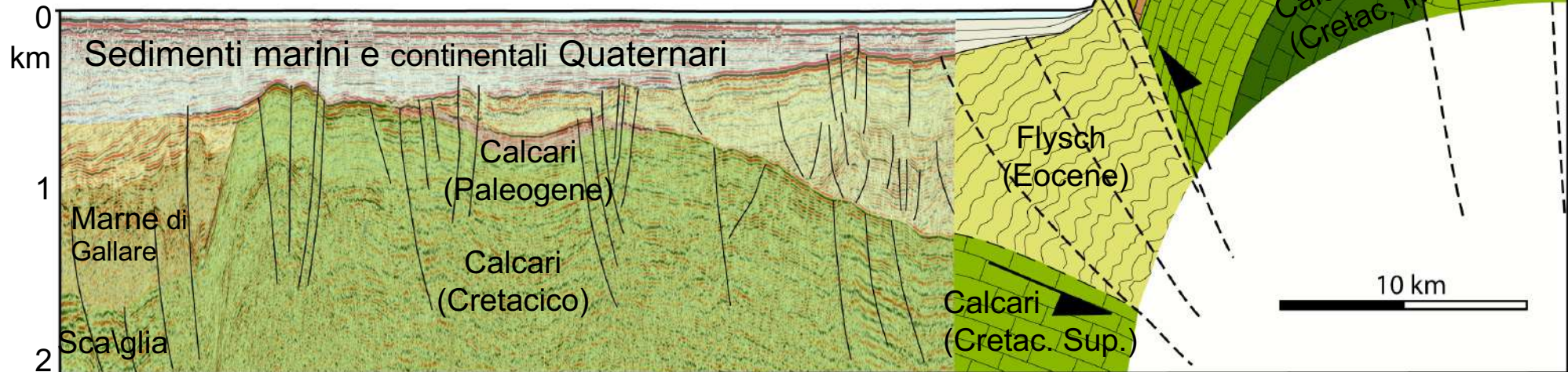
Faglia della Raša

Thrust del Carso Faglia di Divača

**A**

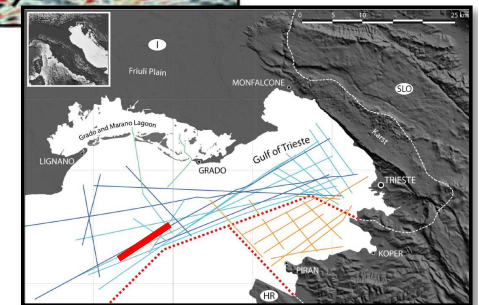
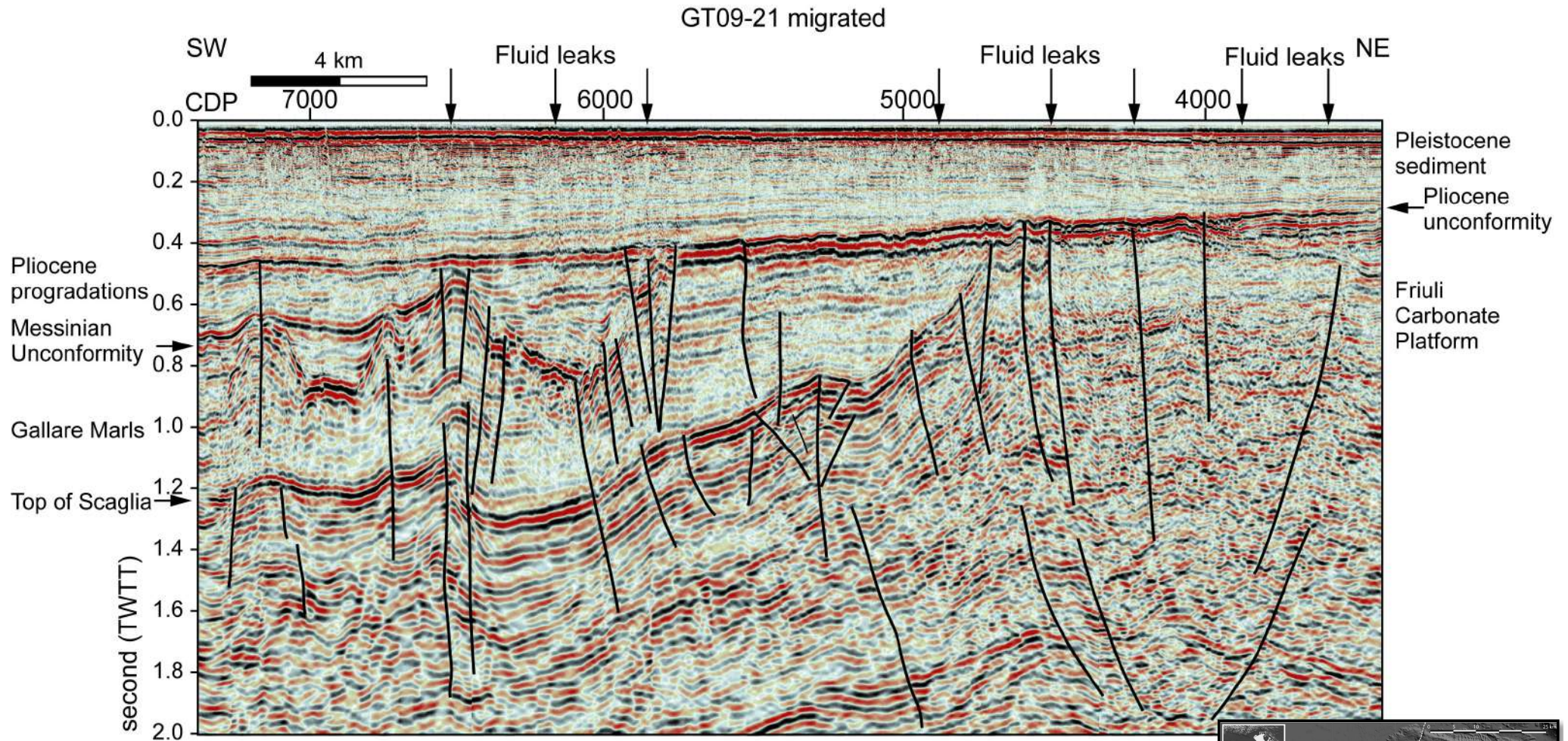
### rialzo periferico

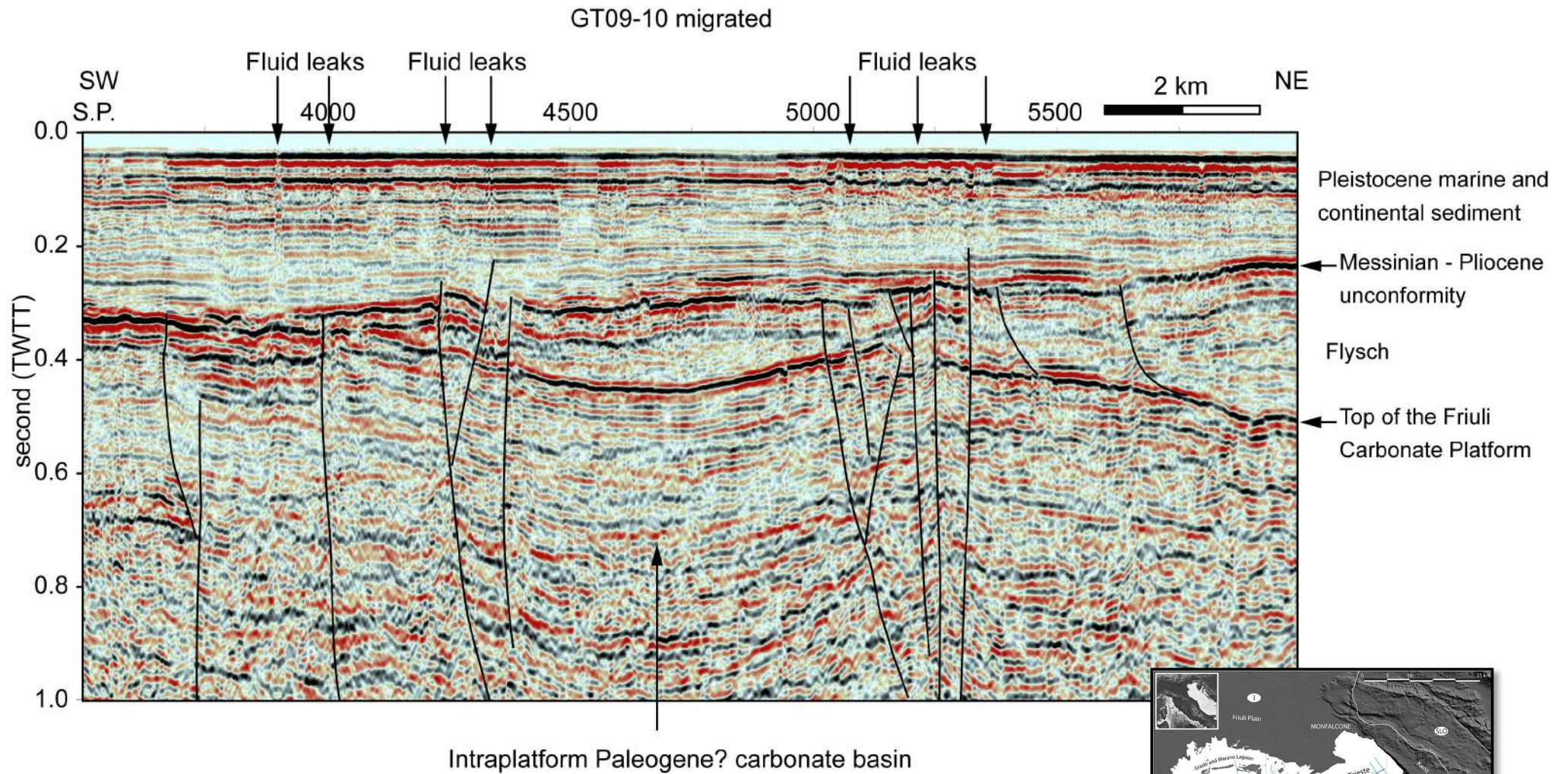
### avanfossa

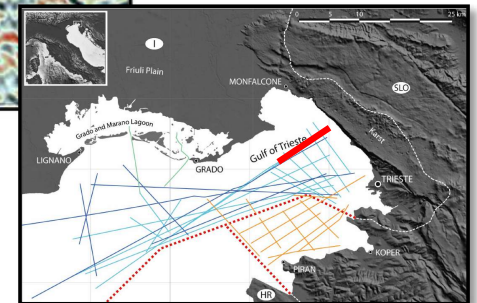
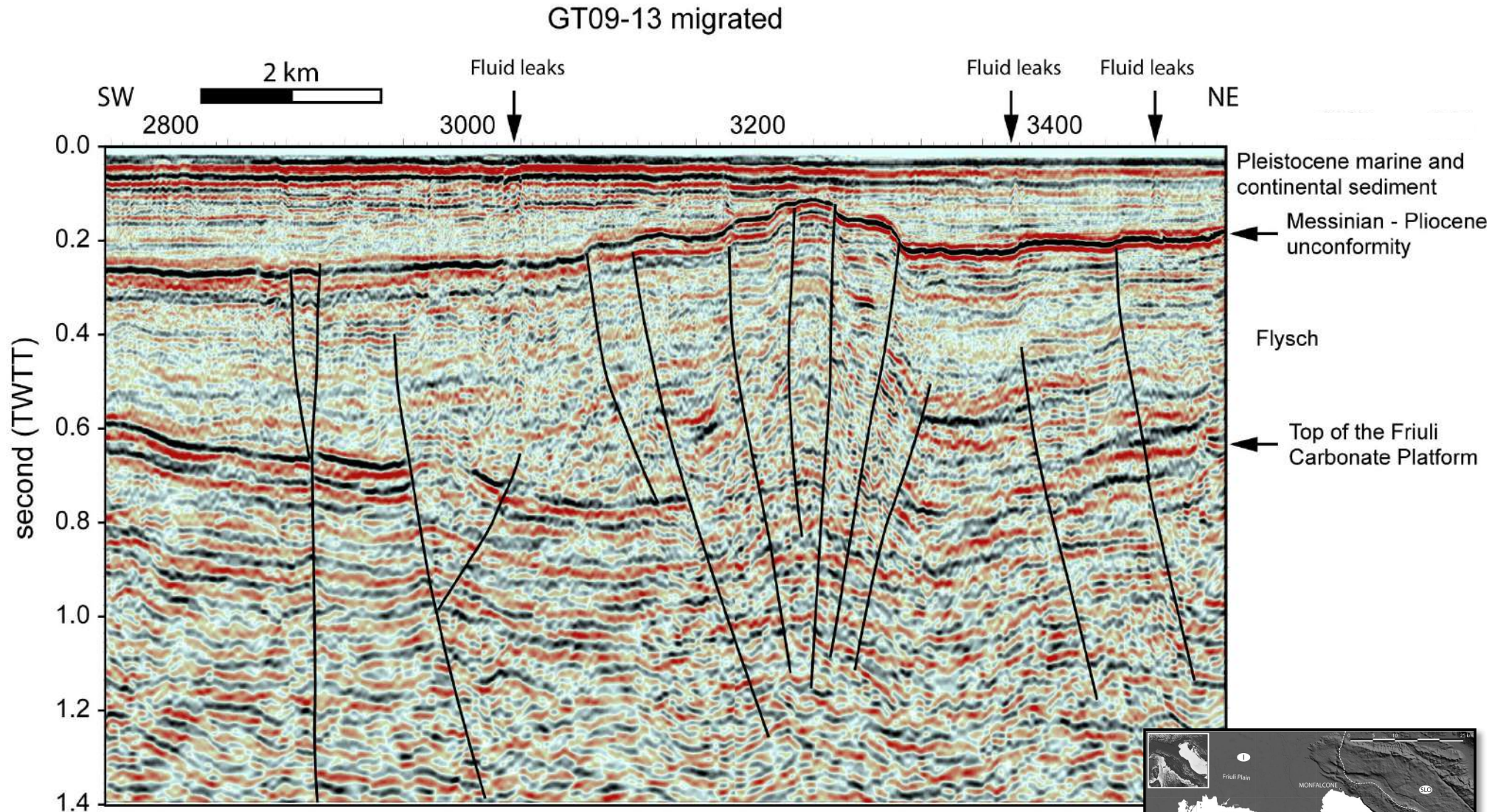


Sezione geologica a terra da GeoCGT FVG 2011



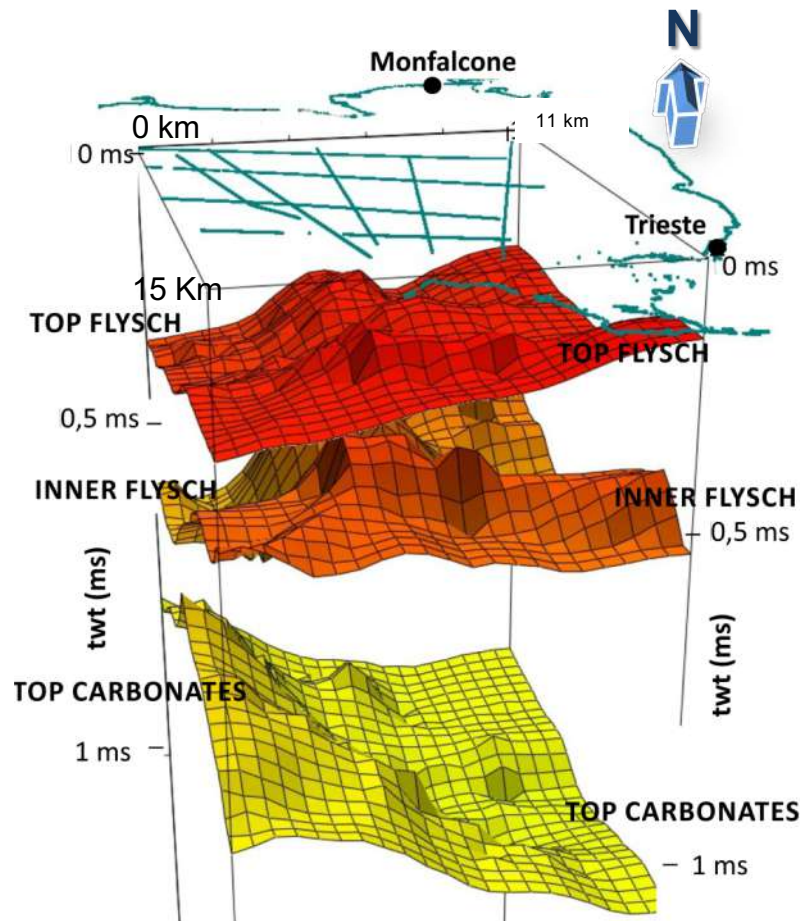




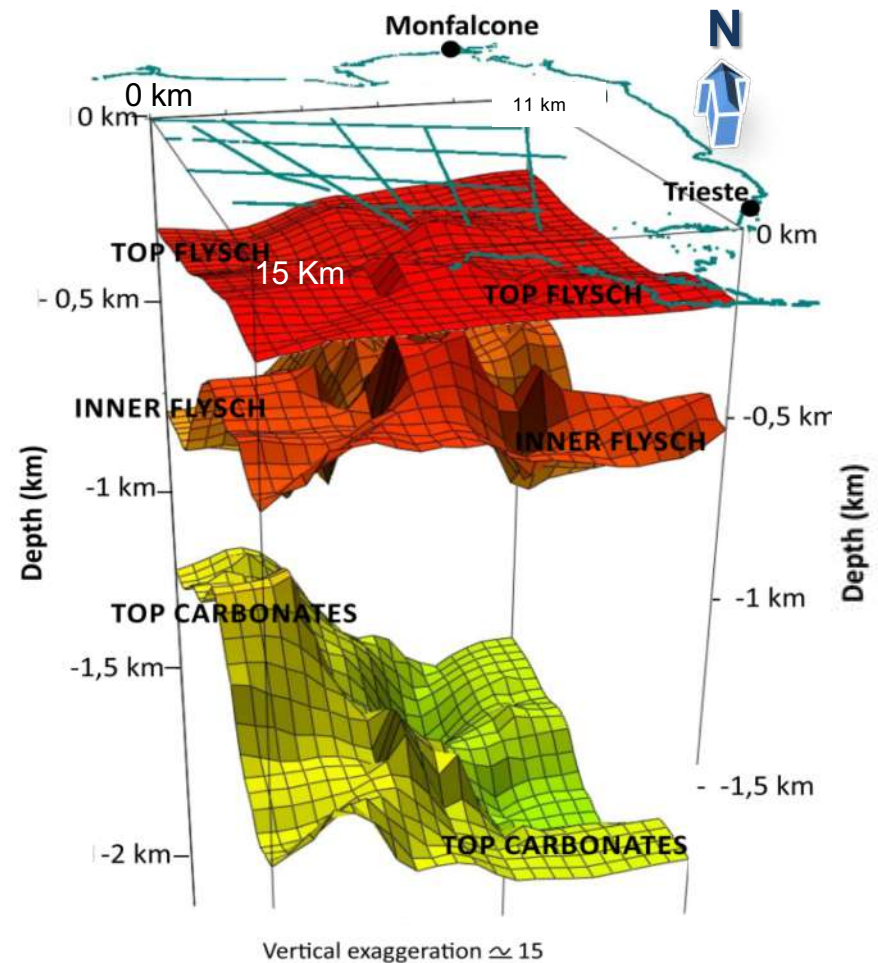


## 3D Time and Depth Surfaces

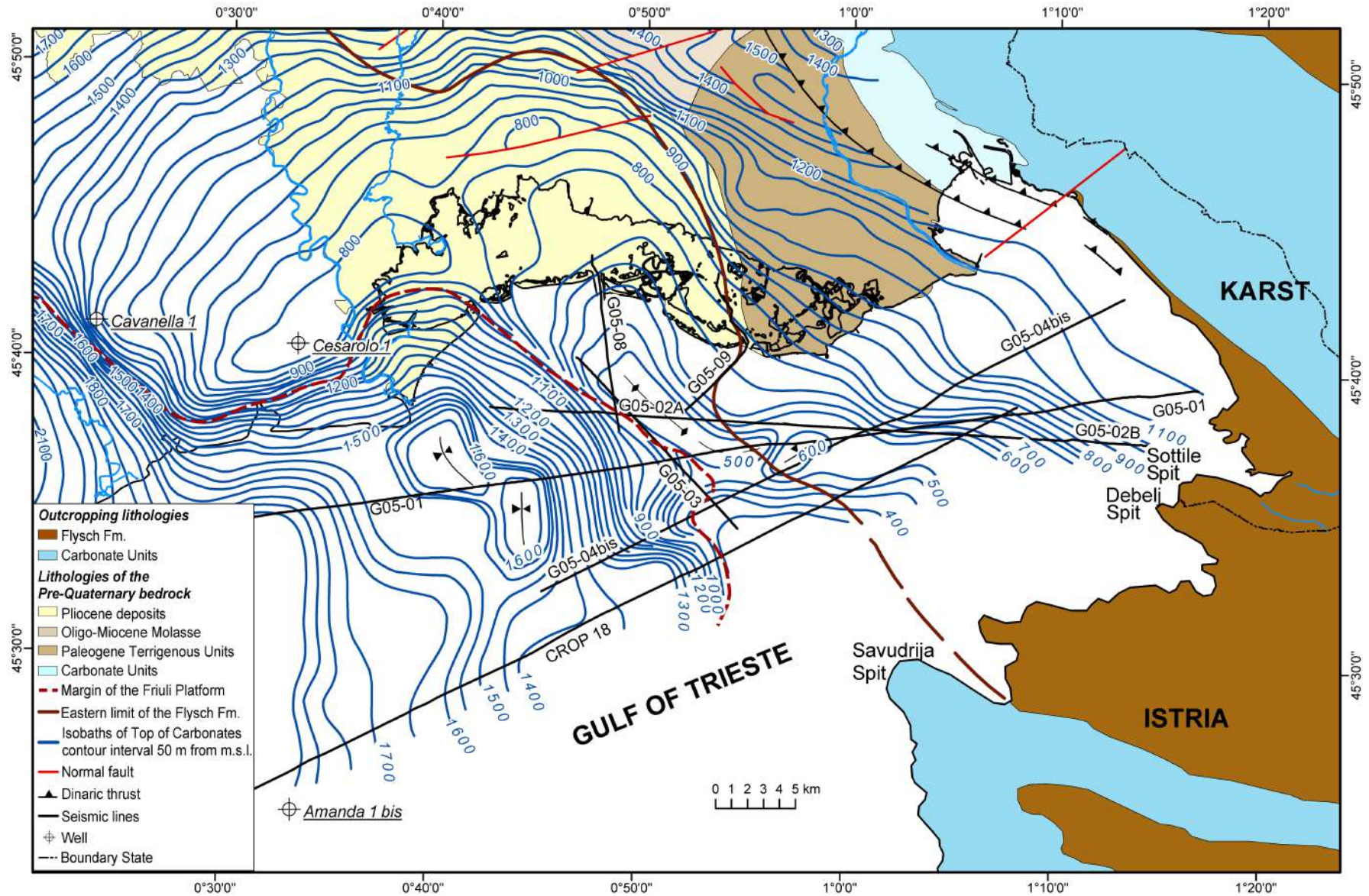
- 3D time surfaces from interpretation of the post-stack time migrated profiles



- 3D depth surfaces
- Time to depth conversion by using interval velocities obtained from MCS data processing in time domain



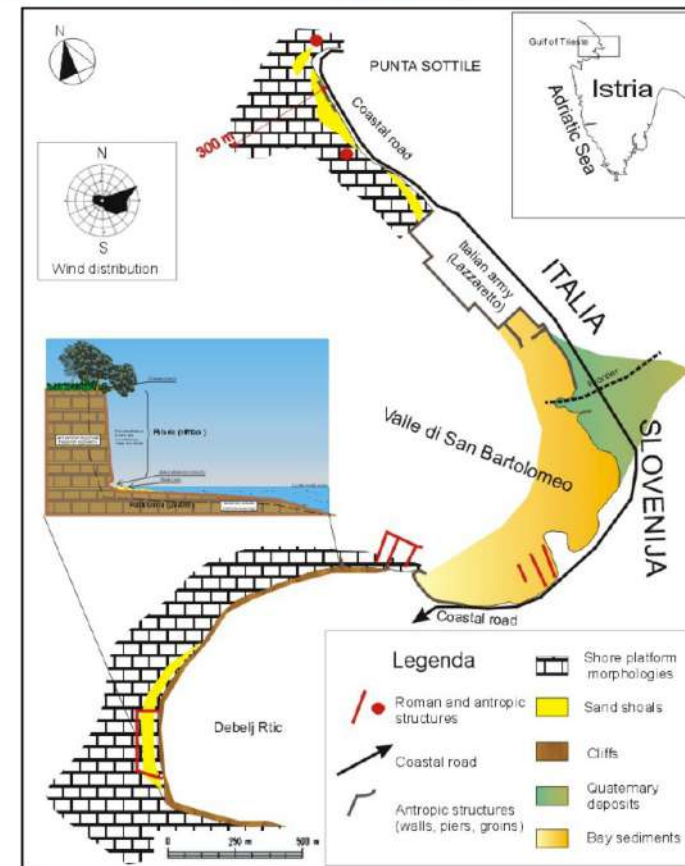
# Tetto dei carbonati



## Terrazzi marini nel flysch

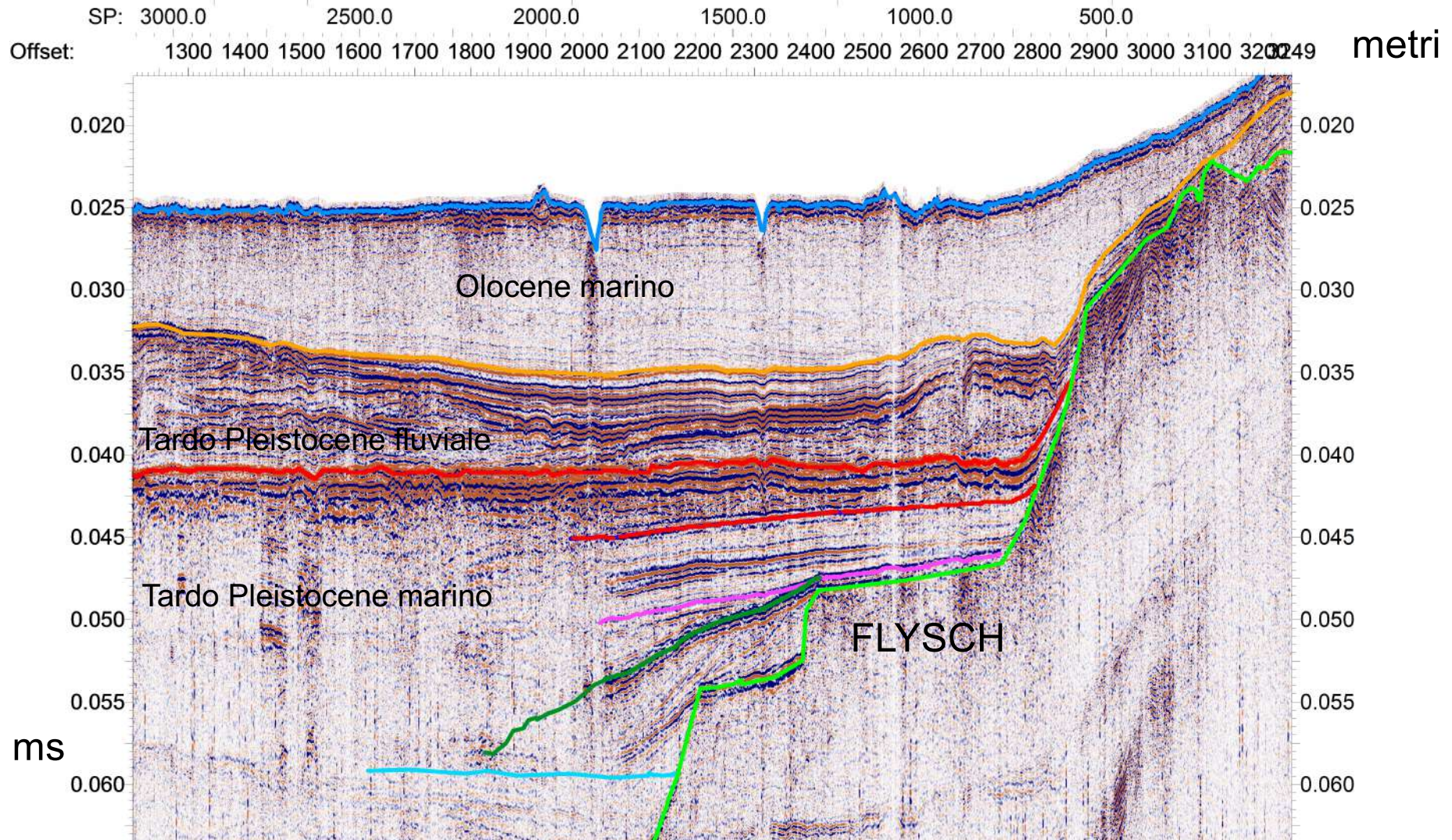


Punta Grossa



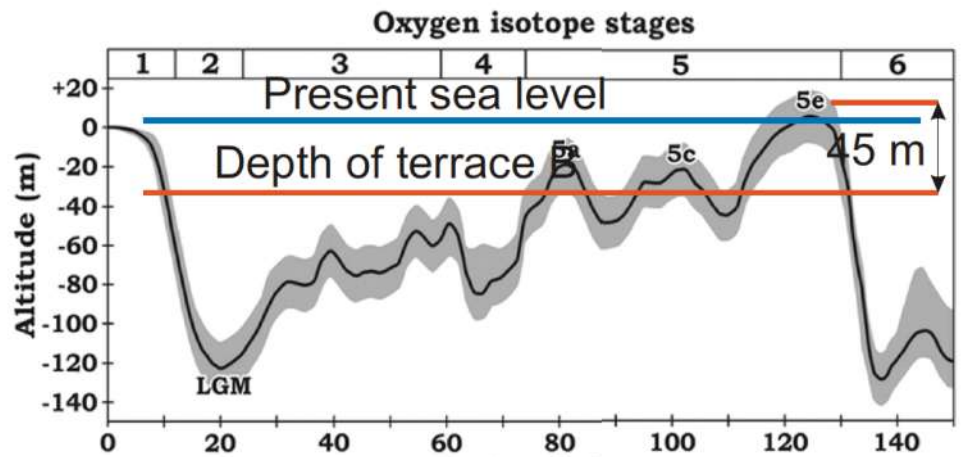
Furlani, 2003

# Terrazzi marini nel flysch Tirreniano (probabilmente Mis 5e - 125.000 anni)

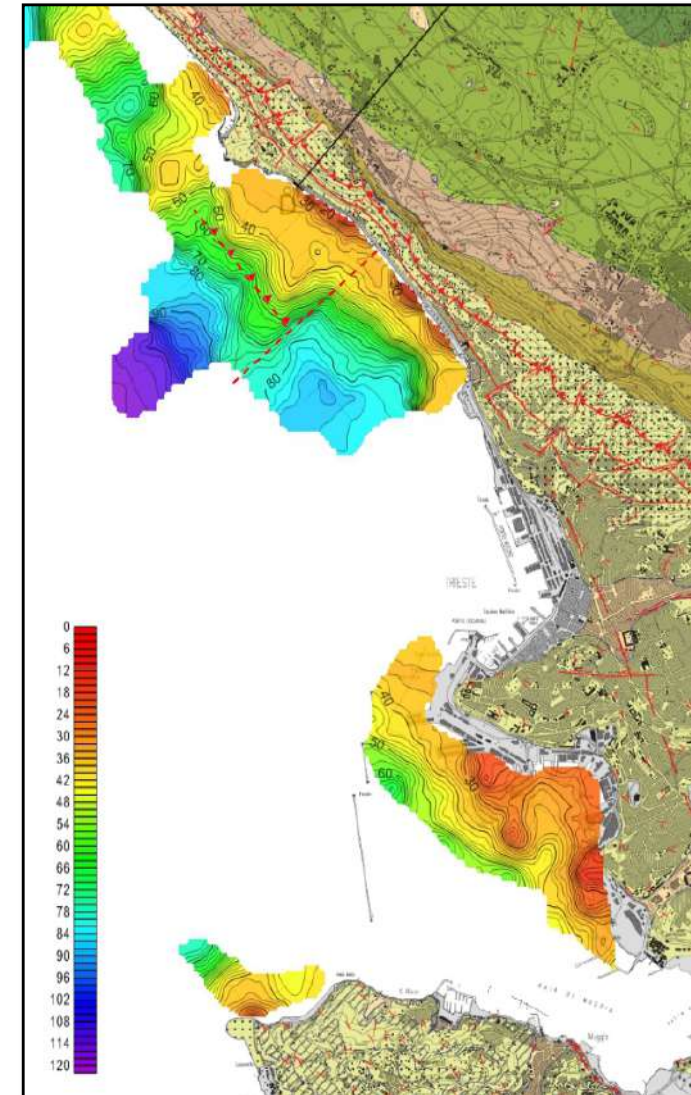


# Tirreniano

probabilmente Mis 5e a 125.000 anni; livello del mare  $+7 \pm 2$  metri  
subsidenza media di 0,36 mm/anno

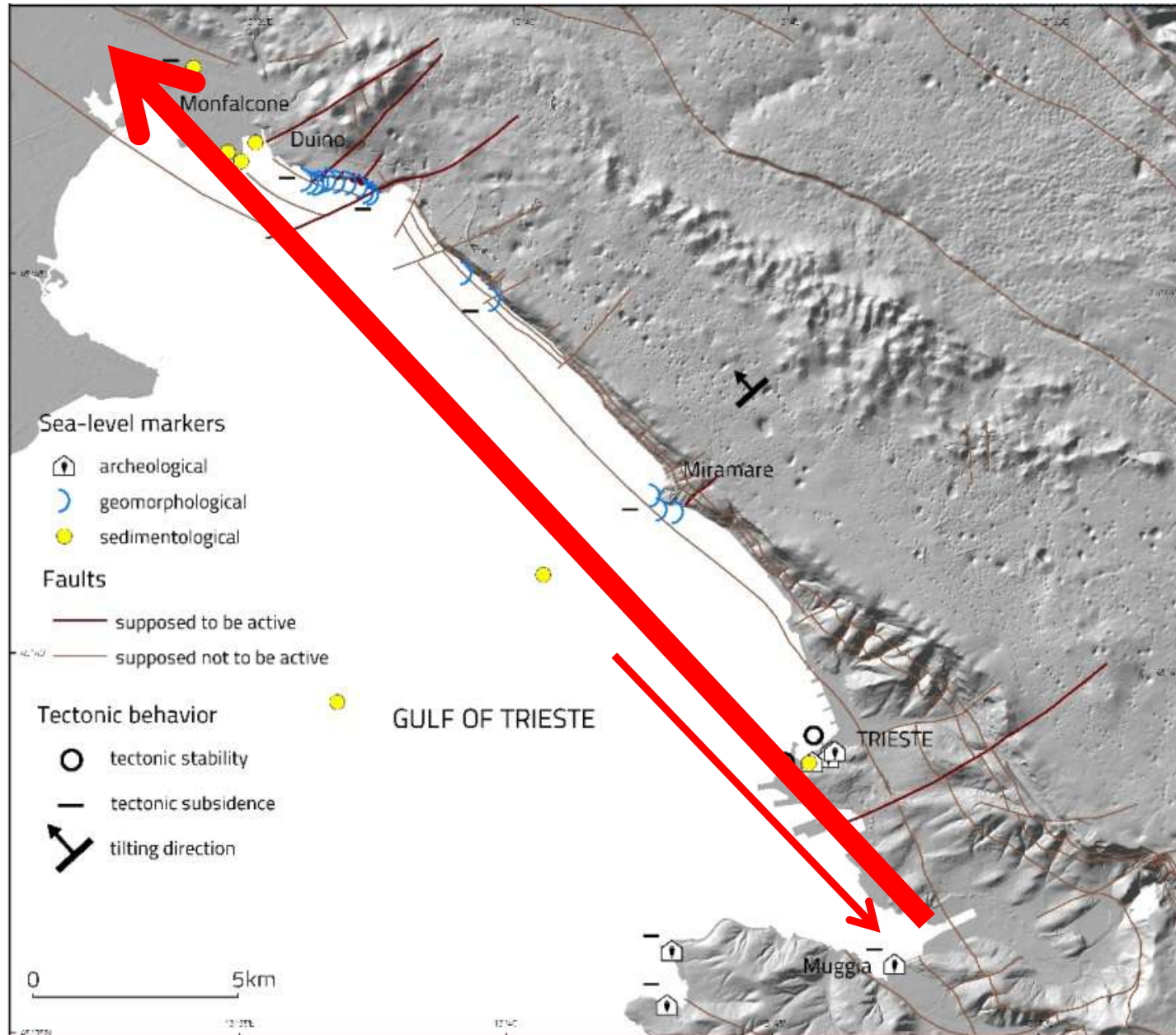


Profondità terrazzi nel flysch



Tesi di laurea, Zampa, A.A. 2013-2014





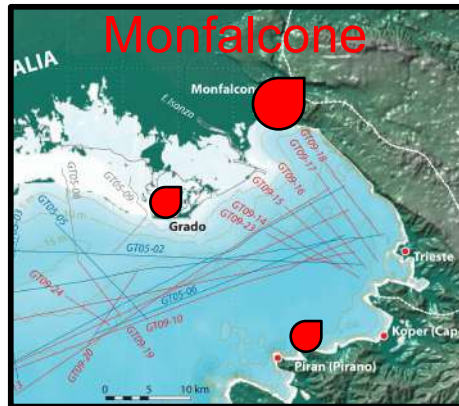
Carta morfo-neotettonica - Biolchi et alii, 2015

# La risorsa geotermica



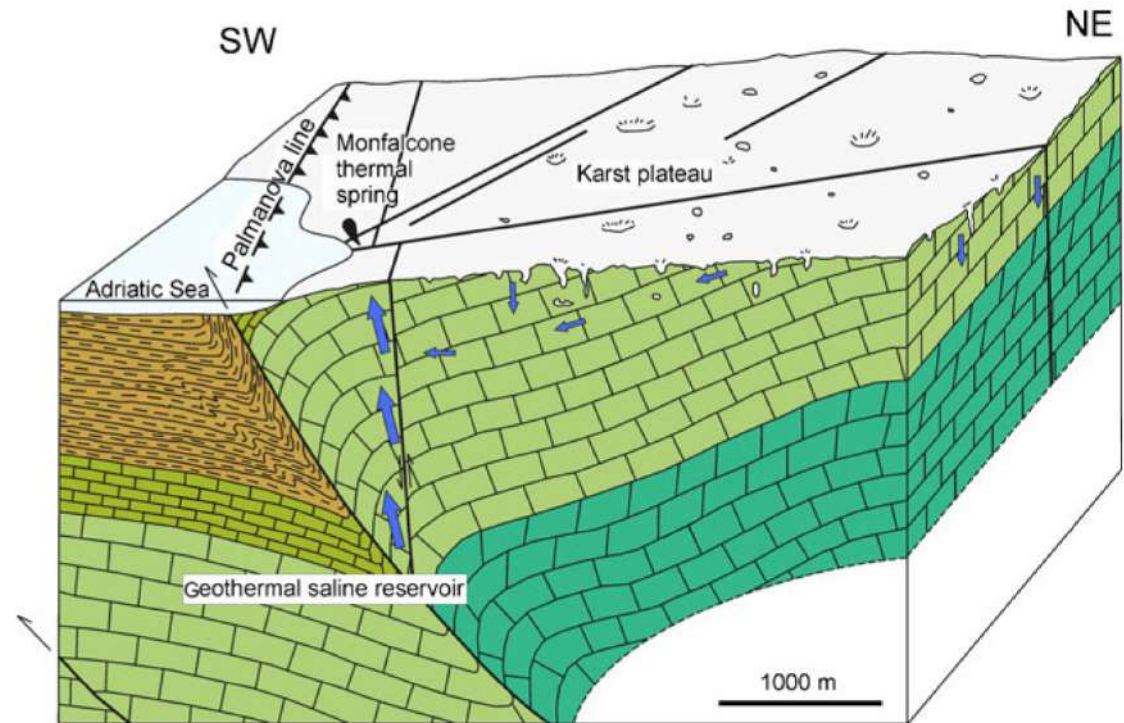
**Tavola Peutingeriana** (Biblioteca Nazionale di Vienna)  
Copia del XII-XIII secolo di un'antica carta romana del IV secolo

## Acque termali: le terme Romane di Monfalcone







Temperatura acqua:  
32.6° – 39.8° C

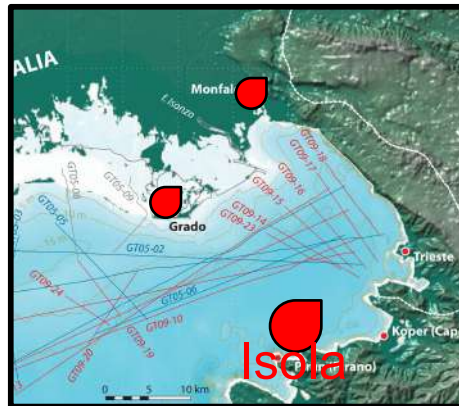
Acque saline mioceniche



### Legend

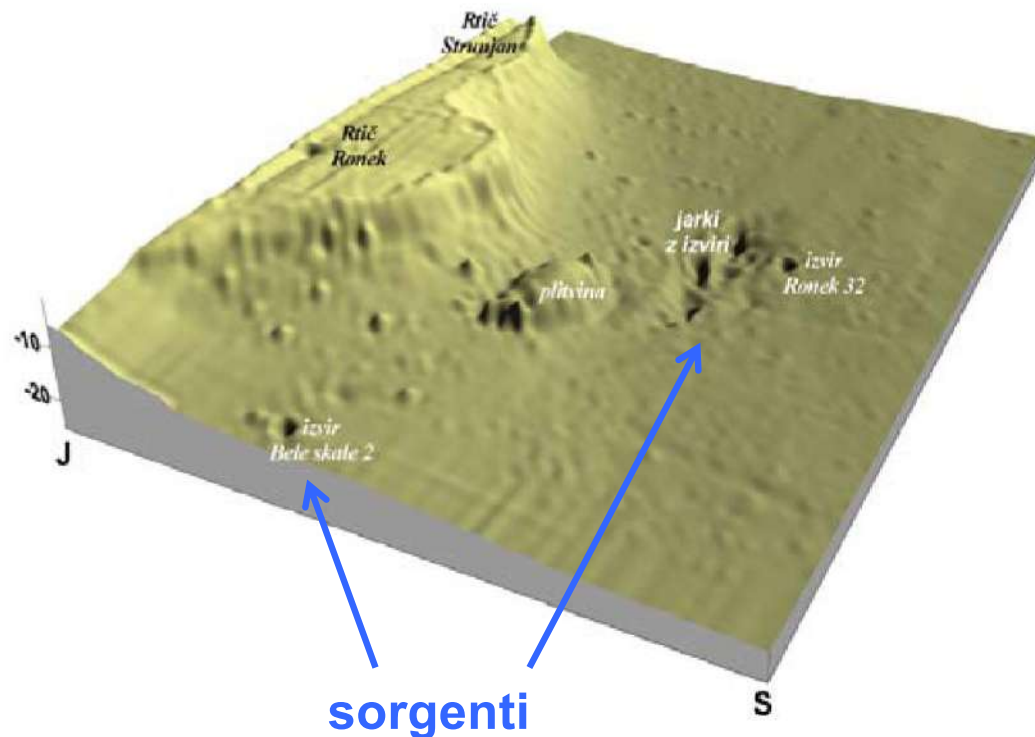
-  Palaeogene flysch
-  Upper Cretaceous - Palaeogene limestones
-  Cretaceous limestones and dolostones
-  Jurassic limestones and dolostones

## Acque termali: le sorgenti marine di Isola



8 sorgenti marine

temperatura acqua 22° -30° C

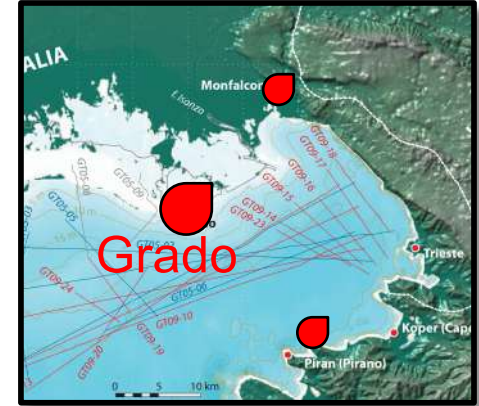


Žumer, 2004

## Acque termali: il pozzo Grado-1



### GRADO-1



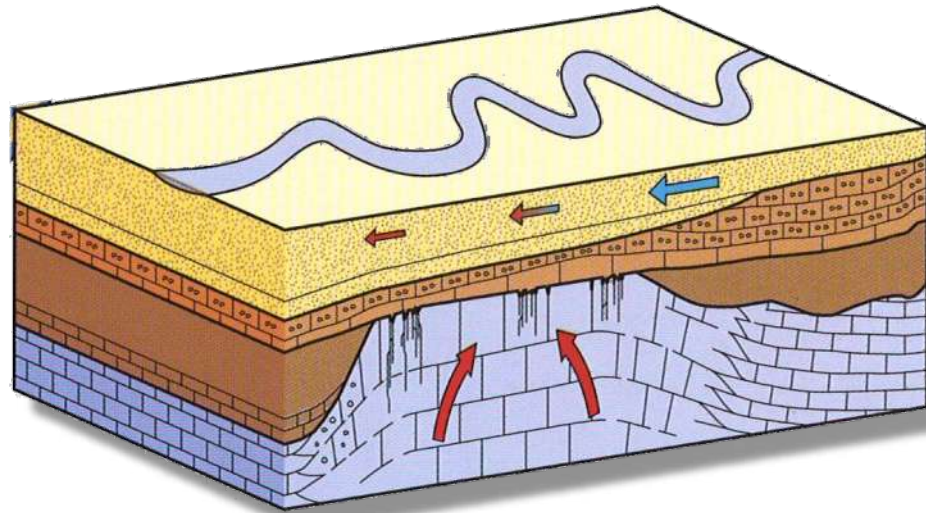
Sedimenti  
Plio-Quaternari

Molassa  
Miocenica

Flysch  
Eocenico

Calcari del  
Paleocene –  
Eocene Inferiore

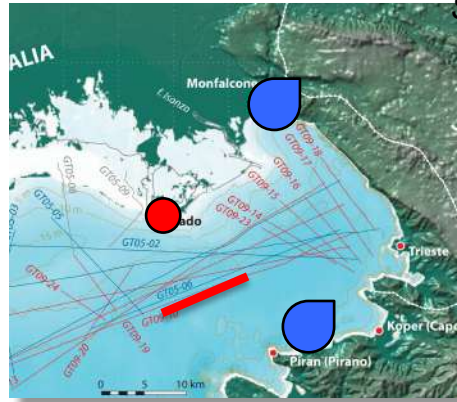
Calcari  
Cretacici



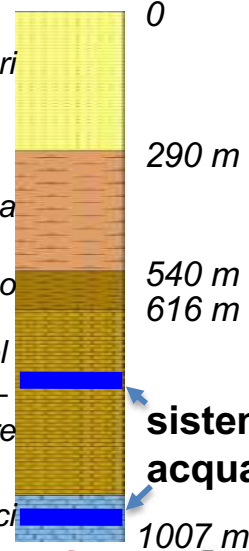
Della Vedova et al., 2008  
Cimolino et al., 2010

Cimolino et al., 2010

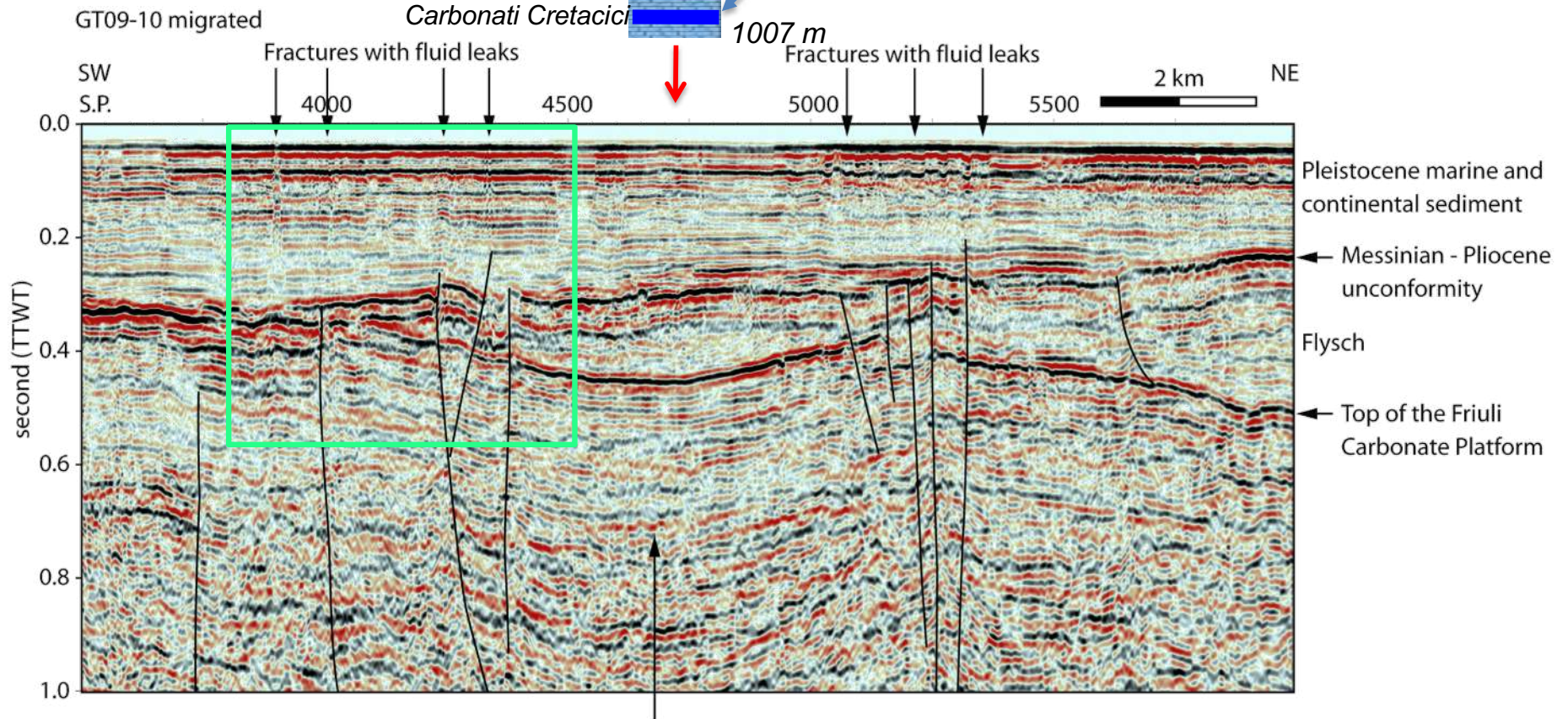
Sedimenti Plio-Quaternari



**GRADO-1**

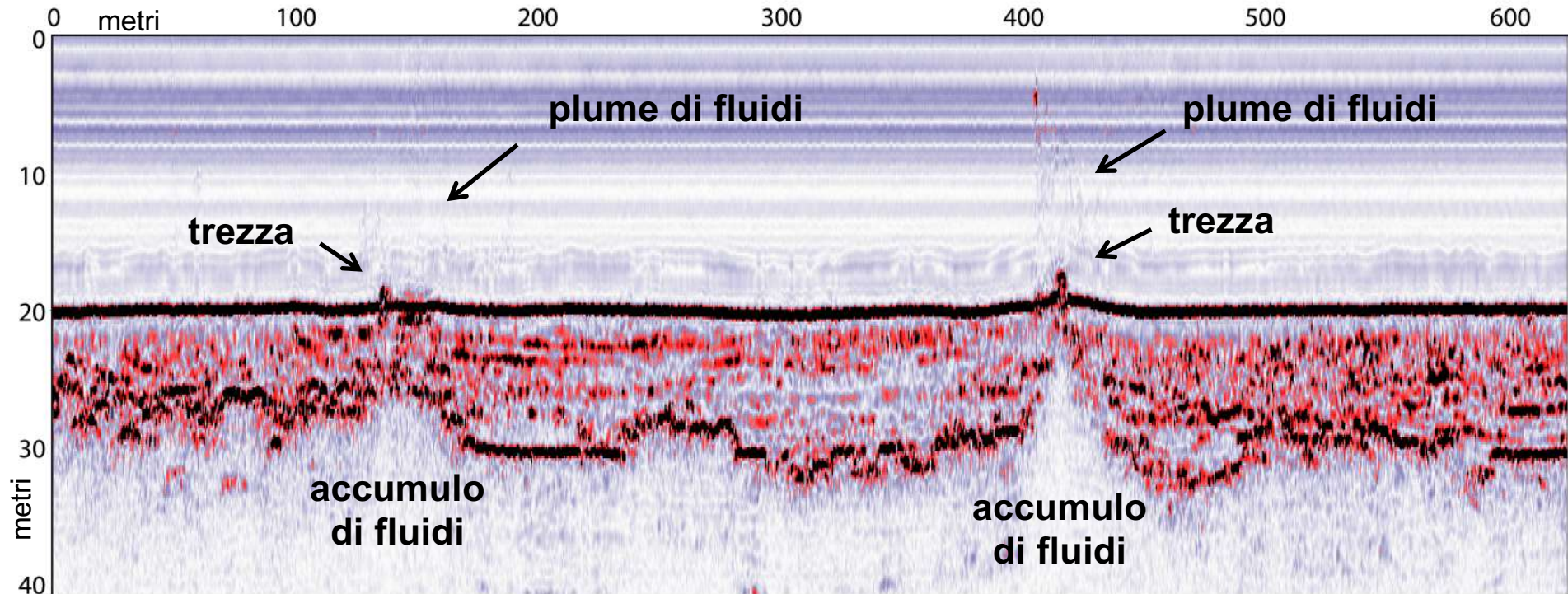
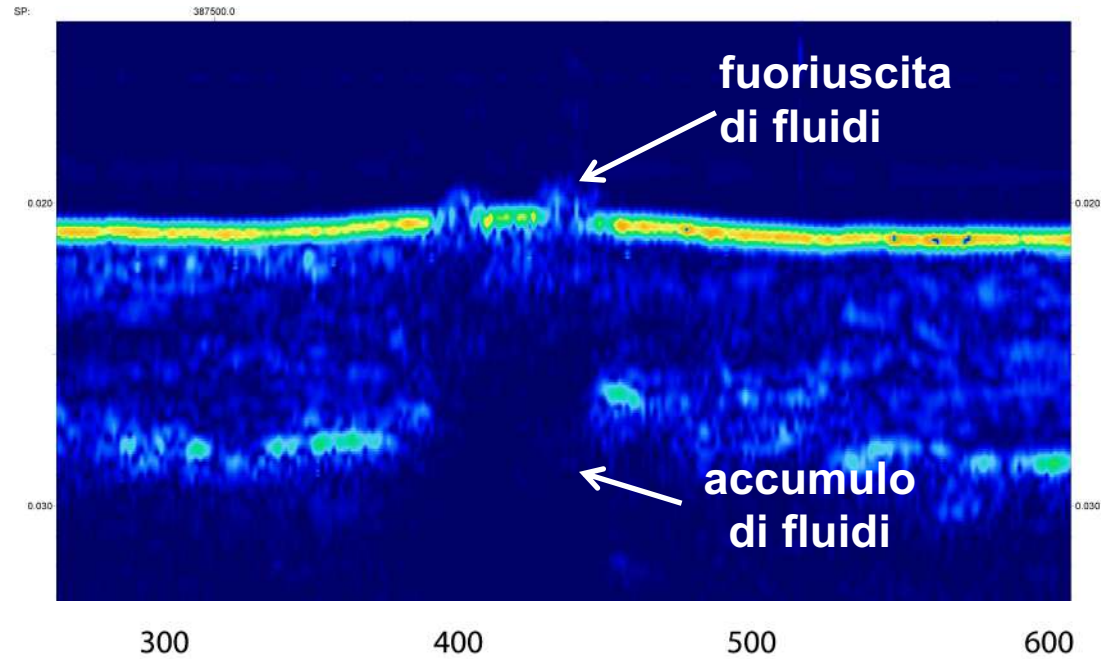
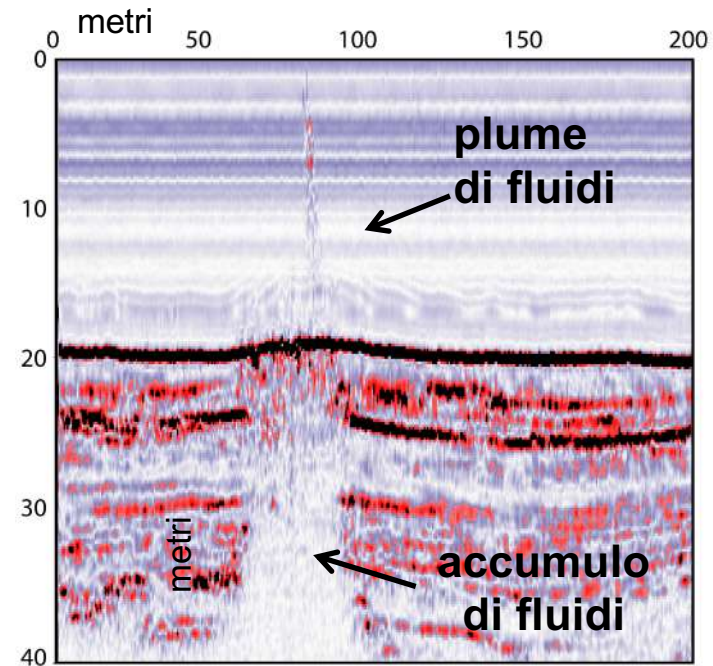


**sistemi di fratture con acqua salmastra a 44° C**

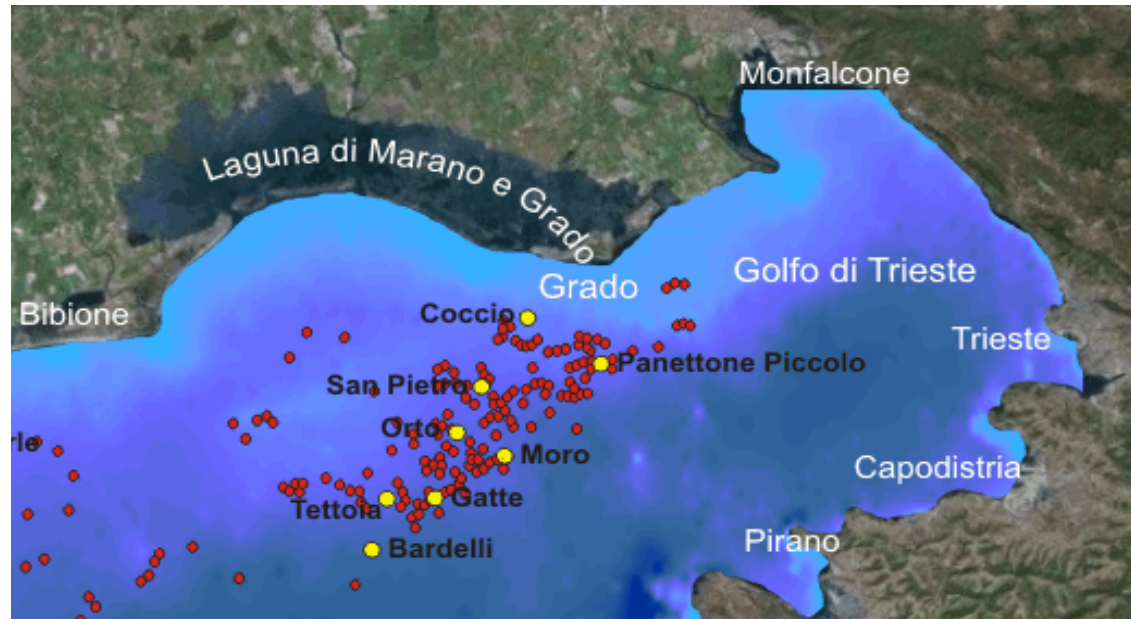


Intraplatform Paleogene? carbonate basin

## Fuoriuscite di fluidi

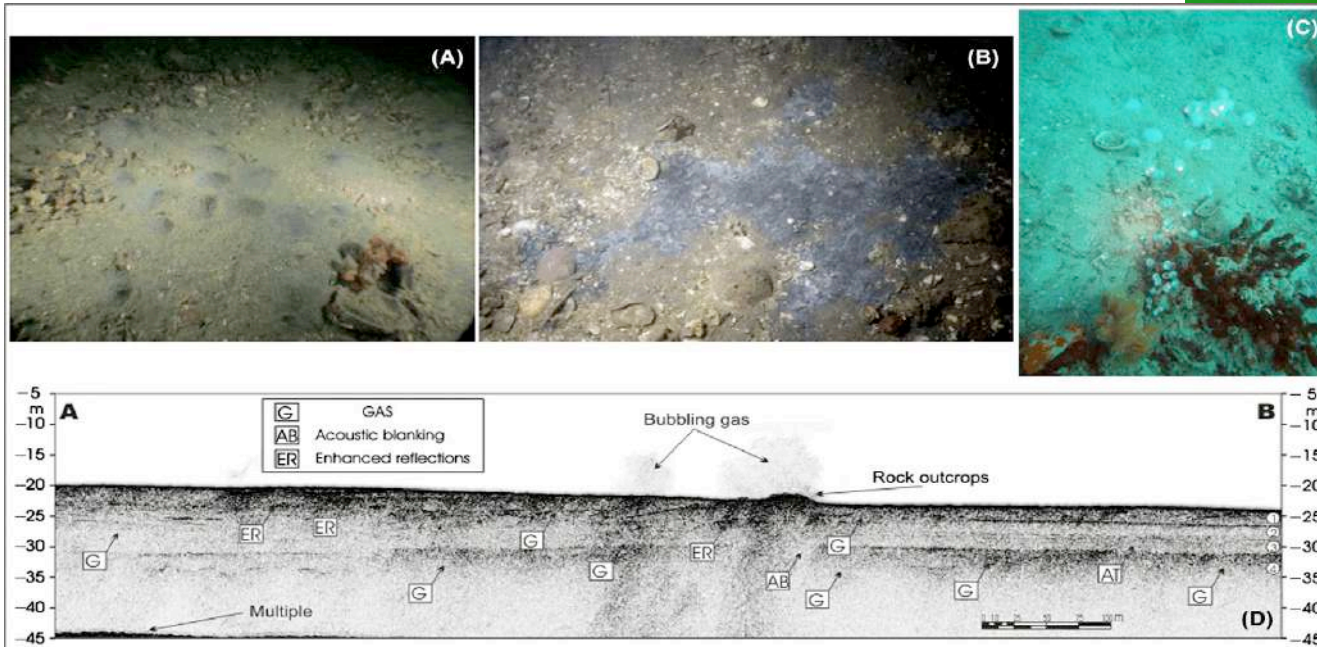
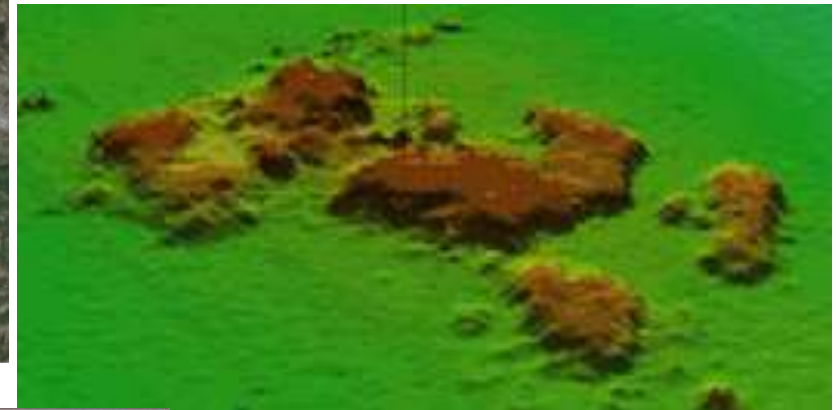


## Le trezze



affioramenti carbonatici  
metano-derivati

emissioni di fluidi  
di cui 80-85 % metano







***FINE***