Il Rift Etiopico

un laboratorio naturale per l'analisi dei processi di estensione e rottura dei continenti

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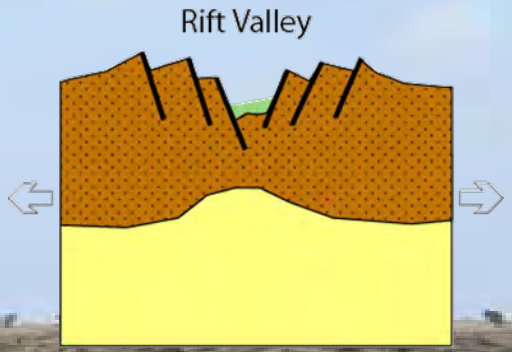
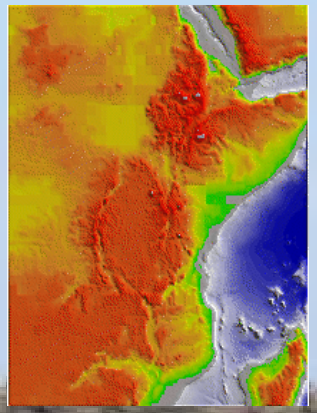
Corti G., 2009.
Continental rift evolution: from rift initiation to incipient break-up in the Main Ethiopian Rift, East Africa.
Earth Science Reviews, 96, 1–53.

Estensione continentale

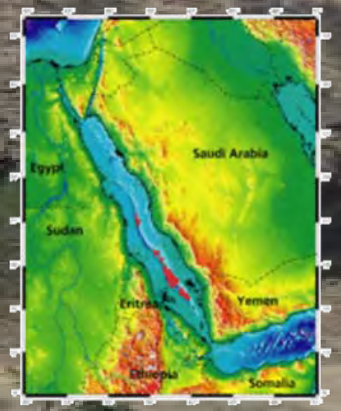
Estensione (rifting) continentale: uno dei processi geodinamici più importanti.
Porta alla formazione di nuovi bacini oceanici.

Importanza:
-scientifica
-economica (giacimenti, geotermia)
-sociale (rischio sismico e vulcanico)

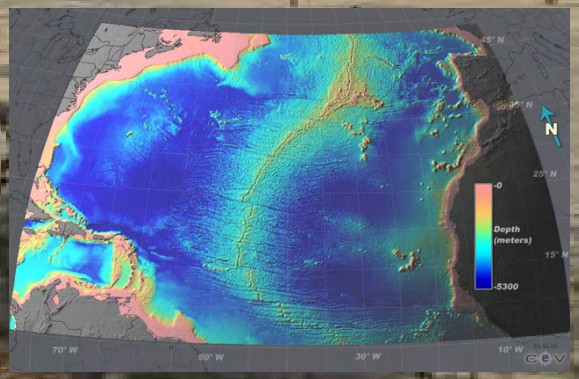




East African Rift

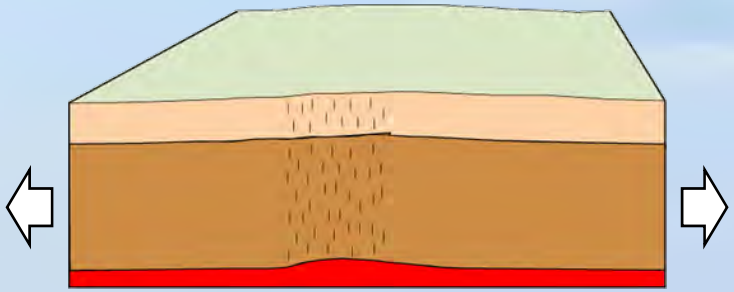


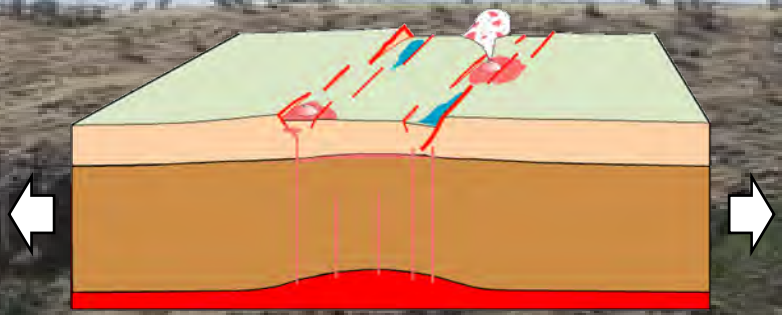
Red Sea



Mid-Atlantic Ridge

Estensione continentale





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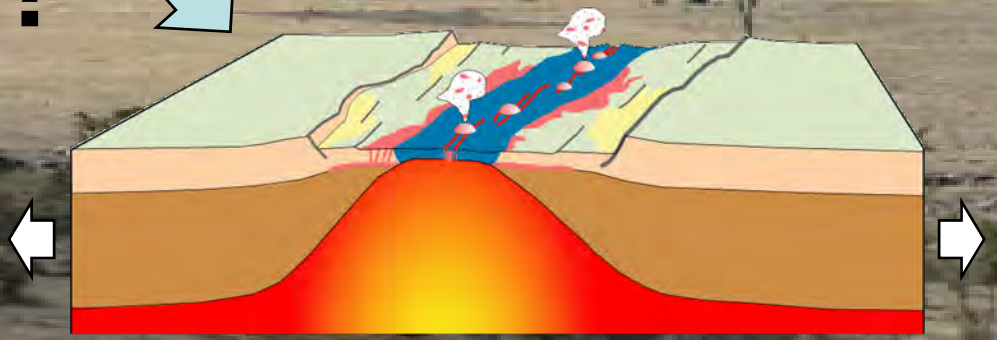
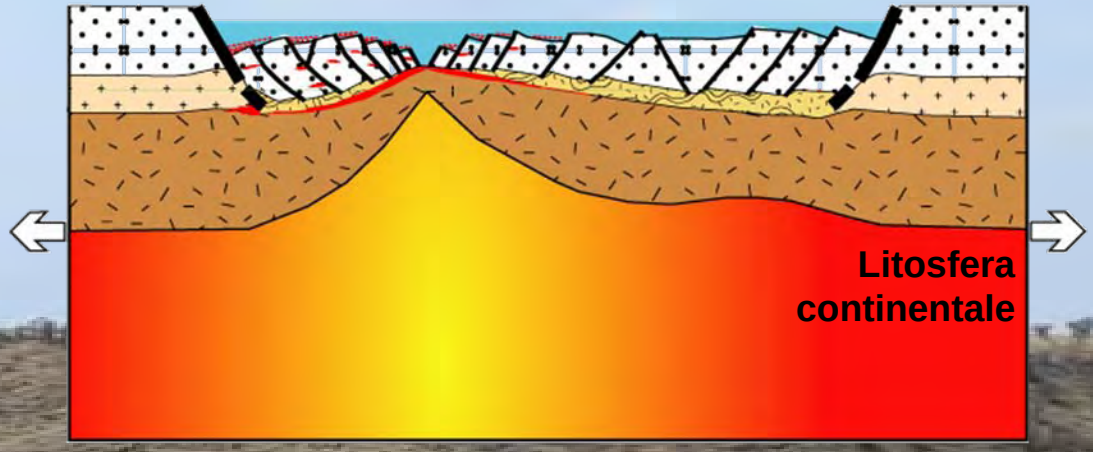
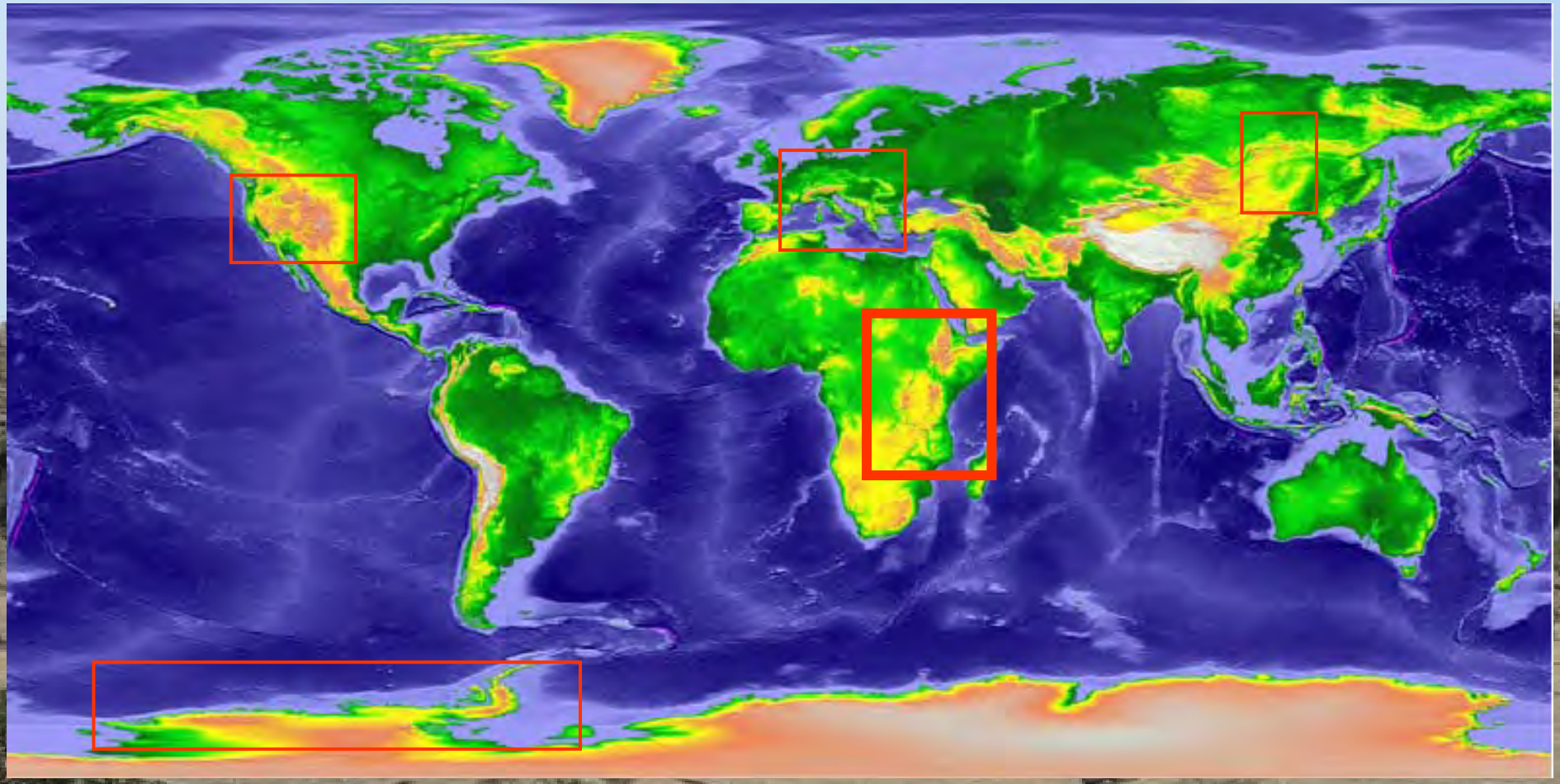


Estensione continentale



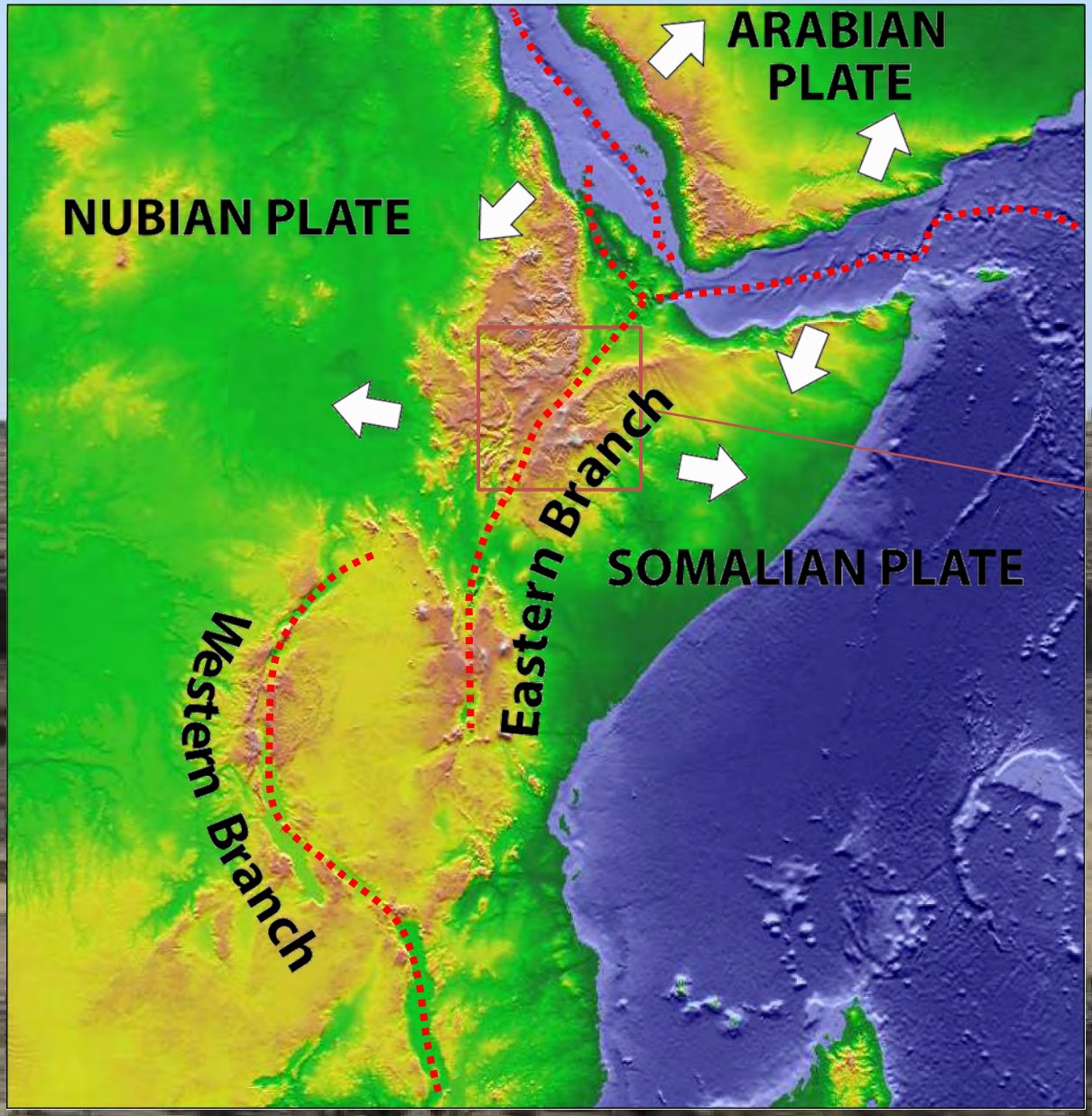
Estensione continentale



Zone di estensione continentale attiva nel mondo

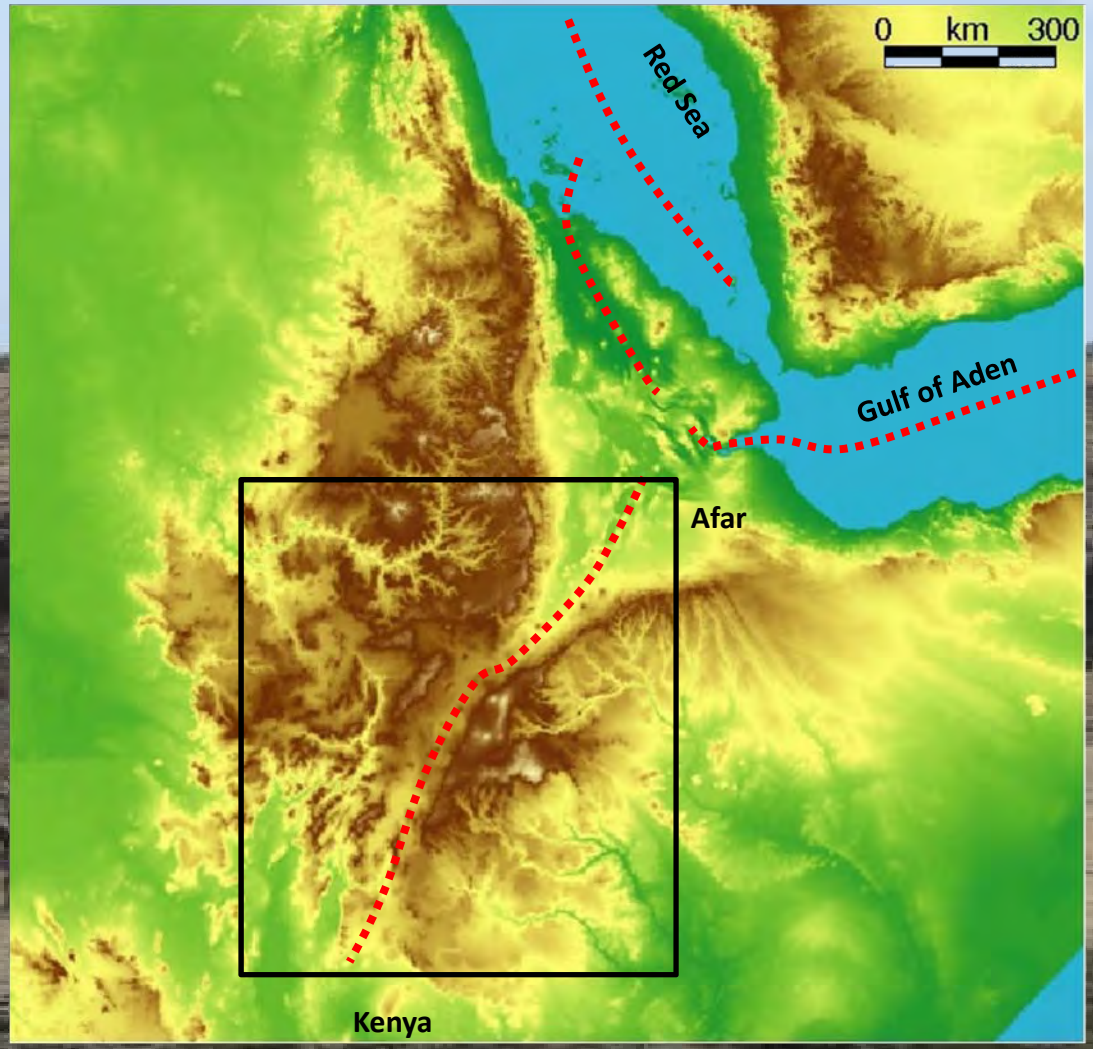
Estensione continentale in Africa orientale

East African Rift System

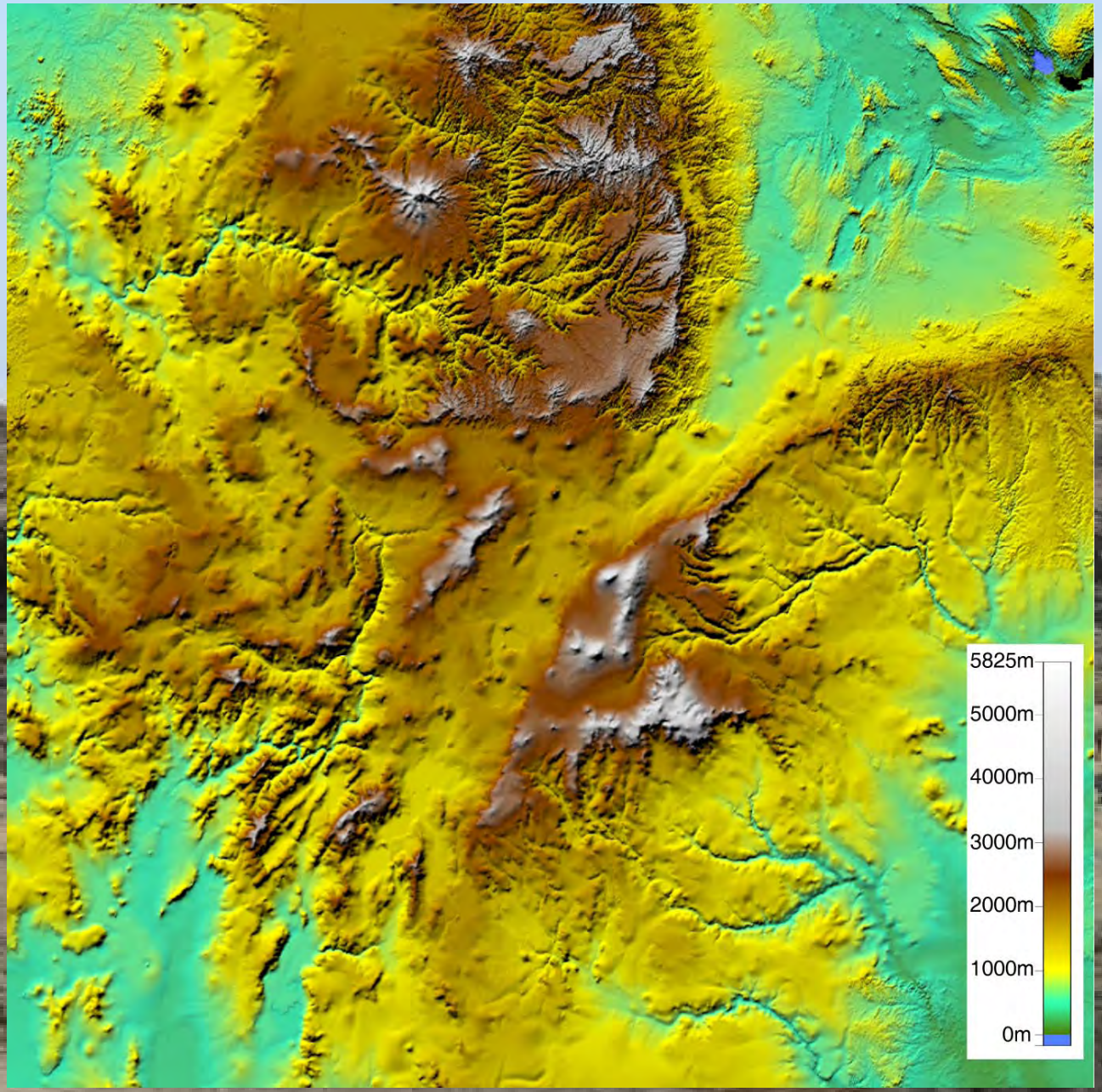


Rift che registra le diverse fasi evolutive dell'estensione continentale→ Ideale per studiare tale processo

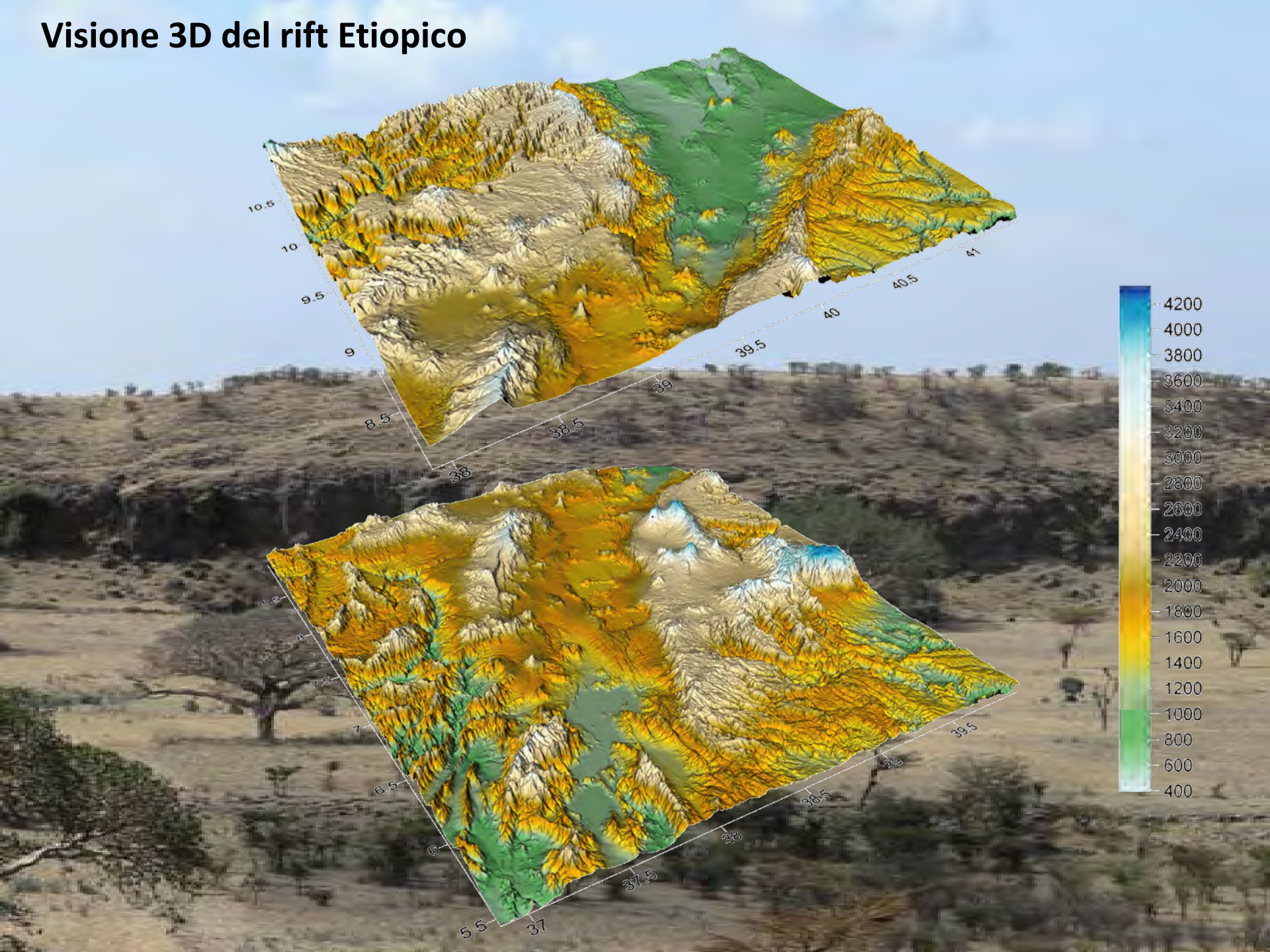
Rifting continentale in Africa orientale: Rift Etiopico



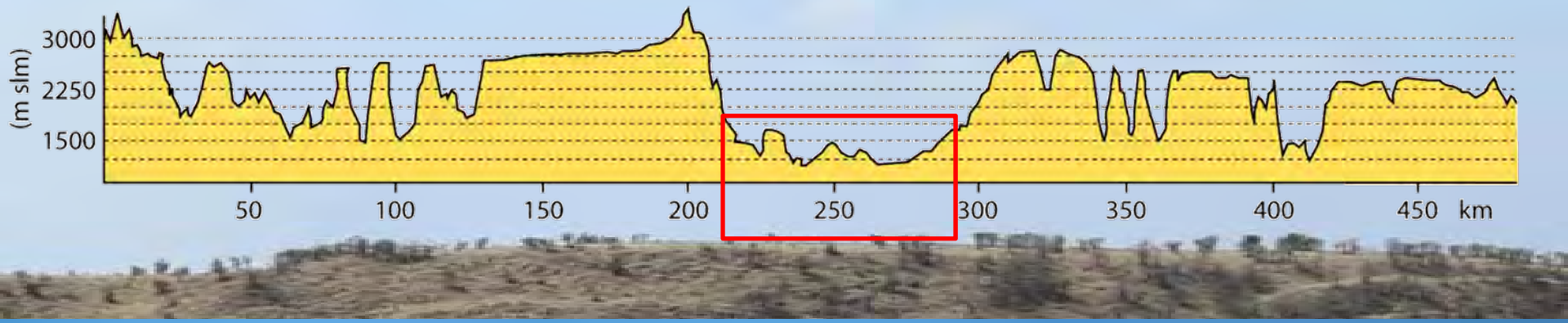
Rift Etiopico: topografia



Visione 3D del rift Etiopico

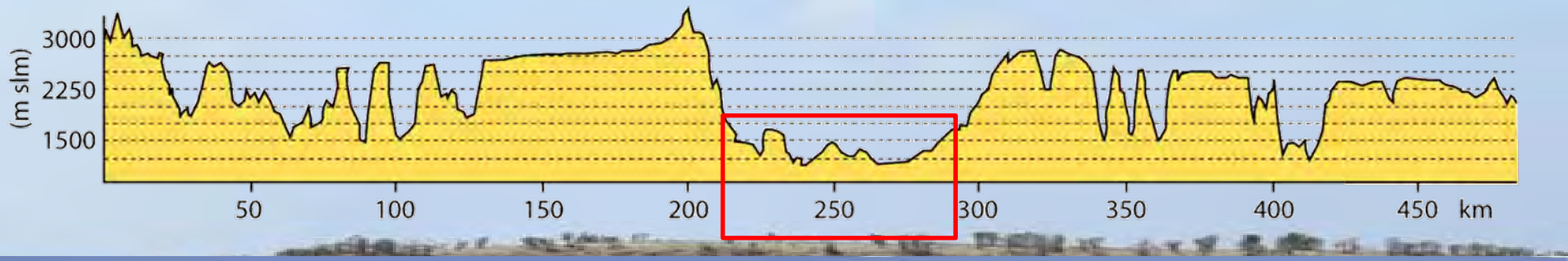


Rift Etiopico: topografia e paesaggio



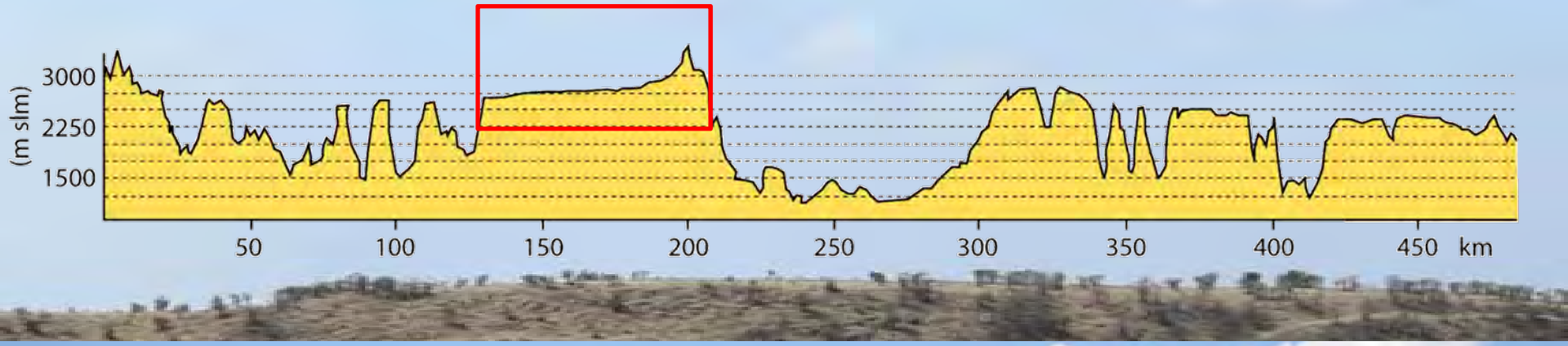
Temp >27°C, Precip <500mm (dati annui)

Rift Etiopico: topografia e paesaggio



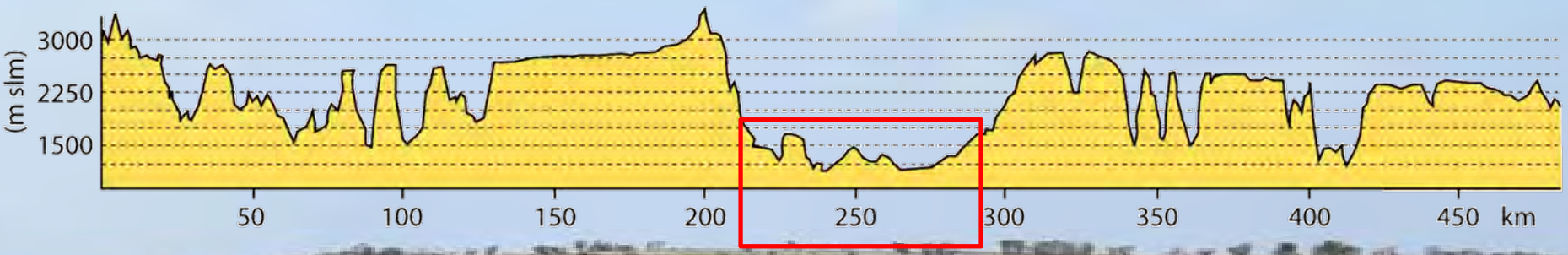
Temp >>27°C, Precip <<500mm (dati annui)

Rift Etiopico: topografia e paesaggio

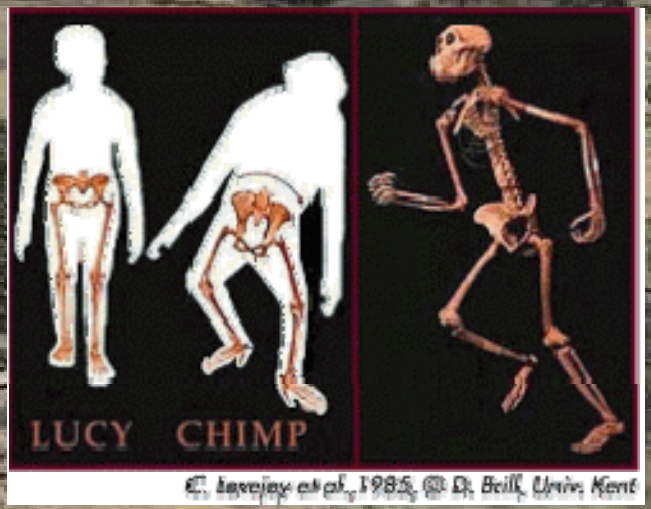


Temp 15-20°C, Precip 1000-1500 mm (dati annui)

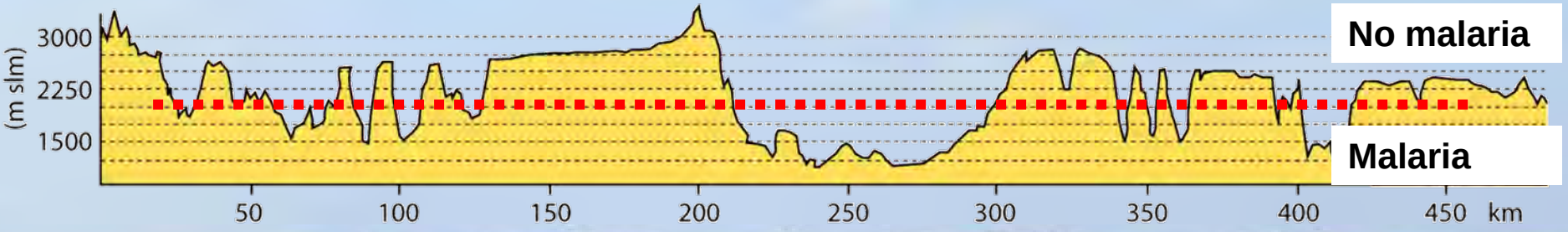
Rift Etiopico: topografia e importanza paleoantropologica



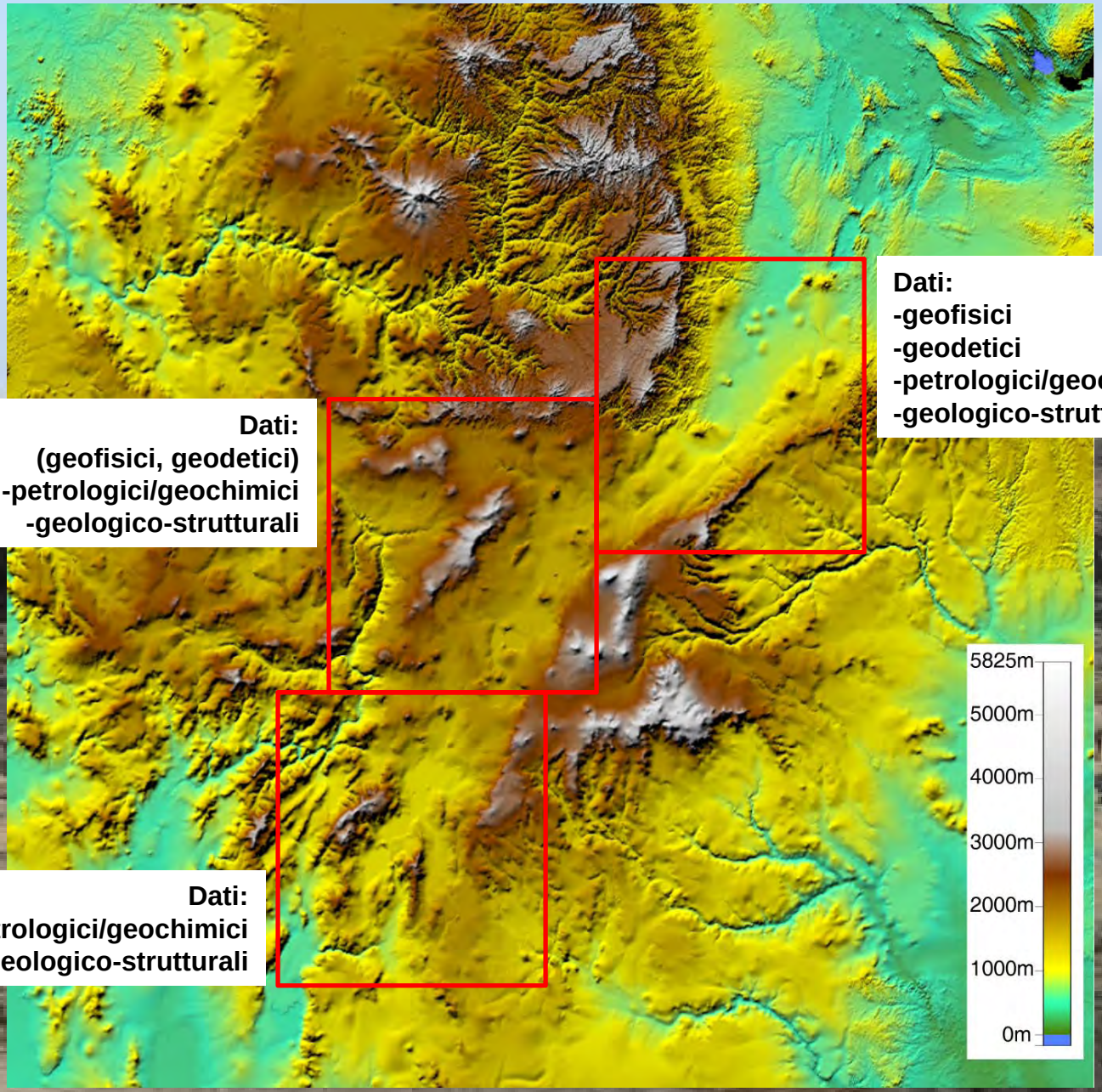
Australopithecus afarensis (Lucy), Afar



Rift Etiopico: topografia e importanza “sociale”

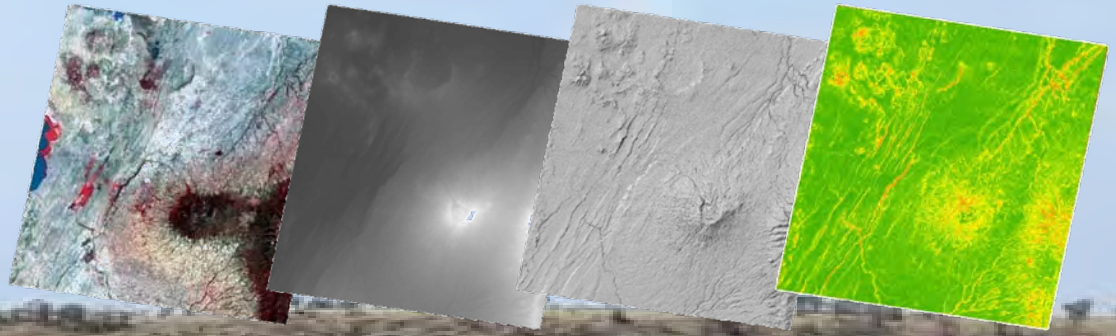


Rift Etiopico: suddivisione in vari segmenti



Rift Etiopico: metodologie di analisi

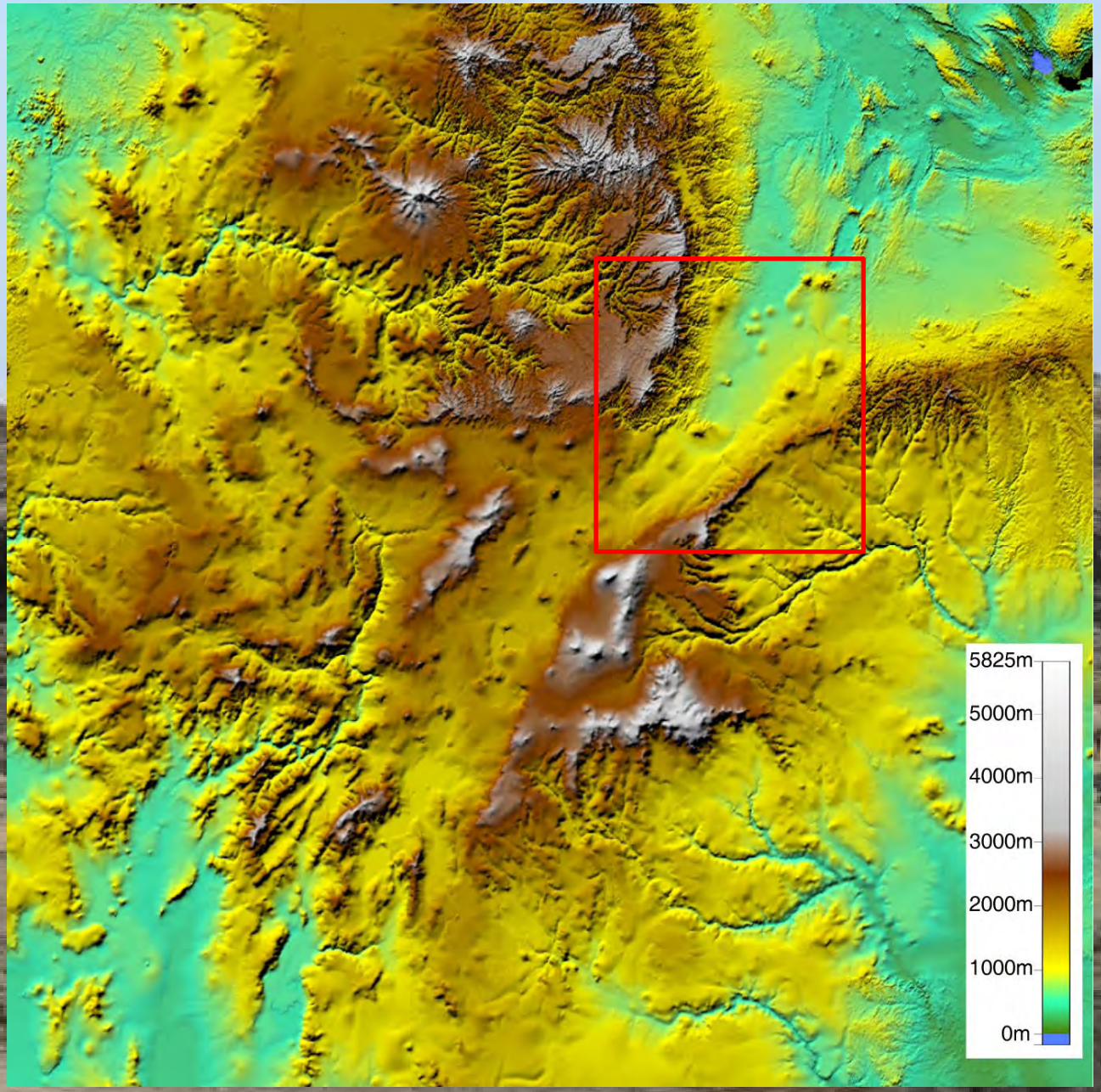
- Analisi del pattern deformativo: database faglie del rift (da: immagini satellite, dem, campagna) con analisi statistica



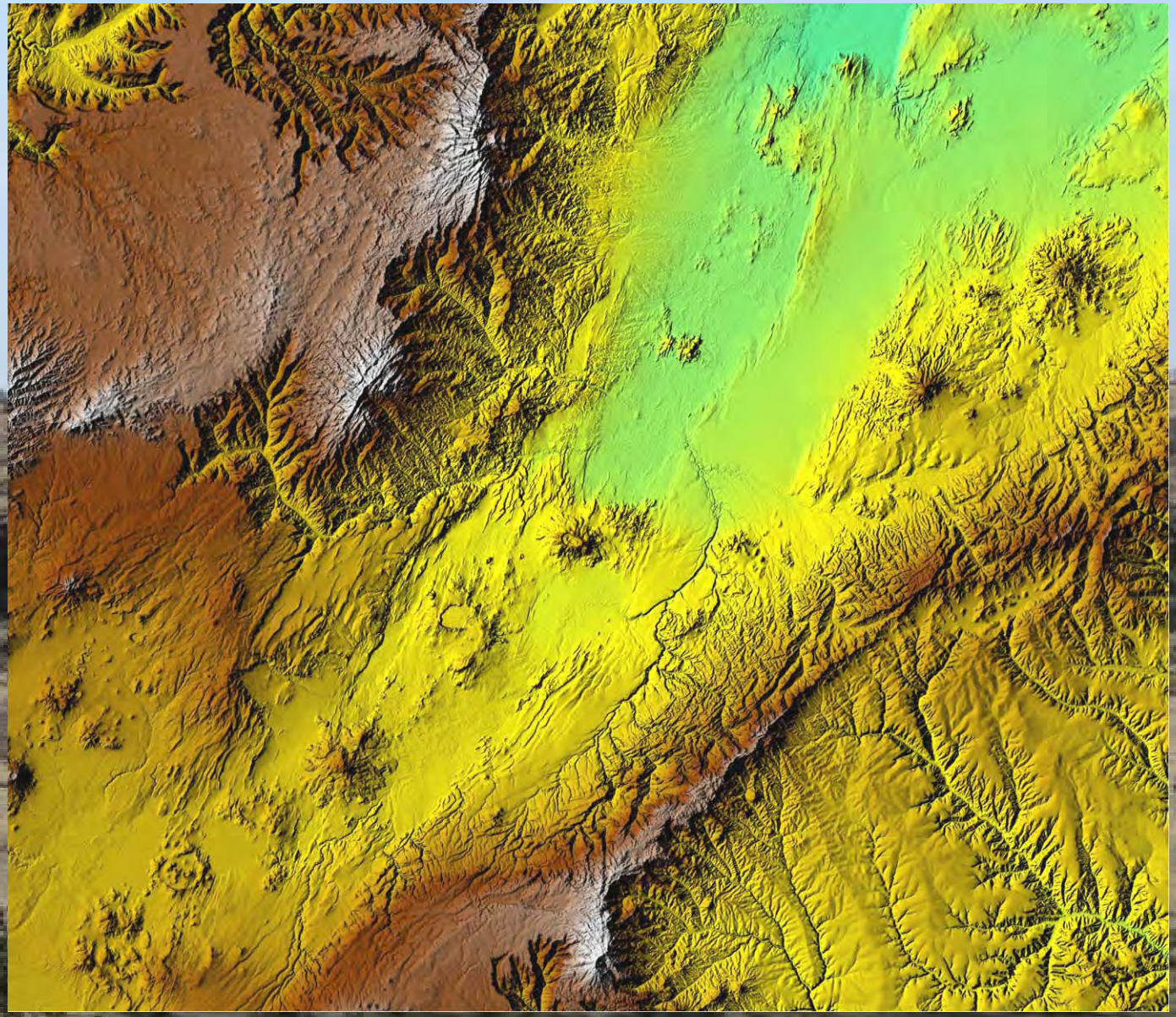
- Analisi strutturale in campagna

- Modellizzazione analogica (laboratorio)

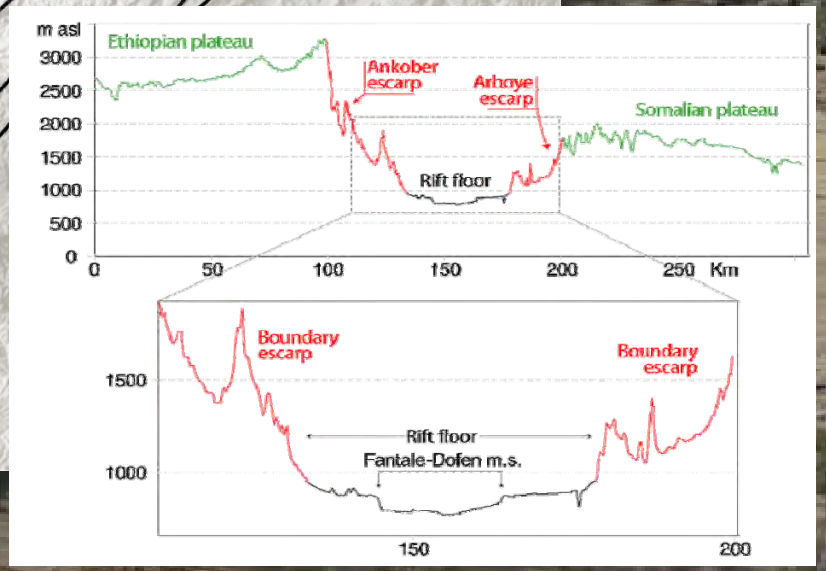
Rift Etiopico: segmento settentrionale (NMER)



Rift Etiopico: segmento settentrionale (NMER)



Rift Etiopico: segmento settentrionale (NMER)



Rift Etiopico: segmento settentrionale (NMER)

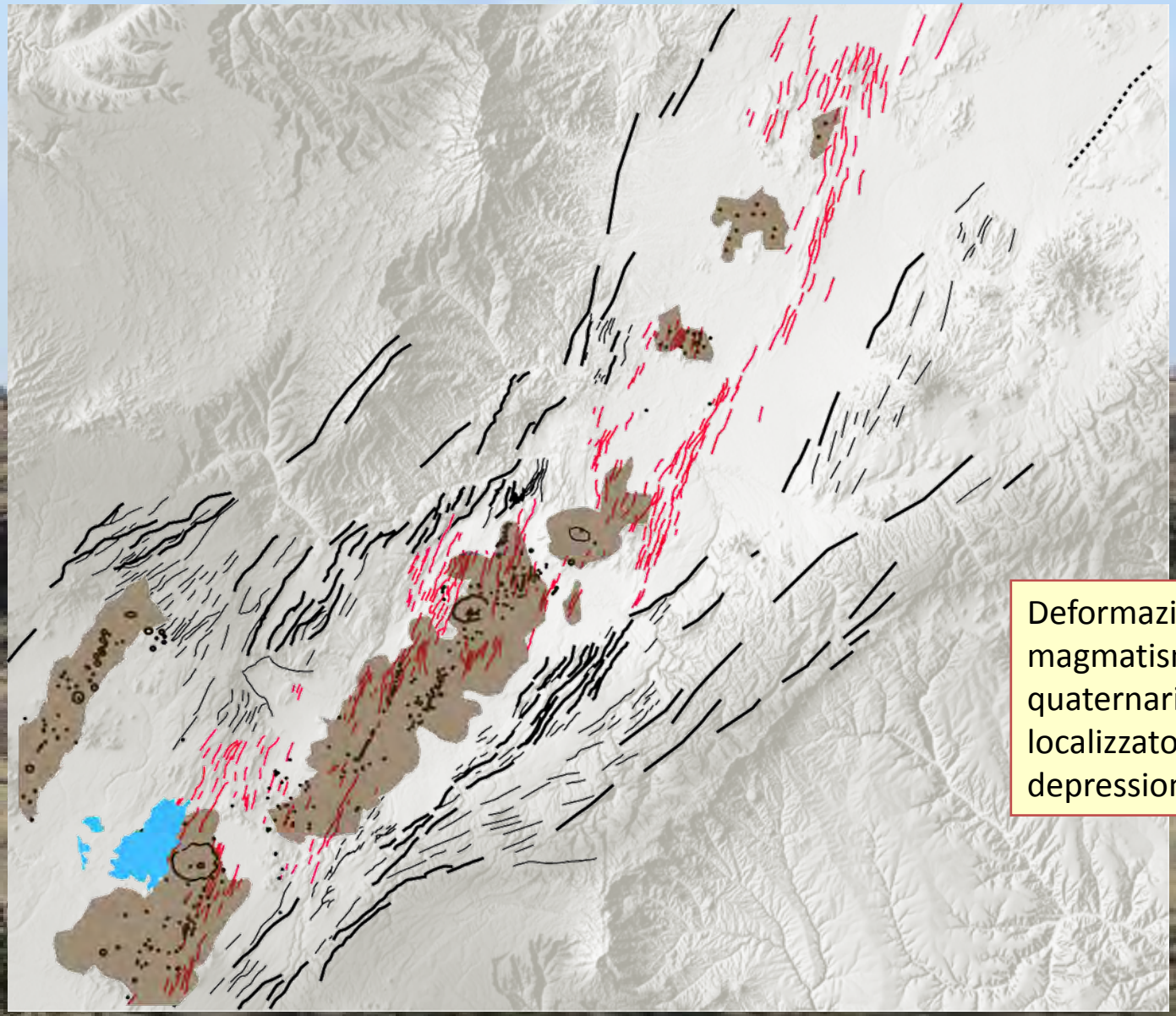
Poche faglie con grande rigetto molto spaziate tra loro

Attive da circa 11Ma fino alla fine del Pliocene
Associate a vulcanismo non localizzato

Rift Etiopico: segmento settentrionale (NMER)

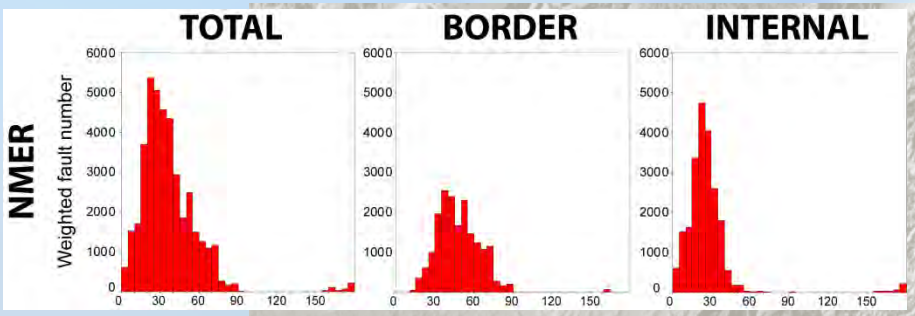
Densi sistemi di faglie normali (WONJI) corte e con rigetto piccolo
Organizzate in segmenti en-echelon
Formate negli ultimi 2 ma

NMER: evoluzione



Deformazione e magmatismo quaternario localizzato dentro la depressione

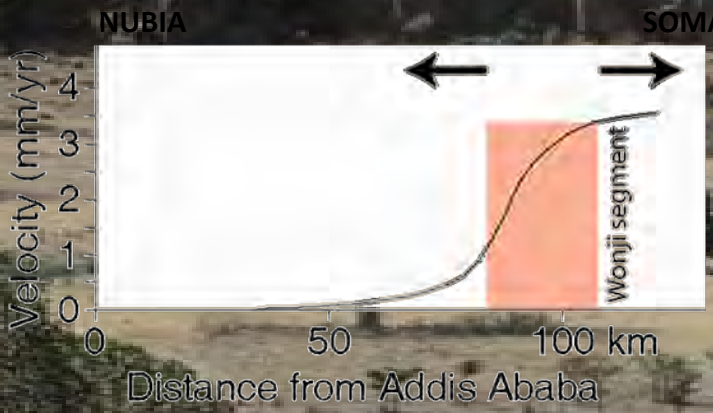
Rift Etiopico: segmento settentrionale (NMER)



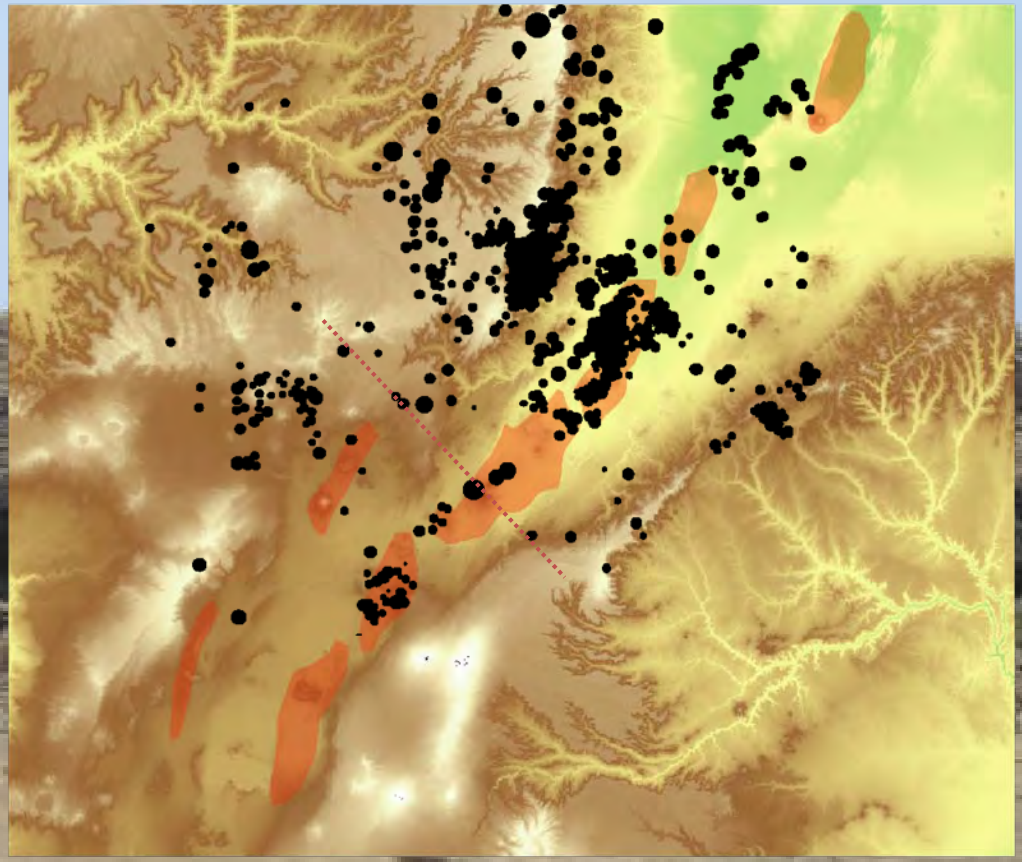
NMER: distribuzione attuale della deformazione

Sismicità e dati geodeitici indicano una deformazione fortemente localizzata lungo i segmenti Wonji

Scarpate bordiere **non** attive

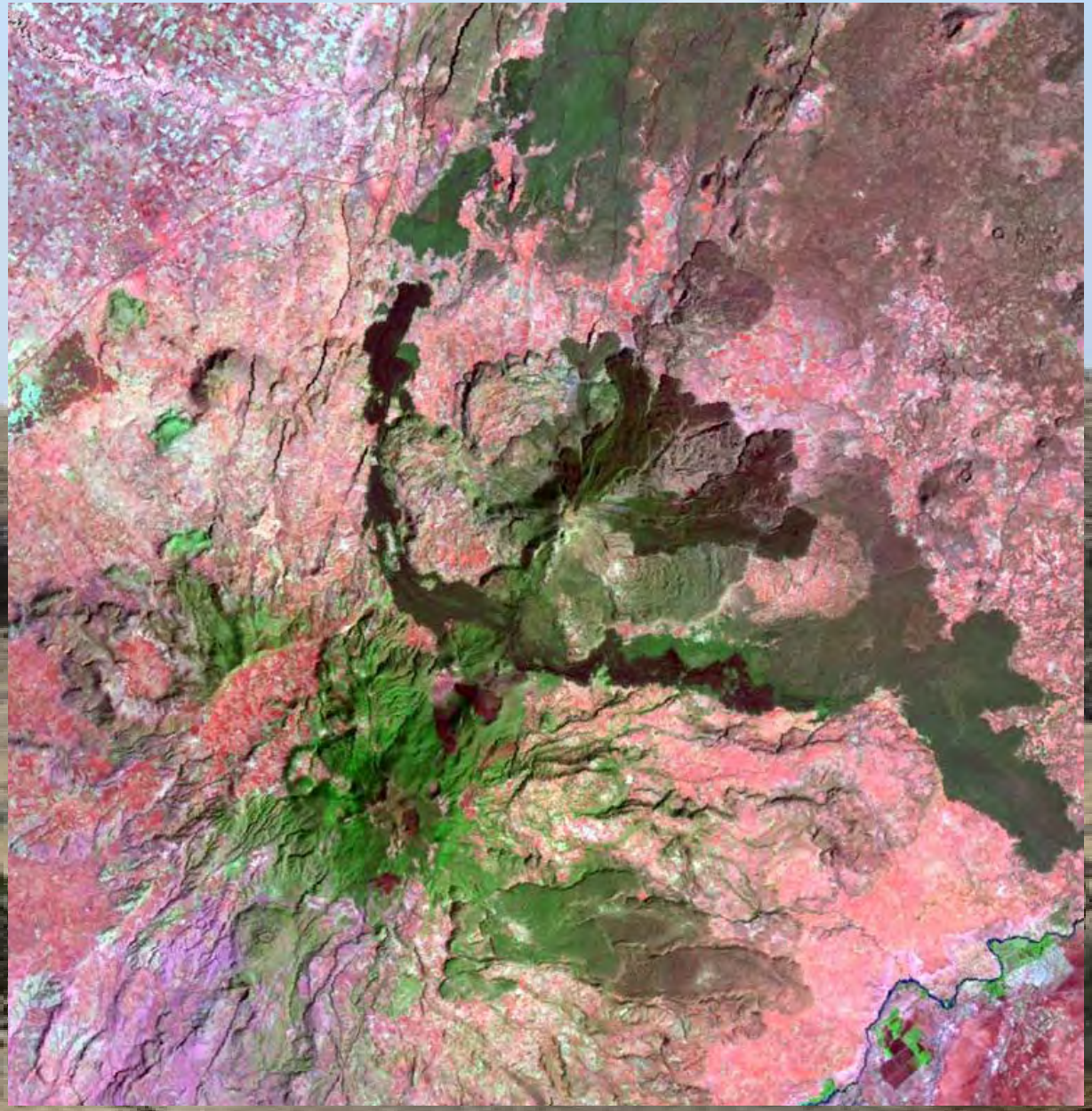


Velocity profile from geodetical data in the MER (after Billham et al, 1999 Geophys Res Lett)



Seismicity of the MER from October 2001 to January 2003 (note that earthquakes mostly occur above mafic intrusions) [after Keir et al, 2006 JGR]

Rift Etiopico: segmento settentrionale (NMER)



Allineamento di centri vulcanici lungo segmenti Wonji

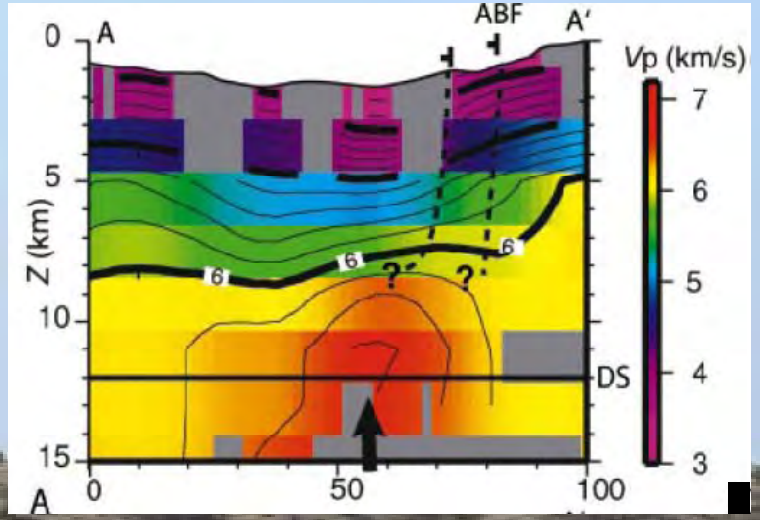
Rift Etiopico: segmento settentrionale (NMER)

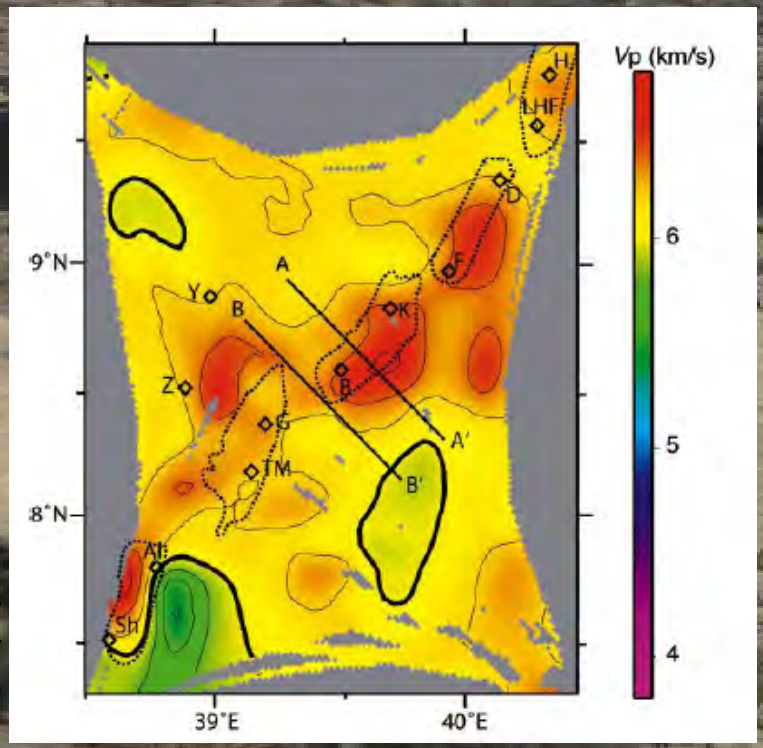
Rift Etiopico: segmento settentrionale (NMER)

NMER: distribuzione del magmatismo

Dati geofisici (Ethiopia Afar Geoscientific Lithospheric Experiment, EAGLE project; Maguire et al., 2003EOS) mostrano importante intrusione di magma in tutta la litosfera (fino a 75km di profondità) sotto i segmenti Wonji

-importanti corpi mafici (gabbroici) nella crosta inferiore-media, mafic intrusions (mid-lower crust),
-dicchi e fratture riempite da magma (crosta, mantello superiore)
-camere magmatiche sotto i vulcani Quaternari (crosta superiore)





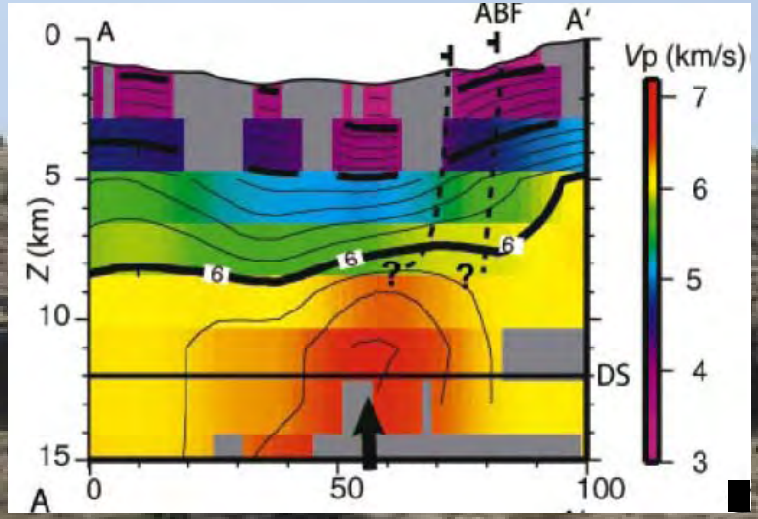
Controlled-source tomography at 10 km below the rift valley (after Keranen et al, 2004 Geology)

NMER: magmatismo e deformazione

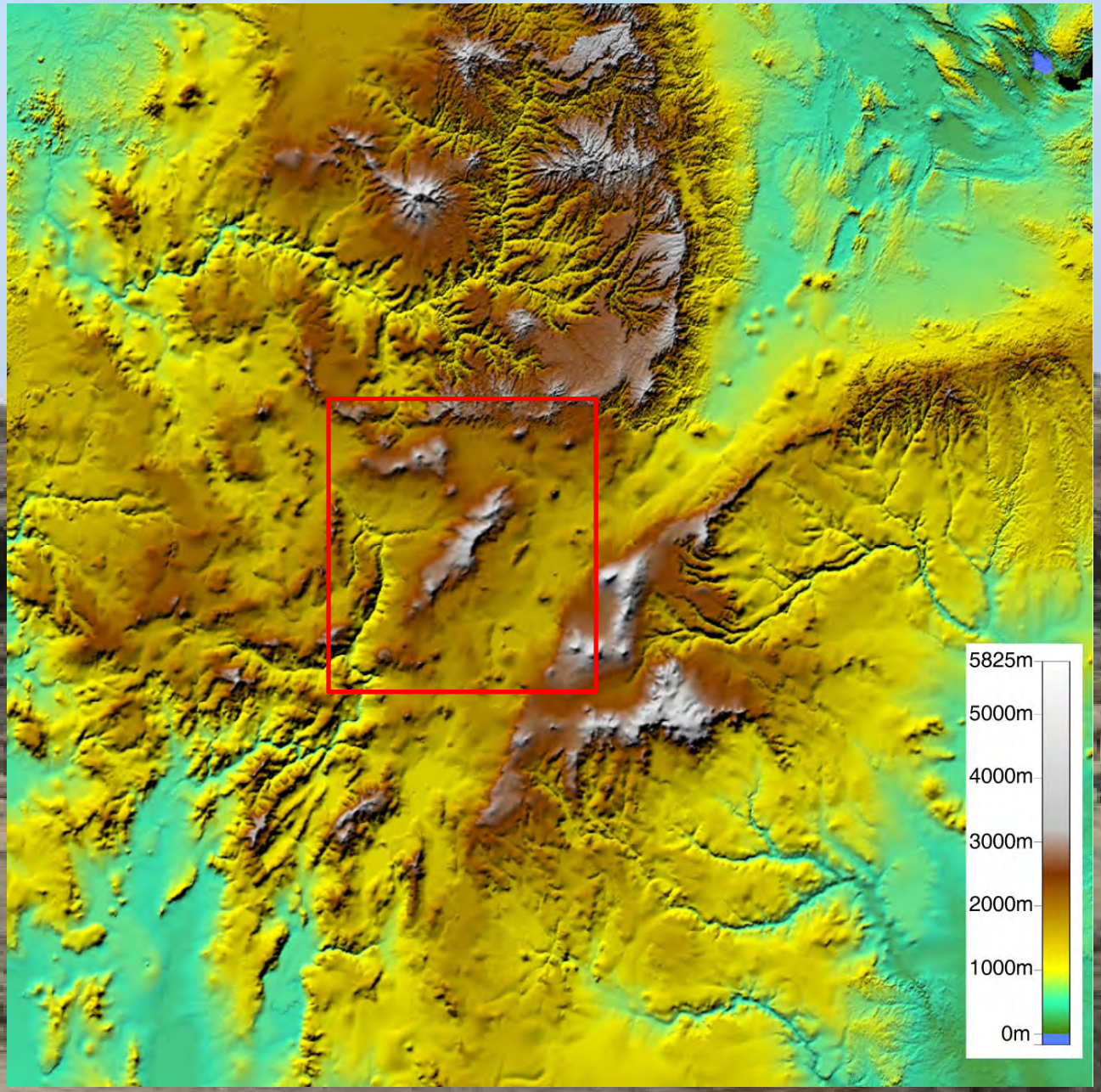
Estensione accomodata :

(sismicamente) da una combinazione di dicchi/faglie nella **crosta superiore**

(asismicamente) dall'intrusione di magma nella **crosta inferiore-media** e nel **mantello superiore**



Rift Etiopico: segmento centrale (CMER)



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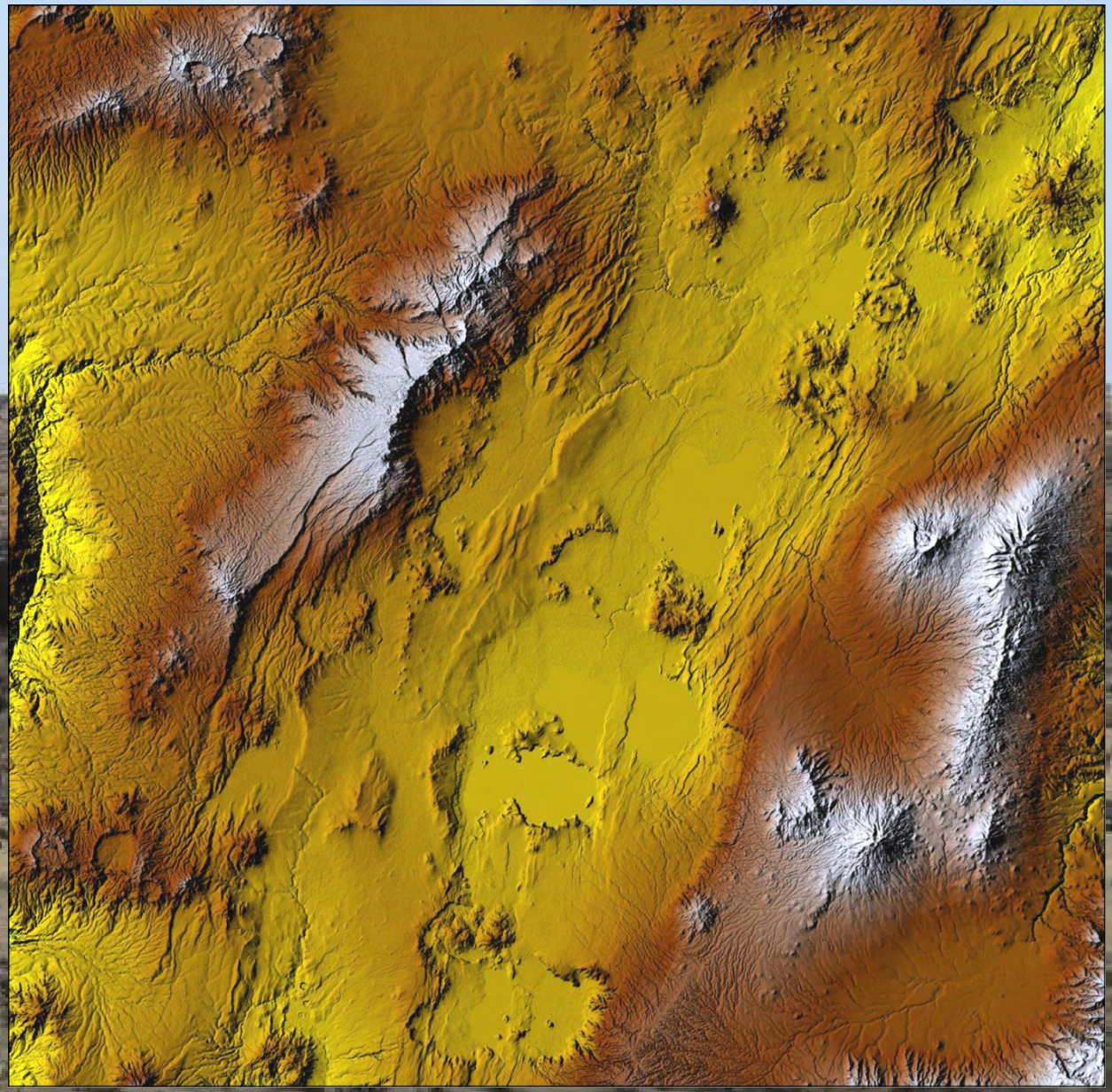

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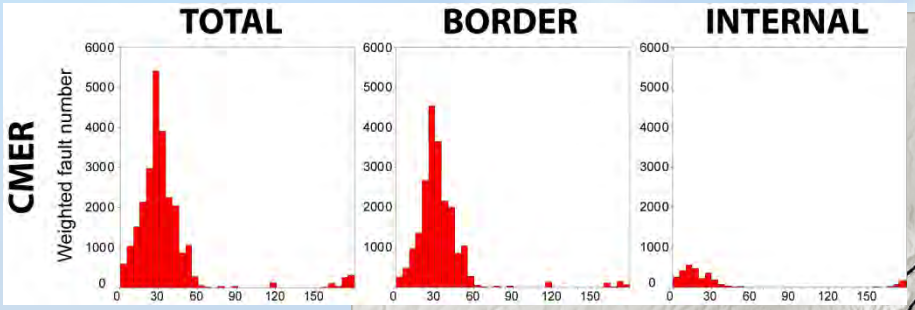
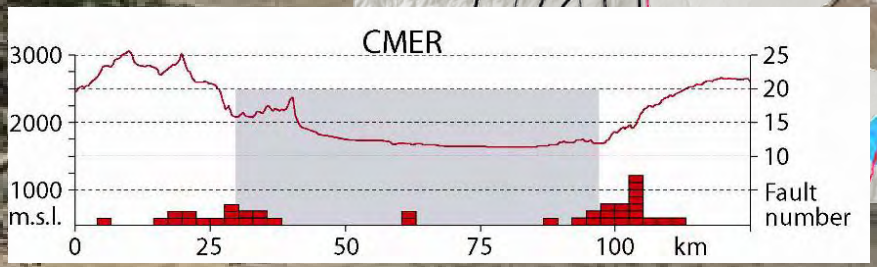
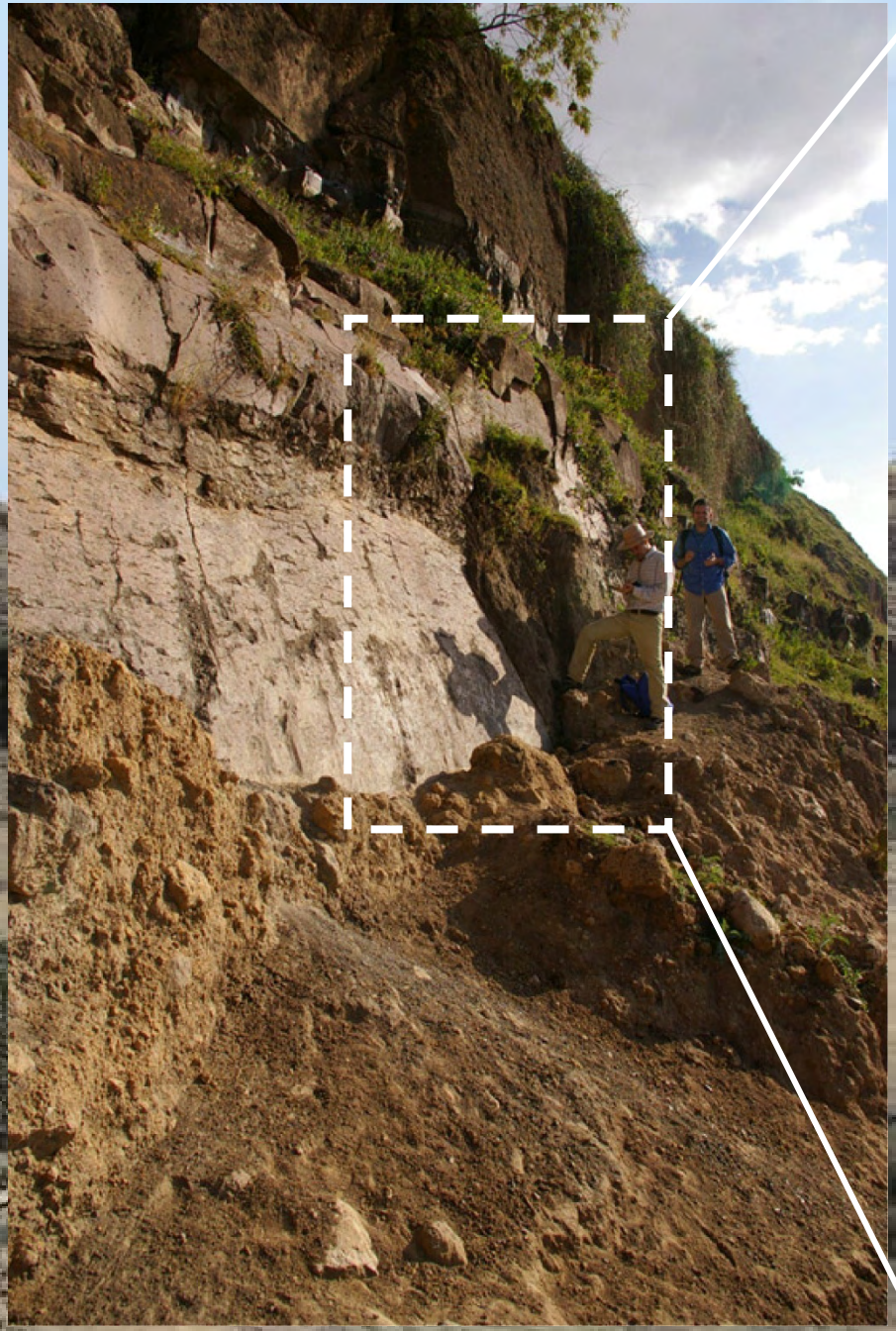
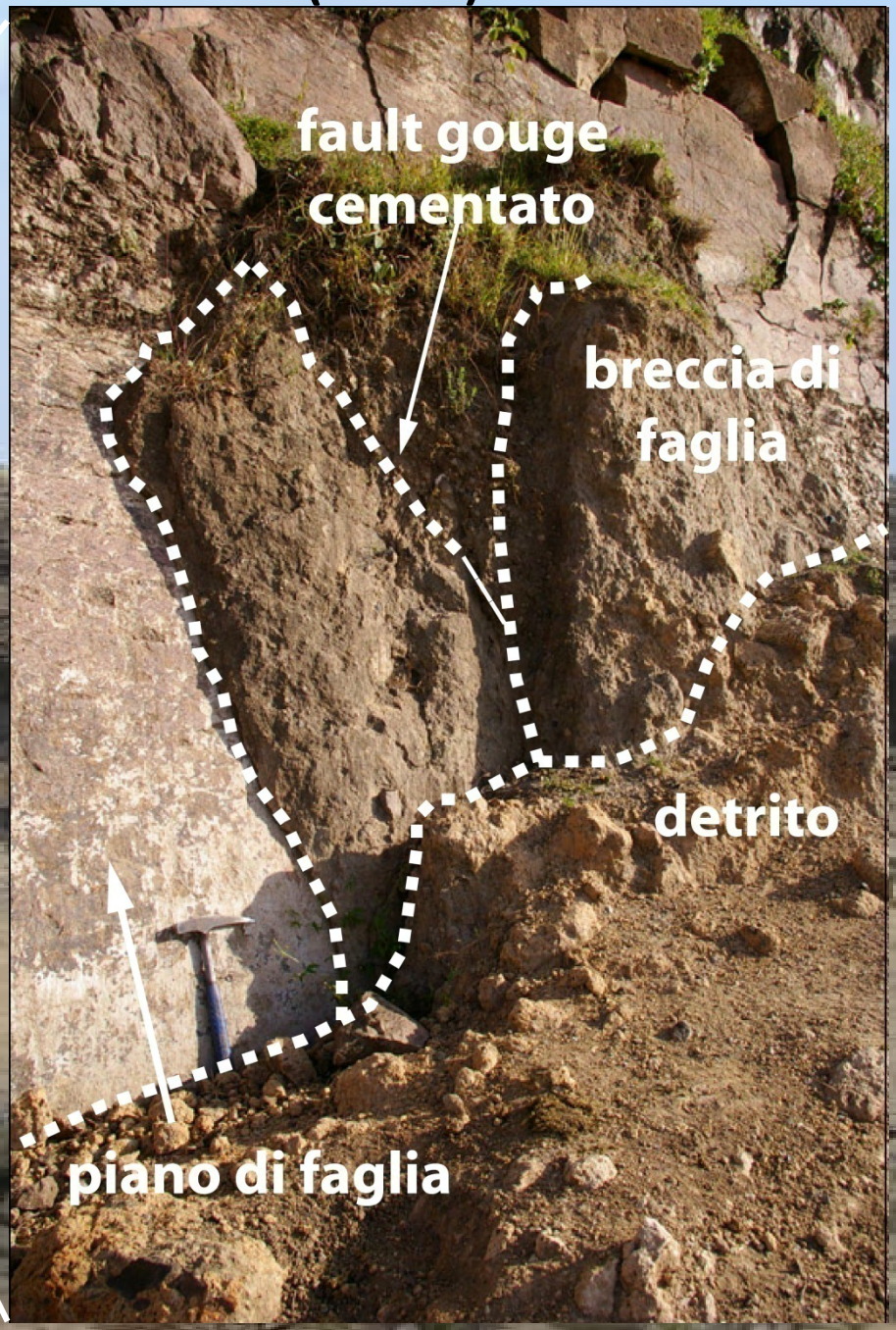




Rift Etiopico: segmento centrale (CMER)

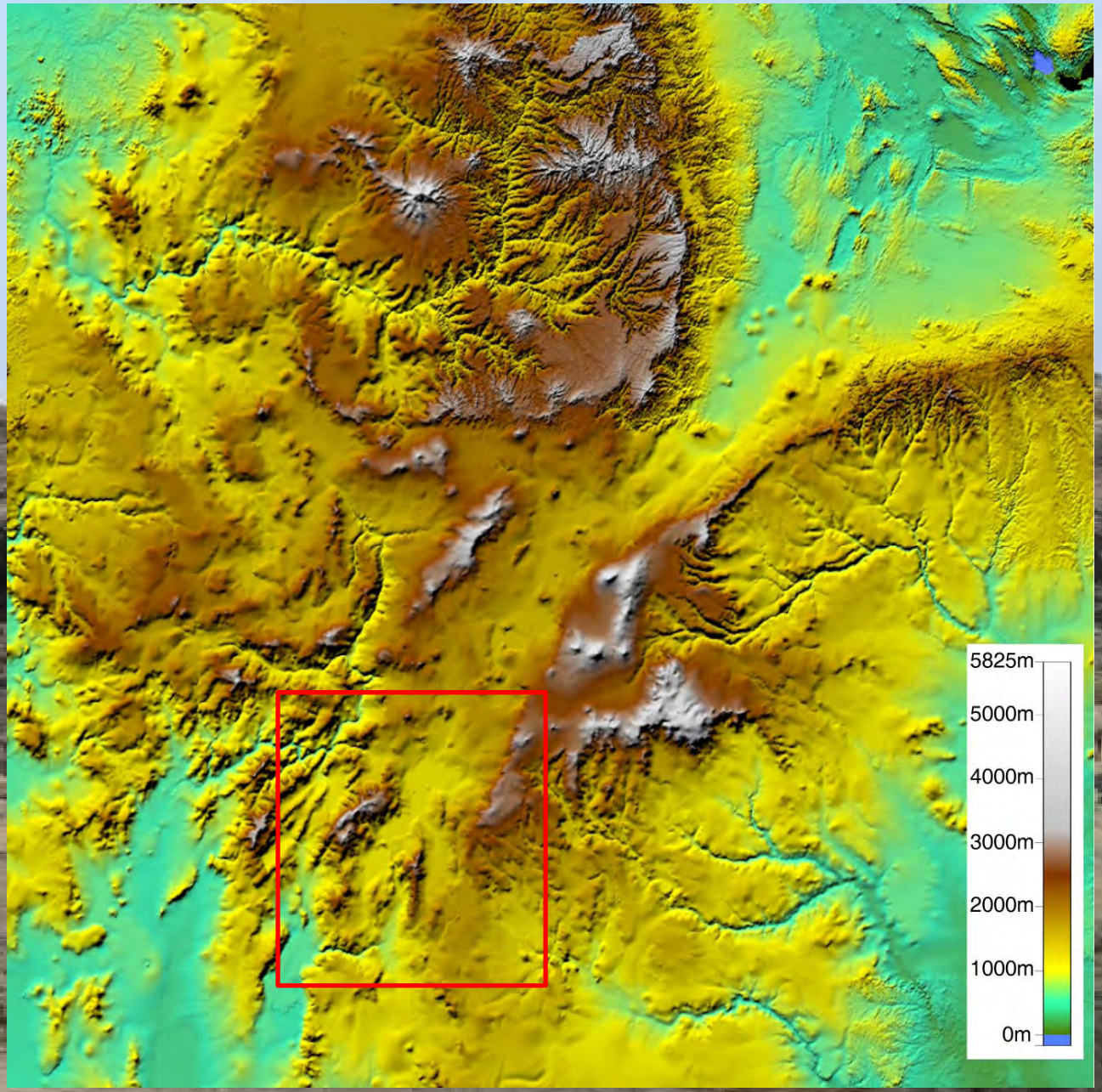




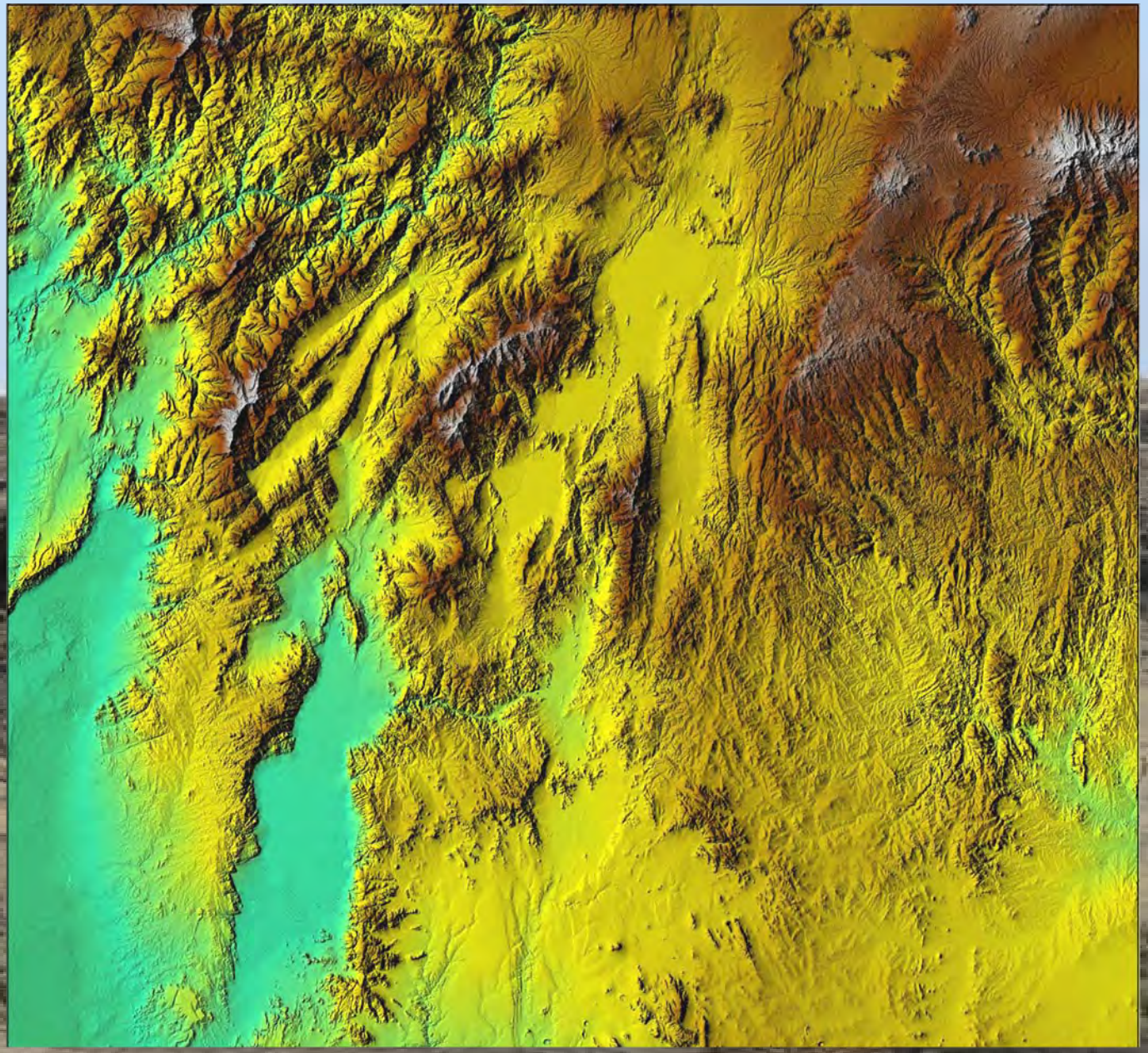
Rift Etiopico: segmento centrale (CMER)

Rift Etiopico: segmento centrale (CMER)

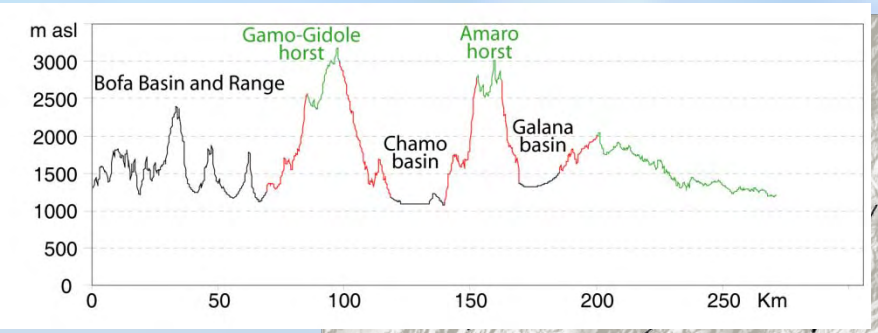
Rift Etiopico: segmento meridionale (SMER)

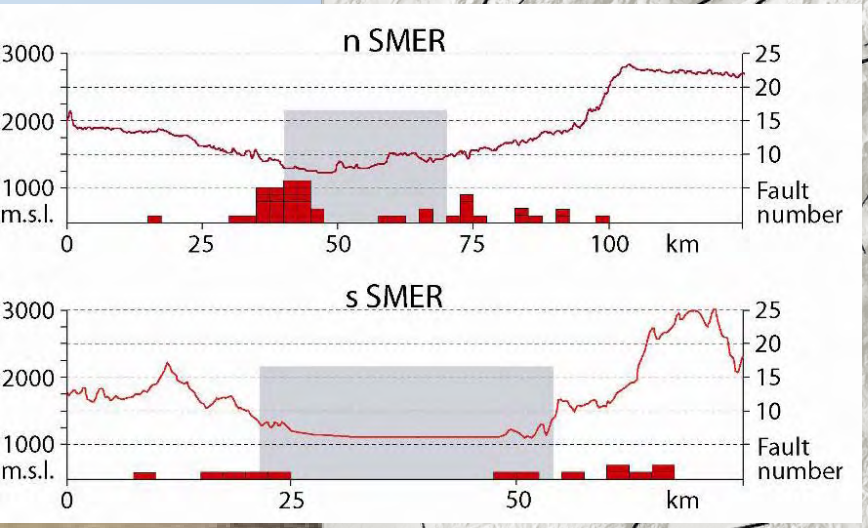


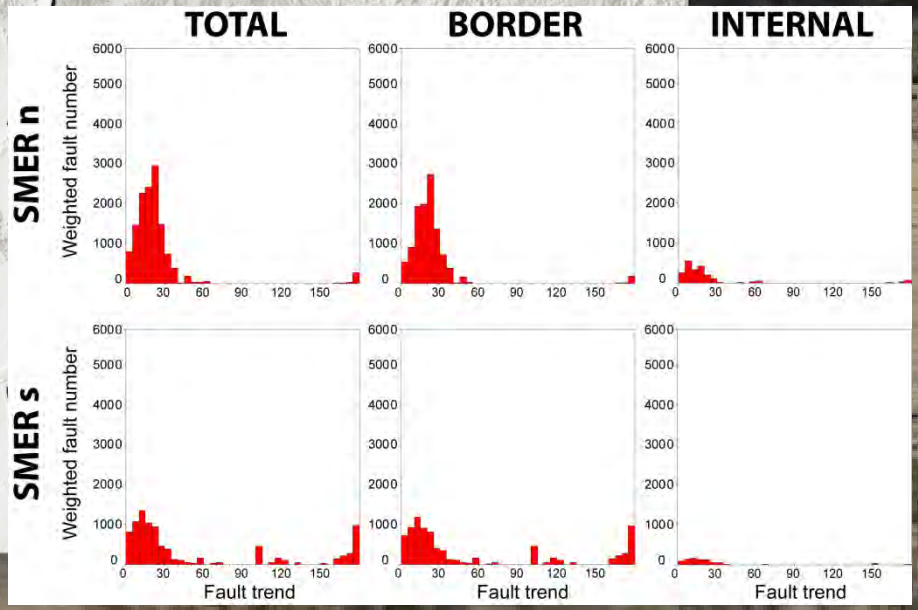
Rift Etiopico: segmento meridionale (SMER)



Rift Etiopico: segmento meridionale (SMER)

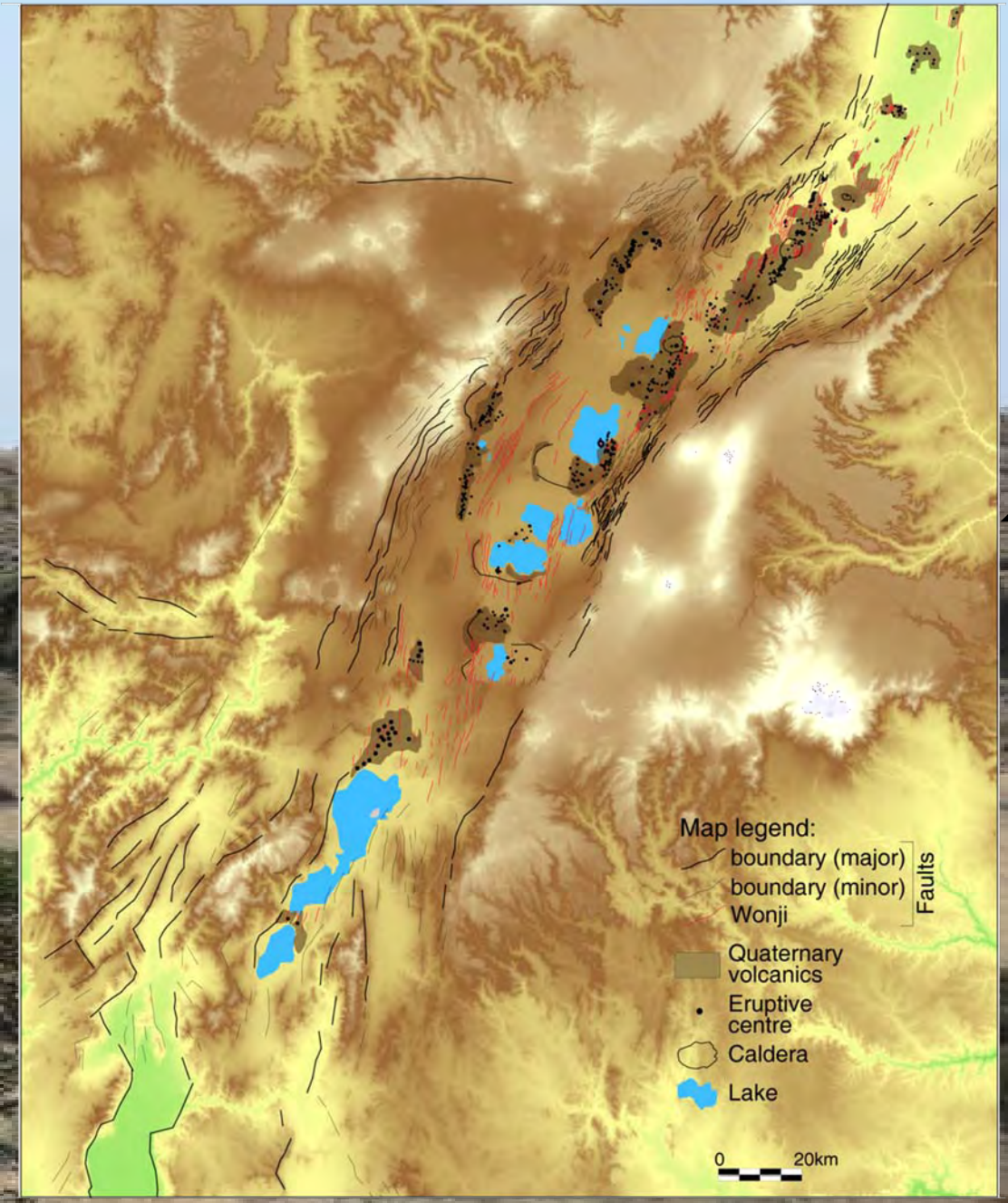






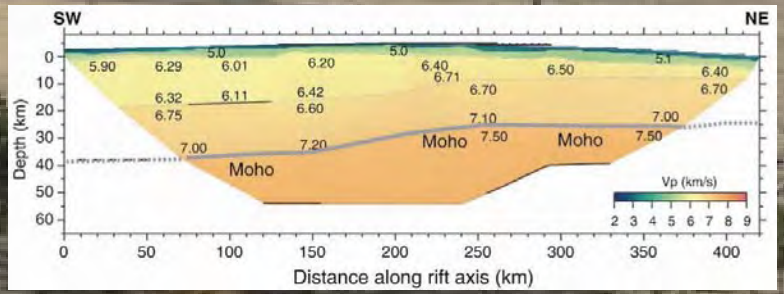
Rift Etiopico: segmento meridionale (SMER)

Rift Etiopico: differenze tra i vari segmenti



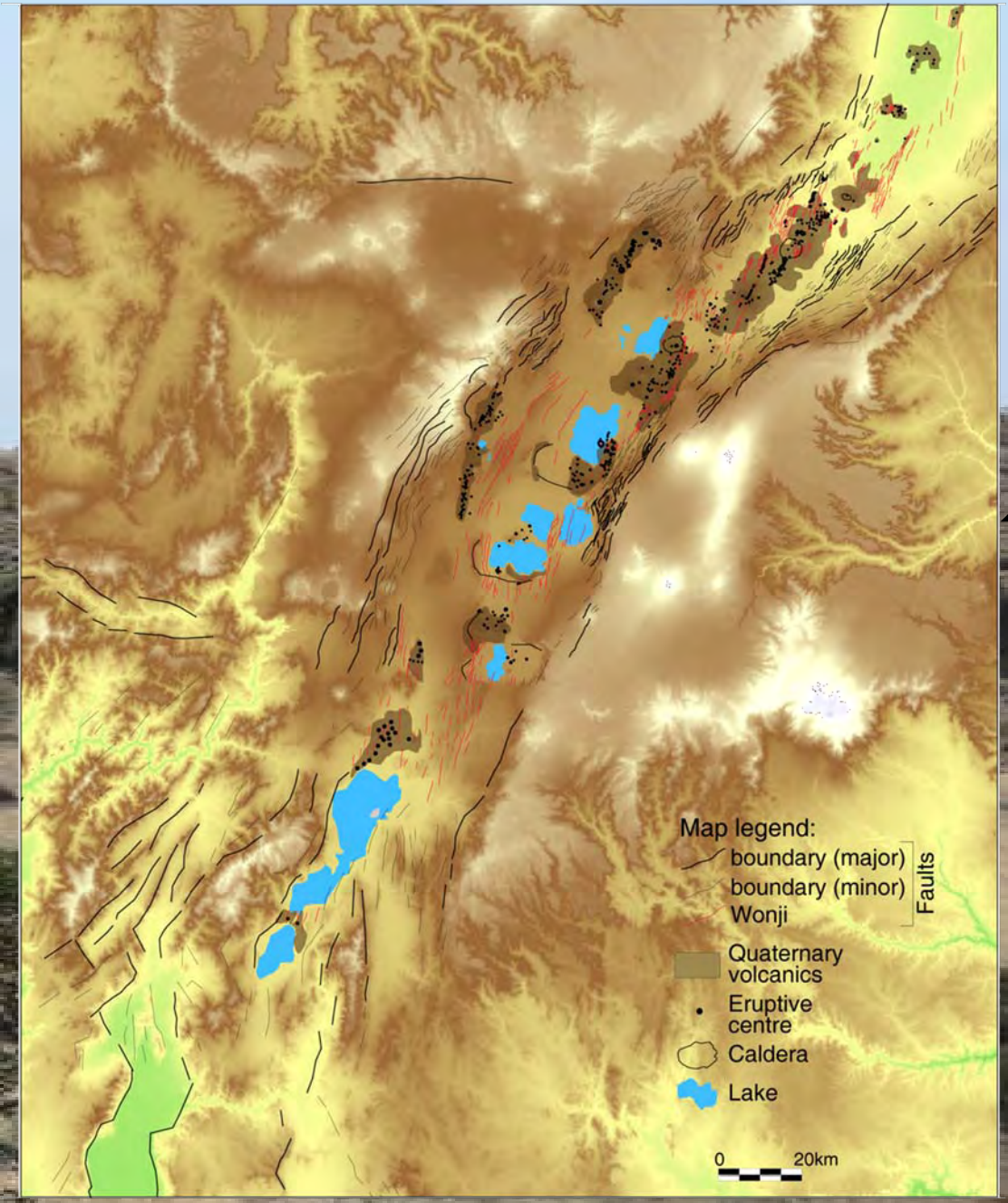
Da Sud verso Nord:

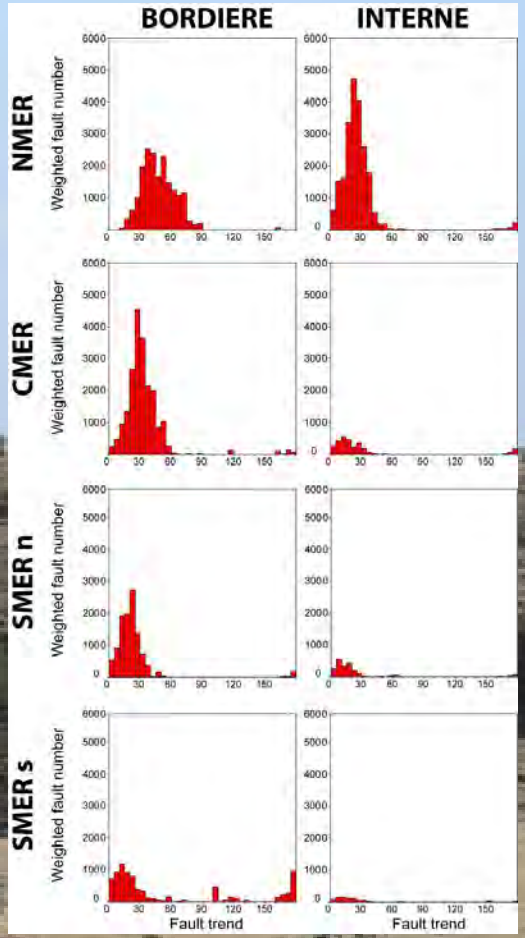
- Diminuzione spessore crostale
- diminuzione magmatismo e modificazione magmatica della litosfera (segmenti tettono-magmatici ben sviluppati)
- variazione del tipo e distribuzione della deformazione (e della sismicità)



(McKenzie et al., 2005 Geophys. J. Int.)

Rift Etiopico: differenze tra i vari segmenti

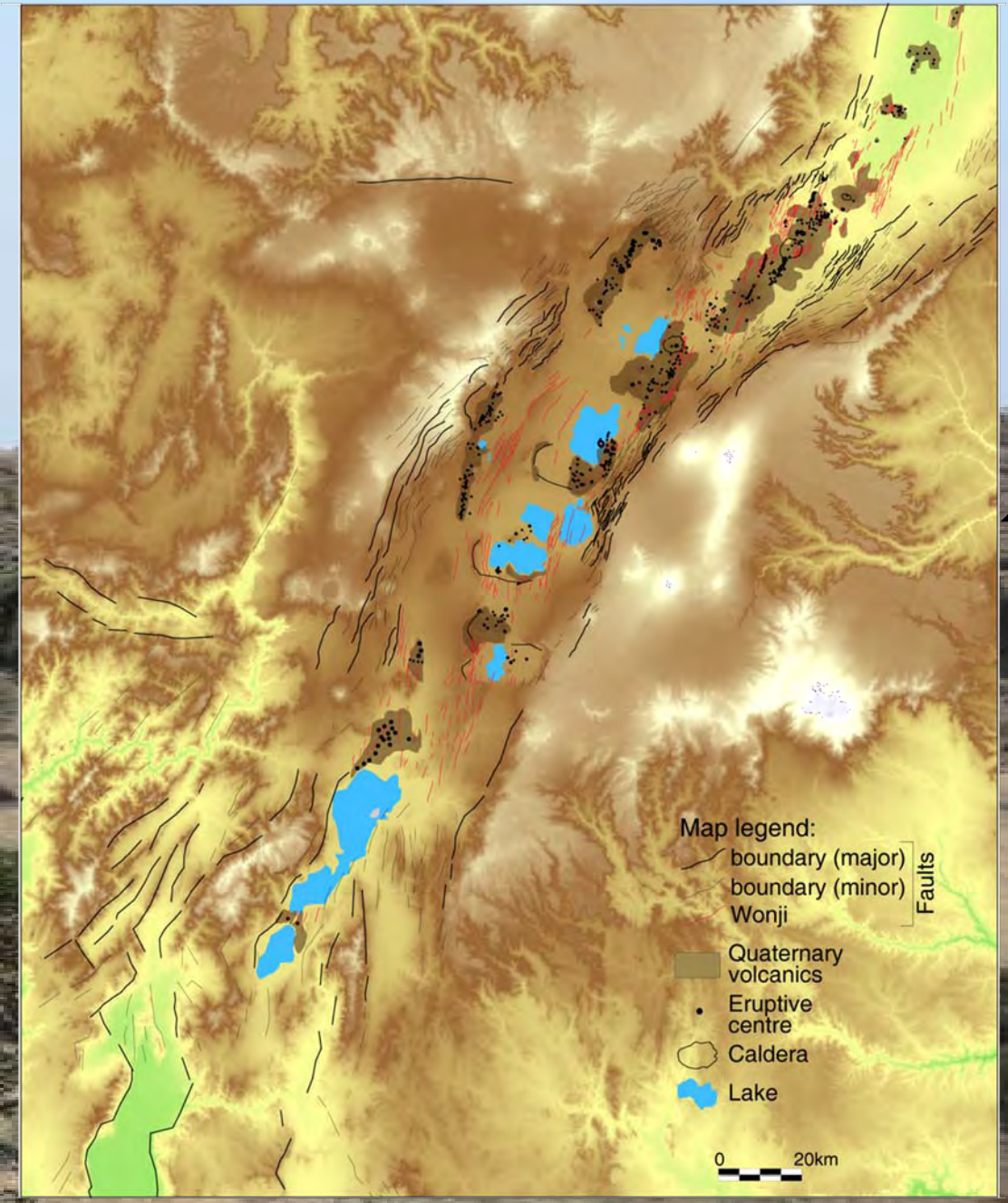


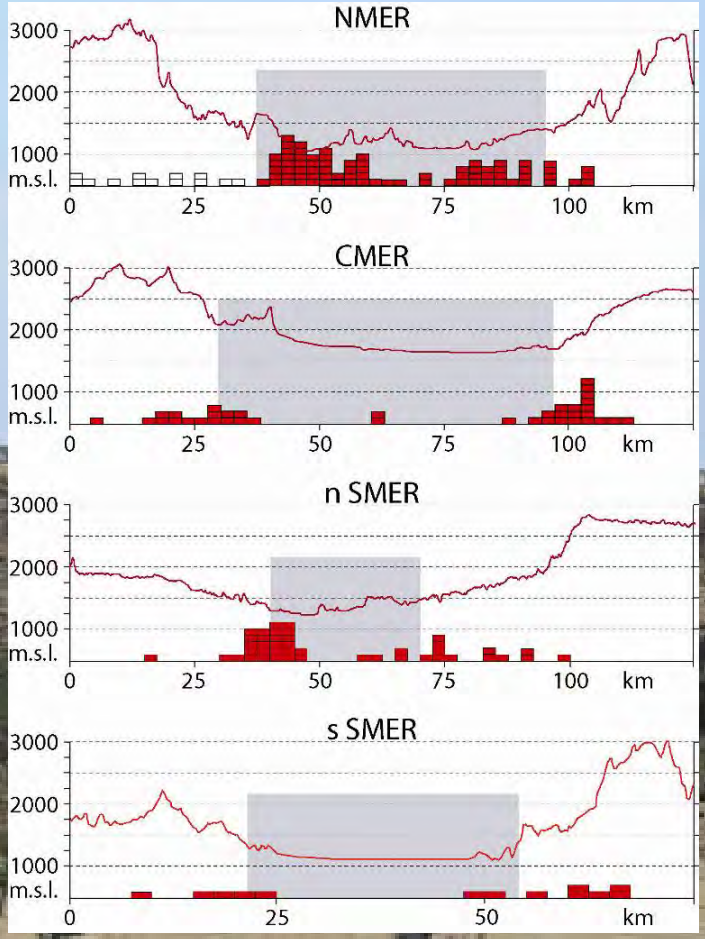


NMER: WFB ben sviluppate, faglie bordiere erose

C-SMER: dominanza faglie bordiere, WFB poco o per niente sviluppate

Rift Etiopico: differenze tra i vari segmenti



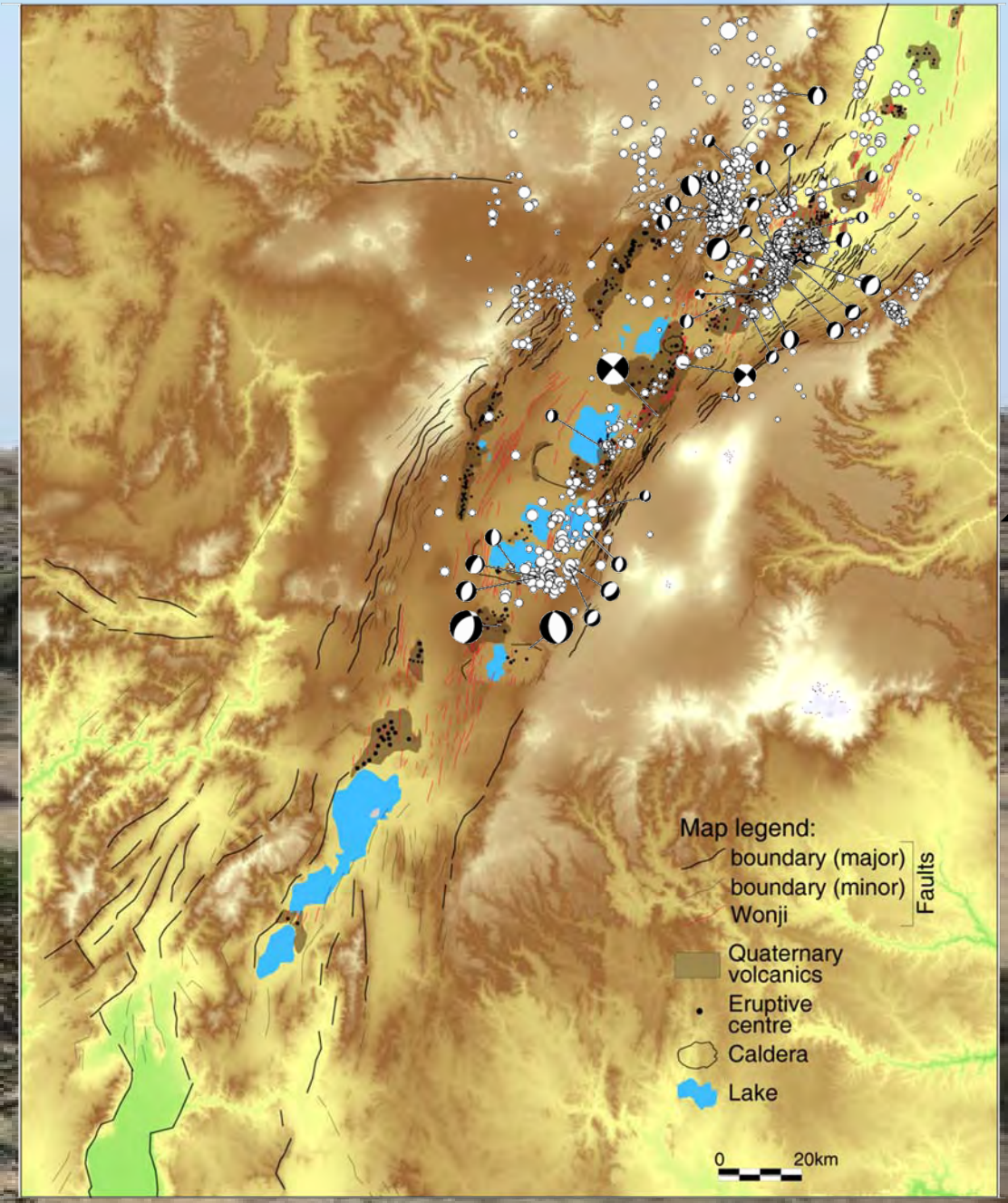


NMER: deformazione nel centro del rift

CMER: deformazione nel centro incipiente

SMER: deformazione principalmente ai bordi

Rift Etiopico: differenze tra i vari segmenti



Sismicità:

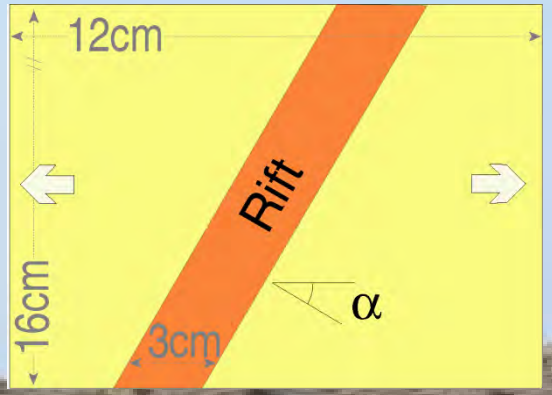
NMER: deformazione nel centro del rift (anche GPS)

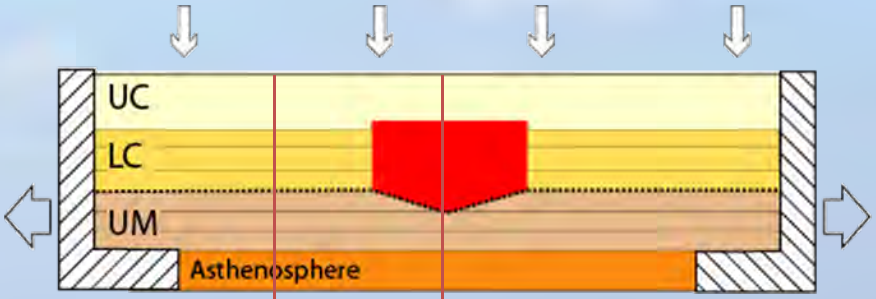
C-SMER: eventi ai bordi

Cosa ci dicono queste differenze?

→ Modelli a scala ridotta (in laboratorio)

Rift Etiopico: modelli analogici





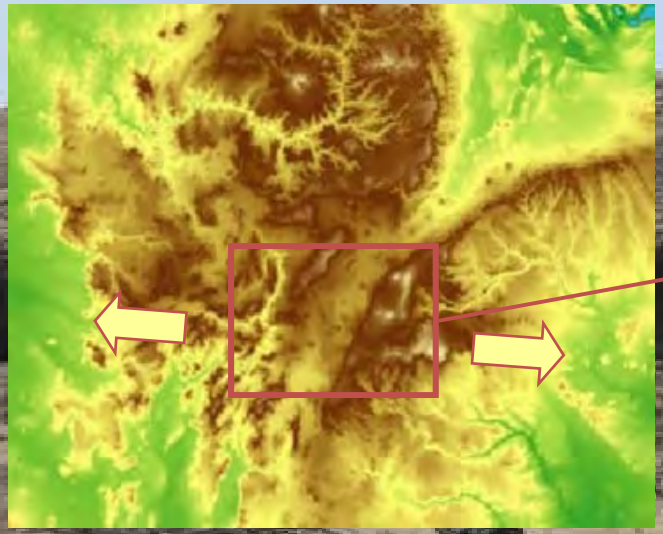
Strength profiles and set-up based on numerical models by Van Wijk, 2005 GRL

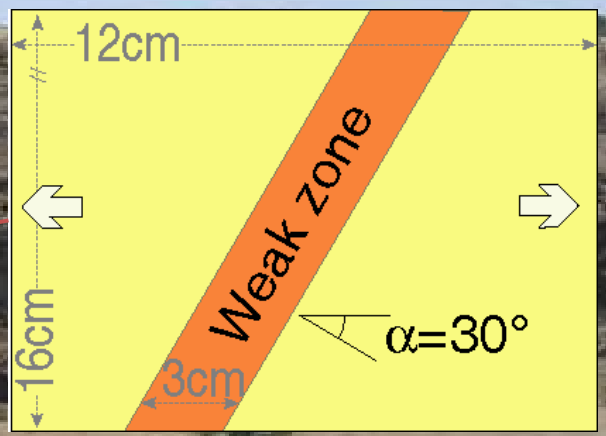
Materials: K-Feld sand, silicone mixtures

Syn-rift sedimentation

Corti, 2008 Nature geosc

Rift Etiopico: modelli analogici

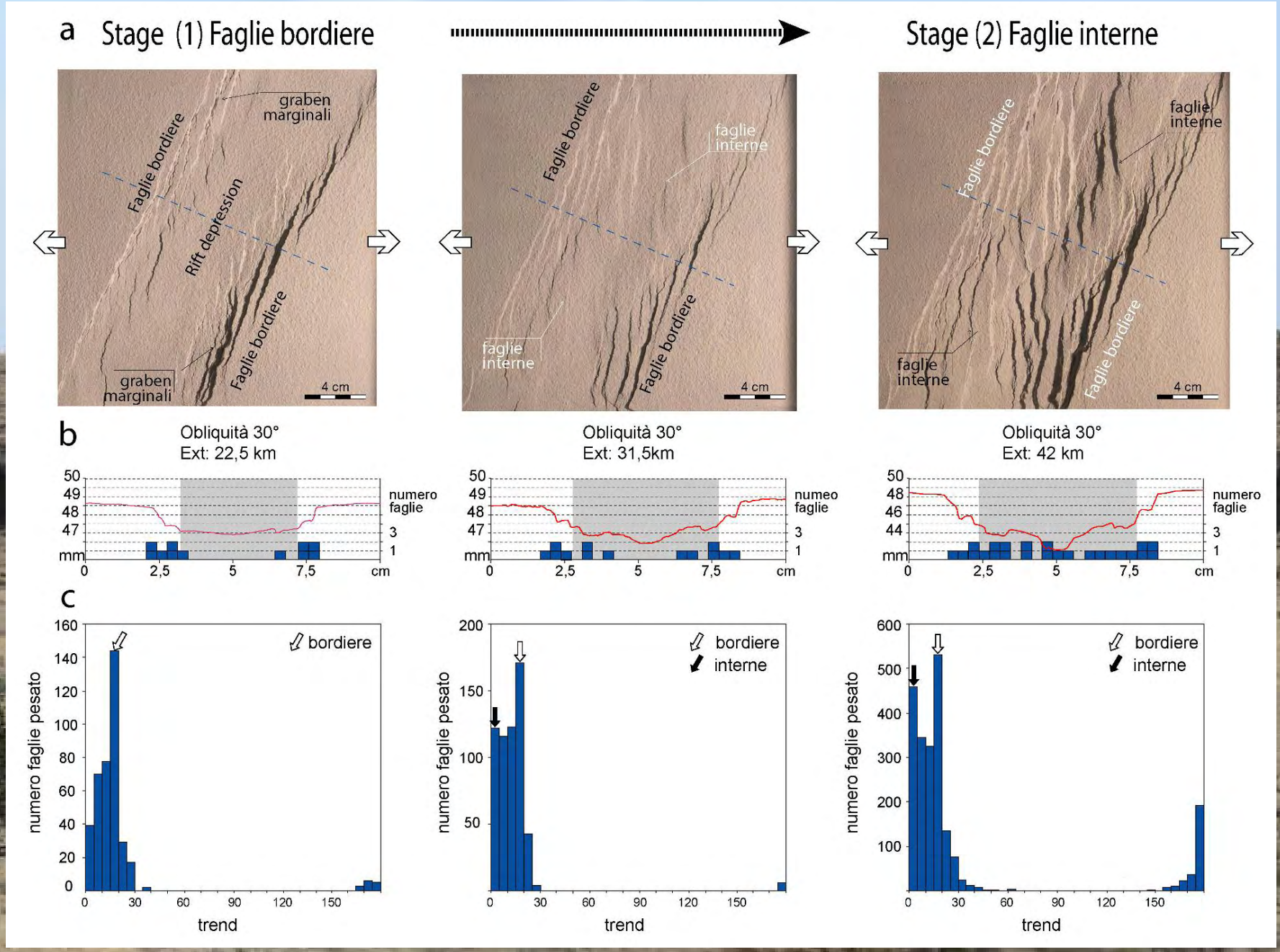




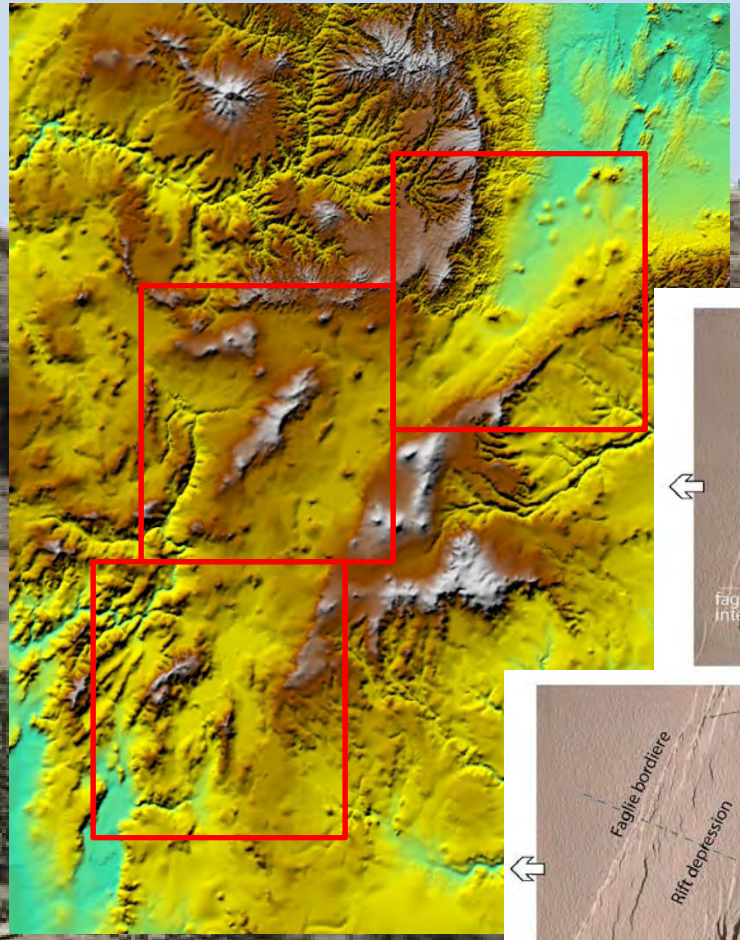
Central MER

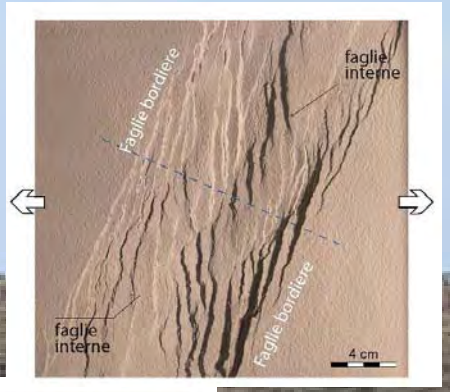
Rift Etiopico: modelli analogici

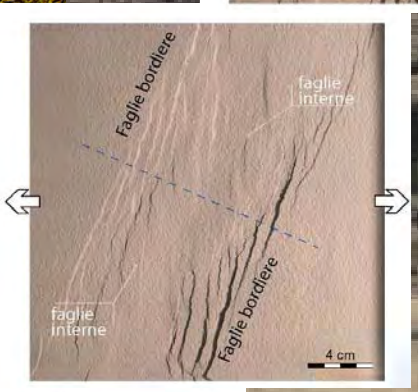
Rift Etiopico: modelli analogici



Rift Etiopico: evoluzione del rift nei differenti segmenti

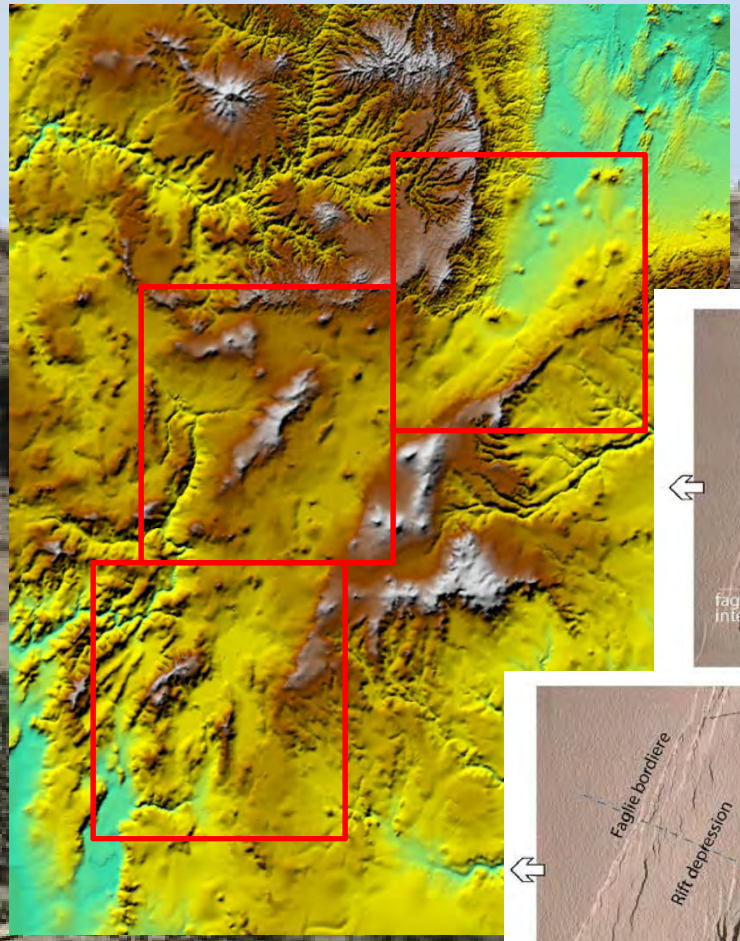


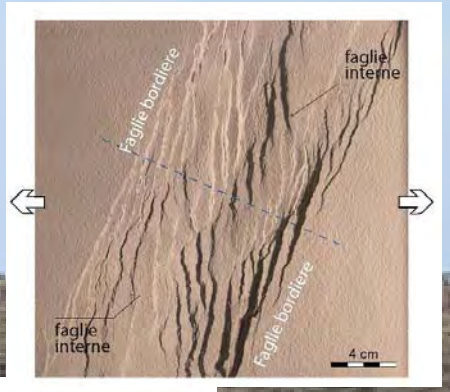


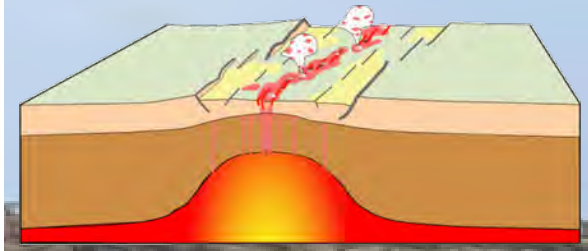


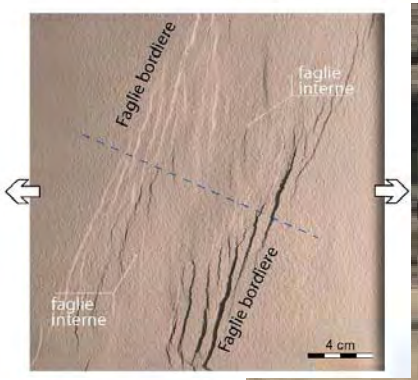
Aumento maturità del rift

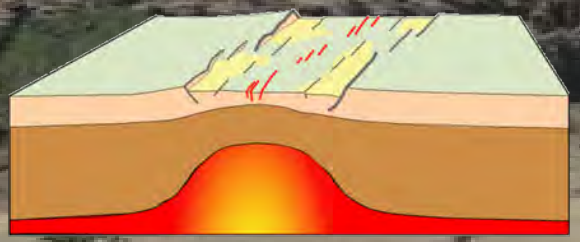
Rift Etiopico: evoluzione del rift nei differenti segmenti

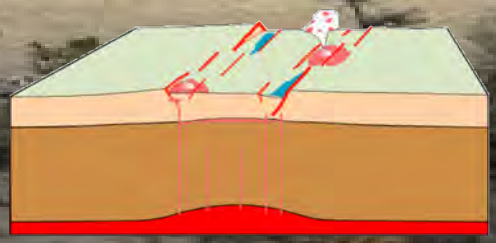








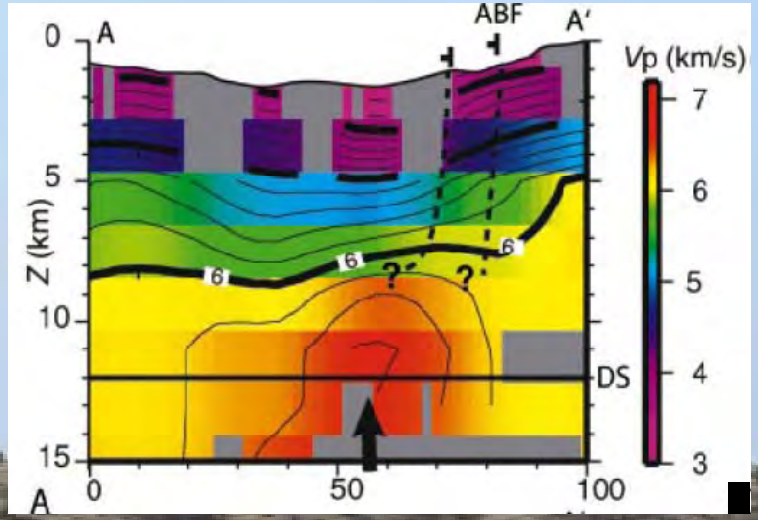




NMER: distribuzione del magmatismo

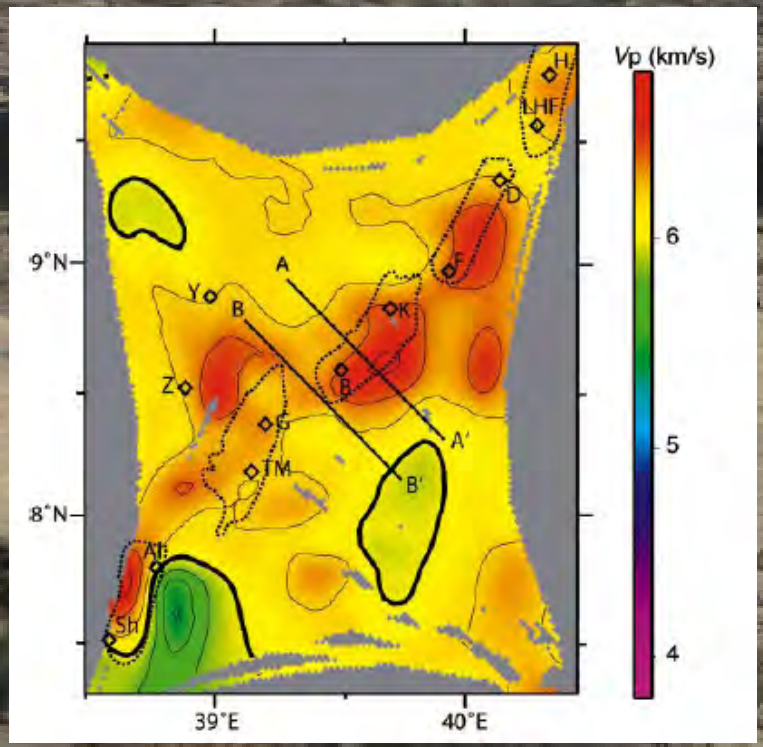
Dati geofisici (Ethiopia Afar Geoscientific Lithospheric Experiment, EAGLE project; Maguire et al., 2003EOS) mostrano importante intrusione di magma in tutta la litosfera (fino a 75km di profondità) sotto i segmenti Wonji

Profonda modificazione magmatica della litosfera



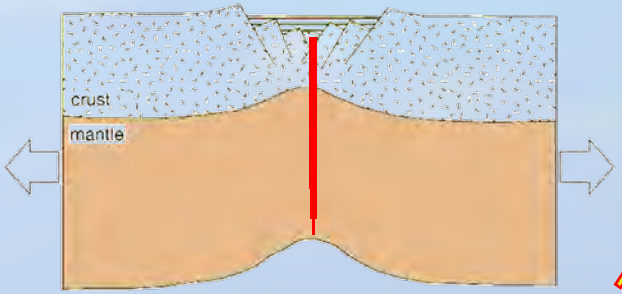
Indebolimento litosferico

Indebolimento termico della litosfera (fino a un ordine di grandezza)

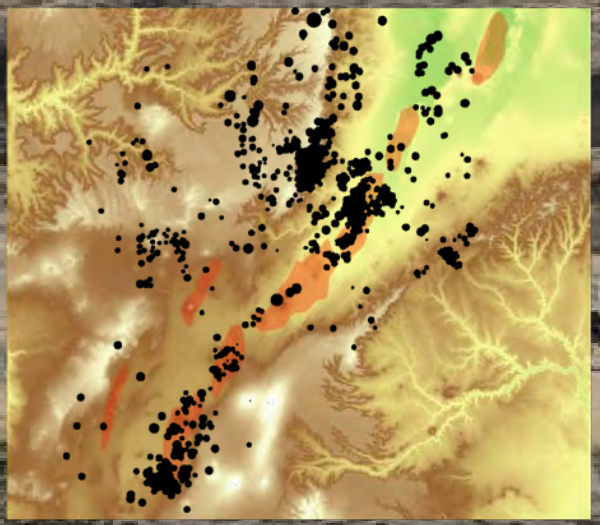


Rift Etiopico: magmatismo e rottura continentale

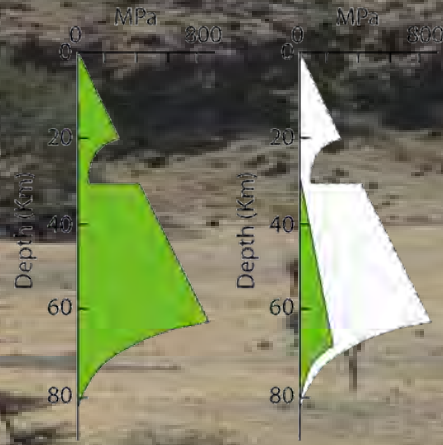
Intrusione magmatica localizzata



Deformazione localizzata

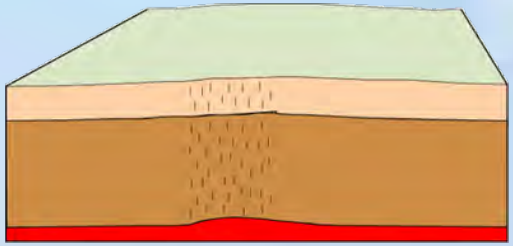


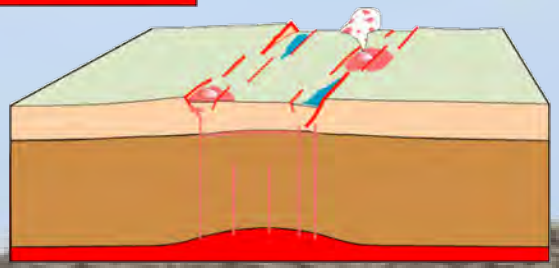
Indebolimento localizzato



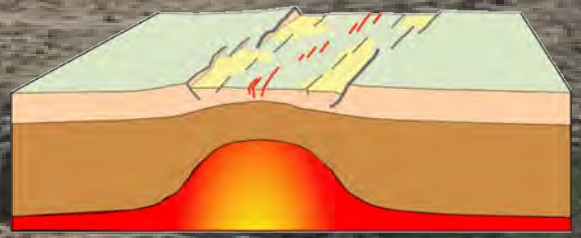
Questo processo si **autoalimenta** e permette la **rottura** della litosfera continentale

Rift Etiopico: dall'inizio dell'estensione alla rottura continentale

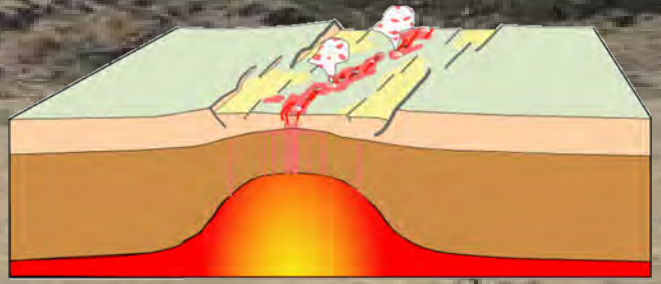




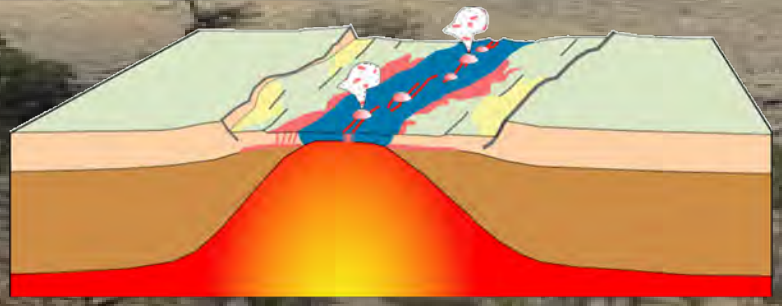
SMER



CMER



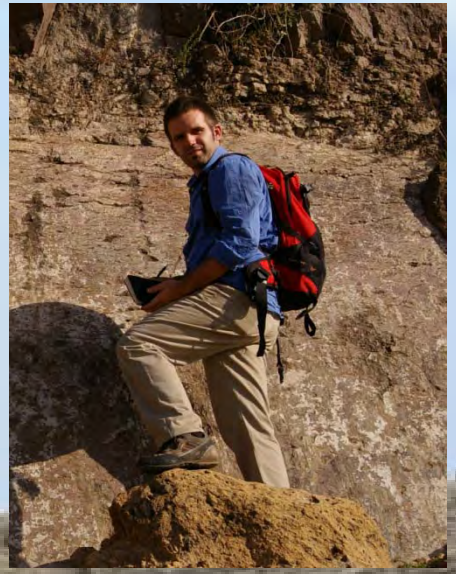
NMER



Transizione da una morfologia del rift dominata dalla tettonica (faglie) all'inizio ad un "magma assisted-rifting" durante la rottura (aumento dell'accoppiamento deformazione-magmatismo con l'estensione)

Feedback magmatismo-deformazione → Litosfera fortemente modificata dal magmatismo → Indebolimento e localizzazione della deformazione

Team members



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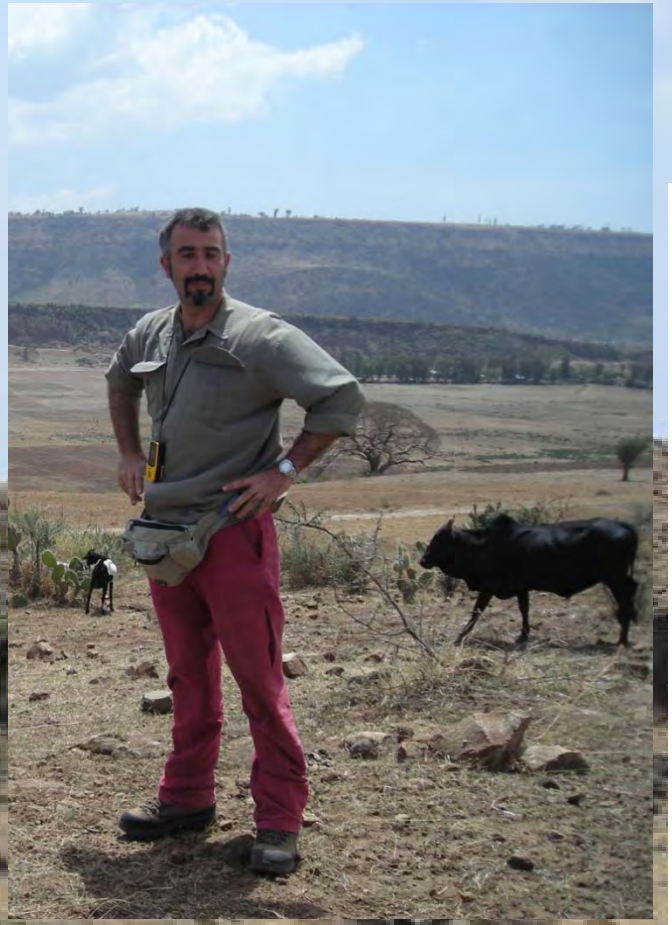
Tsegaye Abebe (Massa spinoff)

Marco Benvenuti (DST Unifi)

Piero Manetti (DST Unifi)

Francesco Mazzarini (INGV Pi)

Antonio Zeoli (MNA Siena)



GRAZIE

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Consiglio Nazionale delle Ricerche
Istituto di Geoscienze e Georisorse

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Dipartimento di Scienze della Terra

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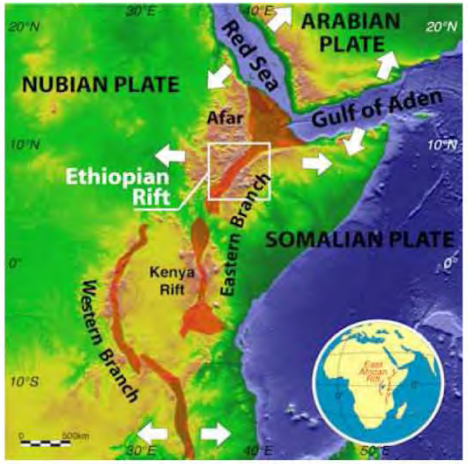

Main Ethiopian Rift web pages

Welcome to the web pages dedicated to the Main Ethiopian Rift, the northernmost sector of the East African Rift System. This rift is a natural laboratory to analyse continental extension, since it records all the different stages of rift evolution from rift initiation to break-up and incipient oceanic spreading. It thus represents an ideal place to analyse the dynamics of extension and rupture of lithospheric plates.
These pages contain some info about the Main Ethiopian Rift and the work our Scientific Team composed by researches of the *Consiglio Nazionale delle Ricerche* and *Università di Firenze* is currently doing to analyse its evolution.

FOR MORE INFORMATION PLEASE CONTACT:
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