



NEW INSIGHTS INTO THE NORTH-CENTRAL AFRICAN LITHOSPHERE FROM THE GOCE GRAVITY AND GRAVITY GRADIENT FIELDS

GNGTS, 14-16 November 2011, Trieste

Carla Braitenberg,

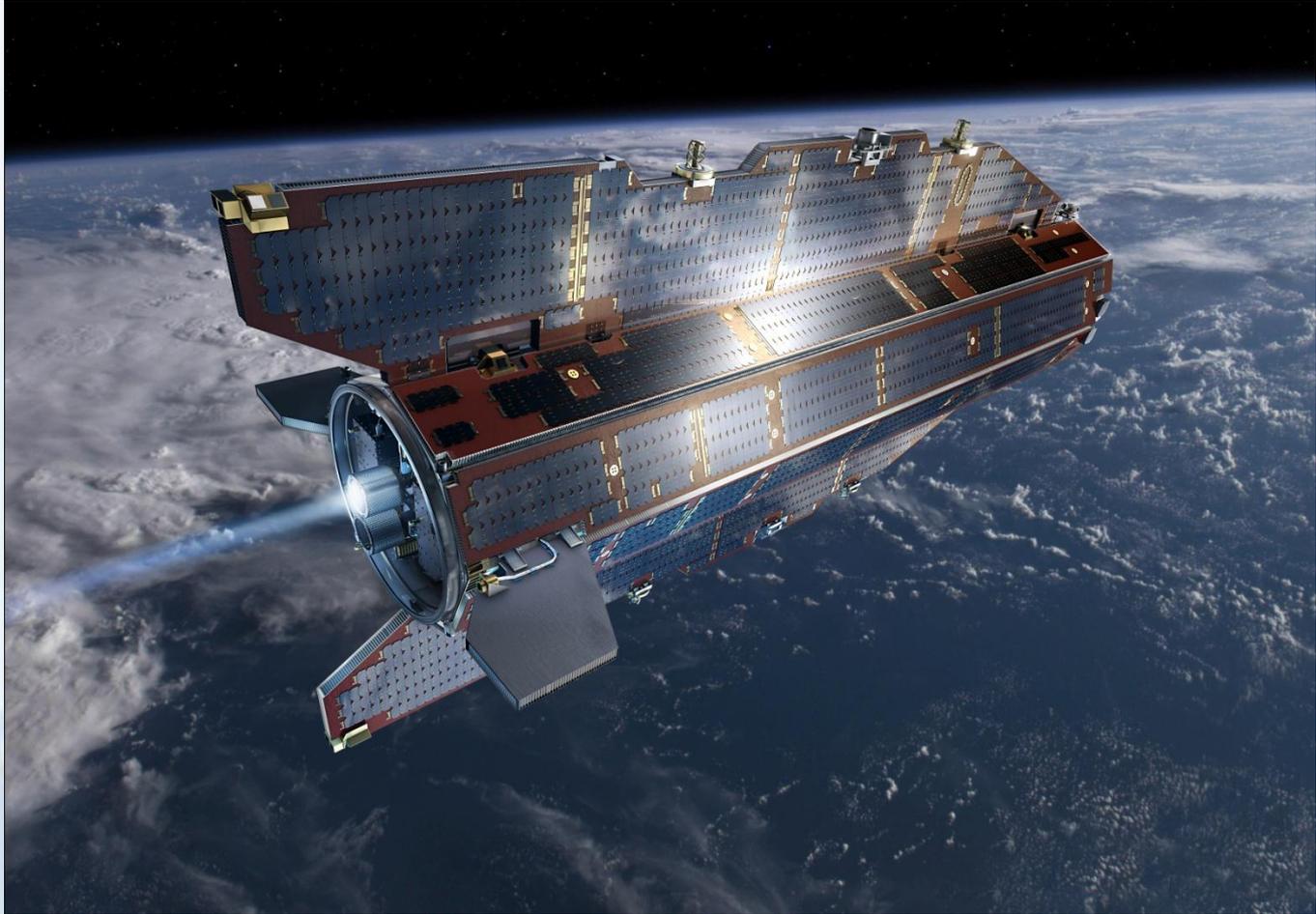
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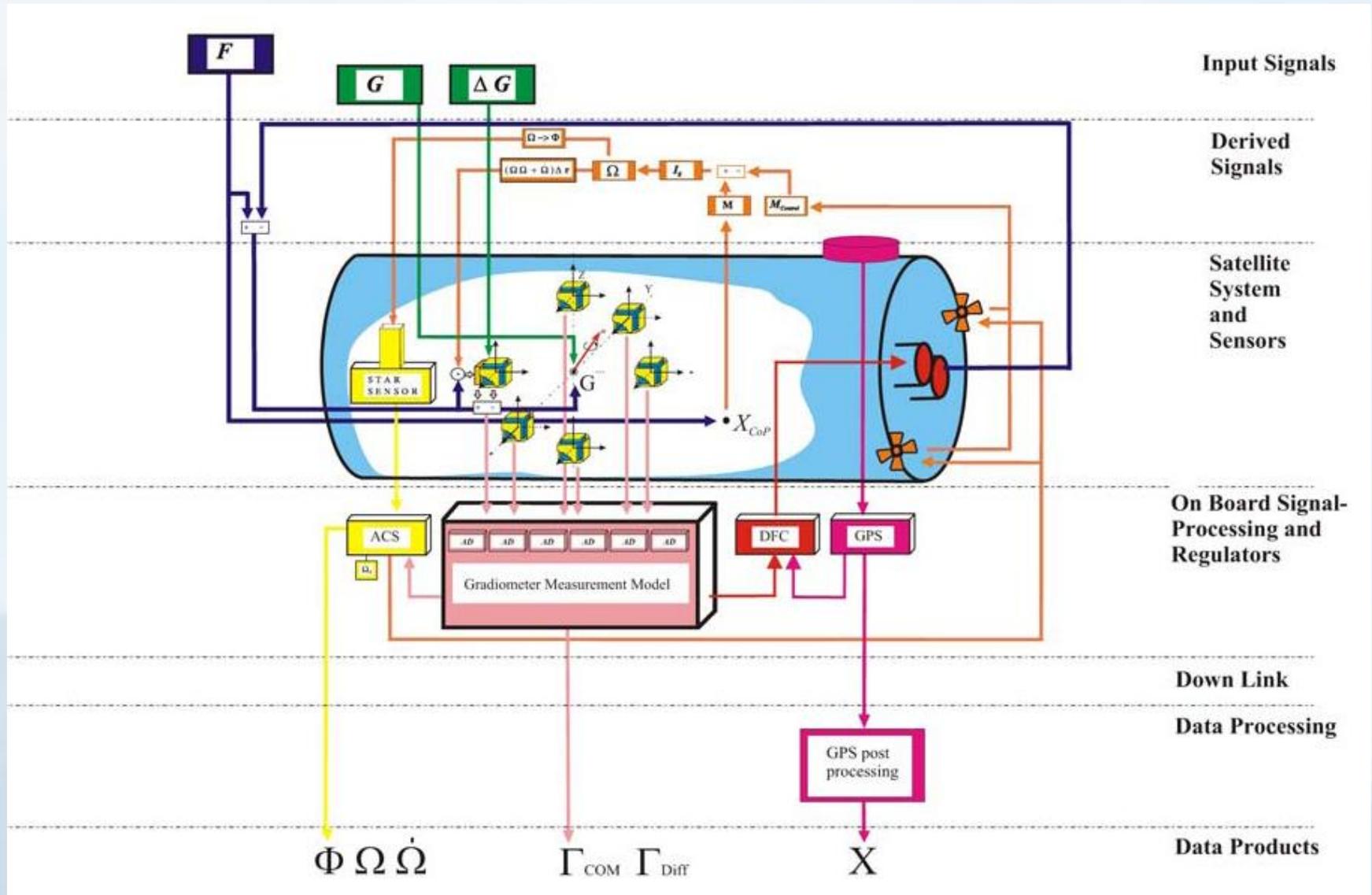
Si ringrazia

Agenzia Spaziale Italiana – *GOCE-Italy*

GOCE satellite



The GOCE Sensor System



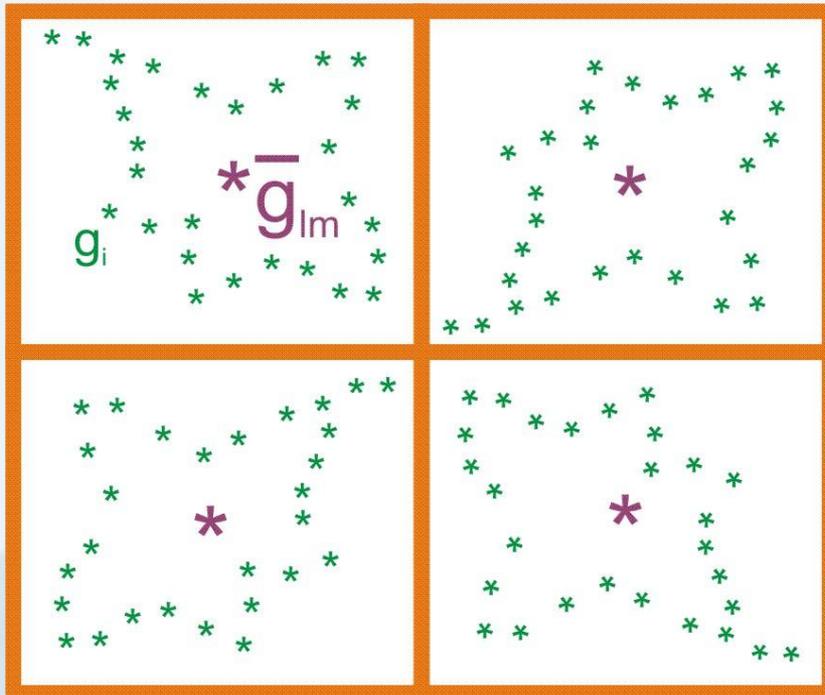
Current global gravity fields

- GOCE-satellite- global potential fields
 - N=250, 80 km resolution
(Bruinsma et al., 2011, Migliaccio et al., 2011, Pail et al., 2011)
- EGM2008 (Pavlis et al., 2008): N=2159, resolution 9 km
 - Combined terrestrial data and different satellites.
- EIGEN06 (Förste et al., 2011)

GOCE: for crustal and lithospheric studies and for quality control of terrestrial data

- EGM08: high resolution of 9km is nominal, field may be only interpolated
- Terrestrial data in many countries very inhomogeneous in distribution
- EGM08 affected by errors in terrestrial data
- GOCE truly global.
 - Although of lower resolution, it gives information on quality of higher resolution terrestrial data.

Downscaling of terrestrial observations and quality control with GOCE



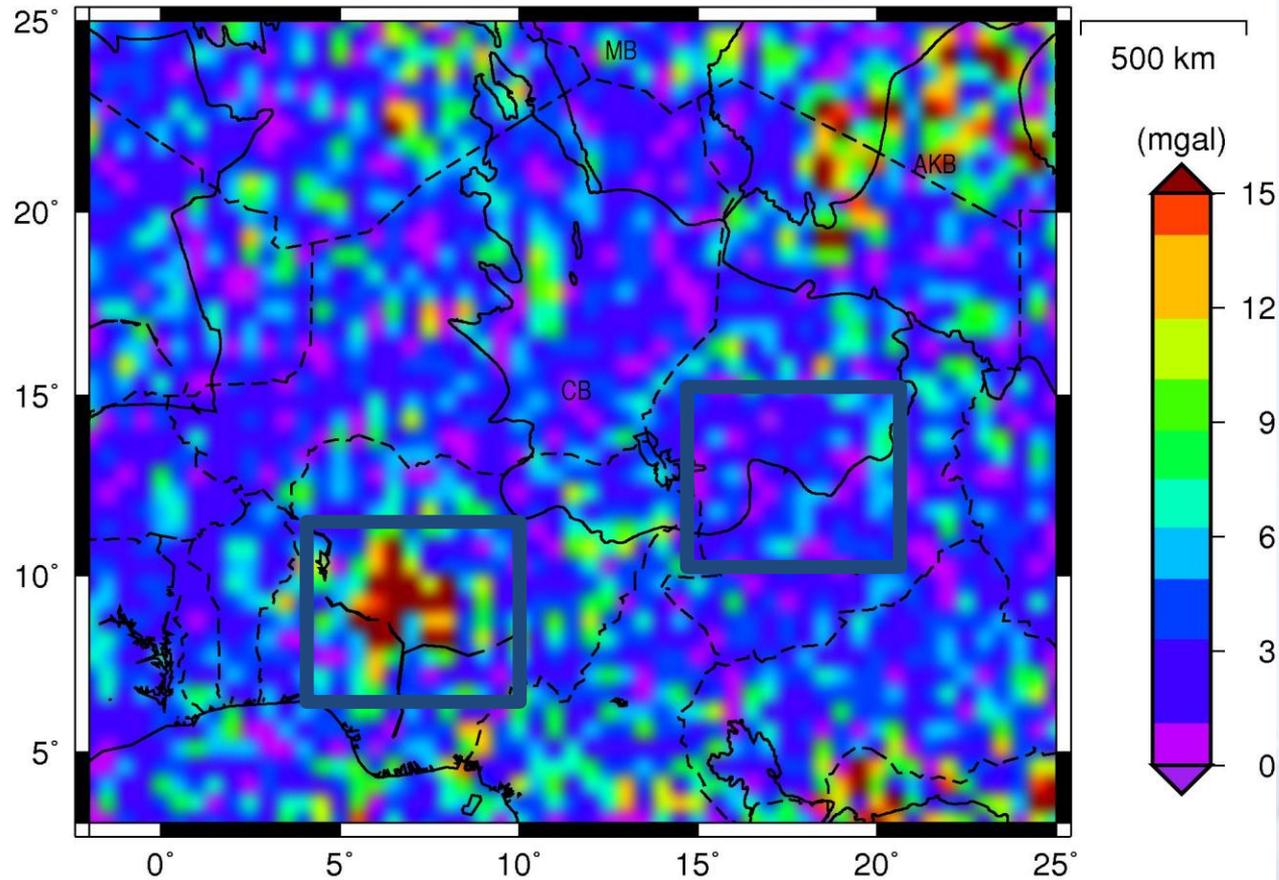
$$\bar{g}_{lm}^K = \frac{1}{K} \sum_{i=1}^K g_i$$

$$\sigma_K = \sigma_T / \sqrt{K}$$

$$\sigma_g = \bar{g}_{lm} - g_{GOCE}$$

Residual: EGM08 and GOCE

Grav.Abs.Residual



GOCE: Pail et al., 2011; N=250.

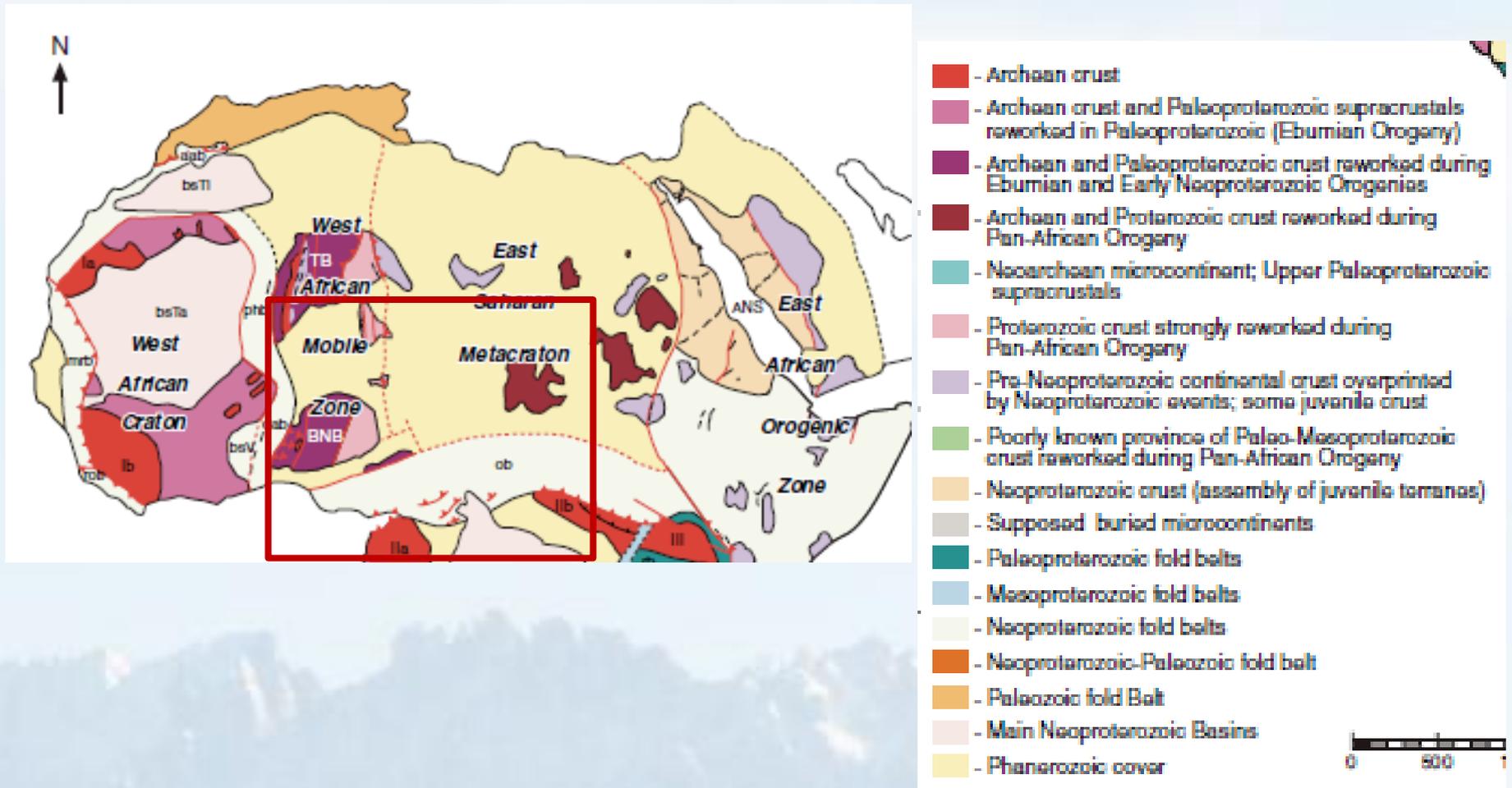
GOCE satellite in North Africa

- Aims of our investigation:
 - model lithospheric and crustal densities

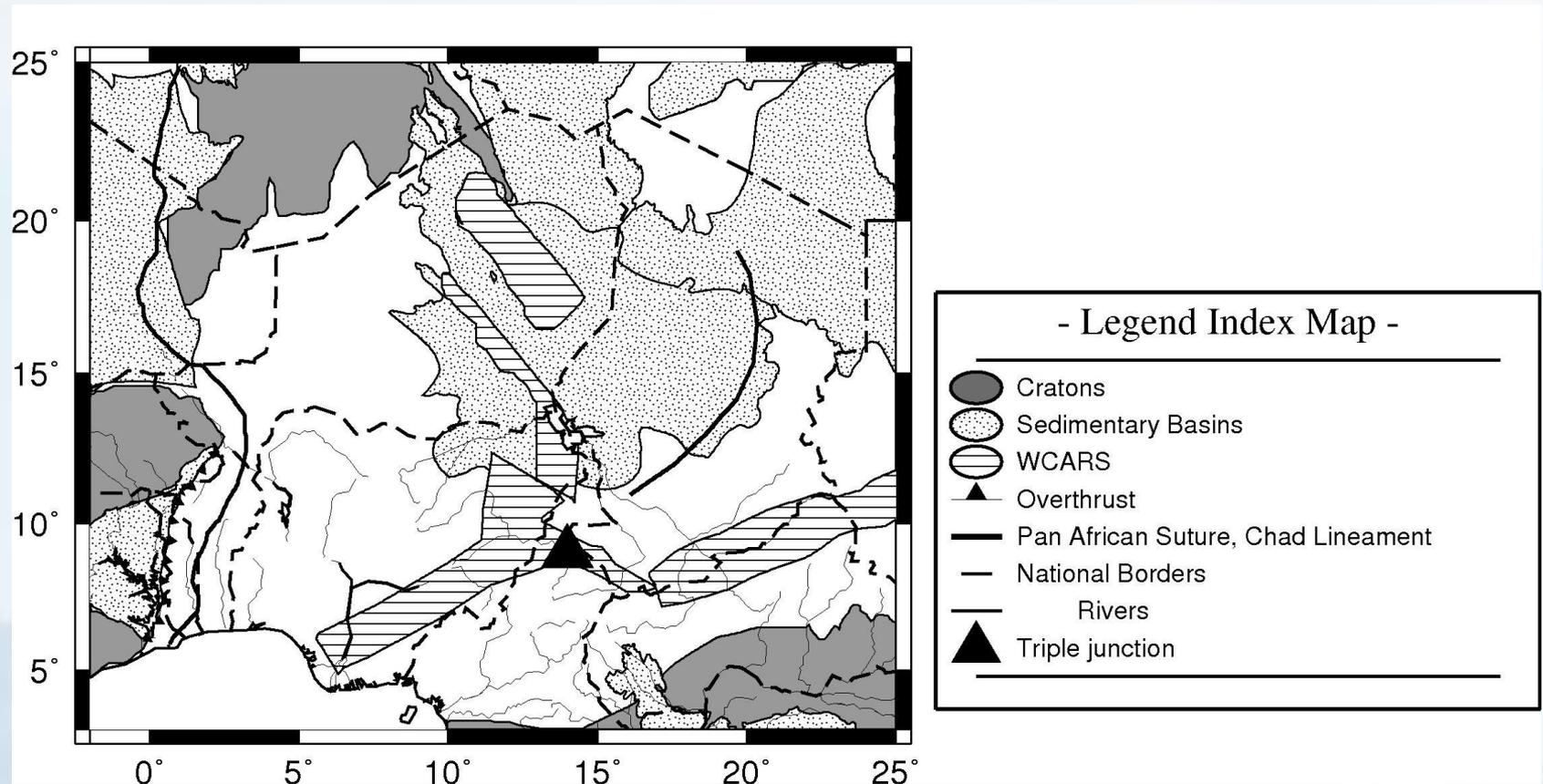
Applications:

- Seismic and volcanic risk assessment
- Natural resources

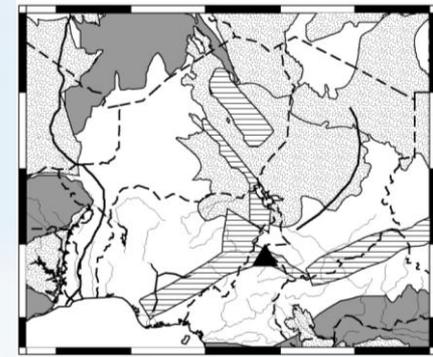
Major subdivisions of the crust



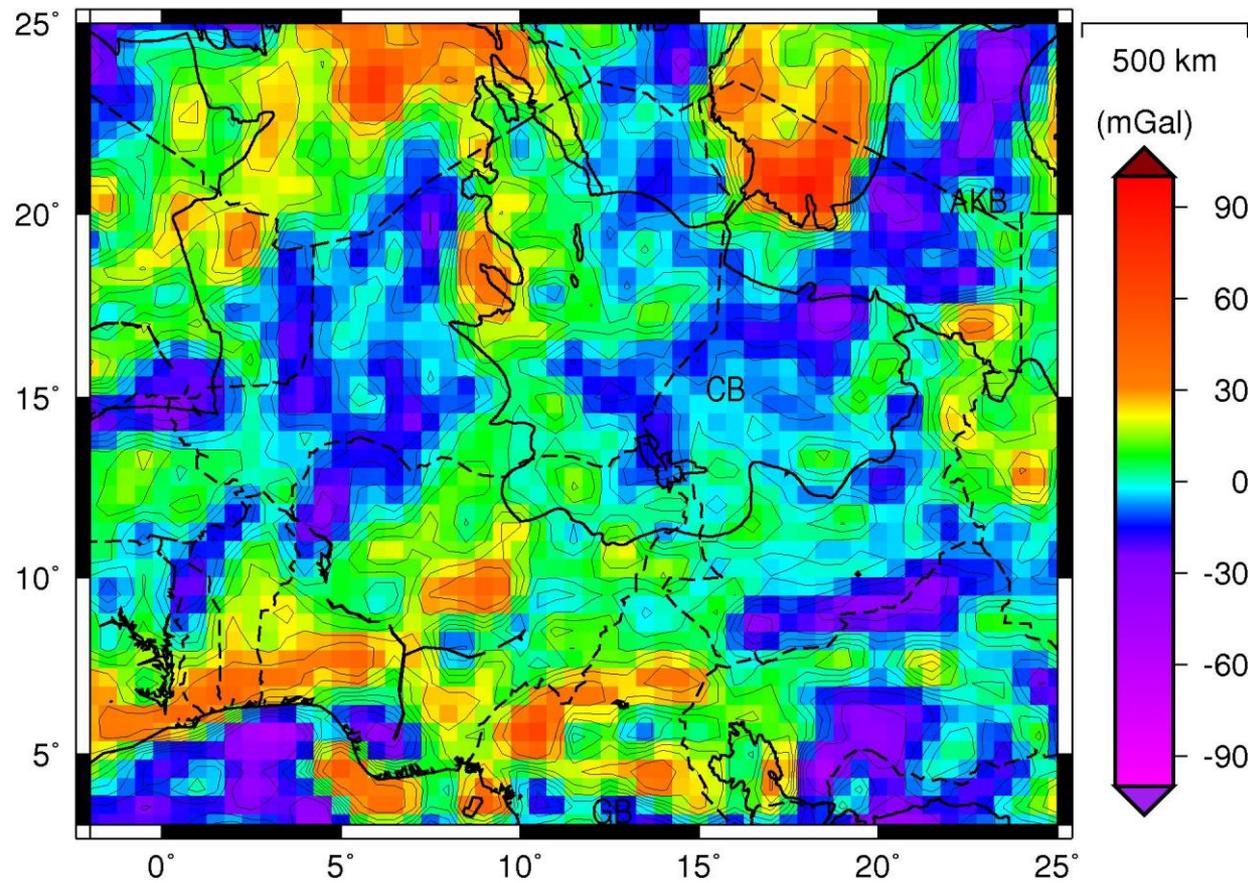
Geologic structures in North-Central Africa. Isolated Chad line



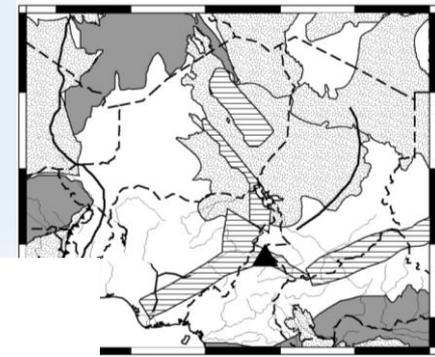
See Poster Tommaso Pivetta: modeling the Benue trough



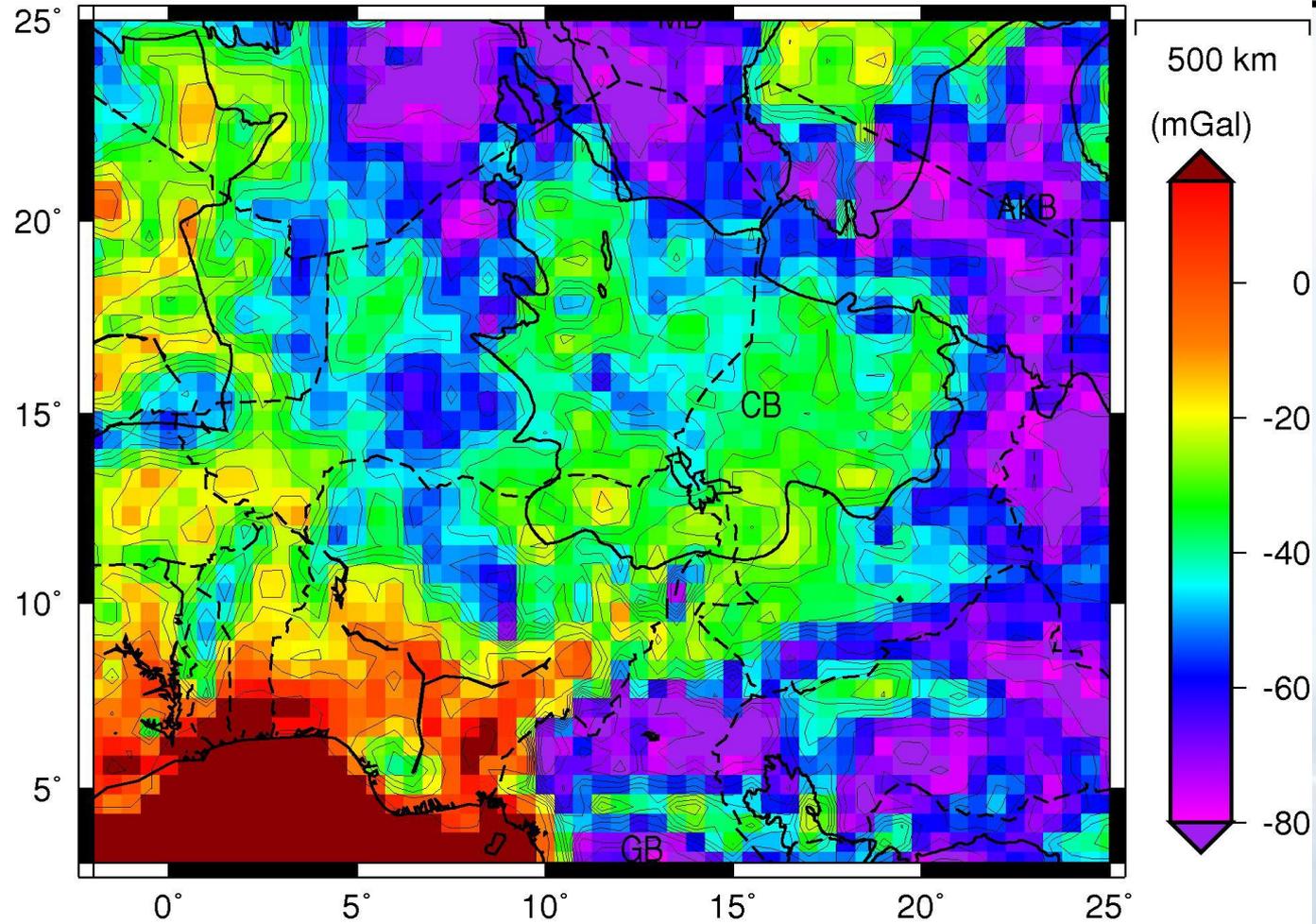
Gravity Anomaly GOCE



(Braitenberg et al., 2011, GSL, in press)

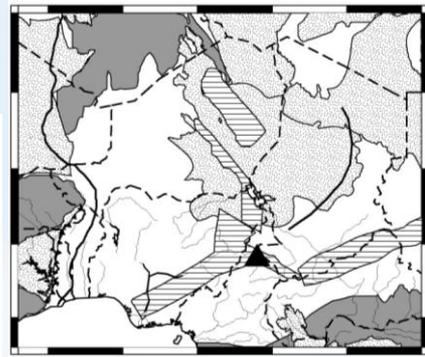
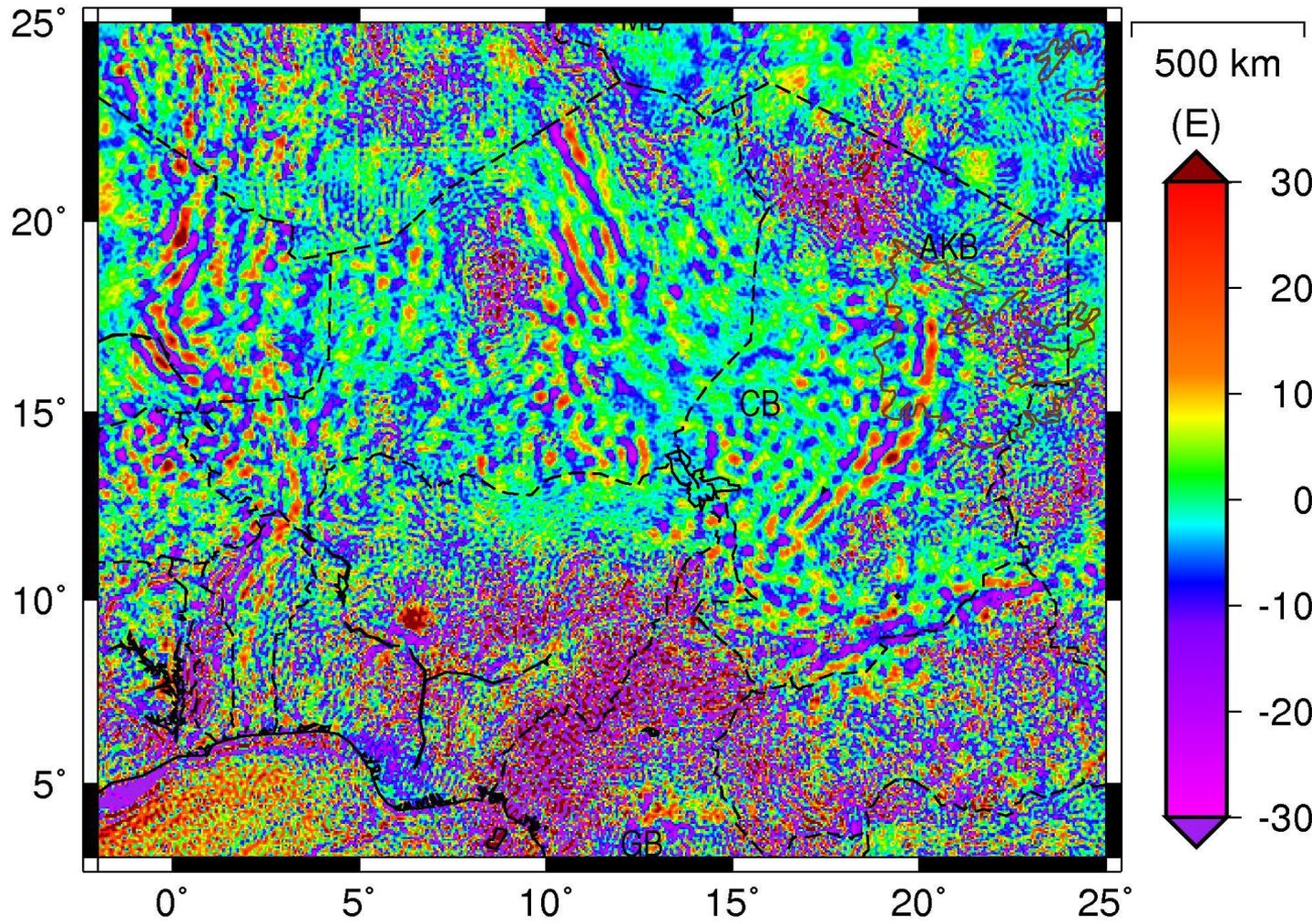


Bouguer Anomaly GOCE



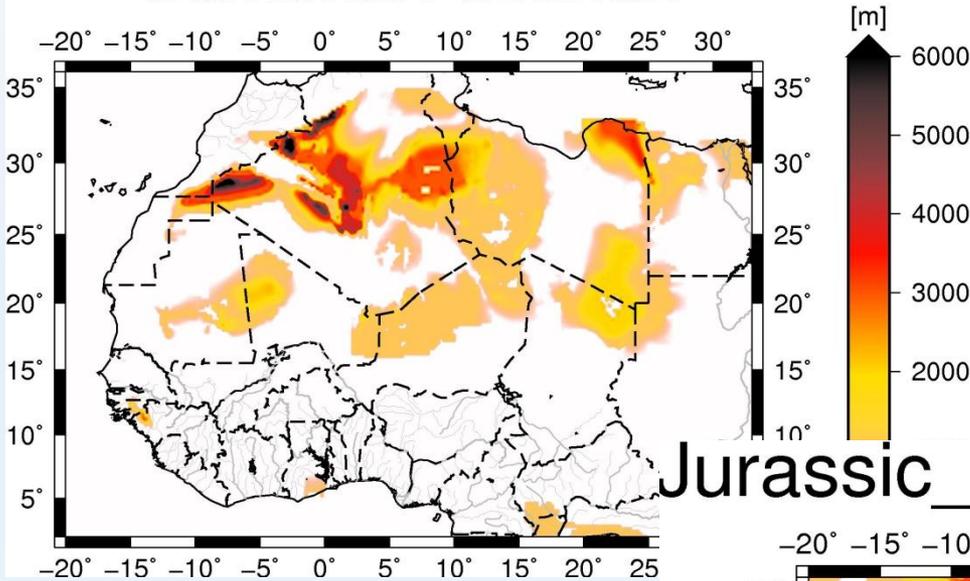
(Braitenberg et al., 2011, GSL, in press)

Vertical Gradient

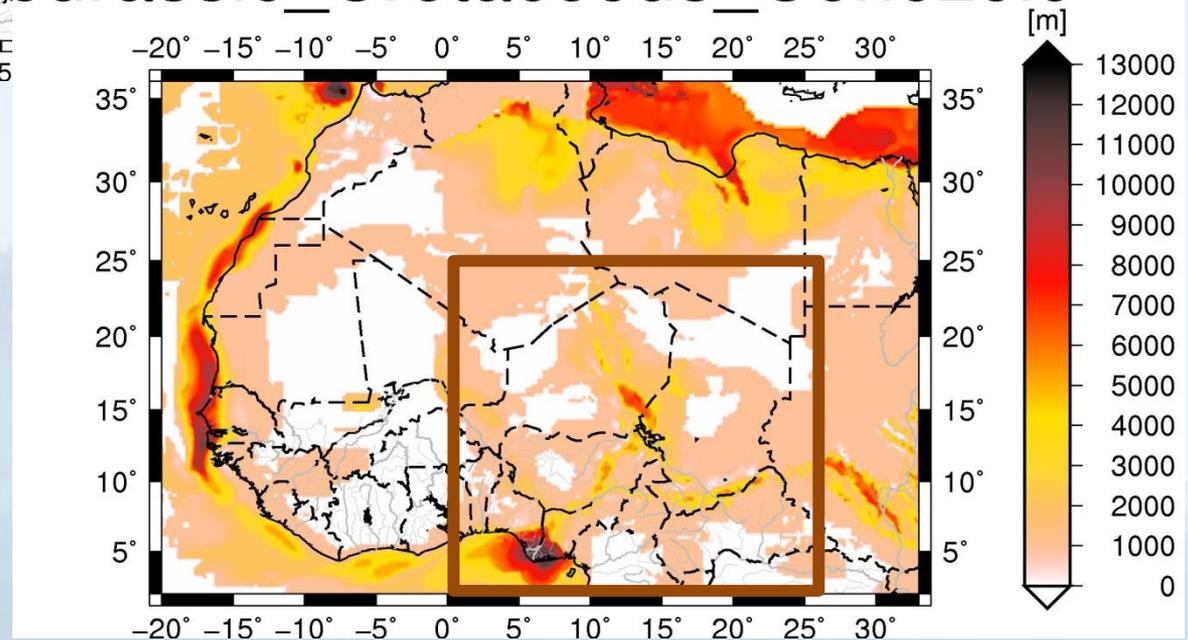


North Central African Sediment isopachs

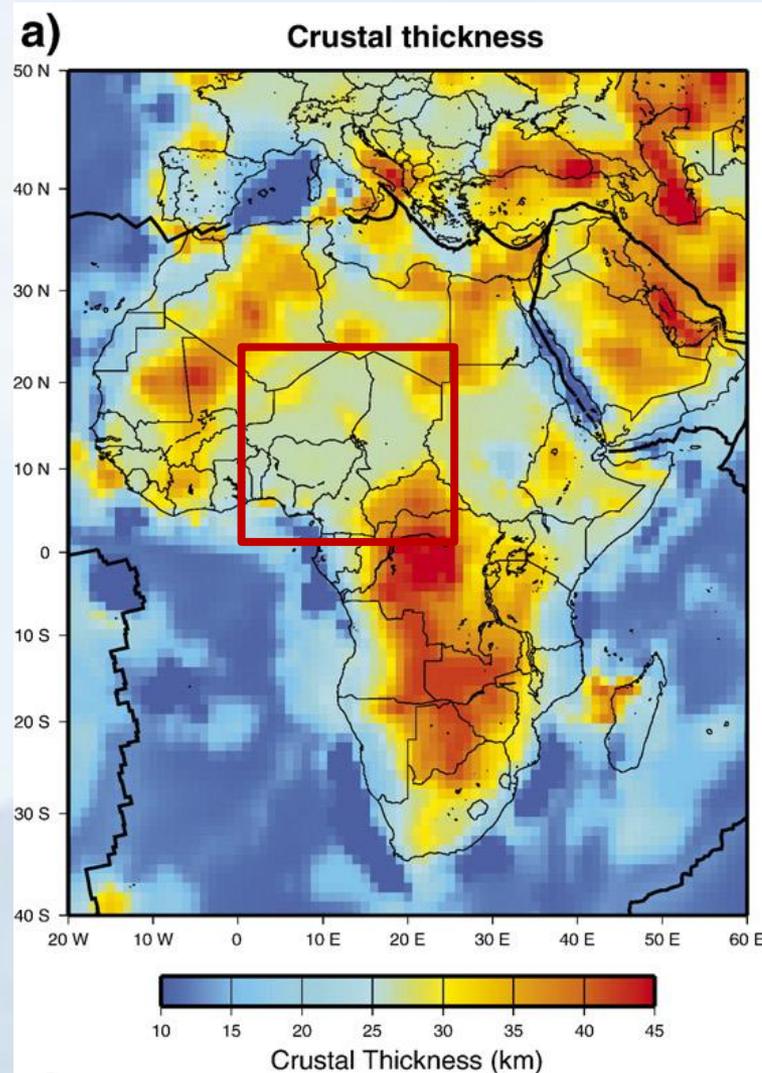
Cambrian Silurian



Jurassic_Cretaceous_Cenozoic

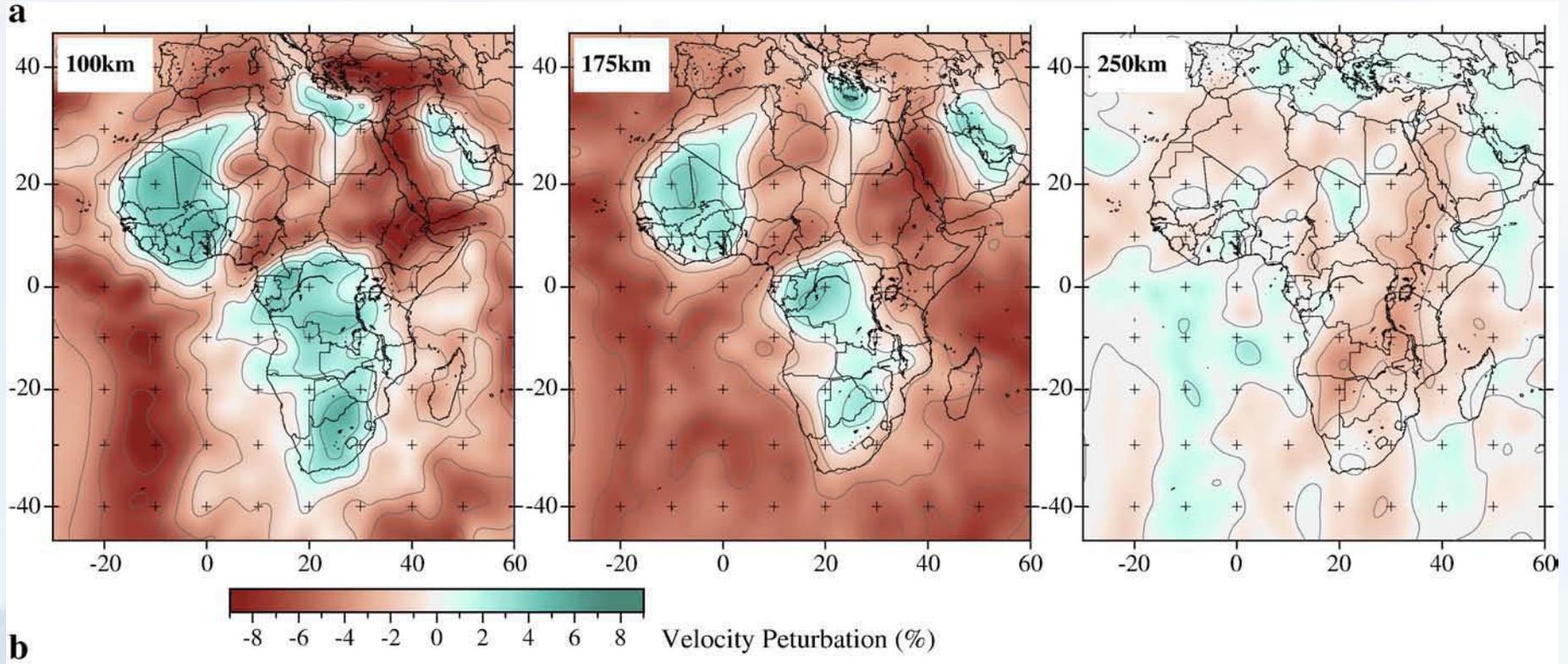


North Central African Crust



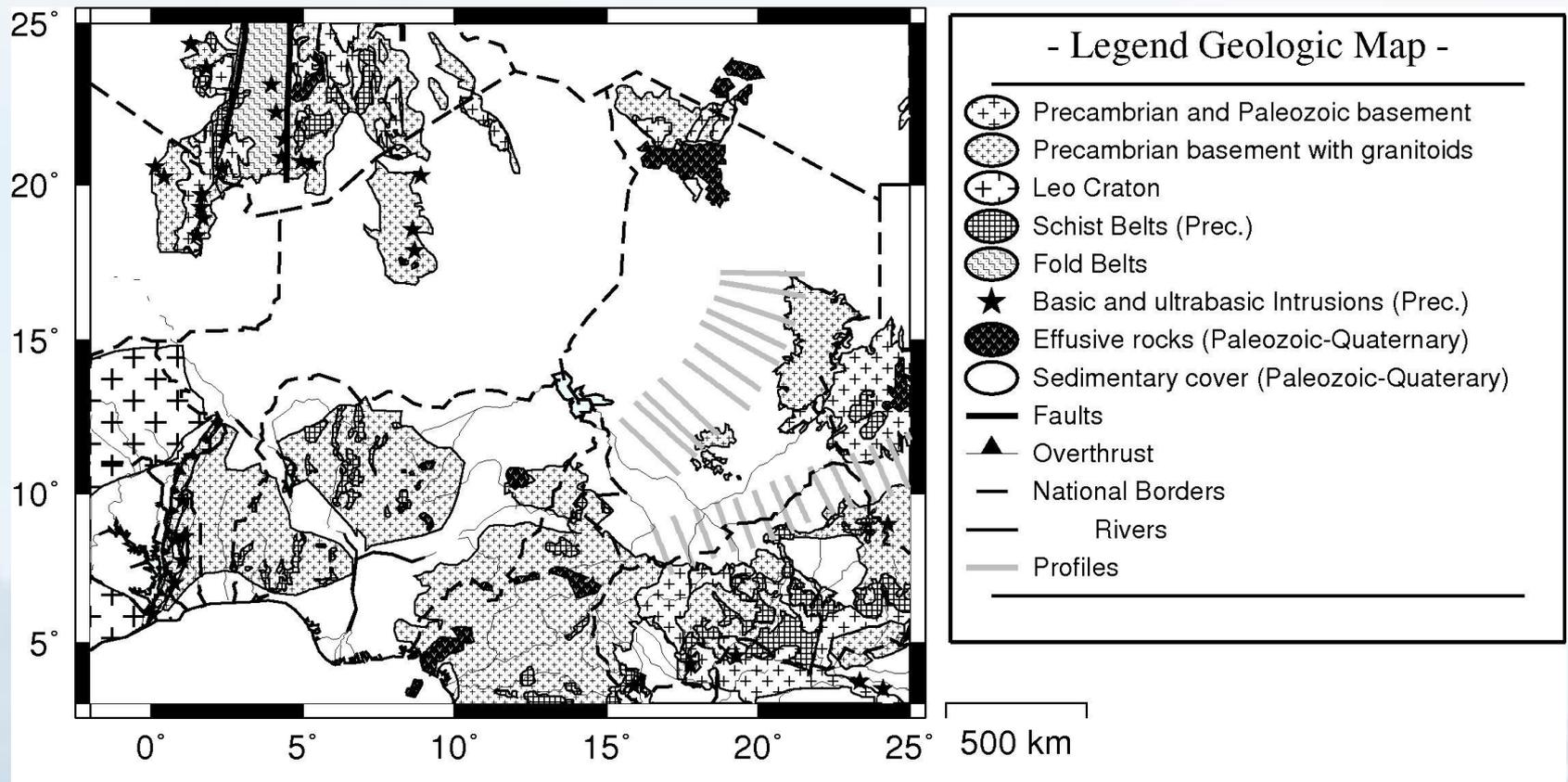
Surface wave tomography. Inversion of Rayleigh and Love wave Dispersion curves (Pasyanos & Nyblade, 2007)

Lithosphere velocity perturbation



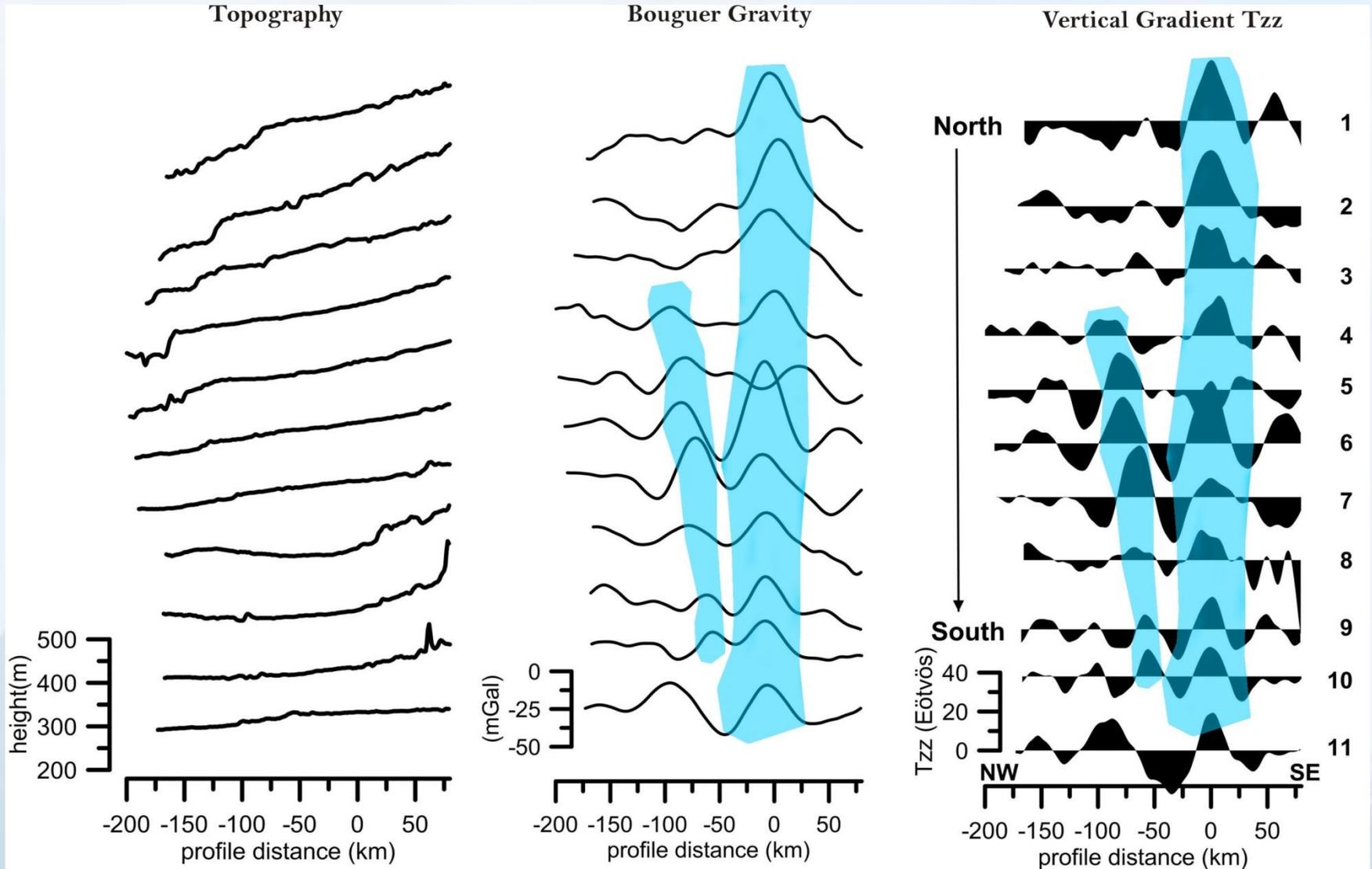
Surface wave tomography, V_s
Fishwick, 2010

Geologic structures in North-Central Africa



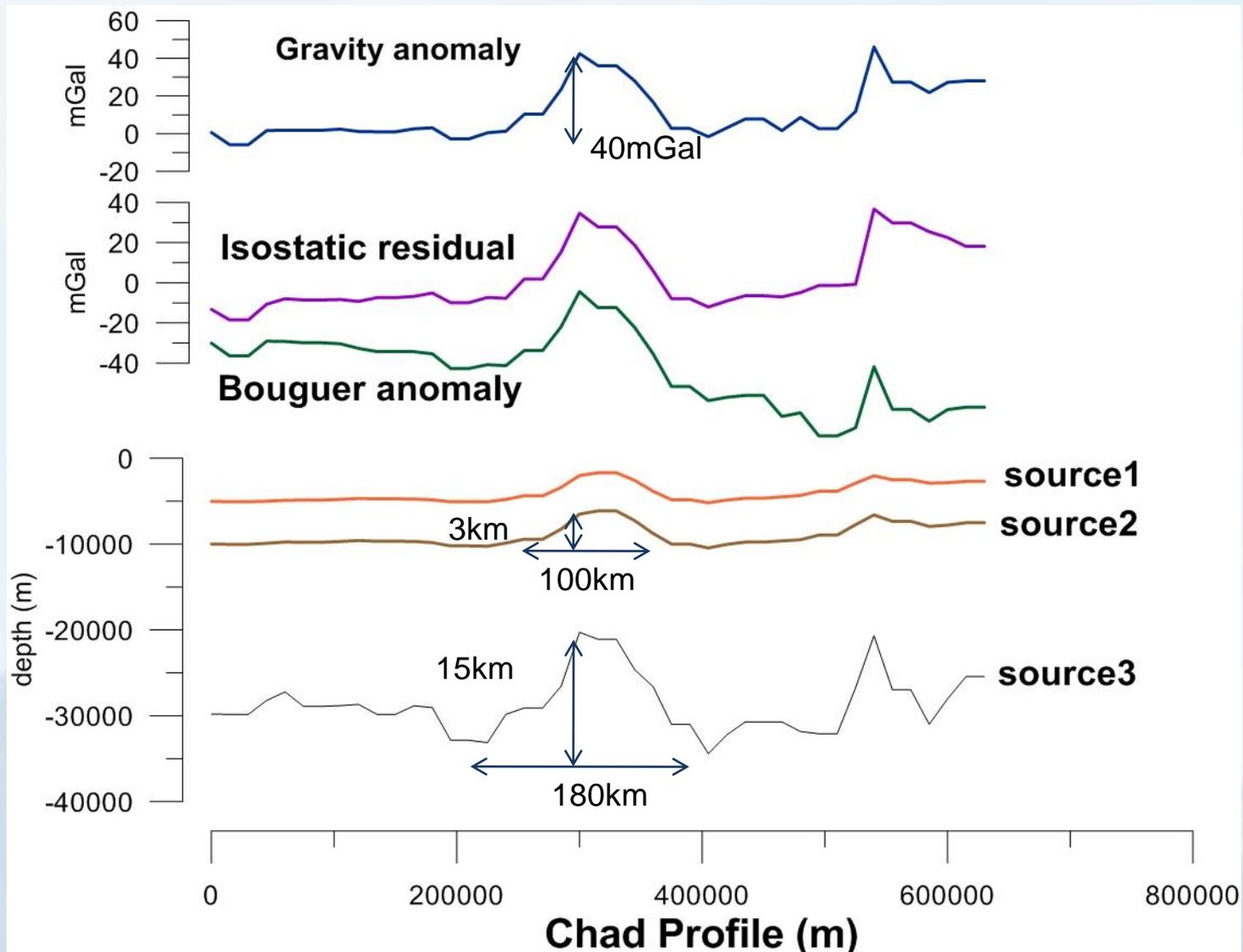
(Braitenberg et al., 2011, GSL, in press)

Chad “Banana High”

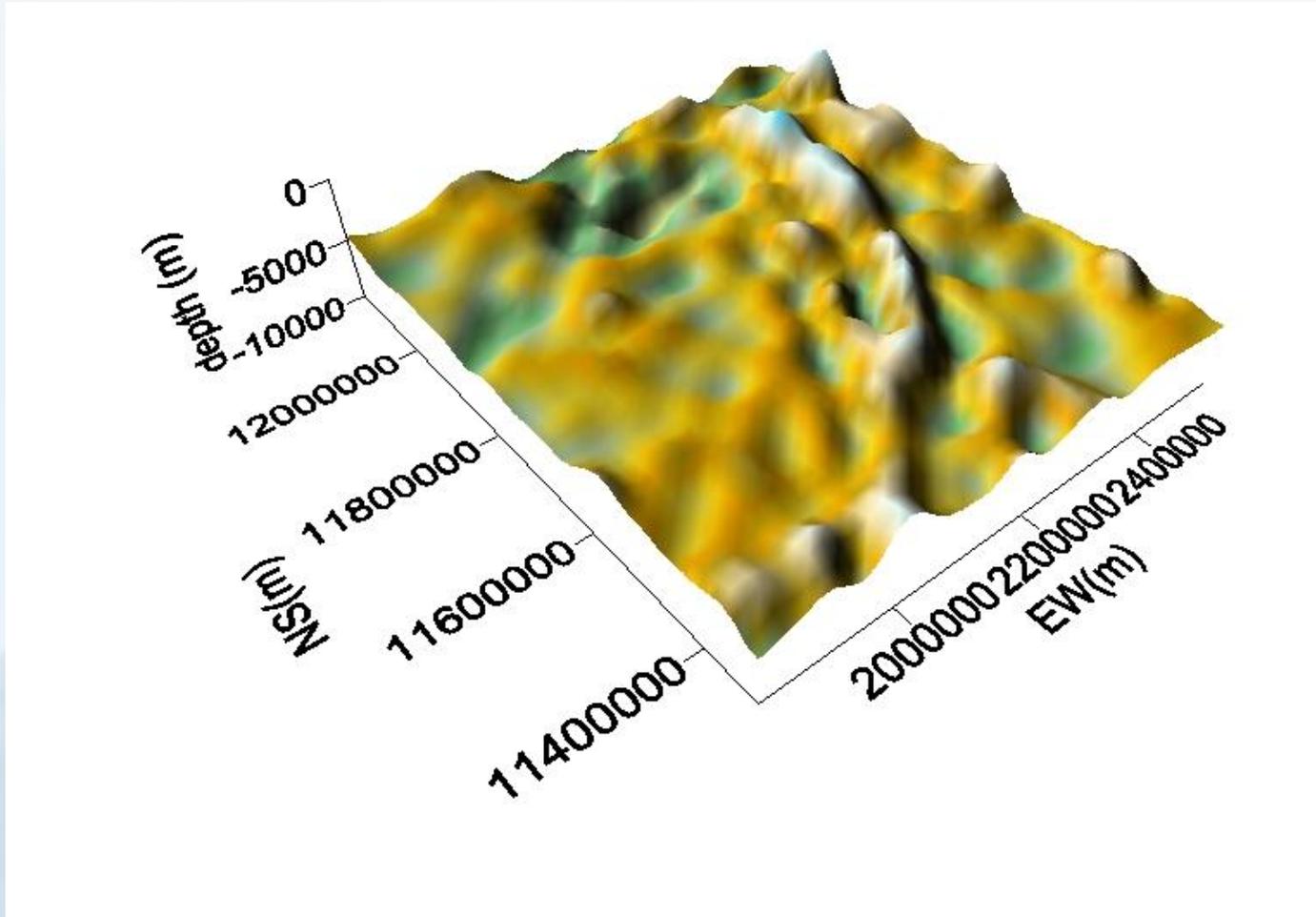


(Braitenberg et al., 2011, GSL, in press)

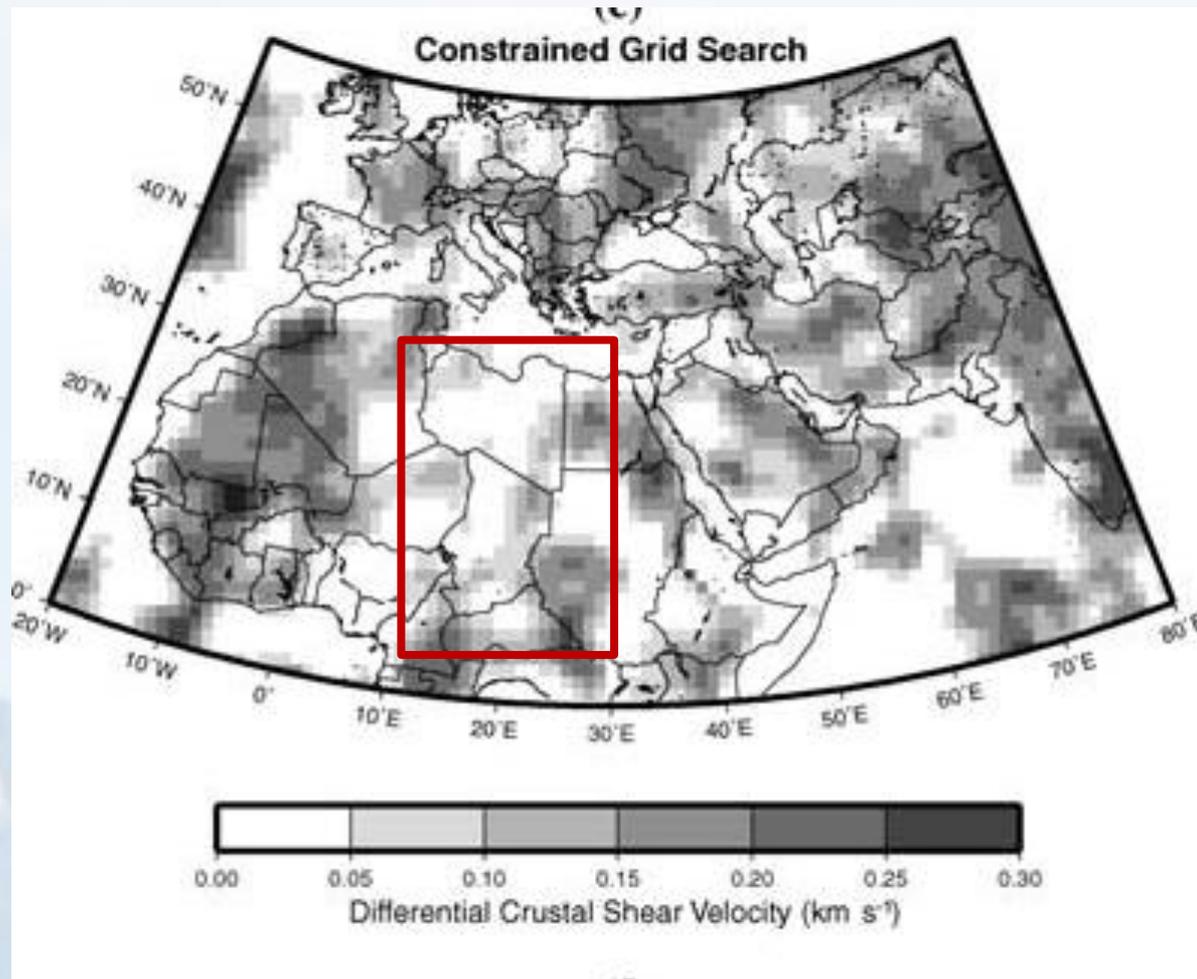
Inverting for the source mass of the Chad line



Source mass Chad high



Differential upper-lower crustal velocity



Pasyanos & Walter, 2002

Results 1/4

- GOCE data used for quality assessment of higher-resolution fields (EGM08)
- GOCE-model alone can resolve crust and lithosphere
- Geologic structures to be resolved with EGM08

Results 2/4

- Chad high:
 - flat crust of near 30 km
 - uncorrelated to sedimentary basins
 - correlates with upper-lower crustal differential S-wave velocity
 - If located in lower crust: up to 180 km width, 15 km thickness. Smaller body if located at upper crustal level.

Results 3/4

- Chad high:
 - At South-western end of line outcrops of ultra-mafic rocks, Serpentine, Talc-schists. Compatible with Neoproterozoic suture linked to Pan-African orogeny (pers. com. Dr. Moussa, Polytechnique of Chad)
 - Very unlikely to be coeval rift due to:
 - Geomorphological aspects- no topography.

Results 4/4

- Chad high:
 - suture-> interesting for mineral exploration.
 - Missing on geologic maps: should be added as discontinuity in future.