Present-day intra-plate deformation of the Eurasian plate

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MOTIVATION

The motivation of our work is to predict present-day lithospheric velocities and deformation of the Eurasian plate and to compare them with observations.

We build on the results of two recent, yet independent, studies. In the first (Warners-Ruckstuhl et al., 2013) the forces on, and stresses within the Eurasian plate were established. In the second (Tesauro et al., 2012) the distribution of mechanically strong and weak parts of the Eurasian plate was found.

By combining stresses with estimates of lithospheric rheology, we evaluate Eurasia's velocity, rotation and strain fields and compare these with observations of intra-plate deformation.

1. FORCES and STRESS FIELD

Warners-Ruckstuhl et al. (2013) found an ensemble of mechanically consistent force models (in mechanical equilibrium) based on plate interaction forces, lithospheric body forces and convective tractions. A subset drives Eurasia in the observed direction of absolute motion and generates a stress field in a homogeneous elastic plate that fits observed horizontal stress directions to first order.

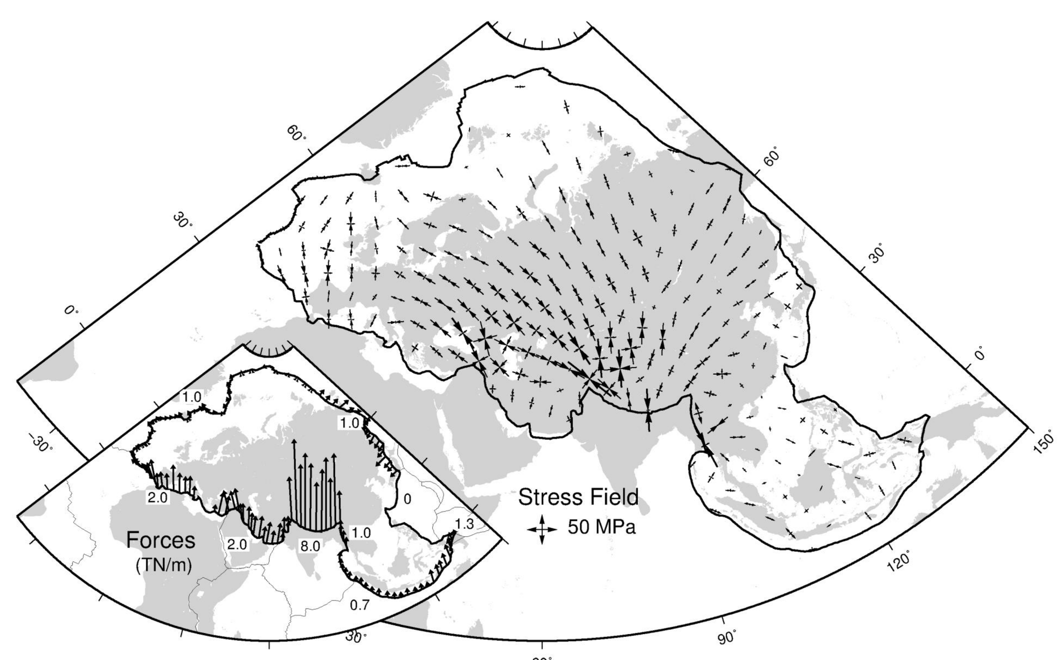


Fig. 1.: Principal axes of the stress field . Corresponding average edge forces are displayed in the inset (Warners-Ruckstuhl et al. 2013) .

2. RHEOLOGY

Following Tesauro et al. (2012) we assume five different compositions for the upper and lower crust. We use their geotherms and crustal thickness maps to estimate vertical distributions of strength at any location within the Eurasian plate.

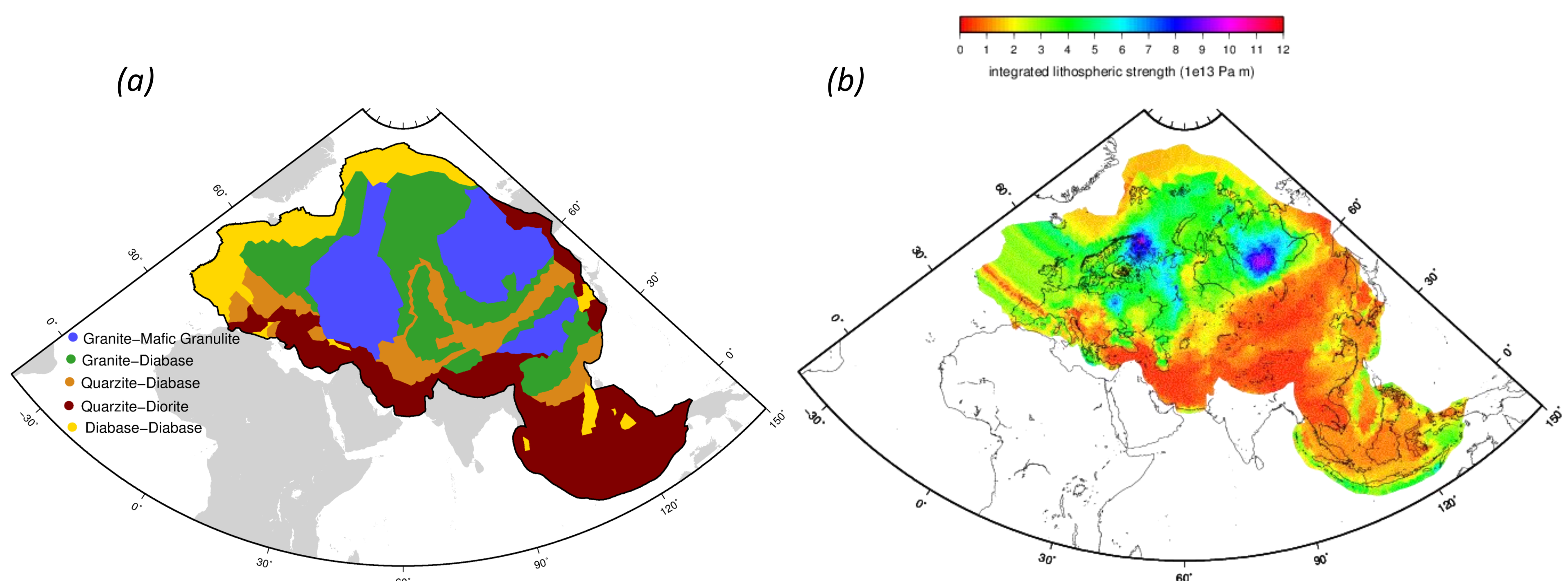


Fig.2. (a) Eurasia compositional types of the upper and lower crust over dry olivine lithospheric mantle. (b) Eurasia integrated lithospheric strength (10^{13}Pa.m)(Tesauro et al. 2012).

3.VISCOSITY

We compute the vertical distributions of strength for each element of the domain, and integrate it up to the value of the previously calculated elastic stress field to obtain the lithospheric strength of each element of the model .

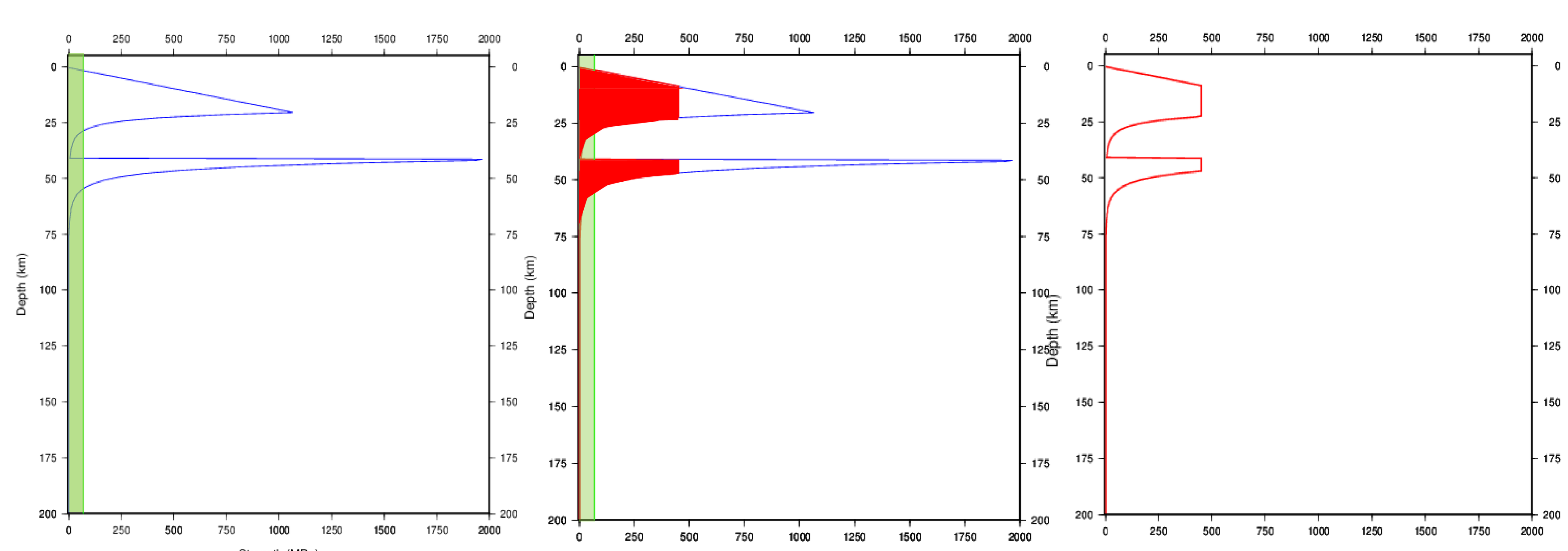


Fig. 3. Redistribution of the elastic homogeneous stress (green) over the rheological stress profile (blue) in order to obtain the lithopheric vertical distribution of strength (red).

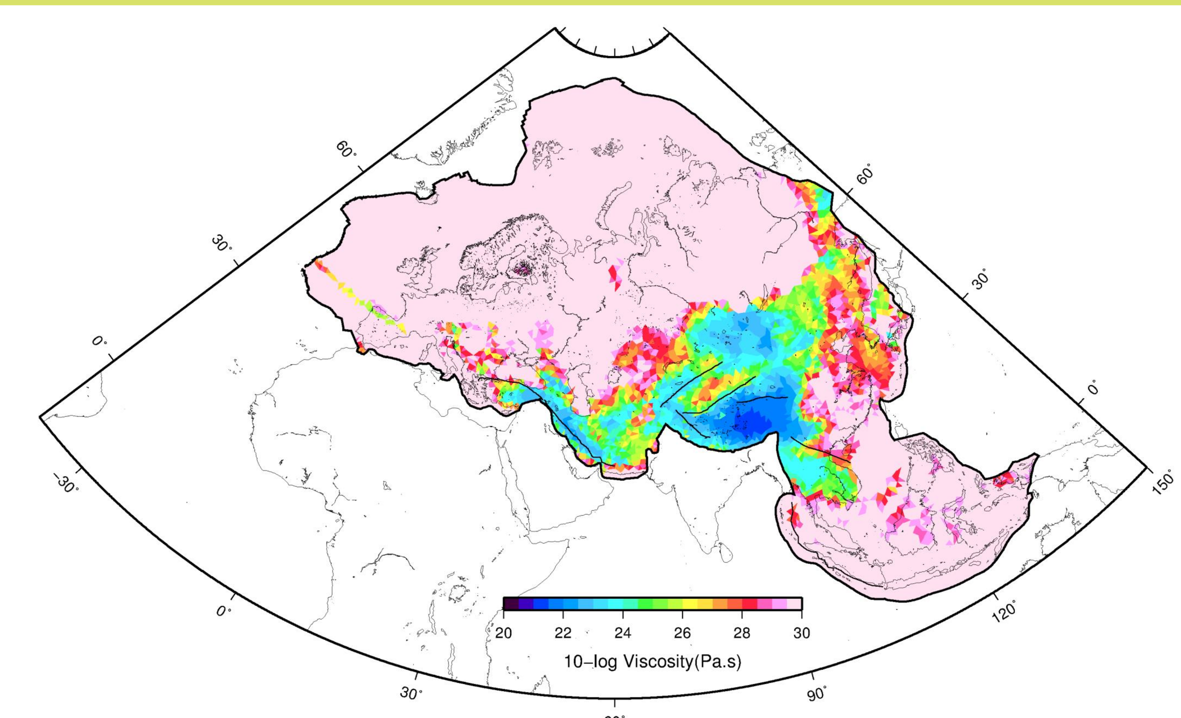
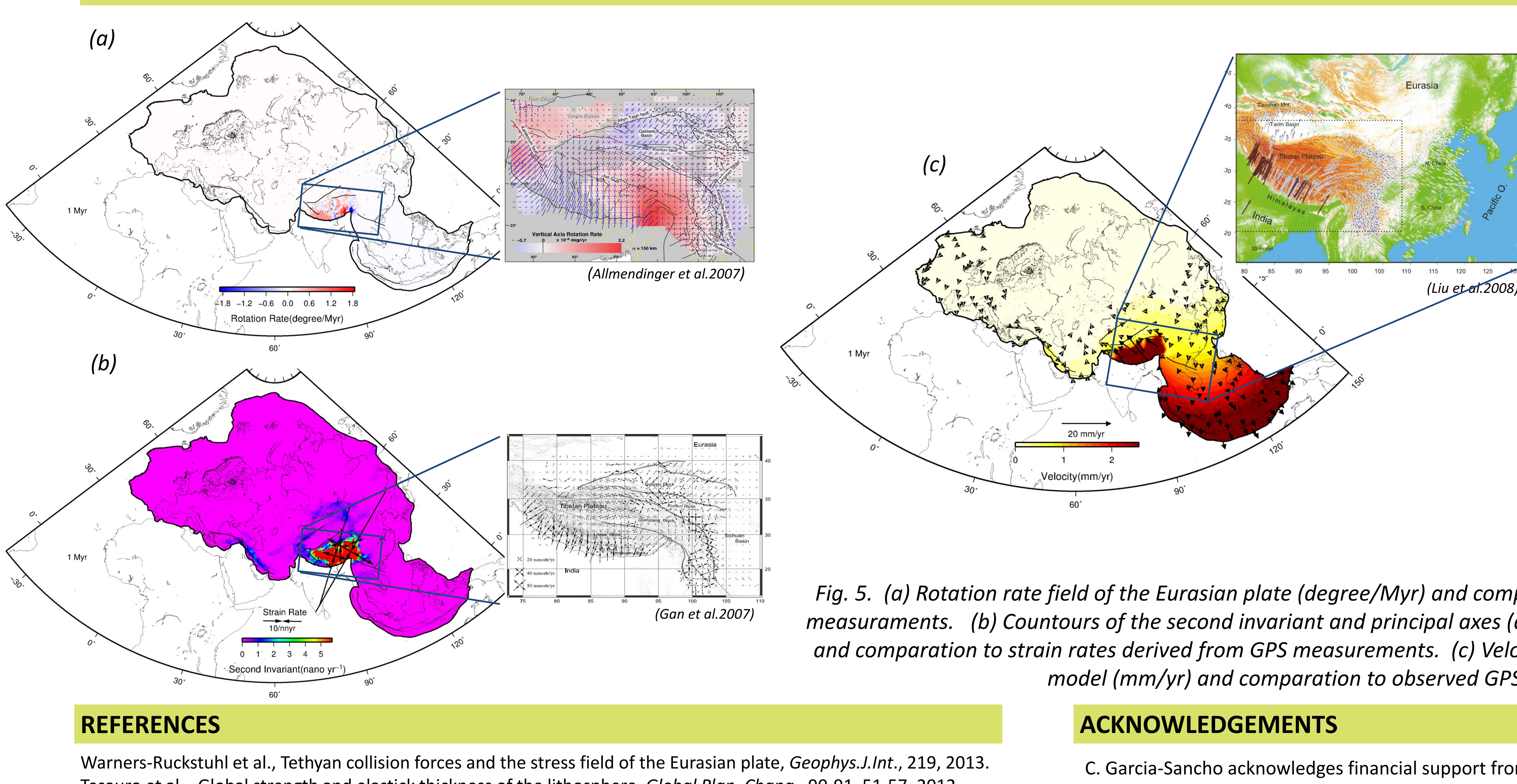


Fig.4. From the power-law relationship between strength and viscosities, and based on the assumption that horizontal strain rates do not vary with depth, we can estimate the vertically averaged viscosities (Pa.s) .

4.DEFORMATION



Preliminary results:

Velocities, Strain Rates and Rotation Rates FIT the observed MAGNITUDES at first order and are SENSITIVE to the different LOWER CRUST compositions.

Velocity field DIRECTIONS are INSENSITIVE to the different LOWER CRUST compositions.

Fig. 5. (a) Rotation rate field of the Eurasian plate (degree/Myr) and comparation to rotation rate field derived from GPS measurements. (b) Countours of the second invariant and principal axes (arrows) of the model strain rate field (10^{-9} yr^{-1}) and comparation to strain rates derived from GPS measurements. (c) Velocity field (arrows) and effective velocity of the model (mm/yr) and comparation to observed GPS horizontal velocities.

REFERENCES

Warners-Ruckstuhl et al., Tethyan collision forces and the stress field of the Eurasian plate, *Geophys.J.Int.*, 219, 2013.
Tesauro et al., Global strength and elastick thickness of the lithosphere, *Global Plan. Chang.*, 90-91, 51-57, 2012.

ACKNOWLEDGEMENTS

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