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ISES

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 deformation of the Eurasian plate and to compare it 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 strain field and compare these with observations of intra-plate deformation.

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.

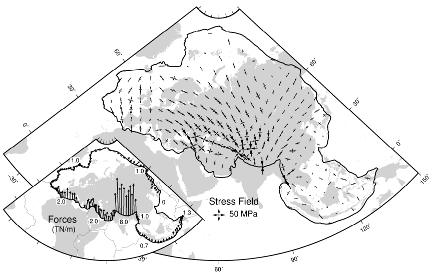


Fig. 1.: Principal axes of the stress field . Corresponding average edge forces are displayed in the inset.

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.

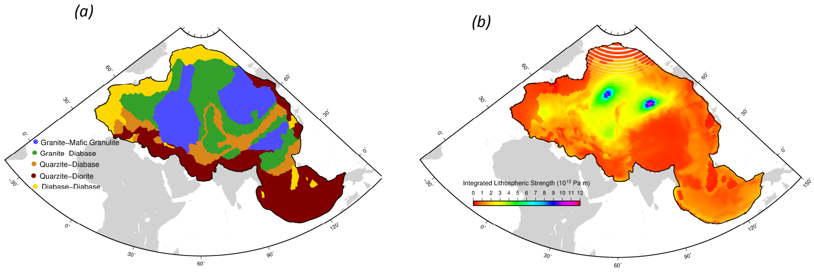


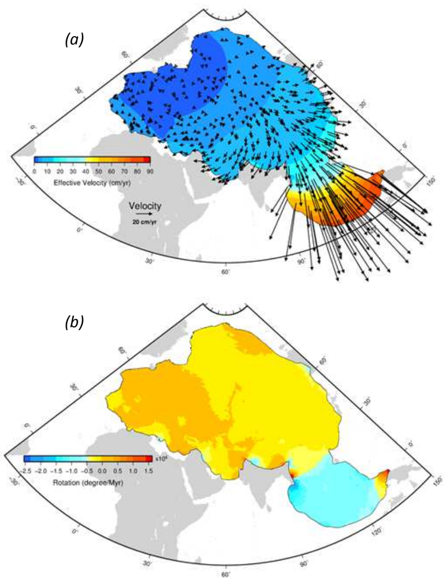
Fig.2. (a) Eurasia compositional types of the upper and lower crust over dry olivine lithospheric mantle. (b) Eurasia integrated lithospheric strength (10^{13}Pa m)

DEFORMATION

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

From the power-law relationship between strength and viscosities, and based on the assumption that horizontal strain rates do not vary with depth, we estimate the vertically averaged viscosity of each element (work in progress) and therefore, the strain rate field.

We compute strain field in our model by solving the mechanical equilibrium equations using finite elements code GTECTON. The strain rate field is computed in a homogeneous spherical shell with a reference thickness of 100km, using plane stress approximation.



The deformation is heterogeneously distributed and highly dependent on the edge forces and viscosity distribution. The strong lateral viscosity variations in the lithosphere are generated by the contrast between the stiff cratons and the weak southernmost part of Eurasia.

For the model, the domain viscosities range from 10^{21} to 10^{25} Pa s.

Intraplate areas are straining at very small rate < 90 10^{-9} yr^{-1}

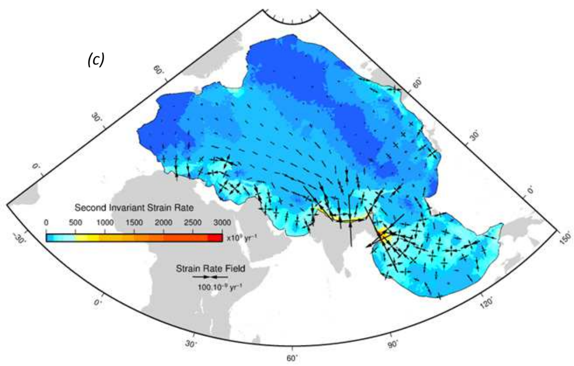


Fig. 4.: (a) Velocity field (arrows) and effective velocity of the model (cm/yr). (b). Rotation of the Eurasian plate (degree/Myr). (c) Countours of the second invariant and principal axes (arrows) of the model strain rate field (10^{-9} yr^{-1}).

OUTLOOK

- Comparison of our results with GPS velocities, InSAR, seismic, and paleomagnetic observations, which capture present-day and long-term deformation.
- Discussion of various causes for differences.
- Specific questions are to which extent stresses localize in specific regions and whether micro-plates as identified by geodesists arise naturally from the results

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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