INTERNATIONAL LITHOSPHERE PROGRAM

Activity Report 2024 – Task Forces / Coordination Committees

Project Title: Global Lithospheric Stress - The World Stress Map in 3D
Project No.: 2021-TF3
PI(s): Mojtaba Rajabi, Sebastian von Specht, Oliver Heidbach

1. Highlights of recent ILP Task Force work/results

Since 2018, the team has started the new phase of the World Stress Map project that will the fourth of this massive project. During 2024, the project has had a major step forward toward the finalisation of the project that will be released in 2025.
During 2024, we worked on various aspects of lithospheric stress at different spatial scales including a new and the most comprehensive in-situ stress map of New Zealand, which will be published in 2025 (Figure 1) and a high-density stress data study in eastern Australia to investigate the variation of maximum horizontal stress orientation vs. depth using high-resolution borehole data (Figure 1b) which is published by Rajabi et al. (2024).

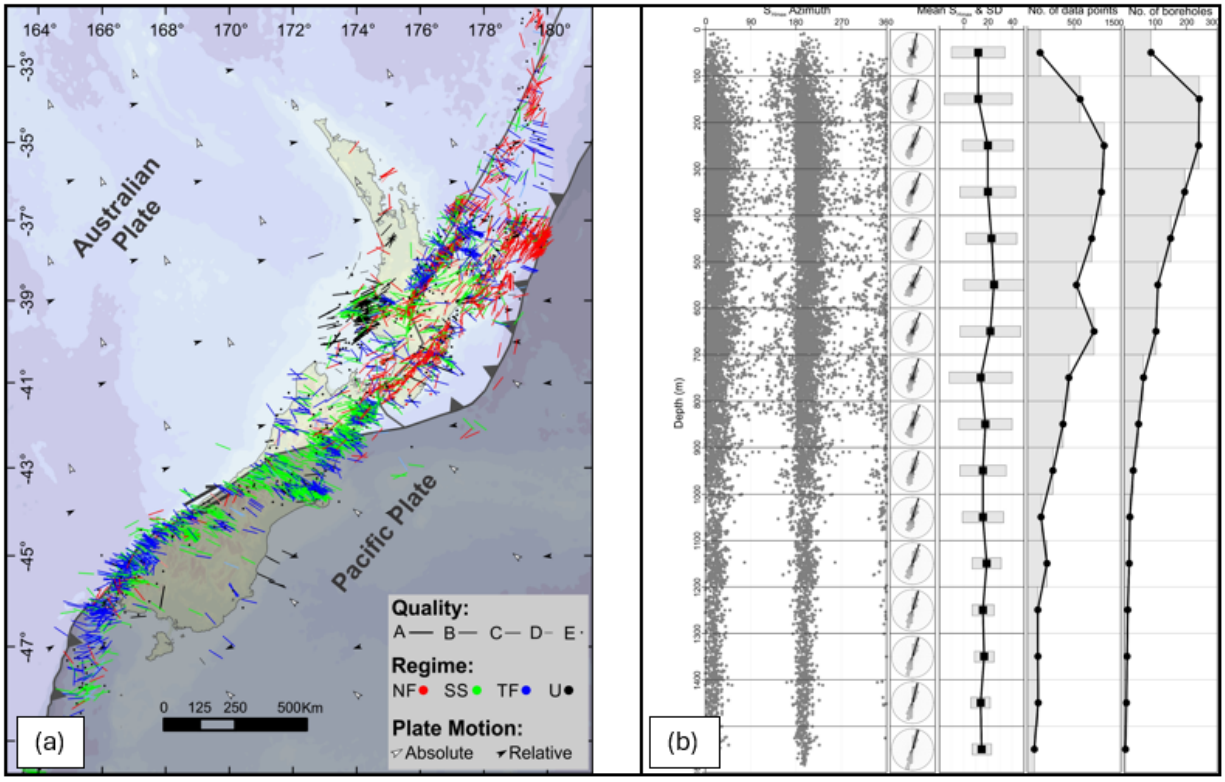

Figure 1: (a) State of present-day stress in New Zealand using 4617 data records. (b) shows a small-scale stress orientation analysis in a mine site in Australia, where we examined orientation of horizontal stresses using >9000 pointwise stress orientation inferred from borehole deformation (Rajabi et al., 2024).

2. Presence at international meetings/workshops (this year)

- April 2024: Research visit from Australia to GFZ-Potsdam (Germany) to work on the new release of the World Stress Map project.
- April 2024: Organising a successful session at EGU 2024, entitled Rock strength, (paleo)stress, fluids, and seismicity: methods, applications and implications for tectonics and mechanics.
- April 2024: Presentation of the New Zealand stress Map at EGU 2024.
- May 2024: Two presentations at Australian Energy Producers to discuss the present-day stress of Beetaloo Basin in Northern Australia for future energy and resources.
- May 2024: Two presentations on the World Stress Map at the workshop (Tectonic Stress: from the lithosphere to the wellbore) organised by the Geological Society of London, London, UK.

3. Important publications of ILP Task Force members (max. five)

Rajabi, M., Ziegler, M., Heidbach, O., Mukherjee, S., Esterle, J., 2024. Contribution of mine borehole data toward high-resolution stress mapping: Example from northern Bowen Basin, Australia. Int. Journal of Rock Mechanics and Mining Sciences 173, 105630.

Ziegler, M.O., Seithel, R., Niederhuber, T., Heidbach, O., Kohl, T., Müller, B., Rajabi, M., Reiter, K., Röckel, L., 2024. Stress state at faults: the influence of rock stiffness contrast, stress orientation, and ratio. Solid Earth 15, 1047-1063.

Rajabi, M., Ziegler, M., Ranjbarkarami, R., Tavoosiiraj, P., 2024. A novel approach for geomechanical modelling in the absence of stress magnitude data. Australian Energy Producers Journal 64, S275-S279.

Reiter, K., Heidbach, O., Ziegler, M.O., 2024. Impact of faults on the remote stress state. Solid Earth 15, 305-327.

Heidbach, O., Rajabi, M., Ziegler, M., Reiter, K., WSM Team, 2024. Recent Findings and Future of the World Stress Map Project, Tectonic Stress: from the lithosphere to the wellbore. The Geological Society, Burlington House, Piccadilly London.

4. New contacts (this year)

- Dr Dmitry Storchak, International Seismological Centre, UK
- Rasoul Ranjbarkarami, the University of Queensland
- Dr Scott Mildren, Tech Limit Pty Ltd, Stirling, SA, Australia
- Dr Domenico Di Giacomo, International Seismological Centre, UK

5. Usage of ILP funding (this year)

Travel support of Dr Mojtaba Rajabi to conduct a research visit to GFZ-Potsdam, to prepare the new World Stress Map release, which will be publicaly available in 2025.

6. Activities planned for 2025

- EGU session on the present-day stress state – starting point for research and subsurface engineering, EGU 2025, Vienna
- PI Rajabi aims to conduct a research visit to GFZ-Potsdam to work on the new release of the WSM project
- Publish the new release of the WSM with massive new data, an updated WSM quality ranking, a completely new database structure, and preparations to include in the future stress magnitude and pore pressure data once their new quality rankings are established in 2025.
- Conduct a research visit to Australia in order to train and share knowledge on geomechanical modelling with the Australian partner (PI Rajabi).