INTEGRATE-Integrated 3D structural, thermal, gravity and rheological modeling of the Alps and their forelands

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The aim of this project was to obtain a better understanding of the crust and the uppermost mantle beneath the Alpine orogen and its forelands and to test different hypotheses on the configuration of the subduction system as well as on the distribution of deformation and seismicity. Therefore, we have integrated the geoscientific observations publicly available so far on properties of the sediments and the crystalline crust (geometry, seismic velocities, and densities) with seismologically derived heterogeneities in the sub-crustal mantle into a consistent data-based 3D structural model that resolves the first-order contrasts in physical properties of the units composing the orogen and the forelands.

The derived structural model was additionally constrained by 3D gravity modelling and used as input to derive a lithospheric temperature field based on petrological assumptions on the composition of the crust and mantle. This is done to study the effects of regional heat-flow into the Alps and their foreland basins. Starting from these 3D density thermal and lithology models, the integrated strength was derived and discussed in the context of stress and deformation fields.

The project led to the successful completion of a dissertation by Cameron Spooner who obtained the highest possible grade (“summa cum laude”) from the University of Potsdam and published 4 high-level papers. Also, a Master thesis was successfully completed by Max Lowe at CAU Kiel that also led to a publication (Lowe et al. 2021).

As members of the AAAGRG, the partners of CAU Kiel were significantly involved in the compilation of the new gravity maps for the Alps and their forelands (Zahorek 2021).

The project contributed to “Theme 3: deformation of the crust and mantle during mountain building”, in providing the configuration of the different crustal units and of the lithospheric mantle. The project also contributed to “Theme 4: motion patterns and seismicity” in that it supported identifying spatial patterns of faulting and seismicity in relation to the rheological configuration. In response to its regional character, the project links with the different activity fields of the SPP and a continuous exchange of observations and modelling results with many working groups in the SPP and supported data processing and interpretation.

Degen, D., Spooner, C., Scheck-Wenderoth, M., Cacace, M.: How biased are our models? – a case study of the alpine region. Geoscientific Model Development 14 (11), 7133-7153

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