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Shear zone pattern in the lower crust caused by indentation and its effect on the upper crustal geothermal ressources

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The largest geothermal resources in the world are coupled with active plate boundaries (e.g. Japan, New Zealand) and areas of extension and rift development such as the African rift. However, geothermal resources are also observed in areas of continent-continent collision. Hochstein and Regenauer-Lieb (1998) showed, that in the India-Asia collision heat is discharged in 30-50 km wide heat bands, that are associated with more than 600 geothermal systems. These bands have been interpreted as segments of major, concentric slip lines caused by plastic deformation within the Asian plate resulting from the indentation of India into Asia. Assuming that this crust behaves like an ideal plastic medium, the heat transfer within and along a slip line can be estimated. It amounts to about 55 mW/m^2 for a 40-km-wide band. Estimates for present-day heat discharges point to 20-35 mW/m^2 for convective, and 10-30 mW/m^2 for anomalous conductive losses for a heated crustal strip in the greater Lhasa area. Computed geotherms indicate that partial melting can develop at c. 30- to 50 km depth within the heat bands.

Regenauer-Lieb et al. (subm.) showed that three different deformation modes fully describe the large scale deformation during indentation: the vertical thickening, the near-field indentation, and the far-field cutting mode. The heat lines in the Himalayan Geothermal Belt are the outcome of the near-field indentation mode.

The far-field cutting of the European plate has been described by Regenauer-Lieb and Petit (1997). Here we present new comparative analyses that indicate that in central Europe heat anomalies (e.g. the distribution of high temperatures at depth in the Upper Rhine valley) can be related to the far-field cutting mode. These analyses provide a new perspective in the validation of geothermal resources in central Europe.