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Tectonic evolution of the Western Eger rift: a tale of two faults

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The Eger Rift and Cheb basin in northwestern Bohemia are part of the European Cenozoic Rift System. They are associated with earthquake swarms, voluminous CO_2 outgassing and Quaternary mantle-derived volcanism. The Eger Graben, of which the Cheb basin is traditionally considered a subbasin, contains a Cenozoic volcano-sedimentary record no thicker than 500 m. The structure of the extensional system is dominated by two large faults: (1) the ENE-striking Krušné Hory Fault (KHF), which delimits the northwestern shoulder of the Eger rift and has accommodated tilting and uplift of the Erzgebirge, creating a present day elevation difference of 700 m; (2) the NNW-striking Mariánské Lázně Fault (MLF), which is the master fault of the Cheb basin. First-order structural relationships indicate that the MLF has cross-cut the Eger rift at right angle and offset it with dominantly normal sense of motion. These relationships suggest that activity on the MLF was accentuated late in the history of the rift, around early Pliocene time, reflecting a fundamental change of the governing stress field. We aim to constrain, in conjunction with a Czech companion project focussing on tectonic geomorphology and seismology, the tectonic evolution of the two basins, and in particular the kinematics and timing of the Krušné Hory (Erzgebirge) and Mariánské Lázně bounding faults over Late Cenozoic time. This will be done by modelling the subsidence of the basins from stratigraphic and structural data. Rift shoulder uplift, exhumation and fault offsets will be constrained by low-T thermochronology, especially (U-Th)/He on apatite (AHe). 2D cross-sections and restorable structural 3D models will delimit the range of possible fault geometries and constrain the magnitude of fault displacements, their gradients and the deep architecture of the large faults. The Cheb basin forms an approximate semi-ellipse in map view, suggesting it is a half-graben bounded by a listric, WSW-dipping MLF. The well-defined N-striking fracture plane traced by the swarm earthquakes of 2000 and 2008 generally lies in the footwall of the MLF, but might branch from the deeper parts of the listric MLF. The first results of our kinematic modelling suggest that the MLF flattens at ca. 7 km in the northern Cheb Basin and 11km in its central part. It is interesting to note that the earthquake hypocenters also deepen southwards from 7-10 km to 7-13 km. A key parameter for the kinematic modelling is the original elevation on the graben shoulders of the basement underlying the basin fill. Kaolonitic relicts (at altitudes 600-650 m and 900-950 m), silcretes (550-635 m) and ferricretes (600-650 m) outside the basin indicate paleosurfaces defining regional levels of the top basement surface and a throw of at least 400 m for the MLF. We expect that the combination of kinematic modelling, thermochronological dating, tectonic geomorphology and seismology will help to constrain the late Cenozoic to Present tectonic evolution of the KHF-MLF system and better understand the present-day localisation of fluid ascent and earthquake swarms.