Combined geochemical and geophysical studies on the western Eger (Ohře) Rift, Central Europe

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Abstract:

The composition of gas emanations, their flow rates, as well as the isotope (C, He) ratios of CO_2 and He of 102 mineral springs and mofettes in the western Eger Rift have been determined. Three gas escape centers may be distinguished based on their CO_2 fluxes: (1) Cheb Basin (≈ 90 $m^3\ h^{-1}$), (2) Márianské Lázně (≈ 156 $m^3\ h^{-1}$) and Karlovy Vary (≈ 356 $m^3\ h^{-1}$). The gas of these escape centers consists of nearly pure CO_2 with $\delta^{13}C$ values between -1.7 and -4 ‰ and contains a high portion of upper mantle derived helium (R/R_a between 2.4 and 6.1). Monitoring studies have resulted in the estimation of a CO_2 transport velocity of about 400 m/day for the upper crust. The combination of high gas flux and the high transport velocity connected with the $^3He/^4He$ ratio of about 6 R_a indicates that the Bublák gas stems from a degassing magma reservoir in the lithospheric upper mantle beneath the area. This was the main motivation for us to start a combined gas-geochemical and local-scale geophysical mapping to search for the depth and structure of the magmatic CO_2 source in the lithosphere of the western Eger Rift [1]. The receiver function (RF) method using P-to-S conversions is a very suitable tool to map seismic discontinuities in subcrustal depths. It provides images of the crust and upper mantle similar to steep angle reflection images. We analyzed teleseismic data from 61 permanent and 84 temporary Czech, French and German stations (BOHEMA experiment) [2]. Beneath the degassing area, the crustal thickness decreases to 26 km from approx. 31 km in the surroundings. The RF´s display a positive phase at about 6 s delay time and a strong negative phase at 7 to 8 s, which coincides with the area of Moho updoming and CO_2 mantle-derived degassing. These phases can be modeled by velocity increase at 50 km and velocity decrease at 65 km depth [2]. The velocity decrease gives evidence for confined body of partial melt, which might be the cause for high magmatic CO_2 flow.

References

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