

ISOTOPIC EVIDENCE OF FLUID-TRIGGERED INTRAPLATE SEISMICITY IN NW BOHEMIA

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We present the results of an extensive three year lasting isotope geochemical monitoring study. The aim of our investigation was to find links between the occurrence of mantle-derived CO₂ exhalations and earthquake swarms beneath the western Eger rift, central Europe. Presently the swarm earthquakes prevalently take place around the Nový Kostel epicenter not far from the northeastern boundary of the Cheb basin.

We have monitored the gas and isotope composition at four locations that are fed by fluids originating from a single magmatic source beneath the Cheb basin. The free gases of the Wetztinger mineral spring and the Bublák mofette were sampled weekly whereas sampling at the Plesná spring and at a mofette in the Soos area took place monthly for three years. These time series include periods before, during and after the earthquake swarm lasting for four months in the year 2000, during which nine different swarm phases with migrating hypocenters could be distinguished.

The free gas of the four locations consists of nearly pure CO₂ with $\delta^{13}\text{C}$ values ranging between -2.0 and -4.7 ‰. This range of $\delta^{13}\text{C}$ values of CO₂-rich gases is due to isotope fractionation between gaseous CO₂, dissolved CO₂ and HCO₃⁻, respectively. The ³He/⁴He ratios at the locations range between 2.4 and 6.0 Ra. From the beginning of the seismically active period in late August 2000 repeated shifts in ³He/⁴He were observed at all four locations for about two years. These shifts are explained by the admixture of crustal-derived helium to the ‘permanent’ mantle volatile flux. The recent study confirms the results of the first monitoring campaign in this region between 1994 and 1996 in this region that encompassed a small swarm earthquake in December 1994 (Bräuer et al. 2003, *JGR* 108, 2070).

In addition we repeated the sampling of our previous fluid mapping (1992-1994) at several gas-rich locations in the Cheb basin and the Mariánské Lázně degassing center. We found ³He/⁴He ratios clearly higher than ten years ago in the Cheb basin whereas at the locations in the Mariánské Lázně degassing center the ³He/⁴He ratios have nearly remained the same. This different trend in the He isotopic composition for the two degassing centers may be connected with the periods of strong and weak seismicity, respectively, by which the two areas are distinguished. In the context of

contemporaneous periods of seismicity the increased $^3\text{He}/^4\text{He}$ ratios are interpreted as the first geochemical evidence for ascending mantle-derived melt beneath the Cheb basin, which is related to the triggering of earthquake swarms.