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Melt Detection and Estimation of the Current Magma Intrusion Rate beneath the East Eifel Volcanic Field, Germany

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Deep low-frequency seismic events are detected in the East Eifel Volcanic Field (EEVF) since 2013. To well detect and locate such events the Deep Eifel Earthquakes Project - Tiefe Eifel Erdbeben (DEEP-TEE) started in July 2014 which now is composed of ca. 10 permanent and 15 mobile recording stations. Up to now, the DEEP-TEE seismic dataset contains eight years of continuous seismic records and the network has been reconfigured and continuously developed to achieve an optimum configuration regarding detection and location of seismic events.

In order to detect the weak deep low-frequency (DLF) events we developed a seismic event detector and found ca. 330 localizable DLF events in 2014-2021. The DLF hypocenter distribution outlines a near-vertical structure close to the Laacher See Volcano (LSV) which erupted about 13,079 years ago. The hypocenters are as deep as ca. 45 km, close to the assumed lithosphere-asthenosphere boundary, and reach to about 5-8 km depth. Most events occur close to the Moho and in the lower crust what is interpreted as magmatic underplating and deep crustal intrusion. In the same depth range but further to the west, we find seismic reflections with a negative polarity. These are also interpreted as magmatic pockets in the lower crust and the Moho region.

We try to estimate the mass flux (magma and volatiles) which is related with the seismicity. For this we apply Aki et al.'s model (JVGR, 1977) for describing the magma movement (a so-called chain of cracks connected by narrow channels) and estimate the related magma intrusion volume rate in the EEVF lithosphere. We assume an initial set of model parameters and evaluate the sensitivity and stability of the modelling results by allowing a reasonable range of each individual input parameter. Our results give an estimate of about 2,000-16,000 cubic meters of melt per year which is transported in the lithosphere.