Using a multi-criteria approach for a regional differentiation of the likelihood of future volcanic activity in Germany

Lisa Rummel, Alexander Bartels, and Franz May

Subsurface Use, Underground Space for Storage and Economic Use, Federal Institute for Geosciences and
Natural Resources (BGR), Hanover 30655, Germany

Correspondence: Lisa Rummel (lisa.rummel@bgr.de)

Abstract. Future volcanic activity, which might influence the long-term stability of radioactive waste repositories, must be evaluated critically. In Germany, according to the Repository Site Selection Act (StandAG), areas in which Quaternary volcanism is either present or future volcanic activity is expected within the next 1 Ma must be excluded from the site selection process for a high-level radioactive waste repository. However, while regions with Quaternary volcanism are reasonably well known in Germany, forecasting volcanic activity in intraplate fields is difficult, as many processes and their interaction control the spatial distribution of the volcanic centres. To develop an appropriate method to forecast possible regions of volcanic activity, a semi-quantitative, multi-criteria approach is used that combines a variety of indicators including, amongst others, seismic anomalies in the mantle, gravity data, tectonic activity, sutures, ground motion, earthquakes, mantle degassing centres and the geochronological data of volcanic rocks. The used indicators provide possible information about the source of melting in the mantle, the ascent of melt through the lithosphere and the eruption process at the surface. In total, 30 indicators were defined and ranked according to their presumed relevance for the long-term prediction of volcanism, following the results of two expert surveys. Quantifiable parameters were selected for the individual indicators, and threshold values were assigned and related to levels of significance. The parameters were uniformly applied for Germany in order to enable a transparent and equal risk assessment of future volcanic activity in all of the federal states. To consider the uncertainties regarding the distribution and manifestation of parameters in addition to their mostly unknown underlying large-scale processes, buffer zones were defined in which the values of relevance decrease with increasing distance from the initial parameter extent. By combining all parameters into an overall index, the presented results allow the regional differentiation of the likelihood of future volcanic eruptions in Germany. The robustness of the results is shown by varying the weights of the used parameters in the Germany-wide risk map. Different categories for the probability of future volcanic activity can be defined and used, depending on the needs and assessment of the volcanic hazard potential.