Geophysical prospection of the Pliocene volcanic massif Königsberg-Klöch in Southeast Styria (Austria)

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Results from geomagnetic and geoelectric measurements in the Pliocene volcanic massif Königsberg-Klöch are presented, which were acquired since 2008 in the frame of geophysical boot camps with more than 50 students as well as 3 Bachelor-theses and 1 Master-thesis. The available data comprise more than 12 k ground magnetic observations and 4 electrical resistivity tomography profiles up to 1,240 m in length in and all around the active basalt quarry. Accompanying oriented sampling provided representative material for laboratory determinations of the relevant petrophysical parameters. Total magnetic intensity measurements with GEM Systems proton-precession and Overhauser magnetometers yielded anomalies between -935 nT and +886 nT in 2 m sensor height after reductions, while the vertical gradient of the total magnetic intensity was comparably low in accordance with a significant depth extend of the anomaly sources. Noticeably, the natural remanent magnetization (NRM) of the basalts deflected strongly from the present-day Earth´s magnetic field, implying the need for a careful consideration of the NRM in the magnetic modelling. Electrical tomography was measured with AGI Sting instruments in Wenner and dipoledipole mode with up to 126 electrodes. The resulting models could be compared with borehole, seismic and outcrop data. Conveniently, due to the ongoing mining activities some geophysical profile positions of earlier investigation years coincided with rock faces in the quarry observed in later years. The southern part of the area around the hill Seindl is dominated by well layered scoriaceous tuff breccia with small lava flows covering massive intrusive nepheline-basanites which also form small vents and dykes from south to north. From the north of the quarry to the south-east (castle of Klöch) and in the areas near Zaraberg and Jörgen, big vertical columns (1 m diameter) indicate the formation of lava-lakes. Three volcanic centres are recognized in the southern area and one at the Königsberg in the north. The entire volcanic massive is underlain by ash-lapilli-tuffs with phreatomagmatic origin. The depression in the centre on top of the volcanic massif is covered by lake sediments with peperites at the base, layers of ash-tuff with accretionary lapilli and bomb-sags of volcanic bombs. Shallow extensive basaltic layers between Königsberg and Seindl can be explained as lava flows. Geoelectrical and geomagnetic measurements provided good means to detect the basalt bodies. Problems only occurred with small-scaled structures and bodies located close to each other.