“and sent for expert men from Rammelsberg…”: the siege tunnel of Henry the Lion at Desenberg from 1168

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Abstract
In this paper, we show first results of seismic and EMI data comprising evidence of a siege tunnel mentioned in medieval written sources. The tunnel would be the oldest archaeological evidence of a man-made tunnel in Westphalia (Germany).

Keywords
archaeological prospection; EMI; medieval mining; reflection seismics

Introduction

The Desenberg mountain cone with its castle ruins is the landmark of the Warburger Börde (Fig. 1 top). In addition to its appearance, however, the history of the castle is also extremely remarkable. The castle was first mentioned in 1070. In that year, King Henry IV laid siege to the castle, which was a stronghold of Otto of Northeim. Through the latter’s heirs, the castle came into the possession of Henry the Lion, who in turn gave it as a fief to Widukind von Schwalenberg (Kneppe and Peine 1991). However, after Widukind had murdered Theoderich, the city count of Höxter, at a public court day in 1156, he was stripped of all his fiefs and banished, but evaded these measures and joined a princely revolt against Henry the Lion in 1166. When he also did not accept the conciliation at the Imperial Diet in July 1168 by Emperor Frederick I, Henry the Lion laid siege to Widukind of Schwalenberg on the Desenberg. But since the castle withstood the besieger and their machines, Henry brought in miners from the Harz mountains near Goslar. They drove a tunnel into the Desenberg and blocked the castle well, after which the castle garrison surrendered (Meyer 1826). The castle was besieged and destroyed several times in the following centuries until it was finally abandoned in the 16th century (Peine and Kneppe 2014).

Smaller archaeological excavations in the 1960s and 90s revealed mainly modern and a few medieval structures, but nothing remains of the 12th century castle. A hollow in the terrain on the north-eastern slope of the mountain (labeled “A” in Fig. 1) was interpreted during prospections as a possible tunnel entrance from the year 1168, which was to be verified with the geophysical measurements. As the area is a nature reserve, invasive investigation methods are not feasible.

Methods

The possible tunnel entrance lies at the foot of the mountain. From here the topography rises by 25 m to the first rampart-protected level of the castle. If the tunnel or tunnel filling was visible at the possible entrance area in the first few meters of subsoil, the distance to the surface would increase significantly when coming to the castle area. Thus, we decided to use large offset FDEMI (frequency domain electromagnetic induction) to be able to trace possible tunnel remains as far as possible up the mountain, and then to switch to reflection seismics to bridge the large distance between surface and tunnel.

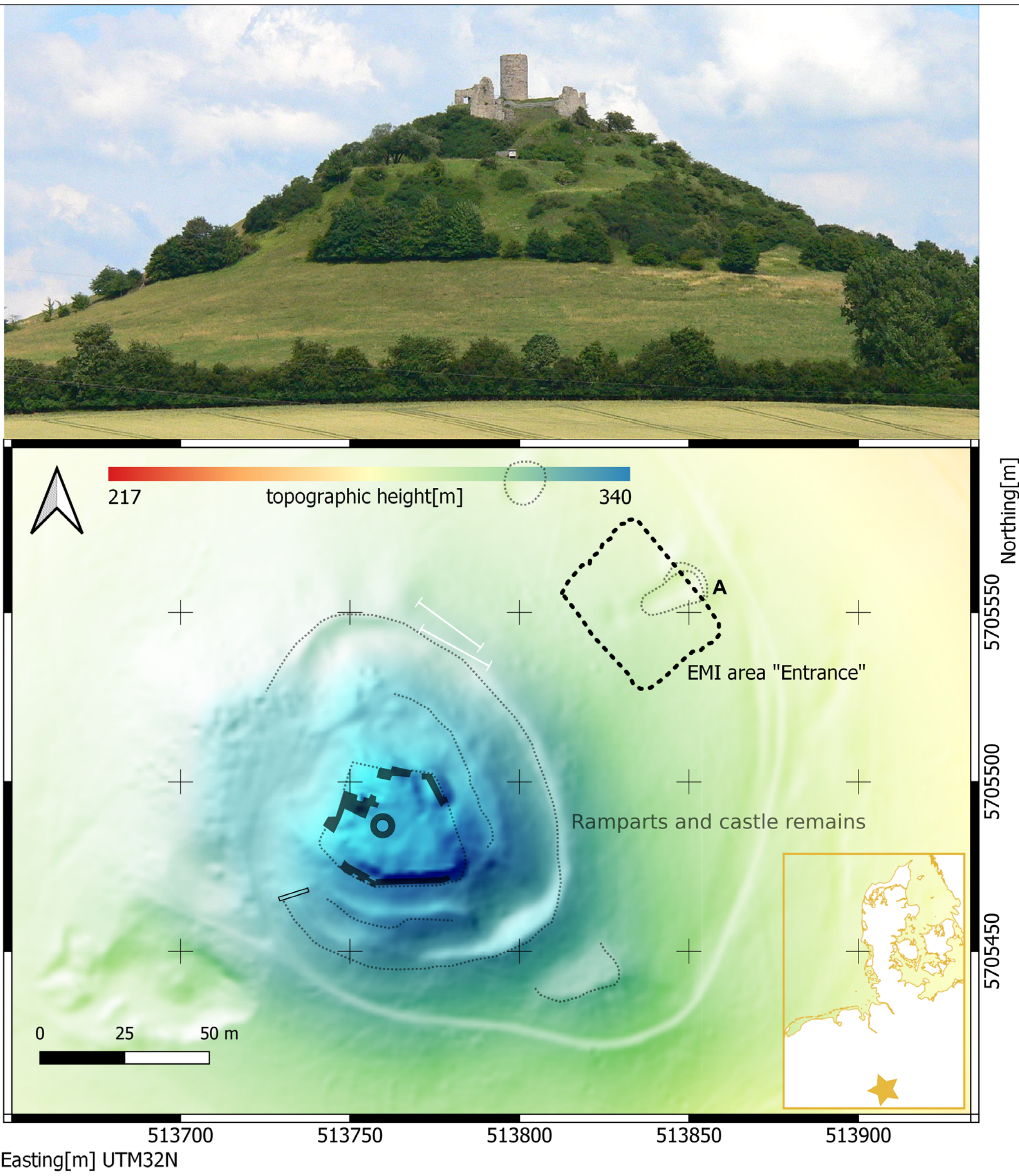

Fig. 1: Top: image of the Desenberg castle and the mountain today (File:Ruine Desenberg Westansicht.jpg by Presse03 (talk) is licensed under CC BY-SA 3.0). Bottom: Topographic map of the mountain with ramparts and plan of the castle remains on top of DEM. The investigation area A is indicated by a dashed line, seismic lines are shown as solid white lines.

For the entrance area, we used the CMD Explorer by GF Instruments. The device consists of one transmitter and three receiver coils. The planes of the coils were oriented horizontally (horizontal coplanar, HCP). The distances between the transmitter and receivers were 1.48, 2.82, and 4.49 m. EMI measurements were done where possible in the surroundings of the so-called entrance. Accurate positioning was achieved by RTK (Real Time Kinematic) DGNSS (Stonex S9i).

Processing of the EMI data included: coordinate offset correction, inline spatial bandpass filtering to remove walking noise, removal of the turns between profiles. Correcting offset of profile direction due to the different distance to the slope of the mountain. A drift correction was not necessary for the conductivity/quadrature data. Finally, the data was interpolated using 2D linear interpolation. Beyond EMI mapping of apparent conductivity, we performed 1D conductivity inversions on example profiles.

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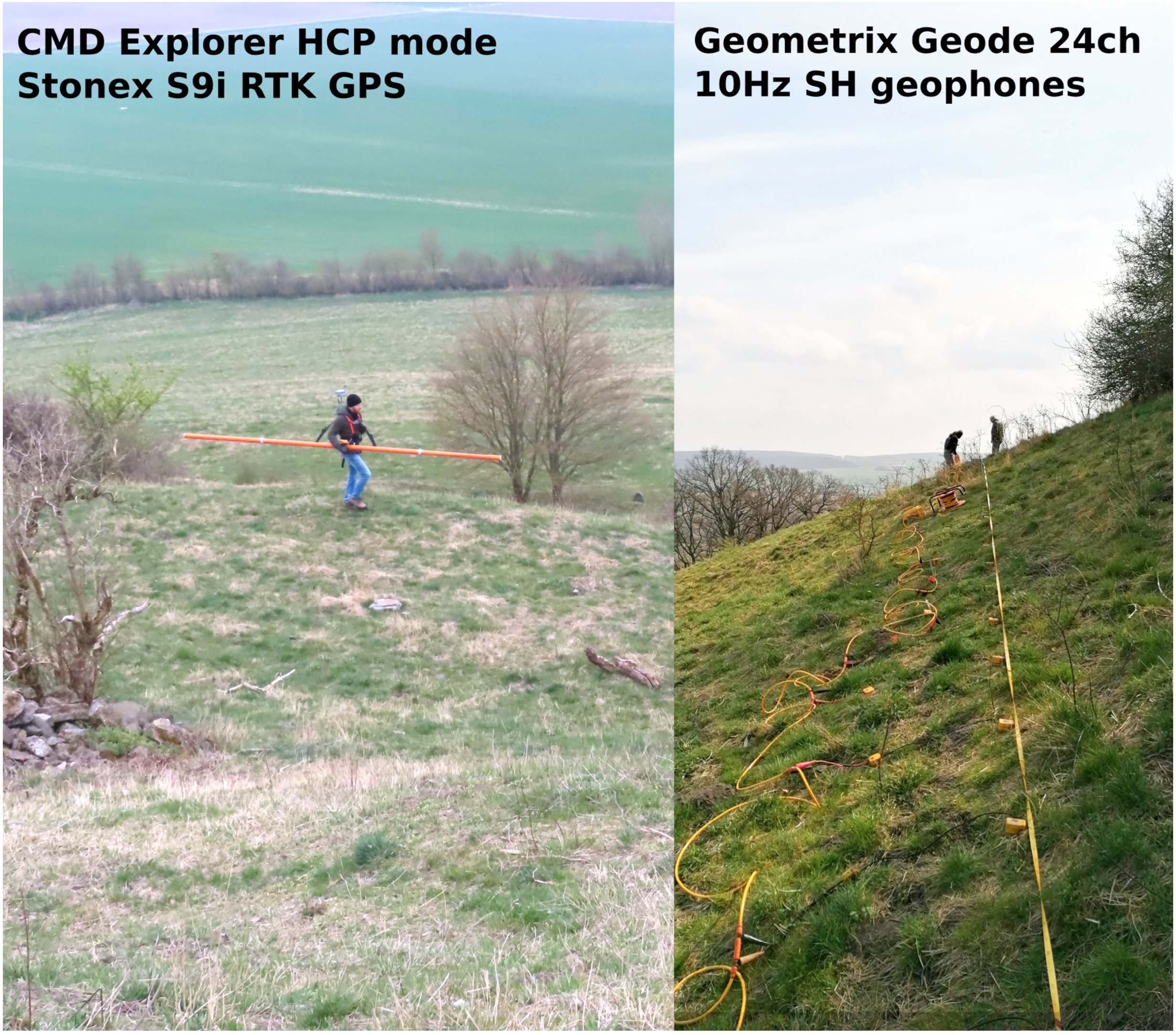

Fig. 2: Left: the CMD-Explorer setup in use at the Desenberg. Right: Seismic line at the Desenberg.

Leaving the entrance area and considering the slope and thus the possible depth of the tunnel, only seismic methods are feasible. We therefore performed two 24 m seismic horizontal (SH) shear-wave reflection profiles with a geophone distance of 1m. Shots were done using a 2 Kg hammer blow on a steel bar perpendicular to profile direction (SH polarization). Acquisition was performed using a Geometrix geode seismograph.

Processing of the seismic data included: sorting of traces, using only the two traces next to the shot point to create a 0.5 m constant offset section. This section was bandpass filtered, trace normalized using the first quantile of each trace, fk-filtered, multiplied by a linear time gain function, and converted to depth using an average velocity of 100 m/s.

Results

Figure 3 a) shows the apparent conductivity maps of the three different EMI coil separations. The first two coils appear quite turbulent, probably due to shallow debris and small scale topographic changes. Nevertheless, lower conductive areas correspond to the two ridges framing the possible entrance area. The largest coil separation clearly shows these two ridges as low conductive linear features, having one small connection in the center. The higher conductive feature framed by the ridges seems to bend westwards at the south-western end of the investigation area.

Figure 3 b) shows the inversion results of the two example profiles, one crossing the two ridges and the ge-

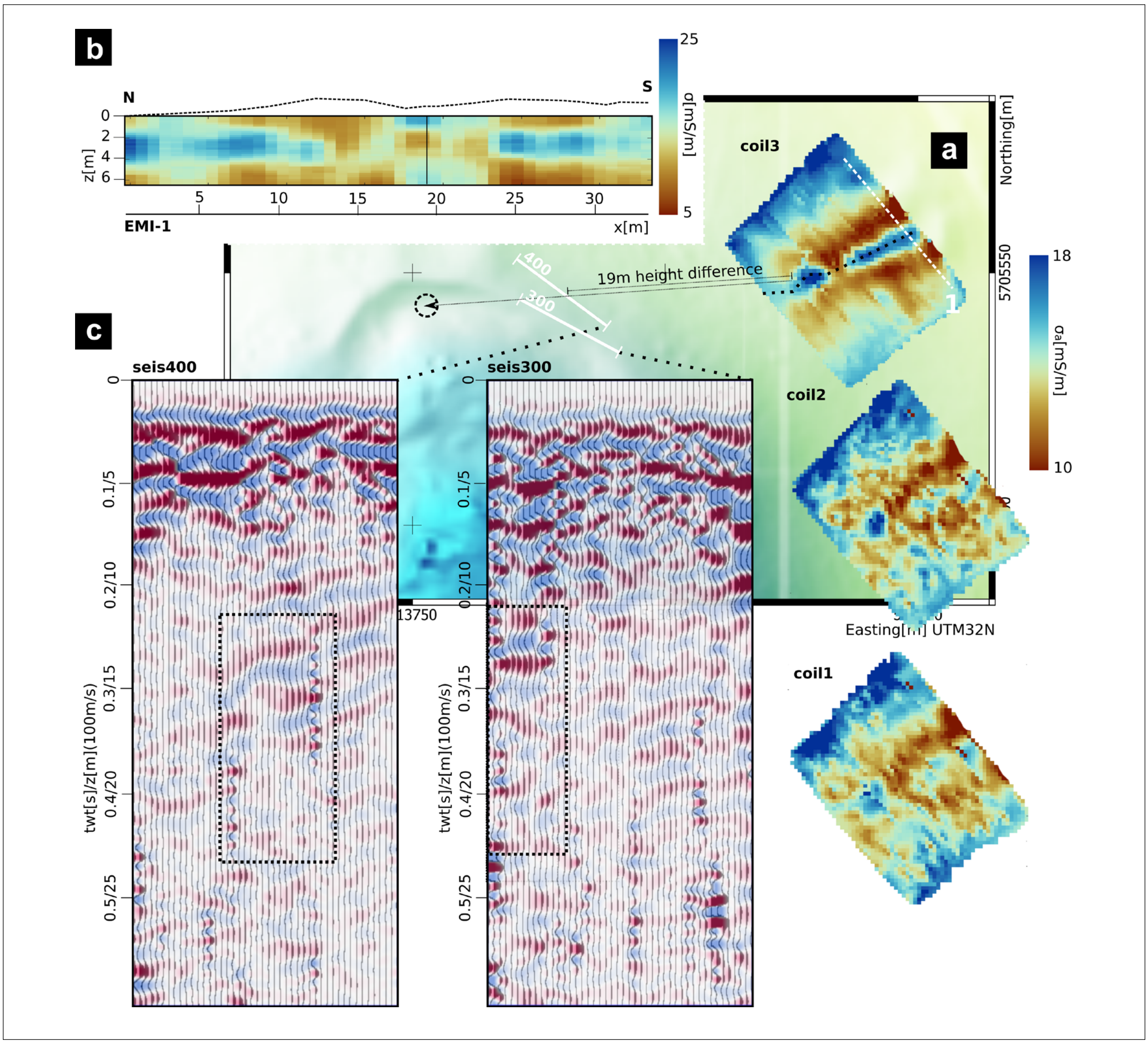

Fig. 3: a) Apparent conductivity maps of the three different coil separations. b) Inversion results showing the conductivity depth distribution on an example profile (see map in the center of the figure). c) Sweismic zero offset sections.

neral background and one crossing the small connection. Figure 3 c) shows the resulting seismic sections. Considering the topographic change and the resulting depth in the seismic lines, we highlighted peculiar reflection/diffraction events interrupting the reflectors of geological origin.

Discussion

Interpreting the measurements taken at Desenberg is not straightforward. The seismic reflection/diffraction events at a depth of about 15 m, that disturb the original geology, might give indications of the tunnel. Their position, in the middle of profile seis400 and at the edge of profile seis300, would support the hypothesis that the tunnel runs towards the first rampart-protected level of the castle. This would be the most suitable location for a well from a construction point of view, as this point of the castle is the lowest and would therefore mean the least effort for well construction. The EMI data from the presumed entrance to the tunnel probably represents a history of backfilling. The lower conductive areas that would correlate with the side walls of the tunnel are striking. Possibly this phenomenon is due to the collapse of the tunnel after its abandonment, when the higher conductive upper earth layers slid centrally into the tunnel area, exposing the underlying lower

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conductive material. The same applies to a round anomaly further up, visible in all three depth ranges of the EMI, which could represent a backfilled funnel, that is typical for those kinds of tunnel constructions.

Based on the EMI, it can be assumed that the tunnel course is imaged by the backfilled low resistive linear structure. Together with the seismic measurements and the archaeological interpretation of the visible castle structures, these probably represent the relics of Henry the Lion's siege tunnel of 1168, which has been handed down historically.

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