The BurVal Project

The interregional Buried Valleys project funded by the European Union is an international investigation of glacial valleys in Northern Europe using various geophysical and hydrogeological methods. The valleys are potential groundwater reservoirs and important for future supply of drinking water. The aims of BurVal project are to deliver substantiated knowledge and understanding of the structural and hydraulic properties of buried valleys, to focus on the vulnerability of the aquifer caused by surface contaminations or other human impacts, and to investigate interactions with other water reservoirs and saltwater intrusions.

Area of investigation

One of the investigation areas is the Bremerhaven–Cuxhaven valley which was carved up to 300m in Tertiary sediments by glacial melt-water and refilled with coarse sand and gravel overlain by fine and medium grained sand and silt. In the upper part, deposits of Lauenburg Clay exist, which differ from the surrounding material by their high electrical conductivities. Thus, they are detectable by electromagnetic methods. Figure 1 shows the location of the survey area in Northern Germany.

Geophysical Methods

The Bremerhaven–Cuxhaven valley has been investigated using several geophysical methods (Gabriel et al., 2003) like reflection seismics, gravity, geoelectrics and airborne geophysics. The Wanhöden area (for location see Figure 1) is a special test area within the BurVal project (Wiederhold, 2005).
Figure 1: Location of the survey area in Northern Germany and apparent resistivity map derived from helicopter-borne electromagnetic (HEM) measurements at a frequency of 1.8 kHz. The airborne survey results clearly outline the clayey deposits on top of the buried valleys. The black box in the center of the map surrounds the Wanhöden area.

Helicopter-borne electromagnetics (HEM) clearly outlines both lateral extent and depth to the top of the Lauenburg Clay (Siemon et al., 2001), but the clay limits the depth of investigation: Where thick clay layers exist, HEM often failed to penetrate the clay and, thus, to outline the thickness of the clay (Figure 2).

Figure 2: The 1D inversion results of the HEM measurements from a part of flight line 35.1. deliver the location of the Lauenburg Clay between 40m and 60m depth.
In order to get additional information on conductivities below the clay layer, transient electromagnetic (TEM) measurements were carried out along a HEM flight line within the test area Wanhöden (Figure 3).

**Figure 3:** Test area Wanhöden. The squares indicate the TEM sites, close to the helicopter flight lines 35.1 and 37.1. The thick black arrowed lines indicate power lines and the colored background represents the HEM apparent resistivity (cf. Figure 1).

Central loop TEM measurements were carried out using a 100x100m$^2$ transmitter loop with a current of 3A. The results of the 1D inversion are shown in Figure 4. As HEM (Siemon et al., 2001), TEM detects a conductive layer between 40m and 60m caused by Lauenburg Clay indicating the Bremerhaven–Cuxhaven valley. Outside the valley we found a conductor at about 180m depth.

In addition, SkyTEM (Sørensen & Auken, 2004) data has been collected recently by the Hydrogeophysics Group (HGG) of the University of Aarhus enabling direct comparison of the geophysical results and survey costs of three different electromagnetic methods. Airborne EM measurements like HEM and SkyTEM have the advantage that a fast resistivity mapping with a high spatial resolution is possible. Ground geophysical measurements, on the other side, are often more accurate, but they are definitely slower than airborne measurements. It depends on time, money and man power available, and the depth of investigation necessary,
which method or combination of methods will be chosen for investigating the conductivity distribution in buried valleys and other targets of interest.

![Figure 4](image.png)

**Figure 4:** Results of the 1D inversion of the ground TEM measurements. The highly conductive layer between 40m and 60m depth indicates Lauenburg Clay in the valley.

**References**


