Chapter 6
Viewing the Subsurface in 3D: Sediment Tomography for (Geo-)Archaeological Prospection in Palpa, Southern Peru

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Abstract This contribution focuses on the application of geophysical methods for geoarchaeological prospection. At first, methodological bases of sediment tomography are presented, especially the use of earth resistivity tomography (ERT) and seismic refraction tomography (SRT) in case of on-site and off-site studies. Then, the results of the measurements within the Nasca–Palpa project are explained in more detail. The results of the measurements at Jauranga show that one strength of the earth resistivity tomography is the possibility to separate different types of fluvial sediments, whereas the seismic velocities give valuable information about the bedrock and the thickness of the overlying loose sediments wherein archaeological findings could be clearly identified. Former loam excavation pits could be detected by the specific use of 3D tomographies. The comparision of 2D and 3D geoelectric data at Yunama showed a very good agreement between the different datasets. Several former soil surfaces could be reconstructed, that were covered subsequently by high-flood sediments of the River Palpa. We present the results of the geoelectric measurements at the archaeological site PAP-83(PV66-057) in comparison to the results of archaeological excavations. Anomalies of extremely high resistivity values could be identified as layers of straw mats, whereas relatively lower resistivity values represent adjacent adobe walls. The results of all 2D and 3D geoelectric tomographies are validated clearly by the archaeological excavations.

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6.1 Introduction: Sediment Tomography for (Geo-)Archaeological Prospection – On-Site and Off-Site Studies

The application of tomographical methods in medicine for the X-ray examination of our bodies for years has been part of the standard repertoire in a variety of medical examinations. Meanwhile, different geophysical methods are also available for the ‘X-ray examination’ of the shallow subsurface for locating archaeological findings. The use of geophysical methods in the context of geoarchaeology offers two main fields of application. These methods can be used to map archaeological structures directly within archaeological sites with high resolution at a small scale (on-site studies). On the other hand, geophysical investigations in the wider environment of archaeological findings may yield valuable information about landscape evolution or environmental changes in close connection with cultural changes (off-site studies). In contrast to detailed on-site studies, information about larger distances is decisively important for landscape-evolution aspects. According to these different requirements different methods or equipment configurations come into operation. The term ‘sediment tomography’ is used in this contribution generally for the application of geophysical procedures in which two-dimensional slices of the underground are produced. Conversely, the construction of ‘real’ tomographies requires a three-dimensional data set.

6.2 Methodological Bases of Sediment Tomography

An important advantage of using geophysical methods for sediment tomography is the nondestructive, complete, and in most cases high-resolution investigation of archaeological sites along a measuring line or across a measuring area. In the past, merely punctual information could be derived from results of landscape reconstruction (e.g., drilling data). Moreover, the areas between the drill holes always held uncertainties as to the interpretation of the data. But the acquisition of complete detailed information is an indispensable prerequisite for the recognition of archaeological structures at a small scale, such as wall remains, postholes, or pits.

A difficulty frequently met when interpreting geophysical data is the ambiguity of the measurements (e.g., Lange 2005; Kirsch and Rabbel 1997). For the reconstruction of the shallow subsurface there often exist several possible solutions explaining the data. In the case of favourable measuring conditions, however, the doubts can be reduced to questions of detail. Another difficulty consists in the correct interpretation of the results inasmuch as data anomalies of the measured parameters can reflect both natural variations of the sediment structures as well as archaeological findings. Because of that, the interdisciplinary cooperation of geoscientists and archaeologists is particularly important to exclude misinterpretations of the geophysical data.