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2 Methods

The methods applied will be presented in the form of the general approach of the study and the interpretation of the remains. After that, the field methods and analyses will be briefly presented. Detailed descriptions are given in the regarding chapters. The aim in this section is to give a concise general overview of the applied methods and approach.

2.1 Approach

A detailed presentation of the detected and recovered material remains will be done in the first part (Chapters 6 to 12). This includes the architecture, burials, artifacts, and botanical and faunal remains. This part will form the basis for all further internal analyses and studies (Chapters 13 to 20), and can also be used for comparisons in further studies regarding the Preceramic Period in Southern Peru, particularly concerning the Andean foothills but also the coastal area as well.

As outlined before, the intra-site analyses are concerned in particular with indicators of the economy and mode of mobility. An important aim of these analyses is to make these indicators quantifiable. Based on these quantifiable indicators, a qualified distinction can be made between a productive economy and/or an acquiring economy. The same would be possible for indicators of a permanent occupation versus a repeated, visiting occupation. As quantified indicators can be compared, a quantifiable comparison of them is possible leading to a qualified weighting.

Problems regarding the interpretation of archaeological material result from (post) depositional transformation processes of cultural and natural origin which affect the archaeological material and can produce a biased interpretation (Schiffer 1987; see Bernbeck 1997: 65–84 for an overview of the processes and a discussion of the theoretical and methodological literature). Therefore, the aim is not a general quantifiable comparability but a diachronic quantifiable comparability of indicators to address such interpretative problems related to transformation processes. This approach is based on the assumption that the remains on the site were affected during all occupation phases by the same cultural and natural effects similarly. Thus, not the general representation of indicators nor their relations among each other's but the dia-

chronic developments of such relations as expressed in observable trends are of importance here. The relation of an archaeological indicator X towards an archaeological indicator Y can be distorted by specific filtering processes. But the trend of the ratio between X and Y in Phase “a” as compared to Phase “b” can indicate a change in the relationship between the factors—assuming the affecting filtering processes are always the same. Thus, the assertion that X represents 10 % in contrast to Y with 90 % is only limited in its validity for archaeological material, as X can be affected by different transformation processes than Y. But if a chronological separation is possible and it can be detected that the *ratio* between X and Y in Phase “a” is of 5 to 95 %, and of 10 to 90 % in Phase “b”, and finally of 15 to 85 % in Phase “c”, then a distinct trend of an increasing importance is detectable within the ratio. As a similar effect of the filters in Phases a–c is assumed, this finding would then be valid. Thus, the ratio in percentage and not the absolute numbers is important for making different phases comparable.

This method of diachronic quantification will be applied especially to those categories of remains which can be realistically made quantifiable and include, in particular, artifacts and botanical and faunal remains. The approach is thereby oriented towards comparable methods of analyses of, for example, drill cores and the diachronic studies of pollen ratios or the diachronic developments of compositions of faunal remains for example in studies of domestication processes. In domestication processes ratios of different species or ratios within species (for example age distributions) are studied, compared, and used to formulate valid interpretations (see for example Lavallée et al. 1985 or Wheeler 1999 for such approaches to study camelid domestication). The material remains, especially in the form of artifacts, will be analyzed in a similar way and included in this kind of analysis. To address the research questions adequately, the analyses of the artifacts will be abstracted towards the reconstruction of activities (Chapter 14). Thus, it is for example of less importance to reconstruct the ratio between digging sticks and projectile points, than the abstracted indication for the diachronic development of activities related to plant use in comparison to that of hunting. Furthermore, the reconstruction of other activities is thereby important and will also be included.

This study will also investigate factors which worked independently and can be studied in a separately. Thus,

artifacts, botanical remains and other indicators will be considered at first independently and then examined diachronically. These independent indicators will then be analyzed within the overall view in a multi-proxy analysis to get valid results (Chapter 17). This final overall analysis considers the economic aspects of Pernil Alto and follows an approach proposed by Deborah Pearsall (2000; 2009), which in general separates between indirect and direct indicators for the reconstruction of subsistence economies.

Horizontal analyses relevant for the understanding of the economy, the mobility, and society of Pernil Alto will be conducted along with those diachronically quantifiable comparisons that are the subject of multi-proxy-analyses. These include the interpretation of important features—like dwellings and burials—and the comparison of those with other sites. The latter is furthermore important for investigating cultural relations with other areas of the Central Andean Middle Archaic Period. Moreover, the mapping of the activities within the settlement (Chapter 15.3) and an investigation of the chronological development of it (Chapter 15), will be conducted to get information of the inner structure of the settlement.

Thus, a fundamental aspect of the investigation is the internal chronological development of the Middle Archaic occupation on the site (Chapter 6). After the general presentation of the site, the investigation will begin with the chronology of the occupation, which includes the setting of the site and an overview of the conducted fieldwork (Chapter 5).

Another important aspect for understanding of the development of the economy and mobility are the environmental conditions which prevailed during the time of the occupation. The reconstruction of the surrounding paleo-landscape will therefore form part of the work (Chapter 4.3). This reconstruction is derived from the results of others (see Chapter 4). The reason for this reconstruction is to understand if the environmental conditions were suitable for distinct modes of economy, and how they may have influenced the economy and mobility, for instance in triggering, necessitating or promoting specific developments.

After an internal overall interpretation of the archaeological record of the site concerning the economy, mobility, and, if applicable, the form of society, these results will be connected with existing results of the socio-economic developments leading to the Late Archaic Period. A first step is the connection to the regional archaeological information within the working area of Southern Peru, which is the Rio Grande basin. As a next step, this general development leading to the Late Archaic characteristics will be evaluated in light of the new results derived from Pernil Alto.

2.2 Field methods

The methods applied during and after the excavation will be explained in more detail in the subsequent chapters and are described here only to give an overview.

2.2.1 EXCAVATION

The site was excavated following the natural or cultural layers and not by artificial strata. The excavation was conducted nearly exclusively by using trowels and brushes. Works in large areas using shovels were not executed. This was due to the sampling technique. A detailed description of the excavation areas, progression of the work, documentation, and sampling can be found in Chapter 5. The results of the excavation form the main objective of this work.

2.2.2 GEOELECTRIC PROSPECTION

Two geoelectric profiles were generated on the site and on the edge of the excavated area to clarify a possible expansion of the archaeological remains. The geoelectric profiles were made by a group of geographers from the University of Heidelberg, Germany, under the supervision of Bertil Mächtle.

2.2.3 GEOMAGNETIC PROSPECTION

A geomagnetic prospection was carried out in two areas of the site by a team of the Bavarian State Department for Monuments and Sites, Archaeological Prospection (Bayerisches Landesamt für Denkmalpflege, Ref. Archäologische Prospektion) under the supervision of Jörg Fassbinder. The general method was described by Fassbinder/Gorka (2008). This prospection was already conducted during an earlier part of the investigation of the site, focusing predominantly on remains of the Initial Period and the detection and analyses of the distribution of archaeological remains.

2.2.4 SURVEY

A small-scale survey was conducted in the middle section of the Rio Grande and in the direct surroundings of Pernil Alto which were delimited by natural formations of the landscapes (narrowing of the river valley to the north and south of the site). The aim was to get information on a possible small-scale settlement pattern during the Middle Archaic Period.

The area was already the object of intensive systematic archaeological surveys (Reindel et al. 1999, 2003; Reindel/Isla 2006; Reindel 2007, 2008, 2009, 2010, as well for references to earlier works). However, the material culture of the local Middle Archaic Period was practically unknown until the discovery of Pernil Alto. Based on this new knowledge of that material culture, this study tried to detect specifically preceramic sites in the area. However, no single preceramic site was detectable next to Pernil Alto. This does not necessarily mean that Pernil Alto was an isolated settlement, but is most probably a result of different factors which hamper the detection and have maybe led to destruction of sites (lack of rising architecture and surface ceramic concentrations; alluvial sedimentation in the river valley bottom; intensive agricultural use of the river valley bottom; superimposing of later sites on the edges of the river valley). Nevertheless, some localities with settings comparable to those of Pernil Alto were mapped and are briefly shown in Chapter 20. They might be helpful for further research but have to be investigated more intensely (e.g. non-invasive site inspections or test excavations).

2.3 Analyses

2.3.1 ARTIFACT ANALYSES

All recovered artifacts were documented, described, measured and weighted. The materials were determined. The artifacts were grouped in general into lithic, bone, basketry, wooden, jewelry, and other artifacts and then categorized more finely (Chapter 9). The analyses formed an important basis for the understanding of the activities conducted (Chapter 14) and the settlement structure. Both aspects are in turn important for the evaluation of the economy, differences in the society, mobility, possible exchange, and cultural relations.

2.3.2 RADIOCARBON ANALYSES AND DATING

Appropriate material for radiocarbon analyses was recovered *in situ* during the excavations and handled with care. The radiocarbon measurements were conducted by laboratories in Heidelberg, Germany (Hd) and Mannheim, Germany (MAMS) by Bernd Kromer and his team. Some radiocarbon dates were given to a laboratory in Zürich, Switzerland (ETH), for control reasons. All datings are AMS-datings. A detailed list is given in Chapter 6.

The chronology of the Middle Archaic was established following four consecutive steps: (1) a stratigraphic

evaluation of the archaeological remains using a Harris diagram, (2) the calibration and modelling of the radiocarbon dates from sequenced stratigraphic areas, (3) the connection of the calibrated radiocarbon dates from areas with less pronounced stratigraphy, and (4) a rectification of the complete Harris diagram.

The modelling of the radiocarbon dates was conducted with the support of Ingmar Unkel, Institute for Ecosystem Research, CAU Kiel, Germany.

2.3.3 ARCHAEOBOTANY

The archaeobotanical analyses were important for the evaluation of the subsistence economy. The goal was to determine the botanic spectrum of used plants on the site. Of special interest was the determination of domesticated, cultivated or wild species. The archaeobotanical determinations included the determinations of macro-remains, pollen analyses from intra site samples and microremains in the form of residues on some stone tools.

Botanical macro-remains

The recovered botanical macro-remains were determined by Gabriela Bertone of the Museo Nacional de Historia Natural in Lima, Peru. She also determined the botanic materials of some of the basketry artifacts. The remains were determined, counted, and weighed. The different plant parts were determined as well. The results are presented in Chapter 10 and form an important part of the evaluation of the subsistence economy.

Pollen analyses

To get more information on the plant spectrum beyond the macro-remains, numerous intra site soil samples were taken from secure archaeological contexts during the excavations. The resulting pollen remains were analyzed by Karsten Schitteck, Institute of Geography and Geographical Education of the University of Cologne, Germany. The results are presented in Chapter 10.5 and delivered some information on the plant use at Pernil Alto. But due to—in contrast to the macro-remains—bad preservation conditions, the information derived from the pollen analyses is limited.

Residues on lithic tools

Ten lithic tools (big ground stones and mortars) were sampled. The samples were analyzed for the remains of pollen, phytoliths and starches. The analyses of the samples were done by Linda Scott Cummings of the Paleo-

Research Institute, Golden, Colorado, USA. The aim was to get information about the processed plants and the use of the stone tools. The results are presented in Chapter 10.4.

2.3.4 FAUNAL REMAINS

The recovered faunal remains fall in two categories: remains of vertebrates and remains of invertebrates.

The vertebrates remains were determined by Enrique Angulo and Carmen Rosa Cardoza of Museo de Arqueología de San Marcos (Casona) in Lima, Peru. The invertebrates remains were determined by Manuel Goritti Manchego. The analyses sought to determine the species, which was not always possible due to the preservation of some remains and the number of identifiable species parts (NISP) and the minimum numbers of individuals (MNI). The results are presented in Chapter 11 and were important for the study of the use of animals in the form of hunting, catching, collecting or fishing.

2.3.5 PHYSICAL ANTHROPOLOGY

The recovered human remains were studied and determined by Elsa Tomasto Cagigao of the Pontificia Universidad Católica in Lima, Peru, and Lars Fehren-Schmitz then of the Georg-August-Universität in Göttingen, Germany.

Elsa Tomasto Cagigao studied the skeletal remains and determined the age (classes) and, when possible, the sexes of the buried individuals. The results concerning

the effects of the form of the economy on the skeletal remains are not yet available, with the exception of the analyses of the caries ratios which Elsa Tomasto Cagigao studied in her master thesis (Tomasto Cagigao 2009). The former results were important for the analyses of the society and paleodemography, the latter were important in the analyses of the economy. The results were incorporated into the descriptions of the burials (Chapter 8). The caries ratios are discussed in Chapter 12.1.

Lars Fehren-Schmitz took aDNA-samples from some individuals. The aim was to evaluate kin relationships of the inhabitants. Unfortunately, the preservation of the aDNA was too poor for such results (Fehren-Schmitz, personal communication). However, the results were incorporated into a wider study of the development of South American prehispanic populations (O'Fallon/Fehren-Schmitz 2011), in which the methods are explained in detail.

2.3.6 STRONTIUM ANALYSES

Strontium isotope analyses from samples of human remains were conducted to support and ensure the archaeological evidence regarding the mobility of the population. The analyses were conducted by Stefan Hölzl, Christian Dekant, and Susanne Rummel, all then from the Bavarian State Collection of Paleontology and Geology, Munich, Germany. The results are presented in Chapter 12.2 and were important for analyzing the mobility of the buried individuals and understand possible areas of movement. A general description of the method can be found in Horn et al. (2008).