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## **Pernil Alto: an agricultural village of the Middle Archaic Period in Southern Peru**

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## 21 Summary and Conclusion

This study on the Middle Archaic site of Pernil Alto (5800–5000 BP) was organized into three major parts:

It began with an introduction (Chapters 1–5) with the explanation of the question of research, the methodology, the applied scientific analyses, and a summary of the archaeological state of research regarding the Pre-ceramic Period in the Central Andes and the prevailing paleoclimatological conditions. It was possible to derive a tentative reconstruction of the paleolandscape which surrounded Pernil Alto during the time of its Middle Archaic occupation to the latter one.

In a next step (Chapters 6–12), all results of the excavations and analyses were presented. The material culture associated with the site was presented, structured and analyzed in particular detail. This detailed presentation of the material thereby closes a large gap concerning the material culture of the Middle Archaic Period in Southern Peru, and especially in the Río Grande basin from which only very little information was previously known. Furthermore, the results of the scientific analyses, especially the botanical and faunal remains, were presented in detail.

Based on this presentation of the materials, the evaluating part (Chapters 13–20) followed. There, the results of the excavations and analyses were systematically analyzed and interpreted.

At this point, a summarized depiction of the results will be made and Pernil Alto will be characterized as a whole. Detailed depictions and explanations will, however, be found in the former chapters. Here, the author will discuss if the applied methods were successful in answering the research question, and the overall results obtained. Subsequently, the relevance of these overall results for the understanding of the Middle Archaic Period in the working area of the Río Grande basin and Southern Peru will be discussed. Furthermore, the relevance of the results for the understanding of the overall developments which took place during the Middle Archaic Period in the Central Andes and which led to a sedentary and food-producing way of life will be evaluated. These latter developments eventually led to the developments of the Late Archaic Period that formed the basis for civilizations in the Central Andes. The results of the research at Pernil Alto will be placed in the context of these developments. Finally, possibilities for further research will be briefly mentioned.

### 21.1 Efficacy of the applied methods and procedures

The aim of this research was to investigate the Middle Archaic site of Pernil Alto and its economy, mobility and society. Various methods and procedures were applied to accomplish this task. These were mutually supportive and integrated into an overall approach. The main approach was a quantitative diachronic comparison of the results of the single phases of the Middle Archaic occupation. This procedure was possible because six occupation phases were identifiable in the archaeological remains by correlation of the stratigraphic information using a Harris-diagram (Harris 1989) and the modelling of 70 radiocarbon dates. With the quantitative diachronic comparison it was possible to measure and compare characteristics of the different occupation phases with each other in a neutral way. This approach was derived from established scientific procedures of analysis and was transferred in an adapted form to the analyses of archaeological remains. Furthermore, a multi-proxy procedure adapted to archaeological remains was applied in the analysis of the economy and the mobility of the site and its inhabitants. Various indicators were included in an overall analysis of these areas. This multi-proxy procedure also represents a scientific approach that was applied to archaeological remains. In both—the quantitative diachronic comparison and the multi-proxy analyses—the neutral assessment of data and their quantification was a first step. The interpretation of the results followed after this. Therefore, all procedures are transparent and criticizable at each point.

Various analytical methods were applied to enable this approach, which had different degrees of efficacy. The application of the quantitative diachronic approach can be rated as a complete success, which enabled important insights into the economy, mobility and society. However, the effectiveness of some applied auxiliary methods was limited.

Samples of aDNA were taken from numerous buried individuals of the site by Lars Fehren-Schmitz (then University of Göttingen, Germany) to investigate possible kinship between the individuals, and to be able to draw further conclusions of the structure of the society and the settlement. However, the state of preservation of the aDNA was insufficient to investigate such relationships.

Thus, the application of this method was not satisfactory in this area of the research. However, the results of these analyses were useful for a study on a supra-regional scale in which the settlement history of South America was investigated (O'Fallon/Fehren-Schmitz 2011).

Some intra-site pollen samples were taken during the excavation to obtain further information regarding the subsistence economy, especially plant cultivation. The analysis of these samples sought to augment the information that was given by the botanical macro-remains. The analysis of the samples was conducted by Karsten Schitteck (University of Cologne, Germany). However, it turned out that the pollen were—in contrast to the botanical macro-remains—very poorly preserved. The most important result of this method was that *Cucurbita* sp. was obviously cultivated near the site, because some of the *Cucurbita* sp. pollen was detectable in the samples. Apart from that, mainly the pollen of large grasses (*Typha* sp.) were detectable, which originated from the roof-tops of the dwellings. The application of this method was thus not very successful.

The same observation can be made for the analyses of pollen and phytoliths of samples from ten mortars, ground stones, and stone bowls. It was possible to prove that these tools were used for processing plants, but the analyses of the pollen and phytoliths never provided more than the genus of the plants—and in most cases, only provided the plant families. Consequently, no distinct remains of plants which were found as macro-remains on the site were identifiable on the grinding tools and therefore the specific use of the tools and relations of the plants processed on or with them remains unclear.

On the other hand, some auxiliary methods delivered very good results. The investigations of the physical anthropology of the skeletal remains of the buried individuals were successful. It was possible to determine the age class and age range for each buried individual, and for those individuals older than juvenile, the sex. The determinations were conducted by Elsa Tomasto Cagigao (Pontificia Universidad Católica in Lima, Peru). Investigations concerning the paleopathology were, however, not complete at the time of publication and these results are still pending. These results can provide further important evidence for the economy of the site. However, it was possible to draw conclusions regarding the paleodemography of the population and to compare this paleodemography with that of other contemporaneous sites.

The analyses of the Strontium samples taken from 16 individuals were conducted by Stefan Hölzl, Christian Dekant, and Susanne Rummel (all then Ludwigs Maximilians University of Munich, Germany). The application of this method was very successful. The results were important for the evaluation of the mobility of the population but served as well in the evaluation of the economy.

The determinations of the botanical macro-remains (conducted by Gabriela Bertone, Museo Nacional de Historia Natural in Lima, Peru), the vertebrates remains (conducted by Enrique Angulo and Carmen Rosa Cardoza of Museo de Arqueología de San Marcos – Casona – in Lima, Peru), and the invertebrates remains (conducted by Manuel Goritti) were of highest importance for the evaluation of the economy. All three determinations delivered very good results even though the determinations of the vertebrates were in some cases restricted due to the state of preservation of the small bone remains. In fact, the results of these conventional methods inform the evaluation of the economy.

Likewise, the reconstruction of the conducted activities based on the information of the artifacts was a complete success. It was possible with this method to make the indicated activities quantifiable and thus comparable. The method was specifically developed and customized for the investigation of Pernil Alto.

Furthermore, the high number of radiocarbon dates ( $n = 70$ ) in connection with the excavation technique of an excavation in area following cultural layers was also a complete success. The radiocarbon samples were analyzed by Bernd Kromer (University of Heidelberg, Germany). The stratigraphic information of all features detected during the excavation was integrated into a Harris-Matrix. The combination of both results enabled a precise modeling of the radiocarbon dates using the program OxCal 4.1. With this, it was possible to distinguish six occupation phases of the Middle Archaic settlement. These phases were the basis for the quantifiable diachronic approach, which was the general approach in this investigation. By applying this approach, middle-range problems were counteracted and valid results were produced.

This successful approach also illustrates that areal excavations are the best applicable technique for answering complex research questions in relation to archaeological sites, even though they are costly and time consuming. This is especially the case when little is known of period to which a site belongs. Excavating one or several trenches would not have delivered valid or evaluable results in the case of Pernil Alto. This would have been only the case if a result of an excavation would have been anticipated.

Finally, the procedures which were applied for the reconstruction of the economy and the mobility should be briefly mentioned. In both cases multi-proxy approaches were applied. These included various archaeological and scientific indicators which were quantifiable and independent from each other. The multi-proxy approaches—which are well established in geoscience—counteracted bias in the interpretation and produced valid results. Their application was also a complete success.

## 21.2 The Middle Archaic Settlement of Pernil Alto

It was possible to distinguish six occupation phases of the Middle Archaic settlement of Pernil Alto by modeling the previously mentioned 70 radiocarbon dates in connection with the stratigraphic information (for details see Chapter 6). Those phases date in the  $\sigma$ -2-calibration as follows:

Phase 0: 5789–5291 BP  
 Phase 1: 5334–5266 BP  
 Phase 2: 5303–5150 BP  
 Phase 3: 5257–5064 BP  
 Phase 4: 5248–4985 BP  
 Phase 5: 5215–4819 BP

Pernil Alto thus dates to the end of the Middle Archaic Period (8000–5000 BP). Phase 0 was the longest phase with a time span of roughly 500 years and was named “Phase 0” because of its long duration in comparison with the others. Furthermore, Phase 0 had some cultural differences when compared to the others. It can be considered as a kind of precursor phase.

The remains of 18 dwellings were detected and excavated during the excavation. Those are circular to oval semi-subterranean dwellings with diameters of 2.5 to 3 m which had been carved up to 80 cm into the ground. They served as simple dwellings for sleeping purposes which principally offered shelter, whereas everyday activities took place in the open air in the areas between the dwellings. The 18 dwellings were not erected and used contemporaneously, but were built successively throughout the occupation phases. Some of the dwellings were used after their abandonment as burial areas, while new dwellings were erected for shelter. The dwellings most probably offered space for 2–4 persons and—when used as burial areas—an average of 2.3 burials were laid in them.

The dwellings were not distributed randomly in the settlement area. They were located in an arrangement. Six dwellings were arranged in a circular pattern around a larger open space in the northern excavation area. This dwelling arrangement appears to have been the central area of the settlement. The remaining twelve dwellings formed two distinct compounds in the northern excavation area and one less distinct compound in the southern excavation area. Each compound consisted of four dwellings which were more or less arranged in a circular pattern around a smaller open space. Everyday activities took place between the dwellings in the larger open space and the smaller ones, which was evident by the associated high number of artifacts, remains, and features (especial-

ly layers, pits, and fireplaces). The circular arrangement of the successively erected and abandoned dwellings was a distinct settlement pattern which can be best described as “circling courtyards”. This specifically structured settlement pattern indicates a planned organization and a continuous use of the site. The internal structure of the settlement thus corresponds with a village rather than with a hamlet, even though the exact size is unknown. Therefore, Pernil Alto is interpreted as a village.

A further internal division of the village into specific or distinctly detectable quarters of special or specialized use is, at best, only slightly indicated. The distributions of the conducted activities—as indicated by the artifacts—were mapped to identify such a structure. The results indicate that all detectable everyday activities were conducted in the larger central area of the settlement, whereas the smaller compounds could possibly show some initial tendencies towards specialization. The differences are, however, marginal and rather suggestive rather than evident.

Numerous artifacts were associated with the cultural remains. They were subdivided into six categories: lithic, bone, basketry, wooden, and other artifacts as well as jewelry. Only very simple techniques had been applied to produce the lithic tools, with the exception of the large ground stones and mortars. The material used for the lithic tools was generally of regional origin. Just a few artifacts were made from obsidian which is the only exotic material, with a probable origin in Quispissia (Burger/Glascock 2000; Contreras et al. 2012; Tripcevich/Contreras 2011, 2013). The artifacts are presented in detail in Chapters 9 and 14. It should be mentioned that the inventory of Pernil Alto is the most comprehensive collection of material of the Archaic Period in the working area of the Río Grande basin, and is one of the most comprehensive in Southern Peru in general. With the completion of this inventory, an important aim of the study was reached by producing a reference sample for the material culture of the Middle Archaic Period of Southern Peru.

Various activities which were conducted by the inhabitants of the site were detectable by the artifacts. These activities were made measurable and comparable through the different occupation phases by the quantitative diachronic approach. Their amounts and thus importance show distinct changes during the development of the settlement. Thus, activities connected with hunting and foraging were of higher importance during the beginning of the occupation in Phase 0, but lost importance over time in comparison with activities connected with plant use. The latter increased continuously. Activities associated with handcraft also increased continuously. All detected activities and their temporal developments were presented in detail in Chapter 14. It is

important to mention that the activities detected at Pernil Alto cover the wide range of a continuously used settlement. Thus, Pernil Alto was not a specialized camp or settlement.

An important category of the detected features is represented by the 33 burials which contained the remains of 35 individuals. Most of them are simple, primary, inhumation burials. Two were double burials. A strict burial rite could not be identified. The burials had a slight tendency towards a body orientation towards the northern hemisphere and a direction of view towards the northeast. These tendencies could have been associated with the course of the sun. Furthermore, male individuals were more often buried alone in abandoned dwellings, whereas female individuals were buried in groups in abandoned dwellings. However, those differences are not very pronounced and the data is very sparse with only seven sex-determined individuals. An assignment of individuals to single kernel families appears to be indicated with burial groups using different compounds. However, this was not verifiable.

The paleodemography of Pernil Alto represents a complete population and includes individuals of prenatal to mature age. Young individuals (up to the age class of infans 1) comprised two-thirds of all individuals, representing the majority of the buried individuals. It was possible to compare the paleodemography of Pernil Alto with that of La Paloma (Benfer 1990; Quilter 1989). This comparison indicated that the child mortality was higher at Pernil Alto than at La Paloma—where the subsistence was based in marine resources.

The burials from Pernil Alto represent one of the largest burial groups found on a single site of the Archaic Period of Southern Peru. Thus, their detailed presentation (in Chapter 8) can serve for comparisons for further studies.

All aspects of the material culture of Pernil Alto—including dwellings, burials, and artifacts—connect Pernil Alto with the cultural developments of the Archaic Period of the Peruvian Central and South Central coast. Pernil Alto has therefore to be seen as a part of these cultural developments. Connections with the developments of the Archaic Period in the highlands or in areas further south are hardly noticeable. Pernil Alto was thus a village of the peripheral area of the cultural developments during the Middle Archaic Period of the Central and South Central Peruvian coast.

### 21.3 The economy of Pernil Alto

A central aim of this study was the reconstruction of the economy of Pernil Alto. Chapter 17 is dedicated to the

economy. A multi-proxy analysis was conducted following the recommendations of Deborah Pearsall (2009), which included all relevant aspects for this area such as the results of the determinations of the botanical and faunal remains, the results of the pollen analyses (although sparse), the results of the Strontium isotope analyses, and the results of the analyses of the activities based on the artifacts. The results of this multi-proxy analysis proved that the overall basis of the subsistence at Pernil Alto had been food-production in the form of agriculture.

In contrast to that, hunting and the use of marine resources were of minor importance. However, the collection of wild plants was important.

Food-production was based on the cultivation of domesticated plants. The most important cultivated plants were Lima beans (*Phaseolus lunatus*) as a source of protein and sweet potatoes (*Ipomoea batatas*) as a source of carbohydrates. The remains of edible parts of these plants represent 87.12 % of all remains of edible parts of domesticated plants at Pernil Alto. However, other domesticated food plants were cultivated as well. Those include the species of edible canna (*Canna indica*), sweet potato (*Ipomoea batatas*), Lima bean (*Phaseolus lunatus*), common bean (*Phaseolus vulgaris*), and guava (*Psidium guajava*), as well as the genera of Jack bean (*Canavalia* sp.), squash (*Cucurbita* sp.), and yam bean (*Pachyrrhizus* sp.). An additional cultivated plant was domesticated bottle gourd (*Lagenaria siceraria*), but this plant was cultivated for industrial purposes as the dried fruits were useful as vessels. The cultivation of plants is particularly evident by the numerous and very well preserved botanical macro-remains. Furthermore, evidence of cultivation is clearly represented in the results of the analyses of the activities. Maize (*Zea mays*) was not detected at Pernil Alto and thus was not part of the diet of the inhabitants, even though maize was already cultivated on the northern Peruvian coast during the time of the occupation at Pernil Alto (Grobman et al. 2012).

Given that no diachronic morphological changes appear in the macro-remains, none of the plants cultivated at Pernil Alto had been domesticated there. Therefore, all cultivated plants had reached Southern Peru in their domesticated forms and had been most probably introduced from the northern areas of the Central Andes. However, it is important to mention that the recovered remains of sweet potatoes (*Ipomoea batatas*) represent the oldest macro-remains of this plant known so far. The remains of Lima beans (*Phaseolus lunatus*) as well represent very old evidence of this plant in the form of macro-remains. However, older macro-remains of this plant were reported from Chilca 1 (Kaplan/Lynch 1999) and from sites of the estuary of the Rio Ica (Beresford-Jones et al. 2015). Plant food was supplemented by the collec-

tion of *Prosopis* (*Prosopis pallida*). The amount of this collected plant at Pernil Alto corresponds to sites of the later Nasca culture (see Chapter 17 for details) which was, without a doubt, agricultural in nature. Technically, plant cultivation at Pernil Alto can be described as horticulture. The cultivation areas were not detected during the excavation but were located most probably on the ancient river meander zone directly south of the site.

As mentioned before, hunting was of only secondary importance at Pernil Alto. The faunal remains and the analyses of the activities based on the artifacts provided little evidence for hunting. Camelids were most probably hunted when the herds were descending from higher zones to reach the coastal lomas during the flowering period. The river valleys were the probable routes for the herds, which passed the location of Pernil Alto on their way. Furthermore, cervids were hunted to a lower extent, which was possible in the riparian forest of the Río Grande, as well as in the grass steppe that surrounded the location of Pernil Alto in the areas beyond the fertile river valley (according to the landscape reconstruction in Chapter 4). Hunting small game was, however, more important than hunting big game. Small game at Pernil Alto included probable wild guinea pigs, other rodents, and birds. Those had probably been attracted by the cultivated plants and the corresponding waste near the settlement.

Marine resources were unimportant at Pernil Alto. Only very few remains of shells of marine invertebrates were recovered during the excavation. Even the results of the Strontium isotope analyses indicate that marine resources were hardly consumed by the inhabitants. However, sea shells were important for jewelry, indicating exchange with other groups on the littoral. Furthermore, fresh water shrimp was captured by the inhabitants in the Río Grande.

In total, the subsistence economy of Pernil Alto was agricultural because the produced plant food contributed more than 50% of the overall plant food, and the subsistence was based on this production. Hunting and marine resources were only of additional importance in subsistence. However, a diachronic development in subsistence was traceable and agriculture was not the basis of the subsistence in the beginning of the occupation.

In Phase 0, subsistence was based on low-level food production of plants (*sensu* Smith 2001) which included nearly all domesticated species that were used later in agriculture, together with plant collecting and hunting. However, in this phase the collection of *Prosopis* was more important than the cultivation of plants. Hunting was also of higher importance during Phase 0 in comparison to later phases, as indicated by the recovered remains of big game and the relatively high amount of activities connected with hunting indicated by the arti-

facts. In total, the subsistence economy of Pernil Alto during Phase 0 can be described as a foraging economy in which plant collecting, hunting, and low-level food production were conducted.

From Phase 1 onward, the amounts of subsistence areas shifted. Agriculture formed the basis of the subsistence from that time on (by about 5300 BP), whereas plant collection was of secondary importance and hunting was hardly conducted at all. The importance of agriculture increases continuously throughout the following phases. However, there was a slight dip in the amount of cultivated plants in relation to the amount of collected plants during Phase 3. However, collected plants still made up more than 50% of the plant food even in this phase. During Phase 4, there was again a slight increase in cultivated plants. These trends were proven by the multi-proxy-approach.

Valid statements on the subsistence economy of Phase 5—the last occupation phase—cannot be made as there were not enough preserved remains from this phase.

In total, the transition from a foraging subsistence economy with low-level food production moving towards agriculture is represented at the site of Pernil Alto. Agriculture prevailed from 5300 BP onwards. This is the oldest conclusive evidence of agriculture in Southern Peru thus far. Taken together with the before mentioned results, Pernil Alto was thus an early agricultural village of the Central Andes. Prior to this study, strong evidence of agriculture is only known from the Nanchoc-pocket in the Zaña/Jequetepeque area of Northern Peru (see Dillehay 2011c, with further literature there). However, no extensive areal excavations were conducted on the remains of settlements there. Village structures are only known from the (post-5000 BP) Terminal Pre-ceramic Period, but thus far have not been excavated in the area. Thus, Pernil Alto represents the oldest known agricultural village of the Central Andes at the moment.

The reconstruction of the subsistence economy represents the completion of an important aim of this study.

## 21.4 Mobility at Pernil Alto

The research aim in regards to understanding the mobility of the inhabitants of Pernil Alto was also completed successfully. The applied Strontium isotope results were very important in this respect. In total, 20 samples were taken from the remains of 16 individuals at Pernil Alto. The samples were complemented by 11 samples taken from other materials. However, the discussion of the archaeological remains was equally important in order to produce a valid result for investigating mobility. The results of both procedures reinforce each other, but

the resolution of the results produced by the archaeological data was finer, which enabled the reconstruction of a diachronic development of mobility. This was based on the investigation of the diachronic developments of the activities represented by the artifacts.

Based on all these results, Pernil Alto was a permanently used settlement. The population was not mobile, but sedentary. However, there are indications for a logistical mobility (*sensu* Binford 1980, 1990) in which small task groups conducted single forays in order to obtain particular materials which were not available on the site or in its close surroundings. These materials included obsidian originating in the highlands—most probably from Quispissisa (Burger/Glascock 2000; Contreras et al. 2012; Tripcevich/Contreras 2011, 2013) and sea shells from the littoral.

Mobility—possibly including as well a kind of residential mobility—was most distinct in Phase 0. Based on the artifacts, mobility was more intense during this phase than in the following phase. The connections into the highlands were relatively intense in comparison with the following phases. However, there were connections with the littoral zone as well which are expressed in the archaeological record by the remains of sea shells and sea snails. Furthermore, most of the remains of big game originate from this phase. This game was most probably not hunted directly on the site, but within an area of 3-hours-walking distance around it. Furthermore, the fewest number of dwellings and burials are known from Phase 0, even though it was the longest occupation phase in time. Therefore, the population of Pernil Alto was probably relatively mobile during Phase 0, at least in comparison with the following phases.

The archaeological record indicates that the population was sedentary during Phases 1–3, that is, from about 5300 BP onwards. The connections into the highlands were less distinct than in Phase 0. However, the connections towards the littoral zone intensified. These intensified connections fit a sedentary group which stabilized its local permanence and therefore intensified the connection routes to other groups. The sites of Las Brujas (Vogt 2007, 2008, 2011) in the lower Río Grande valley and Santa Ana (Engel 1963b, 1964, 1981, 1987a) on the Pacific littoral demonstrate that the areas towards the littoral zone were settled during the Archaic Period. The sites themselves could directly represent connection places or target places of a network of exchange into which Pernil Alto was embedded.

During Phase 4, mobility again slightly increased. This was especially reflected in the increased hunting activities. This increase in mobility thus represents an increase in logistical mobility with movements towards locations in the direct surroundings of the site. Pernil Alto was a permanently used settlement even during Phase 4.

Definitive statements on mobility in Phase 5 cannot be made because of the little archaeological material associated with this phase. However, a permanent use of the site can at least be assumed.

Taken together with the previously presented results, Pernil Alto was a semi-permanently used camp of foragers during Phase 0. Both economy and mobility changed following this, and from Phase 1—that is, from 5300 cal BP onwards—Pernil Alto was a permanently settled, agricultural village.

## 21.5 The society of Pernil Alto

In contrast to the economy and mobility of the inhabitants of Pernil Alto, it was more difficult to come to distinct and valid results concerning the social structure. In total it appears that the social structure was that of an egalitarian society with a special status accorded to male inhabitants.

Important indications for the social structures were provided by the investigation of the spatial distribution of the activities within the site. Based on this result, all activities were conducted in the open air and can thus be interpreted as communal activities. Evidence for specialization in the remains in the two compounds in the northern excavation area and the one in the southern excavation area was scarce. Pernil Alto was most probably inhabited by some extended families. The smaller compounds—consisting of four dwellings each—might be first indications of an early privatization. Furthermore, the deposition of individuals within abandoned dwellings and sometimes in very close spatial proximity—like in the case of burials 35, 36, and 39—indicate family relationships. Therefore the social units at Pernil Alto were most probably the individual, the (kernel or extended) family, and the entire group. However, it has to be emphasized again that indications for such a social structure are only weak and by no means unambiguous.

The burial rites at Pernil Alto were not strict. Consistent body positions, body orientations, direction of views or burial constructions did not exist. Specific treatments of individuals from certain age classes or sexes was not detectable. The dead were buried in simple graves in the settlement and within abandoned dwellings. This pattern is known from sites of the southern Central Coast of Peru of the Archaic Period (i.e. La Paloma, Chilca 1, Paracas 514) and signal the cultural connection of Pernil Alto to this area.

A special status of male individuals is detectable by the spatial distribution of their burials. Three of four recovered male individuals in solitary burials in abandoned dwellings were found, whereas female individuals

were always buried in abandoned dwellings with other individuals. A specific function of male individuals can however not be determined by their grave goods.

The grave goods of the buried individuals were overall rather sparse. Only two burials—burials 10 and 29—were equipped with an outstanding number of grave goods. A social segmentation into “richly equipped”, “well equipped”, and “poorly equipped” burials was only made visible if parts of the burial itself—like the body position or the location inside or outside a dwelling—was included into the analysis. Social differences were thus discrete, but children were treated with special care and were sometimes especially well equipped. The society of Pernil Alto was thus interpreted as having been in general egalitarian, and wealth was not generated or bequeathed.

Burials 10 and 29 were exceptional to this general structure. Burial 10 consisted of a dwelling that had been burned down above an adult male individual. The grave goods associated with this burial thus represent grave goods for the dead, or the original content of the dwelling. In any case, the detection of an individual inside a burned down dwelling is a special case for Southern Peru. The only comparable burials are known from La Paloma where they were interpreted as the burials of “big men” (*sensu* Benfer 1999: 224). It is possible that this interpretation applies to the individual of burial 10 of Pernil Alto as well. As burial 10 is the oldest burial of Pernil Alto, it could as well represent the burial of a kind of founder-individual. However, this is speculative.

Burial 29 was outstanding among the burials because it was extremely well preserved. The buried individual was partly mummified, but it is not clear if this is the result of intentional and artificial or natural mummification. Natural mummification is suggested by the author based on the fact that the burial was found in a location below a later fireplace, leaving thick remains of charcoal and ashes which most probably contributed to the good preservation by building a kind of anti-bacterial filter. However, further investigations and detailed analyses of this individual will provide more valid results.

An important result of the social structure resulted from the analyses of the activities based on the artifacts (see Chapter 14 for details). Some “activities” could be associated with a personal expression of an individual—including, for example, remains of jewelry. In contrast, the determined ritual activities indicate activities emphasizing the community. Interestingly, individuality was more strongly emphasized than the community in Phase 0, whereas the community was more strongly emphasized than individuality in the following occupation phases (see Chapter 14 for details). In the context of the results presented previously, this relationship between

individuality and communality can be interpreted as being linked to the economy and mobility of the inhabitants. Thus, the individual had a higher status during the possibly semi-mobile foraging Phase 0, but the community became more important with the transformation towards agriculture and sedentariness. This change in the economy and mobility had thus a deep influence in the social structure of the population, and resulted in a change which is visible in the archaeological record. A stronger emphasis on communal work is necessary when subsistence is based on agriculture and a permanent stay on one site. Thus, the individual had to be more incorporated into the community to better manage such communal tasks and to counteract internal group conflicts which are more probable when individuals stay together for the majority of the time. Thus, an increase of social complexity accompanied the “new” subsistence economy.

In total, the society of Pernil Alto was largely egalitarian but with possibly slightly higher status accorded to male individuals. The transformation of the economy and mobility towards agriculture and sedentariness beginning with Phase 1—that is by about 5300 BP—led to a change in the status of the individual, according relatively higher status to the community.

## 21.6 The village of Pernil Alto

Pernil Alto was the first *agricultural* village known from the Central Andes. Subsistence was based on the production of plant food. The emergence of this economy by about 5300 BP predates the developments of the Late Archaic Period on the Peruvian Central Coast which were characterized by monumental structures and a marine-agricultural economy beginning at about 5000 BP.

Furthermore, a development from semi-mobile mobility patterns based on a foraging subsistence that already included low-level food production (*sensu* Smith 2001) of cultivated plants towards a sedentary and food-producing subsistence was detectable on the site. The semi-mobile foraging stage is represented by Phase 0 at Pernil Alto and lasted from 5800 to 5300 BP. It is possible that this phase was actually divided into several shorter phases. However, the stratigraphical information and the available radiocarbon dates did not allow for a finer chronological subdivision. During Phase 0, the individual had a higher status in comparison to the community. Individuality was more emphasized during this phase than in the following phases. This was probably related to the subsistence pattern in which the individual performance in hunting and collecting was especially important, whereas middle-term planning—which



gained importance during the following phases—was less important. Pernil Alto of Phase 0 can be interpreted as a camp of hunters and gatherers with an emphasis on the collection of *Prosopis* and the hunting of big game, in which low-level food production was conducted.

From Phase 1 onwards—that is by 5300 BP—the economic, mobile and social circumstances had changed distinctly. Subsistence was based on the production of the—already before—cultivated plants. Those represent the major part of the diet of the then sedentary settlers. Therefore, Pernil Alto was an agricultural village from Phase 1 onwards. The collection of *Prosopis* was, however, still important. Hunting was—even though to a lower extent and mainly concentrated on small game and birds—still conducted. Mobility was reduced and a year-round presence on the site is evident. However, task-groups still conducted forays. Forays into the highlands were diminished, but connections or relations with the littoral area—probably in connection with the reduced mobility—were stabilized. An antecedent of the later important horizontality (*sensu* Murra 1972) can thereby be assumed. However, movements would have been restricted to the inner coastal valleys of Southern Peru and the Pacific littoral. The social organization of the settlement reacted to these changes in economy and mobility. The community was more emphasized in comparison to the individual, as expressed in the archaeological record by increased ritual activities. An explanation of this is that middle-term planning—including sowing, maintenance of fields, harvest etc.—became more important than before, and the distribution of resources had to be organized differently. Furthermore, more frequent internal group conflicts can be assumed in the sedentary group, which could have been counteracted with integrating activities in the form of rituals. Agricultural activities are, in general, connected to communal activities and individual performance has a lower value than communal performance. The changed means of work, organization, and conflict prevention resulted in the community becoming more important than the individual.

The development at Pernil Alto was furthermore autochthonous. There are no changes detectable in the archaeological material regarding typology, technology, or the spectrum of the cultivated plant species. Evidence of external cultural impacts on the developments at Pernil Alto were not found, thus indicating an internal and independent development of the site. Whatever the motivation was, after the change in the subsistence economy, a dependence on the “new” economy can be assumed and a simple return to the previously practiced foraging economy would have been difficult, if not impossible.

The actual success of the newly sedentary and agricultural way of life at Pernil Alto is difficult to measure. The only possibility for comparison was the paleodemography of other economic patterns. When the paleodemography of Pernil Alto is thus compared with that of La Paloma (Benfer 1990; Quilter 1989)—a sedentary village on the southern Central Coast of Peru with a subsistence basis in the exploitation of the marine resources—it appears that child mortality at Pernil Alto was higher than at La Paloma (see Chapter 16). Therefore it seems that the “new” subsistence economy at Pernil Alto was less efficient than “traditional” ones. Agriculture still had yet to become fully established in the Central Andes. However, important steps were taken at Pernil Alto which included the fundamental change towards food production. Some internal crises or difficulties connected with this new economic system are indicated in the archaeological record of Pernil Alto, and were connected to Phase 4. During Phases 1–3 a more or less continuous increase in plant production is evident, but hunting and plant collecting gained importance again in Phase 4. All in all, the economy and society developed during Phases 1–3, but began to crumble during Phase 4.

Pernil Alto was abandoned by around 4900 BP. Agricultural and economic activities were hardly detectable in the last Phase 5. Burials were still placed in the settlement. This last phase appears to be an additional phase as burial site rather than a real occupation phase. The dwellings associated with this last phase had to be associated with it based on stratigraphic relations. It is possible that some later settlement activities of the Initial Period disturbed the stratigraphic information of the upper parts of the Middle Archaic stratigraphy on the site, thus making a precise assignment of these remains difficult (see Chapter 5 for details). Thus, Pernil Alto could have been used as burial site from close-by—or maybe newly founded—settlements.

The reason for the abandonment of Pernil Alto at the latest by the end of Phase 5, but maybe already by the end of Phase 4, is not clear. Distinct changes in the climate at this time (around 5000 BP) are not detectable in the closest climate archives (Eitel et al. 2005; Schitteck et al. 2015). If supra-regional cultural developments were involved in the abandonment—like possible migration towards the attractive “centers” of the emerging monumentality—is not determinable by the archaeological record of Pernil Alto. At best, only speculation on this is possible.

There are some social changes related to Phase 4 (see Chapters 14 and 16 for details) which could maybe have been related to the abandonment of the site. The importance of the individual had decreased in comparison with that of the community during Phases 1–3, possibly indicating an increased social coherence associated with more communal tasks and the greater importance of

counteracting conflicts within a productive economy of a sedentary population. However, during Phase 4, the individual gained importance again which could be an indicator for more internal conflicts and decreasing social coherence. This indicator is only slightly visible in the archaeological record. Furthermore, it is not clear if possible conflicts would have been a result of the same reason that eventually led to the abandonment of the site, or if the conflicts themselves were one factor for the abandonment.

A simple and plausible explanation would be a shift of the river bed of the Río Grande, which resulted in less high water during the rainy season in the river-meander south of the site and thus insufficient moisture for agricultural production. However, this possibility is unverifiable at the moment. Finally, there are possible factors relating to the abandonment of the site which do not leave visible remains in the archaeological record, such as epidemics, personal preferences, or changes in ideological beliefs.

The important conclusion is that low-level food production developed into agriculture at Pernil Alto by 5300 BP and the village depended on it until 5000 BP. This village represents thus the oldest known agricultural village of the Central Andes. It developed independently from marine resources, but was strongly related to prior and successive cultural processes of the Peruvian Pacific coast.

## 21.7 Pernil Alto in the context of the Río Grande basin

Pernil Alto represents the first extensively excavated settlement of the Archaic Period in the working area of the Río Grande basin. It was certainly embedded into a settled landscape. However, sites of the Archaic Period were not detectable in the middle Río Grande section, nor in the close proximity of the site itself. This is probably related to problems with surface detections of sites in this period (see Chapter 20). It is evident that further settlement activities took place in the Río Grande basin during the Middle Archaic Period which is evident by the sites of La Esmeralda on the middle Río Nasca (Isola 1990), Las Brujas in the lower section of the Río Grande (Vogt 2007, 2008, 2011), and Santa Ana on the estuary of the Río Grande (Engel 1963b, 1964, 1981, 1987a). An integration of Pernil Alto into a settlement system is imaginable in the following way: plant production was practiced and intensified in the middle valley sections where Pernil Alto is located until it came to form the basis of subsistence. Simultaneously, stabilizing connections

with the littoral area are traceable by the recovered shell remains. The settlements located on the littoral—like Santa Ana or maybe San Nicolas south of the Río Grande estuary (Rowe 1956; Strong 1957; Vescelius 1963)—probably concentrated on marine resources, simply because they were abundant and the amount of arable land was probably very limited due to the narrow river valley and possibly the influx of brackish water. Those littoral settlements provided some marine resources for the hinterland. Relatively large distances lie between these larger areas—the middle sections of the rivers with agricultural production and the littoral zone with a concentration on marine resources—due to the specific topography of Southern Peru. Covering this distance would have taken at least one day of walking.

A mixture of different economic systems and mobility patterns can be assumed for the area of the lower Río Grande valley, that is, the area between the littoral and the middle Río Grande valley. This intermediate area represents a possible area for passing through or connection between the previously mentioned larger areas. The sites located in it—as represented by Las Brujas—represent possible stopover sites.

However, detailed studies and presentations of the excavation results of Santa Ana and Las Brujas are still outstanding. Therefore, the model presented above can only be understood as preliminary. Further research will improve the knowledge of the regional settlement system of the Middle Archaic Period around Pernil Alto.

Connections with the highlands were, on the other hand, less distinct. They were less stable and provided the Andean foothills and the littoral with some obsidian. A cultural, social, or economic contact beyond that is not indicated—at least not at Pernil Alto.

## 21.8 The importance of the climate for the developments at Pernil Alto

The development at Pernil Alto from a camp of possibly still semi-mobile foragers to an agricultural village took place under favorable climatic conditions (see Chapter 4 for details). A precipitation rate distinctly higher than today prevailed (Eitel et al. 2005) which—when associated with the precipitation requirements of the vegetation—probably resulted in an abundant natural resources in the form of game and collectable plants. Pernil Alto was located in the center of this lavish landscape. Smaller fluctuations are detectable in this overall favorable climate (Schitteck et al. 2015), which indicate a slight increase in moisture in the highland catchment area of the

Río Grande by about 5500 BP. This increase in moisture could have resulted in more water in the river and therefore possibly more favorable conditions in the river valley. However, the connection between this factor and the emergence of agriculture in Pernil Alto is very rough, given that agriculture began around 5400/5300 BP on the site and hence there would have been a temporal discrepancy of more than 100 years between the climatic “event” and its impact on cultural developments. It is possible that the increase in moisture in the highlands and the emergence of agriculture are connected, but further research and a finer resolution of the climatic developments is needed. Furthermore, no distinct climate deterioration—in the sense of a significant decrease of precipitation—can be linked to the shift to agriculture. The change to agriculture was thus not triggered by changes of the climate. In contrast, favorable conditions continued during the change from a foraging economy combined with some low-level food production towards agriculture. This change to agriculture was therefore certainly not a reaction of the settlers of Pernil Alto to deteriorating or improving climatic conditions. An external, climatic trigger can thus not serve as a valid explanation for the developments at Pernil Alto. The change must have been resulted from internal cultural processes. The nature of these processes is very difficult to determine in an archaeological record limited to one site. It is possible that the change to agriculture was a creeping economic process in which stable natural resources successively lost importance, while cultivated plants gradually increased in significance. As the abundance and consumption of natural resources did not change significantly, a gradual process of socio-economic nature and not triggered by environmental changes is assumable.

However, the beginning of the settlement at Pernil Alto occurred in parallel to an important super-regional climatic change in the Central Andes. The onset of the ENSO phenomenon was dated to about 5800 BP on the Central Peruvian coast (Sandweiss et al. 2007) and this probably impacted the working area at the same time or shortly after. Furthermore, a generally increasing aridification is assumed to have hit the lower altitudes of the Central Andes from about 6000 BP onwards (Anderson et al. 2007), even though it is not detectable in the working area. Those two climatic developments (see Chapter 4 for details) could indeed have led to circumstances which made living on the littoral more difficult, and thus made the coastal hinterland more attractive for settlements. ENSO events have a strong impact on the short-term availability of marine resources. Parts of the littoral population could have reacted to a short-term shortage of these resources by moving into the fertile coastal valleys of the hinterland to make use of resour-

ces available there. Sites like this are represented by Pernil Alto and La Esmeralda. With their “cultural equipment” the settlers brought already domesticated plants—which had previously played a minor role in the littoral subsistence—into the hinterland. After an adoption to the landscape of the coastal river valleys an economic transformation towards agriculture took place. This transformation could have thereby been connected to increasing aridification.

This short explanatory model is an assumption at the moment, and is based on limited data. The archaeological record of the Middle Archaic Period of the littoral and especially the hinterland is still too sparse to come to a definitive explanation. Furthermore, records of the paleoclimate with a sufficiently fine resolution to connect cultural developments with climatic developments are still lacking for Southern Peru. However, based on archaeological and paleoclimatological research observed over a wide area, the before mentioned scenario appears at least very plausible. It should, however, not be forgotten that the paleoclimatic conditions under which Pernil Alto was settled were overall favorable.

Some indications of climatic events were detectable on the site of Pernil Alto. Dwelling 6 in the northern part of the excavation area was partly destroyed by water in the *quebrada* north of the site (see Chapter 7), indicating heavy rainfalls at least shortly after the Middle Archaic and before the Initial Period occupation. The occasional detection of small patches of river sand in some dwellings (see Chapter 7) could be due to single flooding events. Such flooding events are also indicated in the geoelectric profiles (see Chapter 5). However, these events did not result in the abandonment of the site, and as it was argued in Chapter 17, the location of Pernil Alto about 10 m above the fertile river valley bottom provided protection from most flooding events. The actual river course was probably located in relative proximity to the site, and more or less in its present location. A plausible—however at the moment not provable—explanation for the abandonment of the site at the latest around 4900 BP could have been a shift of the river course. The river courses of the coastal river valleys of the Peruvian coast can shift, caused by changes between the rainy season with high water flow and the dry season with low water flow. This process can also be enhanced by heavy rain events. If the Río Grande had changed its bed further to the east, there was most probably insufficient water and moisture for plant cultivation and the distance to drinking water was increased, resulting in the eventual abandonment of the site.

Hence, the occupation of Pernil Alto was *plausibly* flanked by two events concerning the paleoclimate and the paleolandscape. The settlement of the middle section of the Río Grande and the emergence of Pernil Alto could probably have been related to the onset of the

ENSO which represents a change in the entire climatic system of the Central Andes. In contrast, the abandonment of Pernil Alto was related to a local landscape event, such as the possible shift of the river bed.

The internal economic development towards agriculture has to be interpreted, however, as a socio-economic development, even though it was possibly flanked by a slight aridification. But this later paleoclimatic development—if it in fact affected Pernil Alto—did not have a crucial impact.

## 21.9 Possible explanation for the developments at Pernil Alto

The transformation from a low-level food-producing foraging way of life towards agriculture at Pernil Alto is very difficult to explain with the archaeological record of one single site. Population pressure, which was assumed by Cohen (1978) as triggering the development towards agriculture on the Peruvian Central Coast is not verifiable at Pernil Alto. Only two out of 33 Middle Archaic burials were associated with Phase 0. A distinct increase of the population should be verifiable before a change to agriculture is identified as triggering the process. This is not observable in Pernil Alto.

An impact of climatic changes on the development of Pernil Alto could not be observed. The shift to agriculture was not a reaction to a deteriorating climate. In contrast, this shift happened under favorable climatic conditions.

It is doubtful if rituals played a role in the shift to agriculture at Pernil Alto. On the contrary, following the results of the analyses of the activities (Chapter 14), ritual activities in relation to individual expression intensified after the shift to agriculture had taken place. A more intense or more complex ritual behavior of the settlers *before* the shift to agriculture is not observable. It appears that more complex ritual behavior was a result of the changed socio-economic system, and not its or one of its causes. However, as Dillehay et al. (2004) were able to demonstrate, social complexity—measured by ritual behavior—intensified in the Central Andes during the Middle Archaic Period before the shift to agriculture. This is not observable in Pernil Alto. However, Dillehay et al. (2004) include especially specialized ritual sites into their study, for example the Cementerio de Nanchoc in Northern Peru (Dillehay et al. 1989, 2011a). Such specialized ritual sites are not known from the Middle Archaic Period of the working area of the Río Grande basin. Therefore, an increasing ritual or social complexity cannot be assumed as causing the shift to agriculture at

Pernil Alto. Further regional studies in the working area examining Middle Archaic sites are necessary to verify or falsify this assumption.

The same applies to possible social causes which could have induced the shift to agriculture at Pernil Alto. These are also not observable in the archaeological record of the site. However, an evaluation of possible social factors is hampered by the fact that only two burials are known from the first occupation phase (Phase 0), which simply does not provide enough data to analyze the social structure of this first phase and compare it with the following ones. Even an analysis of the dwellings does not provide further insight into this matter. Again, further regional studies could help to tackle the question of whether social changes or increasing social complexity occurred in the working area (shortly) before the shift to agriculture.

In total, the reasons for the shift to agriculture at Pernil Alto remain enigmatic. The location (on the Andean foothills), the time (around 5300 BP), and the form (plant cultivation of especially Lima beans and sweet potatoes) could be determined. Unfortunately, the cause could not. The most plausible explanation based on the archaeological record of Pernil Alto seems to be a purely economic one: Pernil Alto was first settled by foragers which secondarily practiced a low-level food production of cultivated plants. The domesticated plants (already including Lima beans and sweet potatoes) were thus a part of the cultural equipment of the first settlers. Over time, the settlement of Pernil Alto stabilized and a successive economic shift from plant-collection and hunting towards agriculture took place. This shift was probably enhanced by experience gained in plant cultivation (planning, tillage, ideal seeding times, anticipated yields, harvest techniques, storage, procession of products, etc.). This, in turn, led to increased efficiency in agriculture. This successive process is difficult to observe in Phase 0, but evident by various proxies in the following Phases 1–4 (see Chapter 17 for details). The amounts of cultivated plants increased, as did the activities related to plant use and those indicating an increased concentration on the site (handcraft activities). This successive shift was probably a gradual process until the diet of the settlers was based on cultivated plants. From then on, the population depended principally on the efficiency of the “new” subsistence economy. Therefore, this successive process at Pernil Alto was a socio-economic process which was not significantly influenced by external factors, but in turn influenced the internal social composition (especially regarding ritualism). Eventually this formed the basis for long-term changes, in the sense that agriculture had a deep impact on later landscapes characterized by agricultural use.

## 21.10 Pernil Alto in the perspective of the emergence of civilizations in the Central Andes

A cultural phenomenon which was characterized by the dense appearance of sites with monumental structures emerged on the Peruvian Central Coast with the beginning of the Late Archaic Period starting by 5000 BP. Especially the sites of the lower and middle Supe valley like Aspero (Feldman 1980, 1985; Moseley 1973) and Caral (Shady Solís 1997, 1999, 2000a, 2000b, 2000c, 2002, 2006a) formed part of this phenomenon. Ruth Shady Solís (Shady Solís 2002, 2006a) interprets the settlement area of the Supe valley as a pristine state, with Caral as the capital, Aspero as a port, and about 20 additional associated sites. The emergence of this phenomenon is interpreted as the beginning of Central Andean Civilization (Haas/Creamer 2006; Shady Solís 2002). A concentration of sites with monumental structures is observable at the same time in the valleys of the Rio Patavilca and the Rio Fortaleza (Creamer et al. 2007; Haas/Perales Munguia 2004). However, the investigators of the area directly north of the Supe valley disagree with the interpretation of this as an early state (Haas/Creamer 2006: 752), but not with the idea that those sites represent the beginning of Central Andean Civilization. More recent research (Fuchs 2009; Fuchs et al. 2006) revealed that monumental structures already existed before those of the coastal area in the hinterland of Northern Peru. However, so far only the site of Sechín Bajo is known, and the surrounding political, social and economic systems are absolutely unknown. It appears that the site represents an advance in ritual development which was adopted on the Peruvian Central Coast, or which was introduced to it.

The basic economic system of the early civilization on the Peruvian Central coast was described as an agricultural-marine system (Shady Solís 2006b, 2006c). Two cultivated plants of major importance were integrated into it: (1) cotton, which enabled the production of better and more efficient nets, which in turn probably resulted in an improved supply of marine protein; (2) maize, according to recent investigations (Haas et al. 2013) had been cultivated on the Peruvian littoral for centuries (Grobman et al. 2012) but had so far not played any major role in the diet of the population of the regarding sites (Dillehay et al. 2012b: Suppl. 8). The economic system of the Late Archaic Period of the Peruvian Central Coast can be described as having been formed out of two subsystems. The first, the marine subsystem located on the littoral zone, concentrated on the exploitation of rich

marine resources and ensured a supply of protein. The second, an agricultural subsystem which concentrated on the cultivation of food plants—including maize—and ensured a supply of carbohydrates as well as industrial plants such as cotton and bottle gourd. Both subsystems were interrelated. Caral—centrally located in the area of these subsystems—had the function of a kind of capital (Shady Solís 2006b), or at least that of the main town. In particular, the complementarity of farming and fishing is seen as the basis for the emergence of the Central Andean Civilizations (Shady Solís 2006b).

The developments which took place during the Middle Archaic Period and which eventually led to this Late Archaic binary system are known to varying degrees. The development of the specialization in the exploitation of marine resources is known from various sites including La Paloma, Chilca 1, the Quebrada de los Burros, the Huaca Prieta and others. A systematic analysis of this development has already been completed (Sandweiss 1996). On the other hand, the development of the agricultural subsystem is drawn from discontinuous archaeological information that has been thus far only poorly understood. The new insights from Pernil Alto extend this archaeological information, opening the possibility of better understanding the Middle Archaic developments which led to the emergence of the early Central Andean Civilization during the Late Archaic Period.

Domesticated plants were distributed in wide areas of Southern America already at the beginning of the Middle Archaic Period around 8000 BP (Piperno/Pearsall 1998). Most of the plants originated from the tropical low-lands and were introduced into areas like Southern Ecuador and Northern Peru, among others (Piperno/Pearsall 1998). However, these domesticated plants were secondary sources of food in low-level food production subsistence systems (*sensu* Smith 2001). The most reasonable model of the processes leading to the domestication of plants and which explains their initially secondary importance is provided by David Rindos (1980; 1984). Following this model,<sup>33</sup> plants suitable for domestication were not purposefully domesticated by mobile groups. Germinable plant material was left with the plant waste when a camp site was left by mobile groups after short stays. The soil on the camp sites had been changed by the settlement activities, and the leftover waste formed a kind of soil microflora and milieu in which the plants germinated and could develop under changed conditions. Repeated stays on the site with a reuse of the found plants led, over generations, to morphologically and genetically changed plants. Those plants were then used, and over time domesticated

33 The model is explained here only very briefly and simplified.

plants developed which would not have developed in the same way under natural conditions. From then on, it was only a small step to an intentional cultivation of these domesticated plants. The plants were introduced from their areas of origin into other areas by migration of people or by transfer to other groups. However, they only formed a secondary part of the subsistence which was still based on hunting and collecting.

Permanent villages emerged on the coast of the Central Andes during the Middle Archaic Period.<sup>34</sup> Examples for such villages include La Paloma, Chilca 1, Las Vegas-80, and others, in which populations became sedentary. Domesticated plants—which were introduced to the zone as described before—were cultivated in these villages but were of minor importance in comparison to the rich marine resources. The latter were the main food source and because of their stable availability most probably enabled the emergence of permanent settlements in the first place. With this, three important factors for the later development of the civilization were developed: the domestication of plants, a specialization in marine resources, and sedentariness.

An early agriculture that was practiced independent from marine resources and which formed the basis of subsistence for the Nanchoc area in Northern Peru is assumed by about 7800 BP (Stackelbeck/Dillehay 2011). One quantitative analysis exists which is an important argument for agriculture (Piperno/Dillehay 2008). Yet the interpretation of the results of this analysis is questionable, because the determined starch-remains of Lima beans do not unequivocally originate from domesticated Lima beans (see Chapters 10 and 18). In addition, some further remains of domesticated plants of the Middle Archaic Period of the Nanchoc valley were found (Rossen 1991; Rossen et al. 1996), even though there were some explainable problems with their dating because direct AMS-datings corresponded with very young ages (Rossen et al. 1996). An additional important argument for early agriculture in the Nanchoc valley are contexts which were interpreted as the remains of irrigation channels dating to the Middle Archaic Period. These had been used at the latest by approximately 5600 BP (Dillehay 2011b: 262). Agriculture as a basis for subsistence can be assumed from this time on for the Nanchoc area, but is not convincing prior to this point at the moment.

No regular burials are known from this time (Tierra Blanca Phase, 7800–5000 BP) from the Nanchoc-Jequetepeque area (Stackelbeck/Dillehay 2011: 131; Verano/Rossen 2011: 166f.). Others have shown that cannibalism

was practiced (Verano/Rossen 2011: 172–175). Village structures are only known from the Terminal Preceamic Period of the area,<sup>35</sup> and a shift from circular dwellings to rectangular stone houses was dated to the Tierra Blanca Phase (7800–5000 BP) (Dillehay 2011d: 18), which is distinctly earlier than in the rest of the Central Andes. The cultivated plant species associated with the Nanchoc development (squash, quinoa-like chenopods, manioc, peanut, pacaes, and beans) were not determined to the species level. All of this indicates that the developments of the Nanchoc area are of crucial importance for the understanding of the emergence of agriculture within the multilineal developments of the Central Andes, but did not profoundly influence later developments of the early civilization on the Central coast. It seems that the Nanchoc development represents an isolated developmental advance.

However, the detection of agricultural systems in the Nanchoc area at the latest by 5600 BP in Northern Peru and by about 5300 BP in Pernil Alto in Southern Peru illustrates that the western flanks of the Andes seem to be of highest importance for the understanding of the emergence of agriculture in the Central Andes. It appears that agriculture first emerged on the western flanks of the Andes in Northern Peru and then reached Southern Peru some centuries later. This happened before agriculture formed the basis of the economy on the littoral and in the highlands. However, agriculture was not introduced to Pernil Alto but developed autochthonously on the site. Therefore, an emergence of agriculture on the Andean western flanks in Northern Peru and a continuous spread to the south following the Andean western flanks is not indicated at the moment, but the entire picture is far more complex. Still, the western flanks of the Andes appear to represent a key area for the understanding of the emergence of agriculture in the Central Andes. Future research will hopefully enable a further understanding of the—obviously complex and multifaceted—process that led to it.

In contrast to the Nanchoc area, the archaeological record of Pernil Alto—including the dwellings, the burials, the artifacts, and the domesticated plant species—shows a distinct cultural relation with the Middle Archaic sites of the southern Peruvian Central Coast, as well as with the developments of the Late Archaic Period on the Peruvian Central Coast. Therefore, it was obviously a part of these developments and thus forms a component for understanding the developments leading to the Late Archaic civilization.

34 For details for this section see Chapter 3.

35 The site of Cerro Guitarra represents a possible village, possibly comparable in size and structure with Pernil Alto but dates to 3835–2867 BP (Dillehay et al. 2011a: 157).

The archaeological record of Pernil Alto proves that agriculture had developed as a basis for subsistence independent from marine resources. This happened by around 5300 BP. The existence of the agricultural subsystem is therefore known for this time for Southern Peru. It is possible that—depending on results of future research—comparable villages had already emerged in the area of the Central Coast. Pernil Alto thus represents a case study for the development of the later agricultural subsystem: the settlers were able to transform the already established technology of cultivating domesticated plants into a sustainable economic system of agriculture. Therefore, it can be assumed that the marine and agricultural subsystem developed during the Middle Archaic Period as adaptations to specific landscapes, and that they existed for at least some centuries in parallel to each other.

Both subsystems were then combined into an interlocked overall system based on a (maybe reciprocal) exchange between both subsystems. The developed and independently functioning subsystems were integrated into a symbiosis. This probably required a higher degree of organization, but also would have stabilized the food supply and could possibly compensate for the effects of ENSO events. Important “new” plant species—cotton and maize which had already been domesticated before—were integrated at the same time into the overall system. This led in probably a short time to an enormous increase (in comparison to the times before) in the production of protein (by increased fish catch with better cotton nets) and carbohydrates (by the planting of maize). This eventually would have made a surplus production possible, which is expressed archaeologically by a concentration of monumental structures with a pristine state behind them.

This first technological (plant domestication), then economic (development of the two subsystems) and social (symbiosis and organization of both subsystem) developments eventually formed the economic basis for further cultural developments in the Central Andes. Pernil Alto is only a small, but important, part for understanding this development.

This millennia-long process was flanked by various climatic changes, but the interpretation of them and their correlation with cultural developments would exceed the scope of this study. However, it is important to reiterate that the shift from low-level food production to agriculture took place in Pernil Alto under favorable climatic conditions and that no climatic change can be associated with this shift. Thus, changing climatic conditions—based on the actual state of research—did not cause the shift. The settlers instead successively used their technological and organizational capacities, which they developed further under optimal, or at least favorable, climatic conditions.

## 21.11 Future research possibilities

The results of Pernil Alto suggest the necessity of further research on the emergence of agriculture during the Middle Archaic Period and the emergence of the Late Archaic civilization in the Central Andes.

First, it is evident from the investigations of the sites of Pernil Alto, Las Brujas (Vogt 2007, 2008, 2011), and Santa Ana (Engel 1963b, 1964, 1981, 1987a) that the middle and lower sections of the Rio Grande were settled during the Middle Archaic Period. A more detailed knowledge of the settlement system would be desirable. The results of the excavations of Las Brujas and Santa Ana could be presented in further detail in the future to investigate the character and amount of the exchange network between the littoral, the lower Rio Grande section, and the middle Rio Grande section. Furthermore, at the moment Pernil Alto is an isolated archaeological site in the middle Rio Grande section. Future detections of simultaneously occupied sites in this area and their investigation would decisively improve understanding of the developments at Pernil Alto within a wider context. Only with this knowledge it would be possible to investigate and understand social and ritual factors which could have impacted or even caused the shift to agriculture, for example population pressure, centralizations, increasing ritualization and organization.

In the technical area, methods enabling the detection of preceramic sites that are not indicated by concentrations of ceramics or architectural remains on the surface should be improved. In particular the very well established and applied method of geomagnetic prospection should be further adapted to the specific conditions of the working area. This would facilitate the systematic detection of preceramic sites.

The results of Pernil Alto show, in a supra-regional context, that important cultural developments in the Central Andes not only took place in the highlands or on the Pacific littoral, but that the Andean west flanks and foothills are important for the understanding of wider cultural processes. Future research on the Pre-ceramic Period could focus on this geographical area—a suggestion that was already made more than 20 years ago by Peter Kaulicke (1994: 162). More recent research (Dillehay 2011c, Fuchs 2009; Fuchs et al. 2006; Goldhausen et al. 2006, 2011)—including the present study—have heeded this suggestion. However, with the exception of Goldhausen, these investigations were of archaeological remains from Northern or Southern Peru. A concentration on the Andean west flank and foothills in the hinterland of the area of the Late Archaic civilization on the Peruvian Central coast should come more into focus.