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No country for old people: a paleodemographic study of Tiwanaku return migration in Moquegua, Peru

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No Country for Old People:  
A paleodemographic study of Tiwanaku return migration in Moquegua, Peru

A Thesis submitted in partial satisfaction of the  
Requirements for the degree of Master of Arts

in

Anthropology

by

Sarah Irmelin Baitzel

Committee in charge:

Professor Paul Goldstein, Chair  
Professor Guillermo Algaze  
Professor Geoffrey Braswell

2008
The Thesis of Sarah Irmelin Baitzel is approved and it is acceptable in quality and form for publication on microfilm:

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Chair

University of California, San Diego
2008
DEDICATION

I dedicate this Thesis to my mother, Christina Baitzel.
In memory of my father, Edgar Baitzel.
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I also would like to thank the members of the South American Archaeology Lab for their patience and support over the last year.

To my family, thank you for always being there and believing in me.
ABSTRACT OF THE THESIS

No Country for Old People: 
A paleodemographic study of Tiwanaku return migration in Moquegua, Peru

by

Sarah Irmelin Baitzel

Master of Arts in Anthropology

University of California, San Diego, 2008

Professor Paul Goldstein, Chair

During the Middle Horizon period (A.D. 500-1000), the Tiwanaku polity, located in the Lake Titicaca Basin of the south-central Andes, established colonial enclaves in the coastal Moquegua Valley. The colonists maintained their Tiwanaku-affiliated identity for many centuries, while living in diaspora. This is indicative of strong ties that must
have existed between the colonists and their homeland. Although archaeological research has focused extensively on the migratory influx of Tiwanaku people to Moquegua, the possibility of return migration from the colonies to the homeland has been less emphasized.

This thesis investigates the migratory behavior of Tiwanaku colonists in Moquegua using a paleodemographic approach. The population samples represent two different Tiwanaku social groups that lived in Moquegua and practiced distinct subsistence strategies. By comparing the demographic samples of agro-pastoralist and agriculturalist populations in Moquegua to the demographic uniformitarian model, it is possible to explore whether or not return migration did in fact impact the colonists and how different sub-groups of the greater Tiwanaku population were affected differently.

The presence of return migration and sojourning between the homeland and the colonies opens up new avenues of research to be conducted in both regions in order to better understand the impacts of migratory processes among the Tiwanaku. This study also carries important implication for the future use of paleodemographic data in the investigation of return migration in archaeological populations.
Introduction

Pre-Columbian complex societies in the Andes relied on a number of strategies to exert social control and ensure resource procurement. Often this was only possible by moving people across the landscape and establishing colonial outposts or settlements, e.g. the *mitmaqunas*, or labor colonies, of the Inca Empire (D’Altroy 2002). While the colonists focused on agricultural production, camelid caravans distributed the goods back to the homeland or traded with other societies. In the case of the highland Tiwanaku people of the Middle Horizon period (AD 500-1000), agriculturalists and pastoralists created a social network that allowed them to live and farm in far-away colonial settlements while maintaining close contact with their home community.

![Map of the Tiwanaku Culture in the south-central Andes](from Goldstein 2005:85, Fig. 4.2).
The movement of people across the landscape necessarily affects the demographic make-up of a population. Demographers and paleodemographers have developed a variety of methodological approaches to the study of population dynamics, including a uniformitarian theory that assumes human demographics to follow certain universal biological processes. This study will use a paleodemographic approach based on unique new research data from a pre-Columbian Tiwanaku cemetery to reconstruct migratory behavioral patterns in the Middle Horizon period in an attempt to understand how migratory behavior was regulated and how it affected the demographic and social composition of a community. The implications of the results from this study will further the anthropological understanding of migratory processes, in particular return migration, as they control economically different groups within a colonial framework.

Based on the available information about migration, paleodemography and the Tiwanaku culture, several testable hypotheses can be developed to approach the issue of demographic population structure in Middle Horizon Moquegua. Even though we know that people moved to the colonies throughout their lifetimes (Knudson and Price 2004), the question remains whether colonists returned to the homeland, on what basis the returnees were selected (e.g. occupation, ethnic or kin affiliation), and what explanations can account for this return migration. If colonists returned to the homeland after reaching adulthood, the absence of adult individuals would affect the mortuary population in two possible ways. It would either lower overall fertility, because young reproductive adults are absent, or older individuals would be absent – and therefore underrepresented. In case the return migration only affected a certain
sub-group of the total population, then we may draw certain conclusions. For one, it tells us about the extent of the return migration movement. Because of the age, sex, and archaeologically visible social markers like status, occupation and subsistence strategy of the returnees, we can also make inferences about the social structure and conditions within the colonies under which the returnees were selected.

While paleodemography will serve here as the method to test for the migratory movements occurring in Moquegua, I will draw on migration theory in archaeology for a more detailed understanding of such processes. In Section II, I focus on the issue of migration demography, and more specifically on return migration and its potential effects on society. The section also considers a particularly relevant case of return migration, namely that of Andean pastoralism, which is intended to provide an overview of the variable socio-economic strategies of Andean herding societies, as they may help in understanding the population movements of Andean people. The next section (III) addresses the role of paleodemography in archaeology and the use of uniformitarian theory, citing previous archaeological studies to show the potential benefits of this approach for the case of the Tiwanaku colonies in Moquegua. A brief overview is provided of the Tiwanaku culture and its colonies in Section IV, followed by the presentation of my demographic data from the Rio Muerto M70B cemetery. The discussion and following conclusion (Section V) draws on the paleodemographic observations for the interpretation of my data in comparison with published demographic data from the Chen Chen cemeteries. In the conclusion I aim to answer the questions and hypotheses posited above based on the results of the discussion. It aims in particular to understand the migratory patterns of agricultural and agro-
pastoralist settlers in Moquegua, and the relative importance of subsistence strategies in determining these migrations. I hope that this paper will not only further understanding of colonial Tiwanaku migration processes specifically, but also present a new approach to studying population movements in general through the use of paleodemography.
II. Migration and Archaeology

The identification and analysis of human migration in the archaeological record has presented scholars with challenges and obstacles, some of which have been overcome, while others remain to be solved. After acknowledging that the movement of cultural traits – as reflected in artifacts and architecture – is not always synonymous with the movement of people, the issue of pre-historic migration was dismissed in the 1960s and 1970s as unsolvable and also, unfortunately, as irrelevant for explaining structural processes in human society (Chapman and Hamerow 1997:3). In the last two decades, however, migration studies have come back into fashion with archaeologists as a way to comprehend processes of physical movement across time and space, as well as their social, political, and economic motivations and consequences. Most importantly, as part of the recent revival of migration studies and migration models, scholars are seeking to elucidate issues of agency, in which the individual or group no longer re-act to external push-and-pull factors but instead use mobility as one of several possible “social strategies” (Anthony 1997:22).

The causes of migration often elude the archaeologist, since they may be too subtle to detect, but structural aspects of migratory movements may help characterize behavior caused by and related to migration processes. As Anthony points out “it is perhaps more important [for the archaeologist] to understand the structure of documented migratory events” (1990:899), as this is often less difficult to do and can prove to be equally informative on the effects of migration on human society. A possible way of investigating migration frequencies would be through ethnographic and ethnohistorical accounts, since “there is no reason to suppose that [pre-historic]
migrations operated substantially differently from more recent migrations, particularly those of rural or farming populations” (Anthony 1990:898). Anthony identifies 5 aspects of migratory patterns: “leapfrogging, migration streams, return migration, migration frequency, and migration demography” (1990:902), all of which facilitate model building for population movements.

The first two aspects are primarily concerned with the out-migration of individuals and groups, describing two ways in which people can move across the landscape. Leapfrogging describes singular migratory movements, in which migrants establish spatially-isolated sites away from the homeland without leaving evidence of occupation between these sites. Falling under the category of coerced migrations, the Inca labor colonies, or mitmaqunas, followed this leapfrogging pattern, because they were resettled in new territory without establishing temporary settlements along the way (d’Altroy 2002:248). On the contrary, migration streams (or chain migrations) are a constant influx of people following a clearly discernible route (Anthony 1990:903-4). Such cases are better known from the historically documented periods; examples include the major population movements in Europe following the fall of the Roman Empire during the 4th century AD or the colonization of the Western United States during the 18th and 19th century.

The processes involving return migrations are often overlooked, as research tends to focus on the migrant groups and the populations on the receiving end of the

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1 Coerced migrations also frequently target smaller groups within the community, but lead to the forced movement of people (Anthony 1997:26-27).

2 Chain migrations are often motivated and facilitated by kinship ties and consequently can affect certain social strata or sub-groups of a society (Anthony 1997:26-27).
migration stream. Generally, “return migration is defined as the movement of emigrants back to their homelands to resettle” (Gmelch 1980:136), without specifying the frequency or scale of the counterstream. Although Gmelch, who examines modern migration processes, concludes that “return migration has no effect on home-communities” (1980:153), other theoretical studies of return migration in pre-history and modern times have proposed different results. Migrants often prefer familiar places with existing social networks to places that may be economically more lucrative but unfamiliar (Anthony 1997:25), and “return migrants may have human and social capital specific to the origin that has not fully depreciated in their absence” (Chiswick 2008:74). Return migration should therefore be considered an attractive option for the deciding migrant. In many cases, strong family ties are the reason for return (Gmelch 1980). In as much as “[e]very migrating family member [during the initial migration] is evaluated […] as to his or her ability to work, skills, and status within the original family group” (Hoerder 2004:21), it may be assumed that similar processes are at work in selecting for return migration. In the case of transhumant pastoralists who move back-and-forth between a limited number of places, return migration may even comprise an integral part of the migratory process depending on the availability of water and pastures (Yacobaccio and Madero 2001:86), also better known as circular migration.

Burmeister suggests that return migrants “interfere with the existing traditional social structure by bringing luxury goods and new ideas home with them[; w]ith their acquired money and commodities, they improve their social position in the home

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3 This conclusion is based on absence of evidence and warrants further study (Gmelch 1980:153).
group” causing social conflict (2000:545). I would like to emphasize this notion that not only the influx of money and commodities can give cause for social conflict, but so may any thoughts or experience that migrants share with their home community upon their return. Examples of this in the anthropological literature are rare, because the focus of return migration studies is often on the causation and on the return migrants themselves rather than the impacts of return migration on the social group in general.

The issue of migration frequency is also relevant to return migration, because “[m]igrants have a higher propensity for a subsequent move than do nonmigrants” (Chiswick 2008:74). Migrants, having “less human and social capital specific to the initial destination” (2008:74), may be more inclined to move again. Unfortunately, migration frequency is often not detectable for archaeologists, because settlements are occupied repeatedly, and did not always create occupational sequences distinctive enough to discern as small time intervals. The temporal resolution of radiocarbon dates and artifact styles is also often not fine enough to identify movement patterns either over short periods of time or of groups or individuals within a larger population.

Recent bioarchaeological advances in the field of stable isotope studies (strontium and oxygen) can now distinguish short-term mobility using organic materials like human hair (e.g. Wilson et al. 2007). The intake of strontium and oxygen isotopes through food and water is reflected in the mineral composition of human bones and teeth. Because geological regions differ in their isotopic make-up of these particular elements, archaeologists can trace changes in residence by comparing isotope ratios in teeth (which form early in life in retain their isotopic signature) with those in bones (which, after a given period of time will reflect the signature of the new residence) (Price et al. 2000:906). Hair and nails, since they grow faster than bone and teeth reflect the individual’s strontium intake over a shorter range of time (months rather than years), and can be used to re-trace movement through space (e.g. Wilson 2007).
Lastly, it can also be assumed that differences in lifestyle and subsistence strategies will influence the degree and frequency of mobility. In discussing different types of migration (local, circular, chain etc.), archaeologists often exclude “alternative forms of mobile behavior”, e.g. seasonal mobility (Chapman and Hamerow 1997:1). This applies, in particular, to subsistence strategies; agrarian populations will be subject to different migration patterns and schedules than pastoralists or hunting and gathering groups for whom mobility constitutes a central part of their lifestyle. Although both groups’ patterns are often determined by seasonality, pastoral migrations are usually less permanent, because their stay is limited by availability of pasture, while agriculturalists remain for longer planting and harvesting cycles. Pastoralist groups are smaller and operate in nuclear family units (Orlove 1982:101); agricultural migration, on the contrary, can be expected to affect a larger section of the population, since more people are needed for labor. Agro-pastoralists may therefore be expected to include a combination of mobile as well as sedentary residential patterns depending on the more prominent mode of subsistence. Consequently, migration frequency, like distance and direction, can strongly impact the age composition of a migrant group, as not all individuals are physically disposed to move long distances at frequent time intervals. This has caused archaeologists and paleodemographers to investigate the particular effects of migration on human populations.

Migration demography

Migration demography, the study of the age and sex structure of migratory populations, proves to be a double-edged sword for archaeologists. On one hand,
migration affects the demographic composition of any population. “Since at any
given time, a population is defined by (1) the birth rate, (2) the death rate, and (3) the
migration rate” (Anthony 1990:897), archaeological evidence of migration plays a
significant role in the assessment and understanding of pre-historic population
patterns. On the other hand, the movement of people causes a *nonstationarity*\(^5\) of the
population (Wood *et al.* 1992:344), making demographic assessments of mortality and
fertility difficult. This can, in turn, overthrow the demographic analysis for
archaeological populations for which only limited data is available.

Nonetheless, as with living populations, distinct ancient migration patterns
must correlate with distinct paleodemographic profiles. We could expect populations
that are subject to local, circular, or career migration patterns to display “normal”
mortality and fertility distributions, since the individuals are absent from the
community for some periods, but are buried in their home cemetery and make up part
of the community’s age-at-death profile (unless they die away from their community).
Conversely, in the case of chain or coerced migrations, emigration of a certain part of
the population will affect the age and sex composition of the homeland community as
well as that of the migrants, given that these kinds of migration are typically long-term
or permanent (Anthony 1997:27).

Because different kinds of migratory behavior produce different kinds of
demographic profiles, the study of these profiles can identify migratory processes that
occurred in the past. Beyond this, paleodemographic studies can also offer insights

\(^5\) As opposed to stationarity, which refers to a “stationary state […] characterized by closure to
migration, constant age-specific fertility and mortality, zero growth rate, and an equilibrium age
into the ways in which migrants may have related to their home and hosting communities, as well as to other migrants. The migrants’ social identity in general, and ethnic identity in particular, must have constantly been re-negotiated as they found themselves in new surroundings. They were no longer spatially integrated, physically present members of their home communities; instead they re-shaped their homeland’s understanding of them as migrants and their perception of themselves as group members in absentia. For example, a study of male labor migration in modern rural Zimbabwe observes the changes in gender roles, primarily among women, who become more economically self-reliant and learn to take on the agricultural tasks of the absent men (Schaefer 2000). It seems reasonable that, like certain gender groups, some age groups were more valued than others, depending on a community’s needs (e.g. labor, reproduction, etc.).

Migrants probably also had to adjust social identities within their group, as new social categories formed and old ones were no longer needed. Upon settling down in a region that was home to culturally distinct groups, they would also have been required or enabled to re-negotiate their cultural or ethnic identity vis-à-vis the host community, a situation that may be advantageous to the migrants to improve their social or economic status (Lightfoot and Martinez 1995:486). The cases of three archaeological sites in the American Southwest make apparent that “[i]nteraction can range from complete assimilation, with the loss of ethnicity as a social category, to the formation of enclaves in which ethnicity is an extremely important social category that channels interaction and maintains social boundaries between two groups” (Stone 2003:61). It must be kept in mind that both social and ethnic identity of migrants
could not have remained unaffected, but were highly subjective as well as dynamic.

Kaulicke fittingly summarizes the above as follows:

> [e]stas identidades son, en primer lugar, autopercepciones dinámicas a nivel individual y grupal, pero pueden expresarse también como estereotipos desde la perspectiva de los otros. En este sentido, la identidad social desafía una relación rígida con la diferencia, ya que ambas fluctúan en sus definiciones, por lo que estas definiciones son situacionales y interdependientes en un espacio social reducido con un número reducido de agentes involucrados (2004:342).

Presence and absence of group members (due to migration or death) would shape the social roles and perceptions of the migrants themselves, as well as that of home and host community. As people were moving across the landscape and taking on different positions in society, they would have had to adjust their understanding of themselves and those surrounding them. Possible demographic differences between home and host community may have contributed to determining the role and relative importance of new immigrants in a group.

**Pastoralism in the Andes**

As mentioned above, it is highly likely that subsistence strategies influenced the migration behavior as well as the social identity of populations in pre-history. In the case of the Tiwanaku, subsistence strategies – in particular agro-pastoralism – have formed a central part in understanding and interpreting the mechanisms of trade, exchange and social hierarchy (Browman 1987; Kolata 1993, 2003b). One of the objectives of this study is to elucidate the possible impact of different subsistence strategies on colonial Tiwanaku populations and their demographic compositions. It is therefore necessary to allow for a brief discussion of pastoralist groups in the Andes.
Recent ethnographic studies of Andean pastoralist societies show the effects of a transhumant and migratory lifestyle on community life. Contrary to the general misconception that pastoralists are “rigid, traditionalist or isolated” (Nielsen 2001:167), scholars, who have conducted ethnographic work, have found their societies to be “flexible” and “pragmatic” (Nielsen 2001:167). In pre-Columbian times, the domesticated camelids of the Andes provided humans not only with meat but also with wool and pack animals, making them a highly valued and socially and commercially profitable capital. Several ethnographic observations allow for an insight into the life of the herders. I will focus here on the aspects of pastoralist mobility and social roles of different age groups among pastoralists in general and Andean camelid herders in particular. Keeping in mind that many aspects of pastoral life have changed with the introduction of an industrial labor market, these analogies will be applied with reservations.

In their study of the settlement patterns of modern Argentine camelid and goat herders, Yacobaccio and Madero found that pastoralists reside in larger base camps but move to temporary sites near pastures when there is a need to do so. Many of the temporary tent sites “lack nearby sources of water” (Yacobaccio and Madero 2001:86), which could have an impact on the health of their residents, young children in particular. The migration frequency and direction is often determined by environmental factors such as water and pasture availability. Kent Flannery observed that the llama-herding Wamani people of the Andean highlands undertake seasonal migrations that occur between wet and dry season, only twice a year (Flannery 1989:36). Their traveling route ranges from the eastern slopes of the Andes to the
Pacific coast, a trip that takes between two to three months (Flannery 1989:115). Such migratory behavior may influence the social structure and the demand placed on particular members of society. According to Orlove, modern-day pastoralists “live in nuclear family households, containing a married couple, their children, and occasionally an old widowed parent” (1981:101). Because of the small size of the group, children are required to partake in labor tasks relatively early on in life. Living among the llama herders of Cerrillos, Bolivia Nielsen found that “men begin to travel as ayudantes approximately at the age of 12, when both men and women assume full responsibility over productive activities in the household” (Nielsen 2001:169). This attests to the early participation of adolescents in the labor structure of Andean pastoral communities. In regard to the Aymara herders of Awatimarka, Kuznar notes that men and women do the same tasks despite the existence of an ideological division of labor (1995:46). Concerning the demographic patterns of pastoralists, a broad study of nomadic pastoral populations worldwide has shown that they have “low rates of natural increase of population compared to neighboring agricultural peoples” resulting from low birth and death rates, and additional factors like high female sterility and high ratios of men to women (Dyson-Hudson 1980:33).

One observation that is repeatedly made by ethnographers is that pastoralists rely to varying degrees on agriculturalists for resource supplementation (Johnson 1969:11; Kuznar 1995:47; Orlove 1982:106). Based on the study of interactions between nomadic pastoralists and sedentary agriculturalists in Western Asia, Rowton coined the term “dimorphic structure” for society, in which the boundaries between nomadism and sedentism become less distinct because of resource trade and exchange
(Rowton 1976:14). This suggests that people cannot always easily be assigned to fixed categories as they adjust their life-styles according to their perceived needs and changing environmental and social conditions.

These observations about nomadic pastoralists in general and particularly in the Andes show that their populations are small, with the nuclear family forming the basic social unit. As a result, family members of all ages contribute to the communal labor force to some degree. Their migration patterns are predetermined by the seasons and the availability of pastures, but both ethnohistorical and archaeological evidence shows the wide spatial extent that their networks encompassed. Since pastoralists are both a herd-owner and trader they may hold important positions in Andean society. In addition to this, however, the dependence on agriculturalists and their products would cause the pastoralists to re-negotiate their social roles; since many engaged to some degree in agricultural production, it remains to be seen how far pastoralist societies differed from contemporary agriculturalist groups in respect to demographic and social structure.
III. Paleodemography and Archaeology

Paleodemography in the context of archaeological migration studies has become a complex and hotly debated discipline. Throughout the 1970s and 1980s, scholars attacked the validity of paleodemographic studies, pointing out the incompleteness of samples, and weaknesses in age determination processes, etc. (Bocquet-Appel and Masset 1982). Others have defended the discipline provided that necessary changes be made to ensure accurate results (Buikstra and Konigsberg 1985). As a result, paleodemography has undergone a number of changes and improvements, primarily in the aging of skeletal remains (Roth 1992:177). “The very nature of paleodemographic data, human skeletons, and their context, prehistoric archaeological sites, form persistent difficulties” (Roth 1992:177), which means that mortality profiles are the only reliable information for paleodemographers to address. This is fortunate, however, because mortality profiles can serve in and of themselves as indicators of population dynamics.

The mortality profile of a population, which in the case of archaeology often consists of age-at-death profiles obtained from cemeteries, may provide evidence suggesting particular social conditions that may or may not be reflected in other lines of evidence. Paleodemographers caution scholars about the usefulness of cemetery data as representative samples of populations. Some claim that skeletal collections from cemeteries are not sufficient for establishing paleodemographic patterns in prehistory (Dumond 1997; Chamberlain 2006; Hollingsworth 1969; Boddington 1987). Hollingsworth called cemetery data the “most unreliable sources for making any demographic estimate” (1969:43; Chamberlain 2006:11-2), because of the bias
introduced by potential errors of age and sex estimates, as well as cultural and
taphonomic factors that play into the preservation and recovery of human remains
(Chamberlain 2006:12). However, as Chamberlain and Dumond point out, cemetery
populations can prove their usefulness in establishing estimates of carrying capacity
and population size when used in combination with additional evidence such as site
size and settlement patterns (Chamberlain 2006:12; Dumond 1997:181).

Ultimately, in cultures where no written records or census materials exist,
cemetery collections are the most valuable tool for paleodemographers, as long as they
remember that “the assessed population [is] the subset of [the contributing
population6] which survives deposition, post-depositional decay, excavation
processing and curation, and successfully yields age and sex data upon examination”
(Boddington 1987:181). I agree with Boddington’s statement about the use of
cemetery samples provided that external influences are factored into the final
interpretations. With many pre-Columbian cemeteries in the Andes, archaeologists
find themselves facing heavily looted sites, human remains without spatial context and
issues of preservation such as prolonged exposure to weathering. Careful excavation
and recording techniques can alleviate some of these shortfalls, at the same time as a
comprehensive interpretation of materials may provide logical explanations for
missing subsets (e.g. evidence of cremation).

Cemeteries always present site- or culture-specific mortality profiles. In order
to identify and study unusual characteristics of a mortality profile, archaeologists and

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6 The contributing population is the subset of a “population living in the area or region served by the
cemetery” that is buried in the cemetery (Boddington 1987:181); for migrant population this may
include a more spatially dispersed population than expected.
paleodemographers turn to normalized mortality profiles that reflect general population dynamics of fertility and mortality based on human biology. The best-known of these is the uniformitarian theory, which draws on processes similar to that of geological uniformitarianism.

The underlying assumption of a uniformitarian theory in paleodemography is that “fertility and mortality processes which shape populations are either invariant or fluctuate with aspects of the environment in predictable ways through a definable range of variation” (Howell 1976:28). These assumptions include the susceptibility of infants and young children to disease, the reproductive age of women and the expected longevity of the human body. Culture-specific behavior may change this biologically expected pattern, as we will see later in the discussion. Under uniformitarian theory, both agricultural and hunter-gatherer pre-modern population samples are expected to follow a uniformitarian U-shaped curve with relatively high numbers of young individuals under the age of 5 years, low numbers of adolescents and high numbers of middle to old adults past 40 years of age (Waldron 1994:20) (Graph 1 and 2).

Demographic data from the pre-Columbian site of Paquimé, also known as Casas Grandes, in Northern Mexico generally adheres to the uniformitarian expectations. The mortuary profile is associated with a fully sedentary, maize-farming community that inhabited the site between the 13th and 15th century A.D. (Di Peso et al. 1974; Dean and Ravesloot 1993). The mortality curve starts high at the beginning, drops quickly during childhood and rises up drastically for young adults only to

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The Waldron graph is based on a demographic census data from Peru in 1989 and serves as a proxy for a population that does not have complete access to modern medicine and sanitation and is therefore most alike to pre-modern conditions.
**Graph 1:** Uniformitarian age-at-death profile based Waldron 1984.

**Graph 2:** Uniformitarian age-at-death profile based Whittington 1989.

**Graph 3:** Mortality profile of sedentary farming population (AD 1200-1400) at the site of Paquime (Casas Grandes), Mexico.
remain at this high level for older adults as well (Graph 3)\(^8\) (Di Peso 1974:326 Fig 332-8). Except for the unusually high numbers of young adults (the cause of which is not specified), the mortality curve supports the uniformitarian theory.

Critics of this approach argue that such models “may mask important biological or behavioral differences between populations” (Paine 1997:192). Although this may be the fact in some cases, a uniformitarian model does provide archaeologists with comparative models of what is to be expected of an age-at-death profile under “normal” or stationary circumstances prior to the introduction of sanitation technologies and vaccinations. Some behavioral differences may in fact be underlined if the archaeological sample deviates significantly from the expected norm, while others are of a nature that produces “normalcy” without following expected processes, e.g. in the case of young adult immigration to Copan, which contributed to the fertility rate, while the age-at-death profile overall remained largely the same (Paine 1997). As long as the interpretations correspond with other lines of evidence and there remains space for different scenarios, uniformitarian theory can be a useful tool in assessing biological and behavioral characteristics of a population.

Even assuming uniformitarian principles, there are various situations that can lead to specific pattern deviations. A high percentage of children in a mortality profile can suggest high child mortality (possibly caused by unsanitary living conditions) and high fertility (caused by a variety of factors, e.g. high standard of living, large number of reproductive individuals, etc.). Another cause that can explain a high percentage of children in an age-at-death profile is the new arrival of young adults in a population.

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8 Age groups are based on available published data and do not necessarily correspond to other graphs.
who add to the number of children born in the community. Since the adults are
unlikely to die at this point in their lives, their presence would go otherwise undetected
as shown in a study of migration demography at the site of Copan, Honduras (Paine
1997). In the Copan case, rapid urban expansion during the Classic period (AD 400-
800) is thought to have been caused by high levels of immigration. A demographic
study established that the incoming migrants must have been young adults, because
the demographic profile for the site did not indicate excessively high numbers for old
adults, but a slight increase in young individuals (Paine 1997). If individuals enter a
society during their post-reproductive years, their presence shifts the age pyramid
towards the high end without showing a similar increase at the low end because of low
fertility (Fix 1999:75). As a proxy for the influx of reproductively active young
adults, high numbers of children in a demographic profile of a cemetery – while not
undisputed proof for immigration – can support a migration hypothesis in combination
with other factors that suggest migratory influx.

An atypical absence of any of the expected age groups could indicate physical
absence of this portion of the group. It is known, for example, that many first-
generation migrants are young adult males (“pioneers”) as they constitute the most
mobile part of a population (Anthony 1997:27). As a result, these individuals could be
absent in the home community cemeteries, but would be overrepresented in the early
cemeteries in the newly-founded communities. Similarly, the absence of old
individuals may be caused by a number of factors that may be acting separately or
simultaneously. The argument here is that the absence of old people, rather than
caused by a short life span, can be attributed to the return of elderly individuals to the
homeland. Return migration, as discussed earlier, is often an integral part of migration, in which migrants return to their place of origin after accomplishing their goals and/or fulfilling their obligations to the community, for example as laborers.

Migration can therefore significantly contribute to the particular formation of mortality profiles. While immigration usually exaggerates the shape of uniformitarian profile through higher infant mortality numbers, emigration will visibly affect the curve by creating absences among age groups that diverge from the uniformitarian norm. In particular, the absence of adult individuals in the mortality curve suggests that behavior (as expressed in the form of life expectancy or migration) altered the population’s demographic composition. Such altered demographic profiles can, in turn, provide archaeologists with further insights about the population’s social and economic conditions.

The case of the Zapotec enclave at the central Mexican site of Teotihuacan illustrates well the importance of demography in studying migratory behavioral patterns and their effect on society. Based on evidence from household and mortuary contexts, the Tlailotlacan compound is considered to present an enclave of immigrants from the Valley of Oaxaca located several hundred kilometers away from the site of Teotihuacan (Spence 1992; Spence and Gamboa 1999). Unlike other immigrants living in Teotihuacán, the Zapotec migrants came from a complex state society in the Oaxaca Valley with a large flourishing urban center at Monte Albán (White et al. 2004:387). As residents of Teotihuacan, they maintained their traditional Zapotec burial program, which afforded subadults their own burial place (unlike Teotihuacanos, who cremated their remains) and women’s tombs and grave offerings.
that were more elaborate than those of the men in their community (Spence and Gamboa 1999:195). Research conducted on skeletal remains using stable strontium isotope analysis has confirmed that several hundred individuals moved from Oaxaca to Teotihuacan at least once during childhood, while others may have moved back-and-forth between their homeland and the enclave more frequently (Price et al. 2000; White et al. 2004).

This example provides an interesting parallel to the case of the Tiwanaku colonies of Moquegua, which will be addressed later in this paper, relevant to the understanding of migrant groups in general. The extensive excavations and subsequent analyses that have been conducted at the Tlailolacan district in Teotihuacan provide archaeologists with insights into the demographic conditions in enclaves (and colonies), gender roles, and maintenance of continued contact with the home community. No evidence was found that indicates that Zapotecs at Teotihuacan were pastoralists.

The foundation of a new settlement demands a certain demographic structure that allows the residents of the enclave or colony to maintain the group numbers at a level that will ensure the “physical and cultural reproduction of the community” (White et al. 2004:386). Women, as the reproductive members of the population, would therefore have played an important role in the community away from home, as reflected in their burial treatment equaling that of the male members (White et al. 2004:390). The results of the isotope study of the Tlailotlacan residents further refutes the common assumption that women, particularly during breast-feeding period, were stationary; both the women and their infants moved across the landscape, creating a
unique social identity for the children who grew up as members of two spatially separated yet culturally similar communities (400). In addition, the authors of the Tlailotlacan study chose to differentiate between “true” immigrants and “foreign sojourners”, who lived abroad for some time before eventually returning to their homeland in Oaxaca (2004:399). This distinction was only possible because of the isotopic values of the individuals; no cultural material evidence has yet been linked to sojourning individuals. Such foreign sojourners can include laborers, merchants, and other specialists who reside abroad for work-related reasons, and return to the homeland when they are no longer able or needed to execute their assigned tasks.

This study demonstrates that pre-Columbian migration was a dynamic process, allowing people to move from and to their homeland based on individual abilities and communal needs.
IV. The Tiwanaku Colonies in Moquegua

Like Teotihuacan, the Tiwanaku culture has caught archaeologists’ interest, both as a case of immigration and one of emigration, which I will consider here. The type site itself and the culture associated with it provide ample evidence that suggests that Tiwanaku expanded its sphere of influence through the movement of people and establishment of colonies.

The site of Tiwanaku is located near the southern shores of Lake Titicaca (today Bolivia) in the Andean altiplano at 3800 masl and was occupied from 400 BC to AD 1000. Tiwanaku consists of a ceremonial center with mounds, sunken courtyards, and residential palaces, and domestic sectors, which could have housed a population of 10,000 to 40,000 (Browman 1978; Janusek 2003:264) during its most concentrated Middle Horizon occupation (AD 500-1000). The existence of extensive agricultural fields suggests that agriculture was Tiwanaku’s primary means of subsistence. Kolata, based on ethnohistorical and proto-linguistic evidence, proposes that Tiwanaku subsistence was three-fold, divided more or less along “ethnic” boundaries. In addition to agriculture, mostly practiced by the Pukina group, the Uru people relied on fishing and the Aymara on camelid herding and tuber agriculture (2003:462). In terms of socio-political power, Kolata conjectures that the Pukina and Aymara held the power within a hierarchical state structure because of their control over the dominant resources (Kolata 1993, 2003:463).

Other scholars have put forward different models about the nature of the Tiwanaku polity. Browman emphasized the importance of camelid caravans in distributing goods and ideas throughout a Tiwanaku trade network (1978). According
to Dillehay and Nuñez, Tiwanaku was “the center of commercial and religious exchange” facilitated by camelid caravans (1988:617) Later settlement surveys of the Tiwanaku Basin have suggested that Tiwanaku was not a unified state society, but a geographically and politically segmented entity that integrated more-or-less independent ethnic groups into a larger political and economic “nested” order (Albarracin-Jordan 1996). Most recently, household excavations at Tiwanaku and neighboring Lukurmata have led archaeologists to believe that multiple ethnic groups co-existed within urban centers where they continued to maintain distinct cultural lifestyles under a shared ideological framework (Janusek 2004; Bermann 1994, 1997).

Leaving the homeland

Although the reasons for Tiwanaku’s expansion remain somewhat unclear, it is known that starting around the 7th century AD, Tiwanaku ceramics and settlements are found in the Bolivian Cochabamba region to the east, and the Azapa Valley and Moquegua Valley to the west of Lake Titicaca (Anderson et al. 1998; Goldstein 1989b). Several hypotheses highlight different push-and-pull factors that could have motivated Tiwanaku residents to leave the highlands and move to new locations. One reason for the establishment of these colonies was the access to agricultural resources, in particular maize, that could not be cultivated in the dry and cold climate of the altiplano. This is not to say that Tiwanaku residents were in need of resources; studies of the agricultural systems show that large populations could be sustained locally (Kolata 1996; Erickson 1988; Janusek and Kolata 2003:163). Instead, maize constituted a desirable crop for the production of chicha, or maize beer, which may have played an important role in the feasting and ritual festivities of the Tiwanaku
people. Examining evidence for feasting at the core site of Tiwanaku and Tiwanaku-affiliated sites throughout the south-central Andes, Goldstein argues that “Tiwanaku’s chicha economy was not part of a fully developed centralized political economy, but a system run through a heterarchy of ayllu-like corporate groups operating within a loose confederative state” (2003:165). Goldstein argues that “[p]erhaps some of the cachet of the Tiwanaku phenomenon lay in its association with feasting and innovative alcoholic beverages” (2003:167). There exists no evidence to suggest that maize was needed to supplement the staple diet of altiplano residents. Rather, its value seems to have been of ceremonial and symbolic nature to the Tiwanaku people.

The expansion into lower, more fertile regions possibly took place within a larger Andean framework of practices, the “vertical archipelago” model. This model was proposed by John Murra (1972) to describe the human socio-economic response to the distinct ecological environment of the Andes at the time of the Spanish conquest. Archaeologists frequently use the model to understand resource management and social structure in the Andes during pre-history, not without criticisms (van Buren 1996). The elevation and climate of the Andes creates distinct ecological zones that allow for the cultivation of certain crops in some zones but not in others. To maximize their access to a large variety of resources and protect themselves against crop failure in different zones, Andean groups distribute their members and farmlands across various ecological zones; this enables them to distribute products across zones to other member communities. The caravans of nomadic pastoralists played an important role as facilitators of exchange of agricultural products as well as producers of fertilizer and wool.
This system of reciprocity was an intrinsic aspect of the ayllu, a nested social unit comprised of members with shared ancestry, history, behavior and ideology (Goldstein 2005; Janusek 2004; Bastien 1978). While ayllu members lived in different regions, they identified and associated themselves mostly with other members of their ayllu rather than spatially close neighbors. Ayllus seem to not have relied exclusively on one subsistence strategy, since their colonists in different microclimates were “herders, gathered salt, grew tropical peppers or coca leaf” (Murra 1967:121). While the agriculturalists are responsible for the production of resources, the herders facilitate their distribution. Goldstein has proposed that the first group of Tiwanaku colonists to enter the Moquegua valley consisted of pastoralists who were “following on a longer tradition of transhumance by highland camelid herders” (Goldstein 2005:312).

The reason that could have caused these nomadic pastoralists and later the agriculturalists to settle permanently in the region may have been a climatic disruption around AD 700. A devastating El Niño Southern Oscillation event may have acted as a push factor out of the Tiwanaku heartland as much as a pull factor into the climatically milder Moquegua valley, whose water resources could have been replenished through the event (Magilligan and Goldstein 2001; Goldstein 2005:312). Studies of changes in the health and diet of the Tiwanaku heartland population have yet to be conducted to assess the El Niño’s effects on the standard of living in the altiplano. Because the evidence mostly suggests that the establishment of Tiwanaku colonies in Moquegua was motivated by resource production, the demographic make-up would have required the presence of able-bodied individuals, mostly children and
young adults, especially for agricultural labor. Old adults, who would no longer be able to contribute to the labor force, would be few at first, as it was undesirable to support those additional family members, who consequently may have never migrated. With the maturation of a colony, the presence of older people would be expected unless, when reaching old age, they returned to live with family members in the homeland.

Tiwanaku in Moquegua

The Tiwanaku presence in Moquegua manifests itself in the form of four spatially distinct settlement groups, three of which are located along the eastern side of the valley and one along its western side. The three eastern site groups are distributed at equal distances from one another, with the Chen Chen group to the north (near the modern town of Moquegua), the Omo site group in the middle, and the Rio Muerto group farthest to the south. The Moquegua colonists distinguish themselves from other Tiwanaku colonies in that they appear to have maintained very little contact with the local Huaracane population (Goldstein 2005:316). Located away from the valley bottom and small Huaracane settlements, the Tiwanaku sites were large nucleated bluff-top population centers overlooking the valley (Goldstein 2005:134, 144-5). Residential and ceremonial architecture, ceramics and mortuary contexts are evidence that altiplano people migrated to the Moquegua valley where they reproduced their ethnic identity on a private and public scale.

More direct evidence was obtained by bioarchaeological studies; a comparison of non-metric cranial traits by Blom of samples from the Tiwanaku colonies, the local Huaracane population and several altiplano locations proves that the colonists are
genetically more closely related to the altiplano populations than the local Huaracane (1999:169). Cranial modification styles of both Huaracane and Tiwanaku populations in Moquegua follow the fronto-occipital style, but Tiwanaku colonists showed a higher frequency of cranial modification in comparison with the local people. Fronto-occipital modification is also found at the site of Tiwanaku, where both this style and the annular modification of the Katari Valley are represented (Blom et al. 1998; Blom 1999:162; Blom 2004:13).

A stable isotope study for strontium by Knudson and Price shows that some individuals buried at the site of Chen Chen were born in the Lake Titicaca region and moved to Moquegua at some point during their childhood or early adulthood (2004). All eight individuals sampled from the Moquegua collection exhibit elevated strontium values in their bones compared to that of modern-day guinea pig (which reflect the geological isotopic signature of the region), indicating that the Tiwanaku colonists procured the food from a wider area (Knudson and Price 2004:11). Two individuals of these eight also display unusually high isotopic signals in their teeth; this indicates that they spent their childhood outside the Moquegua Valley (dental isotopic signatures form permanently during the first 3-4 years of life), most likely in the Tiwanaku region, which is known to produce similar strontium isotope signatures (ibid 2004:11). Additional analysis of individuals from the Chen Chen cemeteries showed two individuals with strontium isotope signatures indicating that they “may have moved between the [highland and valley] on a regular basis” (Knudson 2008:15), a movement pattern similar to the sojourners of the Zapotec enclave at Teotihuacán.

This is the most direct and clear evidence yet for movement of people between the
Tiwanaku heartland and the Moquegua Valley. Stable isotope studies for other regions of proposed direct Tiwanaku colonization (i.e. San Pedro de Atacama) did not identify individuals who had spent their childhood in the Lake Titicaca Basin (Knudson 2007:26).

Another characteristic of the Tiwanaku occupation of Moquegua during the Middle Horizon is the existence of two distinct ceramic styles, which have been found in association with different types of residential settlements, Chen Chen and Omo, named after their type sites. Both groups co-resided in adjacent sectors of each site complex, with the Chen Chen-style colonists living closer to the agrarian valley bottom, while their Omo-style neighbors typically settled farther away from the valley “closer to caravan routes”; these routes are marked by pre-historic camelid petroglyphs and have been in continuous use throughout colonial and modern times (Figure 2 and 3) (Goldstein 2005:312). Additional evidence from architectural remains, lithics and paleobotanical analyses suggests the hypothesis that Chen Chen-style settlers relied on agriculture as a subsistence strategy, while Omo-style groups may have been pastoralists (Goldstein 2005:163, 154).

Differential density of materials from the two site styles suggests that the Chen Chen-style occupation was more permanent and longer-lived. This is further supported by the comparatively high ratio of Chen Chen-style to Omo-style cemeteries and habitation areas, as well as the total number of Chen Chen-style to Omo-style tombs (Table 1). The study of skeletal remains from cemeteries associated with Chen Chen-style residential
Figure 2a and 2b: Omo-style and Chen Chen-style settlement maps in the Moquegua Valley (from Goldstein 2005:153, 161, Fig.5.18 and 5.24).

sites “reveal[s] that males and females of diverse age-at-death, as well as a significant number of children of all ages were buried at Chen Chen” (Blom 1999:161). This supports the theory that agriculturalist families lived in the colonies to ensure the continuity of the colonies and increase their labor force. Blom argues, based on her finding from the analysis of Chen Chen-style cemetery materials, that the presence of families supports the argument of a labor colony, because “both males and females might be expected [to work] and children provided ready labor in agricultural societies” (1999:177). This study will show whether agro-pastoral Omo-style settlers

Table 1: Omo-style and Chen Chen-style site sizes and total number of burials (Chen Chen burials estimated assuming 1 tomb/4m (Goldstein 2005:267)).

<table>
<thead>
<tr>
<th>Site style</th>
<th>Site type</th>
<th>Number of sectors</th>
<th>Area (m2)</th>
<th>Total number of burials</th>
</tr>
</thead>
<tbody>
<tr>
<td>Omo</td>
<td>Domestic</td>
<td>8</td>
<td>281,621</td>
<td></td>
</tr>
<tr>
<td>Omo</td>
<td>Cemetery</td>
<td>2</td>
<td>827</td>
<td>95</td>
</tr>
<tr>
<td>Chen Chen</td>
<td>Domestic</td>
<td>20</td>
<td>543,150</td>
<td></td>
</tr>
<tr>
<td>Chen Chen</td>
<td>Cemetery</td>
<td>45</td>
<td>198,598</td>
<td>49650 (approx.)</td>
</tr>
</tbody>
</table>
follow a similar demographic pattern.

Most evidence for mortuary and bioarchaeological studies has come from Chen Chen-style cemeteries (Blom 1999; Knudson and Price 2004). In comparison to Chen Chen-style cemeteries in Moquegua, Omo-style cemeteries are rare; only two, possibly four, out of 69 cemetery sectors have been identified as Omo-style (Goldstein 2005:136-45). The number of interred individuals from both excavated Omo-style cemeteries is approximately 100. That of the Chen Chen-style cemeteries is upward of 40,000. The overall absence of Omo-style burials therefore indicates a different pattern of interment, and possibly residence, for the Omo-style residents of Moquegua.

Although the small Omo-style cemetery (M16D) at the site complex of Omo (excavated in 1999) was heavily looted (Oquiche et al. 2003:51; Goldstein 2005:261), enough evidence could be recovered to gain some insights into Omo-style mortuary practices. Sixteen tombs were excavated containing 22 individuals, all subadults except for 3 adults (Oquiche et al. 2003:51). These data differ significantly from Blom’s research results of the Chen Chen-style cemeteries. Because of the small sample size, these findings need to be validated by additional data and larger samples from other Omo-style cemeteries, especially in regards to differences in population dynamics between Omo-style and Chen Chen-style colonists.

Until now, it has not been clear what demographic make-up the Omo-style population had, and what role individuals of certain ages would have played in their social group. If the pastoral hypothesis were true, it may be suspected that different migration behavior based on nomadic herding patterns affected the Omo-style group. The presence or absence of young or old individuals in particular could give some
indication to the occupational and social strategies of Chen Chen-style and Omo-style groups. If the Omo-style settlers maintained a self-reproducing population, we expect to see young individuals represented in the cemeteries, similar to the Chen Chen-style cemeteries. Similarly, a high or low number of old individuals would be indicative of the capability or willingness of the social group to care for their elders either in the colonies or return then to the homeland. The Omo M16D cemetery, although seemingly not a representative sample of the Omo-style group due to its small size, supports the theory that Omo-style families lived and reproduced in the colonies.

The mortuary contexts associated with both Chen Chen-style and Omo-style sites display general Tiwanaku characteristics and differ markedly from the Huaracane túnulos and boot tombs otherwise found in the Moquegua valley (Goldstein 2000; 2005:244). The Chen Chen-style cemeteries of the site groups Omo and Chen Chen contain cyst and pit graves, most of which are marked by rock collars on the surface (Goldstein 2005:246). The individuals are seated-flexed, oriented towards the east, and wrapped in woolen textiles fastened with fiber rope (2005:249). Grave offerings typically consist of few ceramic vessels, baskets, wooden spoons, and occasionally metal objects and jewelry. The different Chen Chen-style cemetery sectors may represent different social groups, which express membership through varying cranial modification techniques (Hoshower et al. 1995). Similar studies have not been done to compare social differentiation between Chen Chen-style and Omo-style colonists. Here, new demographic evidence from the Omo-style cemetery at Rio Muerto will be considered to determine the nature of migration, occupational specialization and group interaction in the Tiwanaku colonies.
Rio Muerto M70B

The M70B Omo-style cemetery is part of the Rio Muerto site complex and presents a data set that is unique within the Tiwanaku and Andean realm in general. It is located to the north of the Omo-style domestic sector M70A, separated from it by a quebrada (dry river-bed). It covers an area of approximately 16x20m, and has an oval shape whose long axis is oriented northeast to southwest. Unlike Chen Chen-style Tiwanaku cemeteries, most of the tombs were covered by a thick layer of medium-sized and large rocks that were deposited intentionally during or after the time of use. This layer is up to 100cm high at its center and thins towards the edges. The cemetery was excavated completely during the season of 2006 and 2007 by the Proyecto Arqueológico Río Muerto under the direction of Paul Goldstein and Patricia Palacios (Palacios 2006; Goldstein and Palacios 2007), so that the obtained sample fully represents the cemetery population and their offerings, making the M70B cemetery a unique sample in Tiwanaku mortuary archaeology. Of the ninety-eight features that were excavated, seventy-three were registered as burials (Figure 3). Of these, only thirteen were looted, while all others were intact and completely or partially sealed. Most of the disturbed tombs had been subject to pre-Columbian looting, this includes 6 burials that are otherwise intact but are missing the cranium⁹. Two large modern looter’s pits - identified as such through presence of modern materials and absence of volcanic ash - may have caused the destruction of at least two, possibly up to five, tombs. The time of looting in the southern Peruvian region can often be assessed by

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⁹ The presence of isolated bones in the few looted tombs made it possible in some cases to re-associate the scattered surface remains with tombs; this was especially facilitated by the low occurrence of looted tombs and their spread-out distribution across the cemetery area.
the presence of volcanic ash deposits, which date to the Huayna Putina eruption in 1600 (Goldstein 2005:121). No Tiwanaku cemetery and only few Andean cemeteries have been found in such an intact condition, because they have either suffered from recent looting or bad preservation, and few have been completely excavated. The arid environment of the Southern Peruvian desert, only interrupted by rivers and small stretches of irrigable land, allows for exceptional preservation of materials such as textiles, botanical and organic human remains. At the M70B cemetery, most human remains were skeletonized, and the absence of human soft tissue and organic offerings often corresponds with the presence of remains of rodents that nested in and around the skeletons and probably consumed soft tissue remains. Coincidentally, the absence of soft tissue on the human remains facilitated the estimation of sex and age during analysis.

The majority of skeletal remains encountered in the tombs were in anatomically correct position, except for those of infants, which often disarticulate after the decay of soft tissue (Figures 4a, 4b). This is a strong indicator that bodies were interred soon after death and had not been moved after their initial interment (Brothwell 1987:26). Only two burials appear to be secondary deposits based on the disarticulation and absence of body parts; they were found in a compact, bundle-like shape. Minimal sun-bleaching on some of the superiorly located remains suggests that the bodies were partially exposed to sunlight for short periods of time after decomposition, but that exposure was not significant enough to cause disarticulation or destruction of the remains; it is also consistent with loose stone piling over the
Figure 3: Rio Muerto M70B cemetery; shaded areas indicate tombs (based on Proyecto Arqueologico Rio Muerto Informe Final by Goldstein and Palacios 2007).
partially above-ground interment, instead of filling of the tomb with sediment. Other material evidence from the cemetery indicates that grave construction occurred in two stages. The initial pit was excavated and sometimes lined with stone slabs and the individual was interred in it. Subsequent to the deposition of the mummy bundle and surface offerings, the tomb was covered by a roof of stone slabs or a stone-and-mud seal (neither has been found at other Tiwanaku cemeteries in Moquegua) (Figure 5). This could explain the brief sun exposure and subsequent bleaching. The construction of superficial grave markers and rock-piling, as well as numerous objects found on the cemetery surface (e.g. ceramics, wooden vessels and spoons, baskets) indicate that extensive rituals and offerings accompanied interment and later grave visitations (Baitzel et al. 2008). The importance of mortuary ritual in Moquegua in general has been discussed by Buikstra (1995) and at Rio Muerto M70B (Baitzel et al. 2007; Carbajal et al. 2007; Green et al. 2007) and Chen Chen (Palacios et al. 2007) in particular.

The ages and sex of the individuals were determined post-excavation in the field lab according to the standards and categories proposed by Buikstra and Uberlaker (1994) (Table 2). Dental eruption and epiphyseal fusion were used to assess the age of subadults (less than 25 years of age). For individuals beyond this age class, age determination depends mostly on the degeneration of bone and teeth, for which certain areas of the body, e.g. auricular surface or molars, are more diagnostic than others. In order to match stages of degeneration and attrition that synchronize the individual’s skeletal age with its chronological age (measured in years), “it is essential to rely on recent populations [for reference] as only they can supply large samples.
Table 2: Age and Sex of M70B individuals.

<table>
<thead>
<tr>
<th>Unit</th>
<th>Burial Number</th>
<th>Age (years)</th>
<th>Age determined by:</th>
<th>Sex</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>3</td>
<td>6-8</td>
<td>dental eruption</td>
<td>n/a</td>
</tr>
<tr>
<td>c</td>
<td>5</td>
<td>10-20</td>
<td>epiphyseal fusion</td>
<td>n/a</td>
</tr>
<tr>
<td>c</td>
<td>5-X</td>
<td>20-35</td>
<td>pelvic indicators</td>
<td>n/a</td>
</tr>
<tr>
<td>b</td>
<td>6</td>
<td>2-5</td>
<td>dental eruption</td>
<td>n/a</td>
</tr>
<tr>
<td>b</td>
<td>6-X</td>
<td>1-2</td>
<td>dental eruption</td>
<td>n/a</td>
</tr>
<tr>
<td>b</td>
<td>7</td>
<td>3-5</td>
<td>dental eruption</td>
<td>n/a</td>
</tr>
<tr>
<td>f</td>
<td>8</td>
<td>30-35</td>
<td>pelvic indicators</td>
<td>PF</td>
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<tr>
<td>e</td>
<td>10</td>
<td>20-24</td>
<td>pelvic indicators</td>
<td>PM</td>
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<tr>
<td>e</td>
<td>11</td>
<td>25-35</td>
<td>pelvic indicators</td>
<td>F</td>
</tr>
<tr>
<td>e</td>
<td>12</td>
<td>3-5</td>
<td>dental eruption</td>
<td>n/a</td>
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<td>n/a</td>
</tr>
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<td>17-20</td>
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<td>PM</td>
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<td>g</td>
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<td>20-23</td>
<td>pelvic indicators</td>
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<td>g</td>
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<td>25</td>
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<td>j</td>
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<td>l</td>
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</tr>
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<td>k</td>
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<td>45-50</td>
<td>pelvic indicators</td>
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Table 2: continued.

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<th>Sex</th>
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<tr>
<td>k</td>
<td>58W</td>
<td>35+</td>
<td>attrition, pathology</td>
<td>undet</td>
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<td>PF</td>
</tr>
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<td>66</td>
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<td>PF</td>
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<td>PF</td>
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<td>dental erosion</td>
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<td>4-7</td>
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<tr>
<td>o</td>
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<td>89</td>
<td>7-10</td>
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<td>n/a</td>
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<td>s</td>
<td>90</td>
<td>35+</td>
<td>attrition, pathology</td>
<td>n/a</td>
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<tr>
<td>s</td>
<td>92</td>
<td>18-21</td>
<td>pelvic indicators</td>
<td>Undet</td>
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<td>s</td>
<td>92-X (93?)</td>
<td>5-10</td>
<td>epiphyseal fusion</td>
<td>n/a</td>
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<td>s</td>
<td>93</td>
<td>4-8</td>
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<td>PM</td>
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<td>r</td>
<td>95</td>
<td>35-39</td>
<td>pelvic indicators</td>
<td>PM</td>
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<tr>
<td>RR</td>
<td>96**</td>
<td>&gt;25</td>
<td>epiphyseal fusion</td>
<td>n/a</td>
</tr>
<tr>
<td>RR</td>
<td>96-X</td>
<td>3-5</td>
<td>dental erosion</td>
<td>n/a</td>
</tr>
<tr>
<td>QQ</td>
<td>97/98</td>
<td>35+</td>
<td>attrition, pathology</td>
<td>n/a</td>
</tr>
</tbody>
</table>

(F = female, PF = probable female, M = male, PM = probable male, undet = undetermined)

* based on contextual information, remains may belong to either one of two nearby looted tombs

** individuals are not included in demographic curve, since remains were too fragmentary to determine exact age
with documented ages at death” (Boddington 1987:190). Since such reference collections are often not available for archaeological collections, observers often have

Figure 4a and 4b: Examples of tomb drawing with the individual in articulated, seated-flexed position and rocks along the tomb opening (Palacios 2006).

Figure 5: Rio Muerto M70B tomb profiles. R34 shows the superstructure of piled rock (Green et al. 2007).

to adjust their age assessments to a particular sample set and, using a variety of determinants, create categories that describe approximate age intervals. The characteristics used for adult age assessments are suture obliteration on the exterior
and interior cranial vault, advancement of dental attrition, and changes on the pubic symphysis (Todd and Suchey-Brooks stages) and auricular surfaces based on verbal and visual comparison with standards provided by Buikstra and Ubelaker (1994). The 53 individuals excavated during the 2006 field season were re-examined to minimize errors. All remains were recorded using the field forms supplied by Buikstra and Ubelaker’s Standards (1994), and photographs were taken of all crania, mandibles, and skeletal pathologies.

Sex assessments were undertaken for individuals above the age of 18 years, but were not always conclusive in young adults, since growth is not always completed at the time of death. Pelvic indicators of sex were presence or absence of a ventral arc, ischio-pubic ridge, pre-auricular sulcus, sub-pubic concavity, and the shape of the greater sciatic notch. Cranial indicators included prominence of the glabella, supra-orbital ridges, nuchal crest, and mastoid processes, as well as the shape of the supra-orbital margins and the mental eminence of the mandible. Indicators were evaluated in regard to intra-population variation and recorded using the criteria provided by Buikstra and Ubelaker (1994). In cases in which remains were highly fragmented or primary indicators were missing, sex was left undetermined (8 of 29 adult individuals). Of the remaining 21 individuals, 12 were identified as female, the other 9 as male (see Table 2). Given the relatively high number of individuals with undetermined sex, the difference between females and males could change easily and do not seem significant. Nevertheless, future study of paleopathologies in this population may reveal differing mortality rates between the sexes.

Results
The distribution of age groups in intervals of 5 years for infants and 10 years thereafter is displayed in Table 1 and Graph 2. According to the uniformitarian models of Waldron and Whittington, the number of individuals is supposed to increase again among the middle to old adult age groups to form a J- or even U-shaped curve (see pg. 16: Graph 1 and 2). This is clearly not the case with the Rio Muerto cemetery population (Graph 4). Although the numbers increase slightly among the 35-45 year-olds, the curve drops again to a lower count above age 45. It should be mentioned here that 3 adult individuals from the sample are not included in the graph, since they stem from looted contexts and were too incomplete to be assigned to any particular age group. Yet adding these three individuals to any of the adult age groups does not raise any of them above 12%, which means that the curve still remains significantly flat.

In the next step we add to this comparison the data obtained from two Chen Chen-style cemetery sectors (which were presumably used by agriculturalists). The sectors were excavated as part of the Chen Chen Salvage Project from 1987 and 1995. The site report reveals that the cemetery sectors were heavily looted; less than 10% (334 out of 4291 tombs) were intact (Blom 1999:78). The samples used for comparison were recovered at the Chen Chen M1 site from the two northern-most cemetery sectors (A and B) associated with the complex (Graph 5 and 6). Of the 109 individuals recovered from sector A, thirty-six had been in intact contexts. At the smaller sector B, forty out of ninety-nine individuals came from an intact context. The choice fell on these two sectors, because they are the farthest removed from the urban It immediately becomes apparent that the three mortality curves share a similar
Graph 4: Mortality profile of the Rio Muerto M70B cemetery (n=73).

Graph 5: Mortality profile of the Chen Chen M1A cemetery (n=97).

Graph 6: Mortality profile of the Chen Chen M1B cemetery (n=92).
area and the largest sectors; the large size will hopefully reduce the effects of disturbance on the sample.

shape (Graph 4-6) (Table 3). Here, too, the number of infants and young children is very high; drops off quickly and reaches a low point during adolescence and early adulthood. From there, the two curves diverge, one showing an increased number of young and middle-aged adults, the other decreases. Upon reaching the end of the curve for 45+ years of age, the Chen Chen-style profiles converge with that of the Rio Muerto Omo-style group at approximately 8% (in comparison to the 32% and 42% indicated by the Whittington and Waldron models).

Table 3: Number of individuals for age groups by site location.

<table>
<thead>
<tr>
<th>Site Name</th>
<th>0-5 years</th>
<th>5-15 years</th>
<th>15-25 years</th>
<th>25-35 years</th>
<th>35-45 years</th>
<th>45+ years</th>
<th>Total # of individuals</th>
</tr>
</thead>
<tbody>
<tr>
<td>M70B</td>
<td>n=33</td>
<td>n=16</td>
<td>n=7</td>
<td>n=8</td>
<td>n=3</td>
<td>n=6</td>
<td>n=73</td>
</tr>
<tr>
<td></td>
<td>45%</td>
<td>22%</td>
<td>10%</td>
<td>11%</td>
<td>4%</td>
<td>8%</td>
<td>100%</td>
</tr>
<tr>
<td>M1A</td>
<td>n=45</td>
<td>n=17</td>
<td>n=12</td>
<td>n=6</td>
<td>n=9</td>
<td>n=8</td>
<td>n=97</td>
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<tr>
<td></td>
<td>47%</td>
<td>18%</td>
<td>12%</td>
<td>6%</td>
<td>9%</td>
<td>8%</td>
<td>100%</td>
</tr>
<tr>
<td>M1B</td>
<td>n=46</td>
<td>n=18</td>
<td>n=2</td>
<td>n=11</td>
<td>n=8</td>
<td>n=7</td>
<td>n=92</td>
</tr>
<tr>
<td></td>
<td>50%</td>
<td>20%</td>
<td>2%</td>
<td>12%</td>
<td>9%</td>
<td>7%</td>
<td>100%</td>
</tr>
</tbody>
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Table 4: Chi-square values for significance of deviation between archaeological and demographic data.

<table>
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<th>Site Name</th>
<th>Waldron Demographic Model</th>
<th>Whittington Demographic Model</th>
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<td>p=4.91E-08</td>
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<tr>
<td>M1A</td>
<td>p=5.64E-11</td>
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<td>p=4.28E-14</td>
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A chi-square significance test was used to test for statistical significance in the demographic data. The low p-values (Table 4) indicate that the differences between the Moquegua cemetery demographics and both the Waldron and Whittington uniformitarian models are in fact statistically significant.
V. Discussion

The comparison of the age-at-death profile of the Rio Muerto M70B cemetery with the uniformitarian models reveals some surprising facts about this population. The majority of deaths occurred among infants and young children, who are typically most susceptible to disease. Once an individual has survived this early phase of low resistance to infections, they are less likely to die, which is reflected here through low numbers in ranges of adolescents and young adults; deaths for these groups can be caused by accidents, illness or death at childbirth for women. None of these patterns would strike a paleodemographer as surprising, as comparisons with “uniformitarian” age-at-death models show. A more detailed study of paleopathologies affecting the Rio Muerto M70B population is necessary to assess the overall health of the population. A low rate of Linear Enamel Hypoplasia (LEH) seems to indicate that individuals were not exposed to great amounts of stress (Dahlstedt 2008)\(^\text{10}\).

As expected, the number of adolescents and young adults buried at Rio Muerto M70B is low. The small numbers of old individuals, as previously discussed, can be attributed to a low life expectancy, alternate mortuary treatment or migration. Though the number of old individuals is lower than expected under uniformitarian models, they are present and often exceeded the expected lifespan (25-35 years) of people living prior to modern conditions (Wilmuth 2000:1113). Neither the mortality rate of children nor that of young adults is exceptionally high. This and the absence of

\(^{10}\)LEHs are growth interruptions that manifest themselves as lines and pit marks in the enamel. If the individual underwent systemic stress, enamel depositions would have been temporarily suspended; once the body has recovered, growth recommences. This “hiccup” leaves a visible signature on the enamel. Since enamel formation happens during childhood, LEHs can provide information about illnesses during childhood.
systemic stress indicators (e.g. LEH) lead me to conclude that general population health stress cannot have caused a short life expectancy. Based on these observations in addition to what we already know about agro-pastoral life in the Andes, the ayllu system, and the nature of the Tiwanaku colonies in Moquegua, it is reasonable to argue that many of the elderly members of the agro-pastoralist groups returned to the homeland, where a more extensive social network would provide for them until death. Even though old individuals still assume certain tasks, including herding, the Rio Muerto agro-pastoral colonists may, like other known pastoralists in the Andes, have engaged in agricultural production, for which the older people were unfit. Some elders, those who were buried in the colony, may have assumed minor tasks like childcare to free younger group members for more physically demanding work. The two adult individuals at Rio Muerto M70B that were secondary burials may have entertained a special connection with their colonial community and were returned to Moquegua after their death (bones or mummies would be easier to transport that a decomposing body).

More importantly, the Chen Chen-style agriculturalist age-at-death profiles reflect the same characteristics as their Omo-style co-residents. The earlier-mentioned case of Casas Grandes provided the example of a fully sedentary, maize-farming community whose mortality profile followed the expected uniformitarian shape. The fact that the age-at-death profile of the Chen Chen-style agriculturalists diverges from this expectation suggests that, like their Omo-style neighbors, their demographic composition reflects exposure to similar social processes. As a specialized labor community, Chen Chen-style groups would have been able to maximize their
agricultural surplus by sending their elders back to the highlands. Whether or not the absence of elderly individuals in both Omo-style and Chen Chen-style communities has a functional cause (i.e. to maximize surplus) is difficult to prove. Another reason for the absence of old individuals in colonial settings may be the repatriation of human remains for ideological reasons such as ancestor veneration. It does, however, reflect a shared socio-cultural norm of Tiwanaku colonists, which would have been greatly facilitated by the movement of camelid caravans.

Although the economic and domestic practices of Omo-style and Chen Chen-style differed in an apparent manner, both entities were subject to the pan-societal phenomenon of return to Tiwanaku, either as sojourners or as permanent residents. Whatever the frequency and spatial extent of migration to and from the colonies was during the Middle Horizon, it must have existed according to the demands of the colonial society. It was primarily the need for agricultural labor that determined who was to reside in the colonies, and community membership was limited to those who could contribute positively to the production of surplus and the overall functioning of the colonial society. Expectedly, the return of old individuals to the homeland would have relieved pressure on the social network in the colonies that no longer had to support additional family members. The identification of immigrants (and possible remigrants) at the site of Tiwanaku through stable isotope analysis is a first step into the direction of understanding the role of home-comers on society. For example, the remains of one of these immigrant individuals to Tiwanaku were found in a ceremonial sacrificial context at the Akapana mound at the site of Tiwanaku (Knudson 2008:12).
Conclusion

In the case of the Moquegua colonists, paleodemography and the uniformitarian model have proven to be useful and even necessary methods in determining the processes of migration in a colonial setting. Without an expected agrarian mortality profile with which to compare the Moquegua data, the archaeological samples from Rio Muerto and Chen Chen could have misled the observer to believe that such a distribution is, in fact, normal. The unusual demographic profile of the Moquegua colonies, reflected in mortality profiles from different sites throughout the valley, can provide possible answers for the questions asked at the beginning of this paper.

The absence of a significant number of old individuals from the Rio Muerto and Chen Chen settlements can be explained by a number of factors, such as differential burial treatment, short life-span, or outmigration or repatriation of remains. The evidence provided in this paper on life in the Andes in general, and Tiwanaku in particular, enables me to argue that return migration is the most likely scenario to have influenced the social dynamics of the Moquegua colonists. The integration of agriculturalists and pastoralists would play an important part in moving resources from and to the homeland. The presence of infants and children supports the notion of family-structured social units, which allowed the colonial population to reproduce in addition to growing from immigration. According to the demographic profile, return migration does not seem to have strongly affected the younger, reproductive portion of the population, unless they were sojourning between the highlands and colonies, as may have been the case of the individual from Chen Chen identified by Knudson.
(Knudson 2008:15). Instead, we find that older individuals are underrepresented, not only among the presumed Omo-style pastoralists but also among the agriculturalist communities. One possible functional explanation, given the socio-economic nature of the Moquegua colonies as resource producers for the Tiwanaku core region, is that the colonial system sought to maximize the labor force. By returning to the homeland, older individuals would not stress the social network in the colonies, allowing for an increase in exported resources.

Other possible explanations, including ideological or social motivations that caused the elderly to return, demands further investigation. Return migration and a constant movement of people back and forth between the homeland and the colonies correspond well with Murra’s “vertical archipelago” model and Knudson’s isotopic studies. The movement of people would have facilitated the movement of goods across ecological zones from one ayllu settlement to another; at the same time, it would have strengthened the structure of corporate identity of the ayllu members. As seen in many ethnographic studies discussed earlier in this paper, return migration plays an important part in the migrant’s decision to leave the homeland. Clifford, in his discussion of diasporic communities, states that community members “see the ancestral home as a place of eventual return, when the time is right” (Clifford 1994:304). It is only reasonable to assume that for those whose memory of the homeland is fresh and contact more recent, the prospective of eventual return must have been a promising one.

The limited archaeological research conducted at Tiwanaku highland cemetery sites has not yet produced conclusive evidence that could suggest a higher-than-
expected number of old individuals (Korpisaari 2006). More extensive mortuary research is needed in the Tiwanaku region to test for reverse patterns of the Moquegua colony situation, i.e. a high frequency of old individuals in relation to younger individuals. Similarly, investigations of demographic distributions at other Tiwanaku colony sites like Cochabamba may be indicative of similarities and differences of Tiwanaku colonization patterns. Future study of stable isotope ratios may add additional support to the proposed hypothesis of return migration for the Moquegua colonists.

As this study shows, paleodemography, in combination with archaeological, isotopic and ethnographic evidence, offers a compelling approach to the study of past migration dynamics. It provides archaeologists with a new device, with which to unearth history and look at old things in a new light. This particular case study about demography and Tiwanaku colonial migratory processes has much larger implications for the study of migration in archaeology. Comparison to uniformitarian models offers a method to explicate social structure and practice by means of studying the age composition of a population. Material culture can often serve only as a proxy for migration in archaeology, while bioarchaeological analysis concern themselves more with the individual rather than society at large. In the absence of census or other written data, paleodemography presents information about demographic composition and, ultimately, can uncover migration dynamics that may otherwise elude the archaeologist.
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