Analyzing the Invisible:

An assessment of the applicability of space syntax analysis

to ritual and domestic architecture at ancient Tiwanaku, Bolivia

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Abstract:

This thesis addresses the archaeological application of spatial syntax analysis to ritual and domestic architecture, focusing on the pre-Inka state of Tiwanaku in the highlands of South America. The pan-Andean tradition of ceremonial architecture known as the Sunken-Court is examined from both hermeneutic and quantitative perspectives. To test the practicality of the quantitative methods explored, topographic and geophysical prospection techniques were used to detect and visualize buried ritual and domestic architecture at the site of a non-elite residential sector of Tiwanaku known as Mollo Kontu. The potential of an archaeological methodology that combines geophysical and quantitative spatial analyses is then critically assessed in light of the survey results, suggesting the need for more nuanced qualitative approaches to the analysis of the ancient built environment.

Résumé

Cette thèse porte sur l'application d'une analyse spatial syntaxique sur l'architecture rituelle et domestique, avec focus sur l'état pré-Inka de Tiwanaku dans les hautes terres de l'Amérique du Sud. La tradition pan-Andine d'architecture cérémoniale connu sous le nom de Temple Semi-Souterrain est examinée avec une perspective herméneutique et quantitative. Pour tester la faisabilité des méthodes quantitatives explorées, des techniques de prospection topographiques et géophysiques ont été utilisées pour détecter et visualiser l'architecture rituelle et domestique enfouie dans une aire résidentielle non-élite de Tiwanaku, nommée Mollo Kontu. Le potentiel d'une méthodologie qui combine l'analyse spatiale géophysique à une analyse quantitative est ensuite jugé de façon critique à la lumière des résultats de prospection, et suggère ainsi le besoin d'ajouter une approche qualitative nuancée à l'analyse d'anciens environnements construits.

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Chapter 1: Introduction to the archaeological study of the built environment and the organization of the thesis

The following study of the built environment at the pre-Colombian site of Tiwanaku, Bolivia investigates both ritual and domestic architectural space through a combination of traditional and innovative archaeological investigative techniques. By examining a specific ritual space known as the Semi-subterranean Temple located at the very centre of the site's ceremonial complex, the present study will develop a consideration that the design of urbanized space at Tiwanaku was ritually prescribed and centered on the recreation and maintenance of mythic landscapes.

Through a combination of both hermeneutic and quantitative approaches to spatial analysis, the highly organized ceremonial space of the truly pan-Andean "Sunken-Court" architectural tradition is analyzed here in direct relation to the example located at Tiwanaku. By quantitatively analyzing the spatial configurations of both earlier and later examples of sunken-courts also located in the Lake Titicaca Basin and elsewhere in the Andes, the unique variant found at Tiwanaku indicates a shift in form and ideology directly related to the site's ceremonial and political importance as a complex ancient Andean urban center.

Extending from this study of ritual space, the latter part of this thesis proposes the application of the same quantitative spatial analyses to another ceremonial structure located in an ancient residential sector of Tiwanaku known as Mollo Kontu located outside of the central monumental district. With the ceremonial area of Mollo Kontu surrounded by densely inhabited residential space, the relationship between ritual and domestic spheres is then investigated through an innovative methodology that combines topographic and geophysical survey with both excavation and quantitative methods of spatial analysis of architecture. Using these methods, the present study asks whether there is a unifying architectural grammar that stretches across space rather than time in both elite and non-elite ritual and residential contexts at Tiwanaku.

By attempting to define the degree to which the signature of an architectural tradition exists at Tiwanaku, the goal of this study has three main objectives. First, this study interprets ceremonial space at

Tiwanaku from a symbolic and cosmological perspective that relates basic spatial dualities in architecture to the particular worldview assumed to be held in antiquity. Secondly, the use of quantitative spatial analyses of these ritual structures serves to assess the potential of more hermeneutic approaches to the built environment that extend beyond traditional social economic and energetics approaches . Finally this thesis will present a discussion and critique of how such quantitative methods in archaeology may be beneficial to the analysis of domestic space at the urban scale through a practical case study in the Mollo Kontu sector of Tiwanaku.

In approaching the built environment from an archaeological perspective, one is faced with an enormous and eclectic body of literature that covers topics at every scale of lived space. From the level of the individual dwelling through the consideration of house plans and domestic activity areas to the layout of an ancient community, the method and depth of analysis of architectural remains is as diverse as the subjects themselves. Because architecture is a relatively conservative element of culture (Parker-Pearson and Richards, 1994: 62), such defined and seemingly immutable space become an ideal container of sorts, sheltering and preserving more ephemeral material culture while their design serves as testament to the situational worldview of the builders. By the same stroke, drastic changes in architectural design through time often signal shifts in other aspects of social order. It is through a close consideration of the degree of change in the built environment that cultural information is assumed to be discernible and thus a viable object of study (Van Gijseghem and Vaughn 2008: 136).

To construct the theoretical foundations of any archaeological study of the built environment, scholars have borrowed widely from art history, cultural anthropology and linguistics, resulting in a vast array of theoretical innovations, analogical models, and interpretive frameworks (Lawrence and Low 1990). Despite the variety of approaches taken, it is clear that the dialectical relationship between society and the space of the built environment is of fundamental importance. Functionalist approaches rely on the primacy of environmental and technological limits that direct and establish the enduring relationship between people and their structures (Kuper 1972; McGuire and Schiffer 1983.). This viewpoint provides only a very basic consideration of seemingly indisputable elements, and does not take into account the

variability of human coping mechanisms that diverge greatly from rational Western models. It is through more symbolic and structuralist considerations of the built environment that specific situational conditions can be brought together under an appreciation that the physical structures of a society reflect a shared mental and ideological order. Anthony Giddens' (1984) structuration theory makes explicit the role of architecture in arranging social interaction in recurrent patterns, thereby giving form to social structure. Following Martin Heidegger, Giddens also suggests that all forms of social action within a space occur as well within at least three intersecting "planes of temporality". These are the rhythms of daily routine, the biography of lifecycle of the individual, and the inheritance or longue durée of social institutions (Giddens 1979: 198). With such collective and unconscious cognitive and temporal patterns generating the diversity of discernible material patterns, as exemplified and manifested by architecture, it is the documentation and categorization of this cultural signature that is of utmost value to the archaeologist (Eliade 1959, Wheatley 1971; Tuan 1977).

The control of space through architectural design not only defines our practices and everyday actions, but the resulting structures also serve as complex symbols that can be as emotionally and physically affecting as they can be banal. As a direct attempt to create a physical embodiment of an imperishable and eternal social order, building on a monumental scale seeks to deny change and transmute "the fear of the passage of time, and anxiety about death, into splendour" (Lefebvre 1991: 121). In this way, architecture can be considered as "symbolic technology" with a vast array of applications and an equal number of intended impacts (Parker Pearson and Richards 1994, 3). The manner by which these often institutional intentions are made manifest through monumental architecture can be considered to present the most complete picture of a given culture's ideological framework. As Lefebvre makes explicit "Space commands bodies, prescribing or proscribing gestures, routes and distances to be covered... monumentality always embodies and imposes a clearly intelligible message... buildings mask the will to power and the arbitrariness of power beneath signs and surfaces which claim to express collective will and collective thought" (ibid, 1991: 143).

As perhaps the most closely considered component of built environments, the study of the structure and function of ritual space has fueled a continuous and important theoretical discourse. The early works of Emile Durkheim and Marcel Mauss considered ritual as being the enactment and reaffirmation of social structure by renewing social ties and reiterating normative and symbolic meanings (Durkheim and Mauss 1963 [1903], Durkheim 1965[1915]). The stereotypical designation of a 'ritual' function to those artifacts and structures that resist direct interpretation stresses the acceptance of the impenetrable complexity of ritual behaviour. Structural functionalist approaches to the consideration of ritual by Arnold VanGennep in his Rites de Passage and later refined by Victor Turner, provided the archaeological community with a theoretical framework on which to hang and analyze both artifactual evidence and the remains of the built environment (Van Gennep 1960, Turner 1967). The obvious dangers in applying strict structural simplifications of complex ritual behaviour, especially through the interpretation of assumed 'ritual' space, has lead to a necessary diversification of theoretical directions. In her analysis of the nature ritual from a theoretical perspective, Catharine Bell adapts Bourdieu's discussion of practice to consider a "... natural logic of ritual, a logic embodied in the physical movements of the body and thereby lodged beyond the grasp of consciousness and articulation." (Bell 1992:99). Accepting that built environment is structured "...not merely as an arena in which social life unfolds, but rather as a medium through which social relations are produced and reproduced" (Gregory and Urry 1985: 3), the organization of quotidian domestic space expresses elements of unconscious and invisible social structure as much as highly organized ritual contexts. It is the signature of the structure of this particular socio-spatial practice is perhaps more thoroughly disguised as functional activity in the material record of residential settings when compared to ritual or ceremonial built environments.

Almost ubiquitously, the archaeological investigation of households in terms of residential patterns and activities (Healan 1993, Kent 1990) seem to extend directly from Bourdieu's theory that the house is an active setting for the formation and maintenance of social structure, stemming from his ethnographic analysis of gendered activity spaces in the Berber Kabyle house. (Bourdieu 1973, 1977). According to Bourdieu, the physical features of a house can encourage specific types of behaviour that

conform to expectations of proper social action. It is the boundaries in built space formed by walls and furniture that transform ideas about social relationships into a material form and in turn, the physical form of the house reinforces the social ideas. The divisions and arrangements within a house can set up hierarchical or other relationships between people, objects, and activities. Thus, this daily use or "practice" within a space helps to maintain and reinforce social organization. This practice-based social theory also emphasizes the "actional" element of spatial production in light of prescribed history. This is Bourdieu's concept of habitus, a system of dispositions by which people create and re-create structures includes "both a way of being...[and the] result of an organizing action." The *habitus* is a "generative principle of regulated improvisations," such that "the 'unconscious' is never anything other than the forgetting of history which history itself produces" (Bourdieu, 1977: 78). In this way, both memory and meaning are inscribed in social space by historically and culturally permitted patterned actions whether they unconscious or not. The habitus which creates such space must be appreciated as "...an instant of practice, an irreducible 'unit' of culture that cannot be broken down into any real, autonomous, constitutive forces." (Bell 1992:79). With this being the case, it is not surprising that any attempt to study ancient habitus through the quantification and analysis of ritual or domestic space would be face considerable difficulty regardless of the method by which that space is recorded and interpreted.

According to Amos Rapoport, the built environment consists of three basic element: fixed features such as those aspects of the environment that are permanent or will change only very slowly over time; semi-fixed features such as those elements in the built environment that can change position quickly and relatively easily such as furniture and artifacts; and non-fixed features, the human element of activity, the habitus of people going about their lives (Rapoport 1990). With these elements as the physical determinants of built space, Rapoport (1988) also identifies three levels of meaning in the built environment. Lower-level meanings correspond to the basic function of a building in terms of the use of space, such as the way that connectedness and accessibility limit and allow movement and thus dictate proper behaviour in a given space. Middle-level meanings are associated with the explicit socially communicative elements of architecture that allow concepts of identity, wealth and status to be

appreciated by those interacting with a space. Finally, high-level meanings are generally involuntary, unconscious and unquestioned as they arise from elemental aspects of cosmology, worldview and the most fundamental philosophical systems of a given culture.

In his “non-verbal communicative approach”, Rapoport (1990) actively observed and then interviewed people in the built environment in order to identify distinct cues that lead them to behave in a particular, and as he argues, prescribed manner. Within this widely ranging “environment-behaviour studies” discipline is the field of proxemics as developed by Edward T. Hall (1968). Proxemics is a branch of semiotics that seeks to define the parameters of unconscious rules of behaviour through the study of physical modes of movement and interpersonal interaction as dictated by human perception. Based on the thresholds of communication as limited by the abilities of human vision, speech, and hearing, Hall distinguishes between intimate distance, personal distance, and social distance. Such studies underline the fact that the built environment is designed to manipulate these basic limitations thereby exerting varying degrees of control over an individual interacting in specific built and un-built environments. Although both of these methods rely on direct interviews with living informants who are affected by modern spatial ideas, the basic concepts are still of considerable value in archaeological settings to address all manner of potential questions concerned with the ancient built environment.

Combining both structuralist, post-structuralist and behavioural sentiments, there is a considerable body of work that considers that the unconscious social rules which shape and are shaped by the built environment are akin to linguistic rules. In this way, spatial organization can be seen as a “morphic language” which abides by distinct and observable grammatical structure and syntax (Hodder and Preucel 1996). In this way, patterns in architecture can be read as text, with the rules that govern the syntactic arrangement of this architectural ‘language’ as a way to understand the overall spatial organizational rules of a given culture (Hillier and Hanson, 1984).

It is from this perspective that my own research was originally informed, seeking to understand the syntax of ritual and domestic space at Mollo Kontu as an extension of that found at centre of Tiwanaku itself. The details of the quantitative syntactic methods I use will be discussed in greater detail

and experimentally applied in chapters 4 and 5 of this thesis. By comparing monumental space that is tied directly to ritual practice to the more quotidian practices inherent to residential domestic space, the degree to which Bourdieu's practice theory is visible as an element of a potential spatial grammar will be investigated. With monumental space designed to strictly control a very specific ritual experience, a strongly defined spatial grammar should be expected to effectively displace the more complex and variable habitus of domestic activity within an urban residential setting. In theory, the application of quantitative methods of spatial analysis to both ritual and domestic structures should help define the similarities and differences between both architectural settings. The resulting quantitative data cannot be considered in complete isolation from qualitative and hermeneutic interpretations of symbolic elements, thus it is in the combination of both strategies that spatial analytical tools have the capacity contribute to the study of the built environment in the past.

Despite the lack of living informants from the numerous prehistoric cultures actively studied in the Andean region, there is no doubt the spatial organization of such societies were based strongly on symbolic structures that were dictated by social and ritual considerations of enduring and potentially pan-Andean cosmologies (Bauer 1991; Urton 1993). With large monumental sites such as Tiwanaku and Cuzco considered to have been built along distinct cosmological lines there is a trend amongst archaeologists to assume that any and all settlements adhere to some form of solar or astronomically based organization of social space (Kolata and Ponce 1992, Urton 1981, Staller 2008, Stross 2008, Meddens *et al* 2008). As appreciated through ethnographic work in the region, it is clear that contemporary Andean communities continue to value highly organized spatial considerations of the landscape and the celestial sphere (Bastien 1978; Urton 1981). Although the cosmological mindset of these modern groups cannot be thought of as direct transcriptions of ancient cosmologies, they are of significant value as comparative starting points for the interpretation of archaeological materials.

In Andean archaeology and throughout the Americas, there is a tendency to look to the built environment for cues of a cosmologically organized hierarchy within the assumed social and political structure of the culture in question, with a distinct interest in establishing the presence of class separation

(Haas et al, 1987). Andeanists frequently return to the ethnohistorically and ethnographically documented *ayllu* system of social organization along familial lines. Although the basic definition of the term itself remains a point of debate, every consideration of this social structure look to clear elements of dual organization of every of Andean life at every scale, from the arrangement of public space (Moore 1996), to landscapes (Erickson 1993), and in settlement distribution (Albarracin 1996). According to Janusek (2004:28), an *ayllu* ‘‘was a flexible term for community,’’ a group of people building relations on shared productive, political, and ritual experiences, relationships that are based on kinship, real or fictive. Ayllu members expressed a common identity, and their membership gave them use of common resources, and perhaps other entitlements. *Ayllu* were ‘‘to varying degrees an economic, ritual, and political group’’ (Janusek 2004: 28).

Processual and Marxist archaeological interpretations of ancient Andean monumental architecture see these structures as direct reflections of political control over an ancient population, enacting authority through coercive manual labour and conspicuous consumption (Haas *et al.* 1987). More nuanced considerations of the manner by which access and communication in architectural space organizes social structure consider that monumental constructions, as sacred spaces and public places, actively embody ideas of differential inclusion or exclusion in various activities both ritual and secular (Moore 1996, Czwarno 1989).

Of greatest importance and inspiration to the present study is the indispensable body of work offered by Jerry Moore on the study of the Andean built environment from an archaeological perspective (Moore 1992, 1995, 1996a, 1996b, 2003, 2005). Moore’s thorough examination of the relationship between public architecture, authority, ritual activity, and social organization in the varied cultural landscapes of the ancient Andes was a powerful resource in the development of the present study.
In that Andean cultures lack a traditional written record, it is through an inextricably linked combination of iconography and monumental architecture that the desired social message was disseminated to the public. Any highly visible monumental structure is immediately associated with some form of ritual

purpose by archaeologists for entirely physical reasons, clearly showing that the desired impact of the original builders endures to the present.

According to Moore in his consideration of Andean plaza spaces:

> "Ritual concepts are expressed and created via paralinguistic, verbal and non-verbal modes of human communication. Because of the innate properties of human perception, spatial thresholds structure the ability to communicate over distance, and consequently, the architectural modes of ritual communication that occurred in those spaces" (Moore 1996b: 789).

To clarify, the paralinguistic communication Moore refers to are the non-verbal vocalizations, pauses and tonal properties that provide an underlying context for speech. In the case of ritual space, it is the gestural and visual elements of nonverbal modes of communication that must be most closely considered. These three categories of communication (paralinguistic, verbal and non-verbal) extend directly from Hall's proxemic approach discussed earlier and are widely used by Moore in his interpretation of various forms of Andean architecture. For instance, Moore's work on the degree of visibility as one approaches Andean mound structures uses a somewhat experiential consideration of the human sightlines or "isovists" has led to some interesting comparisons of monumental architecture. These isovists consider each structure studied in terms of what can be seen from three crucial angles (18, 27 and 45 degrees) that are linked to the limits of visual perception, and thus the potential visual and psychological impact a structure may have at various distances from it (Moore 1996a: 113).

Ranging from the open performative space of Inca plazas at Cuzco to the spatial grammar of the restrictive layouts found in the complex internal spaces of the *ciudadelas* of the Chimu at Chan Chan, Moore's work is fundamentally concerned with how monumental architecture reflects and transmits ideology in efforts to control and manipulate social order in the ancient Andes (Moore 1996a, 1996b). With Moore's work as a conceptual foundation and inspiration, the present study focuses on an investigation of the relationship between ritual and domestic space specific to Tiwanaku.

Following a description of both the site of Tiwanaku generally and Mollo Kontu specifically, discussing briefly the work previously and presently conducted there in chapter 2, I will present a

hermeneutic study of the Sunken-Court tradition at the site in chapter 3. With this foundation I will then introduce and discuss the theory and method of the specific quantitative spatial analysis I will employ to analyze the Sunken-Court form in chapter 4. Chapter 5 will present a practical application of this quantitative method by comparing the Sunken-Court structures located at other sites that both precede and follow after the Tiwanaku tradition. This will serve to place the Semi-Subterranean Temple at Tiwanaku within the overall stylistic trajectory of the architectural form throughout the Andes. After this, I will introduce the specific methodology of the field work I conducted at Mollo Kontu in chapter 6 and discuss the results of topographic and geophysical surveys as well as excavations in both ritual and residential areas of the site in chapter 7. These results will then be compared to the quantitative studies of the sunken court tradition, seeking to assess the viability of a similar analytical method to both ritual and domestic space outside of the ceremonial core. The final section of this thesis will serve to critically consider the potential of quantitative spatial analysis in archaeological investigations in light of both the hermeneutic and theoretical considerations of the Sunken-Court form as well as in practice at Mollo Kontu. With the conclusion of this thesis, it will become clear that the combination of computational and qualitative methodology employed in this study are problematic from a technical standpoint, yet have significant potential to the study of ancient architecture at many scales. This particular study stands as both a methodological experiment and as an exploration of the interface between increasing technological possibility and the interpretive value of the resulting data in archaeological contexts.

Chapter 2: Site description of Tiwanaku, Mollo Kontu and the *Proyecto Ja'cha Marka*

Located at the altitude of 3810 masl in the northern Bolivian altiplano just south of the shores of Lake Titicaca, Tiwanaku was the urban capital of an important pre-Incan Andean state whose power and influence extended from northern Chile and coastal Peru to the eastern lowlands of Bolivia that reached a cultural apex from AD 500 to 1100 (figures 1a/1b). With a moated monumental precinct central to the site with palaces, temples, pyramids and sunken courtyards built of fine ashlar masonry, it is not surprising that most nineteenth century scholars (Bandelier 1911; Squier 1877; Uhle 1912) and early twentieth century archaeological excavations (Bennett 1934; Créqui de Monfort 1906; and Posnansky 1945) at Tiwanaku focused mainly on the ceremonial components of the site (figures 2a/2b). To these early scholars, Tiwanaku stood as an empty ceremonial or pilgrimage centre defined by its circumscribed monumental complex that was thought to house a small resident population of ritual practitioners. Within this ceremonial district (figure 2b) the principal monumental structures include the partially excavated Akapana Pyramid (figure 2a:1), the Semi-Subterranean Temple (figure 2a:2), the Kalasasaya(figure 2a:3), the Putuni Palace Complex (figure 2a:4), the Chunchukala (figure 2a:5), the Kheri Kala (figure 2a:6), with the Pumapunku located outside of the moated core to the southwest. (figure 2a:7). The Akapana pyramid, the Semi-Subterranean Temple and the Kalasasaya will be described in greater detail in the next section of this thesis, and so will not be presented in the following descriptions of the various monumental structures mentioned above.

Directly to west of the Kalasasaya platform are the remains of the elite residence and activity areas known as the Putuni Palace and the Kheri Kala (figure 2a/2b). These two walled compounds located very near to the centre of Tiwanaku's ceremonial space are thought to have been occupied by a core elite group or lineage accompanied by specialists and retainers (Couture 2002). The Kheri Kala compound, measuring 50m north-south by 75m east-west, contained a large open courtyard surrounded many narrow rooms connected by corridors (Janusek 2008: 144). East of the Kheri Kala is the Putuni architectural complex that is also centered on a platform and courtyard form and just slightly smaller than the Kheri

Kala on the east-west axis at 70m in length (Couture 2002). With finely-cut stone staircases, paved corridors and small rooms surrounding the courtyard that would have restricted access to the structure, the west side of the Putuni accommodated an elite residential complex that included food preparation, feasting and dwelling areas (Couture and Sampeck 2003). North of the Putuni and west of the Kalasasaya is the Chunchukala complex, a platform of finely cut andesite of which relatively little is known. This is due mainly to the dearth of publications resulting from early excavations there that are acknowledged to have been as poorly conducted as they were documented resulting in considerable damage to the remains of the structure (Janusek 2005:57). Approximately one kilometer southwest of the ceremonial district is the Pumapunku, an independent and unfinished ritual complex thought to have served as an entrance point or gateway into the Tiwanaku area (Vranich 1999). Roughly T-shaped in plan, the Pumapunku is a platform structure composed of superimposed terraces built into a natural escarpment and measures over 500m in length east-west with a primary entrance on the west side (Janusek 2008: 118).

It is only in the last few decades that archaeological investigation has turned to consider the periphery of these ceremonial areas, now appreciated to have been a densely inhabited urban residential area measuring approximately 6.5km^2 (Parsons 1968; Ponce 1972; Kolata 1993) (figure 3). Housing a projected population between 15,000 and 20,000 (Kolata 2003a: 5), the urban population of Tiwanaku are thought to have been grouped into highly organized walled neighbourhood compounds or barrios that were oriented to the cardinal directions and were physically and symbolically separated from the civic and ritual core by a rectangular water-filled moat thought to contain the area. Kolata (2003b) argues that these residential areas were organized such that the socio-economic status of barrio inhabitants decreased the further they were located from the ceremonial center. These distinct residential units are known through excavation to contain collections of smaller domestic structures organized around private patios and have been considered to represent a heterarchical or “horizontal” urban organization which groups inhabitants along kinship and ritual lines (Janusek 2004). Excavations within a some of barrios across the site and at Lukurmata have shown evidence of craft specialization while others seemingly maintained ties

with distinct ethnic groups from the eastern lowlands of Bolivia (Couture 2003a; Couture and Sampeck 2003; Escalante 2003; Janusek 2004; Rivera Casanovas 2003). With the suspected grid-like urban plan of the residential sectors at Tiwanaku buried beneath the current ground surface, our sense of the scale of this city is lost as is our understanding of the degree of homogeneity or variation between barrio structures and their inhabitants. With the structures in the residential sector built primarily of sun-dried adobe brick set on stone foundations, seasonal rains have melted all evidence of the ancient walls leaving an undulating landscape of low rises and shallow depressions that obscure our understanding of the true monumentality of the site as an urban centre.

While the University of Chicago's Proyecto Wila Jawira conducted broad excavations outside of the ceremonial core, in Akapana East 1M, Akapana East 1, Akapana East 2, (Janusek 2003, figure 2a: 10-12), Chiji Jawira (Rivera 2003, figure 2a:13), La Karaña (Escalante 2003, figure 2a:14) and Mollo Kontu South (Couture 1993, 2003, figure 2a:9), as of yet no compound has been excavated in its entirety. As such, the size, internal organization, and duration of a typical Tiwanaku residential compound are still unknown (Kolata 2003a) . It is suspected that the appearance of homogeneity imposed by Tiwanaku's rigid grid plan may be masking considerable economic and social diversity in the organization and use of internal domestic space within and between residential compounds (Williams et al, 2007).

Located directly south of the Tiwanaku central monumental district lies an area of roughly 8 ha known as Mollo Kontu where the Proyecto Jach'a Marka has conducted large-scale excavations in conjunction with topographic and geophysical survey of a non-elite ceremonial structure known as the Mollo Kontu Mound, an associated residential area and a nearby mortuary complex (figure 2a:8/9, figure 3 and 4). Recent excavations at Mollo Kontu have shown that major adobe perimeter walls thought to enclose the residential compounds are aligned to the cardinal directions and tend to be built one on top of the other, suggesting great continuity in the organization of architectural and social boundaries across time (Couture 2003a, Augustine et al, 2009). Concurrent to these excavations and surveys were intensive programs of analysis of physical anthropology, palaeobotany, zooarchaeology and ceramic analysis all

taking place within the project's laboratory built in 2006. (Berryman et al 2009; Bruno and Ramos-Fernandez 2009; Vallieres et al 2009).

This international, multi-year, and interdisciplinary archaeological project serves as an exploration of the residential periphery during and after the apogee of urban life at Tiwanaku. Extending directly from Couture's M.A. thesis research (Couture 1993, 2003a) which investigated the above mentioned ceremonial earthwork Mollo Kontu Mound or Monticulo, (figure 2a:8) as well and an associated residential area to the south (figure 2a:9) , the current project serves to broaden our appreciation of the overall organization of the area by opening extensive horizontal excavations in three distinct locations; the ceremonial mound itself known as MK-M, a residential area known as MK-D, and a mortuary area known as MK-A (figure 4). Couture's initial excavations at Mollo Kontu in 1990 and 1991 focused mainly on the excavation of the westernmost wall and a section of the northern wall of the Mound structure, uncovering fifteen human burials thought to be ritual offerings from six separate episodes (Couture 1992, 2003a). In the residential Mollo Kontu South excavations during this same period, Couture uncovered a series of superimposed compound walls oriented north-south representing at least three distinct occupation phases (Couture 2003a).

Prior to the 2006-2008 excavation seasons which formally comprised the three year tenure of this project, systematic survey and surface collection followed by a number of small exploratory test excavations were conducted throughout the MK area in 2001 and 2005, serving to locate potential targets for subsequent major horizontal excavation (Couture *et al,* 2001 and Couture *et al,* 2005). During the spring of 2004, at considerable effort and expense, a 1.2 hectare area of Mollo Kontu was plowed using oxen in preparation for intensive geophysical survey involving magnetometry, ground penetrating radar, and electrical resistivity (Couture *et al*, 2004, Vining et al 2008). In 2006 the project began in earnest with the excavation of two large areas (MK-D and MK-A), as well as one smaller area to the west known as MK-E. This third study area was chosen due to the fact that earlier test excavations there had uncovered a

substantial andesite block of a quality and size only seen in the central ceremonial district (Couture *et al,* 2006) (figure 4).

With both residential and cemetery contexts successfully located, the 2007 excavations focused mainly on the previously opened MK-D and MK-A areas with the latter mortuary area fully excavated and documented by the end of the season, not to be revisited in the final year of the project. As well, during this season the north face of the Mollo Kontu Mound was fully excavated yielding eleven more burials, further developing the recognition of the unique and clearly sacred function of this monument. Alongside these excavations, a fine-scale topographic survey of the Mollo Kontu area was conducted during this phase, allowing for greater spatial control during excavation as well as an increased appreciation of minute differences in the topography of the area that are potentially indicative of buried architectural features (Couture *et al,* 2007).

The 2008 season marked the final year of the Proyecto Ja'cha Marka, with most excavation focused on expanding and completing our study of the residential MK-D area. In concert with these excavations, geophysical survey of the MK-M mound as well as a one hectare area surrounding the MK-D excavations provided targets for two small test excavations; MK-F which is located in the vicinity of the mortuary complex and adjacent to the previously excavated MK-A area, and MK-G which is located directly west of the MK-D excavations (figure 4).

Having been involved in the latter two years of the Proyecto Ja'cha Marka investigations, first conducting the detailed topographic survey in 2007 and then running the geophysical survey in 2008, I will present a detailed account of both the methods and results of my particular fieldwork in chapters 6 and 7 of this thesis. Prior to this, I will first further discuss the archaeological setting of Tiwanaku and Mollo Kontu through a hermeneutic study of the Sunken-Court architectural form as a ubiquitous element of the ancient Andean mindset in the following chapter.

Chapter 3: Hermeneutic study of the Sunken-Court tradition at Tiwanaku

Cosmological dualism is directly related to the inevitable asymmetry of human relationships, both with each other and with their environment. The pairing and separation of diametrically opposed elements of the natural world serve as the basis on which ideology and tradition is built. As yet another permutation of this universal, structuralist condition, the mindset and worldview assumed to be held by the Tiwanaku serves as an ideal illustration of how social order is dependent on the recognition and control of difference. The landscape in which Tiwanaku is situated in contemporary Bolivia is one of stark extremes; towering snow-capped mountains in the east, seasonally unforgiving expanses of the dry high altitude inter-valley altiplano, and the vast freshwater 'inland sea' of Lake Titicaca in the west (figure 1a and 1b) This intimidating scenery set the stage for an expansive empire whose influence radiated outward in both time and space, disseminating a distinct ideology that consolidated previous Andean principles and paved the way for the later Inka Empire.

According to Tilley (1984), the creation of monumental architecture is a physical expression that legitimizes ideology, cementing specific cultural values in time and space. By projecting authority "into the past and onto a mystical place… in a manner in which the principles underlying social relationships" appear timeless, inevitable, and unquestionable, "…creates a legitimate form of inequality in an imaginary world dislocated from ordinary experience" (Tilley 1984:122). In this way, monumental architecture is entirely affected by its place in the space of others, with the presence, position and absence or negative presence of the built environment being of fundamental importance. A consideration of the absence of traditional monumentality in the negative, underground space of the Templete Semisubterráneo (Semi-subterranean Temple) at Tiwanaku will be offered in the present chapter, in efforts to theoretically, symbolically and archaeologically unpack what is essentially an empty space.

Specifically, the following discussion will suggest that the Sunken-Court temple form is a mimetic representation of the unseen and sacred sub-surface realm of Lake Titicaca, and of the linked aquatic and chthonic elements ubiquitous to Andean cosmology that have persisted from antiquity into the present. Through an ethnohistorical and ethnographic discussion of the significance of cosmological

dualism in this region of the Andes, the sunken court will be presented as a physical and symbolic inversion of those monumental structures that have been suggested to mimic the mountain peaks for which the region is famed.

High and Low, Urco and Uma: Cosmological Dualism in the Altiplano

Sparked by the ethnohistorical work of Murra (1968) and his definition of the 'vertical archipelago' model which defined and linked ecological, economic, and social hierarchies in the ancient Andes, there has been an increased focus on the stratigraphic nature of social and symbolic elements so elemental to this region. In his discussion of the of the organization the Lupaqa kingdom in the Titicaca region based on the 1567 *visita* (journey of inspection) of Garcia Diez de San Miguel, Murra outlines the overall division of the kingdom into upper (*alasaa*) and lower (*maasaa*) moieties. These dual divisions apparently cut across and incorporated two different ethnic groups; the highland Aymara and the lake dwelling Uru, also known as the "water people"(Murra 1968:126). Subsequent ethnohistories and ethnographies of the Aymara, the indigenous peoples of the Titicaca Basin who are seen as the direct descendants of the Tiwanaku, have repeatedly shown the overarching significance of dual organization in this area (Platt 1986, Bouysse-Cassagne 1986). Of particular importance to the present discussion are the Aymara spatial concepts of urco and uma which separate the world into upper and lower spheres. Although the urco-uma division is present throughout Aymara territory, it is considered to be most notable in the lakeside region where all señorios (municipal areas) are known to have had a bipartite social organization (Bouysse-Cassagne 1986: 202). The definitions of urco and uma are most clearly understood from the original chronicle written on the Titicaca region in 1585 by Luis Capoche:

> "The Collasuyu was divided into two suyus, which bore the names of Urcosuyu and Umasuyu. Urcasuyu refers to the dwellers of the mountain peaks, called urco in this language, whereas the Umasuyus were those who inhabited the level lands below, beside lakes and rivers (uma means water); some say that Urcosuyu implies a manly and courageous people, since urco denotes the masculine sex, and Umasuyu whatever is feminine and of less value. The Urcosuyus have always had a higher reputation, and the Inka placed them at his right hand in public places; they were preferred to the Umasuyus and were better thought of than them" (Capoche 1959[1585]:139-140 as translated by Bouysse-Cassagne 1986: 202).

As mentioned, the Aymara word uma directly translates to ‘water’ and always has connotations to liquidity or to whatever does not have a solid consistency, such as mud (umachata) snow or melted metal (umaptatha) (Bouysse-Cassagne 1986: 207). Added to this idea of fluidity is a secondary connection to hollowness, such as the hollowness of a crop furrow, valleys, lowlands or the concave parts of an object. According to Bouysse-Cassagne, the Aymara consider “the water of Lake Titicaca, the bottom of valleys, and the rut of a furrow all to belong to the same category, the first because of its internal nature (the contained) and the others due to their form (the container)” (Bouysse-Cassagne 1986: 207). Between the conceptual and regional opposition of Urco and Uma is the intermediary zone or taypi that is formed by Lake Titicaca itself.

Beyond being a specific geographic location, Lake Titicaca is an element of Aymara thought that serves as the centrifugal force that permits the differentiation of urco from uma, while being the centripetal force which keeps them in balance (Bouysse-Cassagne 1986: 207). This middle ground is known as the taypi, literally meaning whatever is situated in the middle, a crucial piece of symbolic architecture that serves as a place of convergence which maintains cosmic equilibrium. To the contemporary Macha of Bolivia, lakes continue to serve as taypi, as they are considered to have mirror-like qualities, sacred objects that have considerable symbolic power throughout the Andes (Platt 1986:247). The Macha see the level, reflective surface of a lake being a mirror-like interface between vertically distinct cosmological spheres, especially between the dead and the living, the past and the present. This dual character of the mirror is clearly seen through its incorporation as a positive symbol of conjugal duality in Macha marriage ceremonies as well as negative associations when mirrors are laid on new graves to block the exit of the soul of the deceased (Platt 1986:247).

The idea of the taypi was repeated and likely borrowed by the Inka through the Quechua term chawpi, which for the Inka was a distinct point located where the four regions of the empire meet at the capital of Cusco (Bouysse-Cassagne 1986: 217). Although this symbolic centre shifted from the lake to the imperial captial, Lake Titicaca itself remained of vital importance to the Inka as a mythic origin point that legitimized their authority throughout the empire. These linguistic and ideological elements will

prove to be of considerable gravity when presenting the archaeology of the sunken court form, but before this, a more comprehensive discussion of the mythic importance of Lake Titicaca must be laid out.

Lacustrine Origin Myths and the Significance of Lake Titicaca to Tiwanaku:

Through the ethnohistoric records of 16th and 17th century Spanish chroniclers, we are able to appreciate the overwhelming importance of Tiwanaku and the Lake Titicaca region to the Inka as the mythic origin point from which the world and all of humanity was formed by the creator deity, Viracocha. In his 1653 chronicle of Inka legends and history, Cobo recounts that Viracocha "made all things in Tiaguanaco, where they pretend that he resided, he ordered the Sun, Moon and Stars to go to the Island of Titicaca, which is located in the lake of this same name, and that from there they should go up to the sky" (Cobo 1984[1653]:105). A variation of a Lake Titicaca genesis offered by Sarmiento de Gamboa describes two distinct creation episodes, with the initially created world devastated by a catastrophic deluge that gives rise to a second creation episode in which the progenitors of the Inka establish their capital at Cusco (Sarmiento 1908 [1571]). Following this flood, "At the sound of his voice every place obeyed, and people came forth, some from lakes, others from fountains, valleys, caves, trees, rocks and hills, spreading over the land and multiplying to form the nations which are to-day in Peru" (Sarmiento de Gamboa 1908:26 [1572, Ch.7] as translated by Kolata 2003:176, emphasis mine).

The role of water features as generative loci in both of these accounts is of greatest importance to the present argument, water clearly having symbolic connotations to the primordial environment of the womb as well as more functional associations as the source of fertility from an agricultural perspective. The raised field agricultural techniques developed and widely exploited by the Tiwanaku in the Pampa Koani (Janusek and Kolata 2003:130, figure 2b) can even be argued to have symbolic undertones to fertility and to the creation myths themselves. Quite apart from the practical elements of this marvel of agricultural engineering, the creation of raised planting beds surrounded by water from which crops grew and sustained the population of Tiwanaku could be seen as microcosmic representations of the Islands of the Sun and Moon located in the centre of Lake Titicaca from which all life is thought to began according

to myth. Considering that numerous Tiwanaku and later Inca period shrines have been found on these actual islands (Bauer and Stanish, 2001:154), such a proposed miniaturization of these mythic spaces would again speak to the importance of the lake in the Tiwanaku worldview.

Substantial numbers of ritually significant objects dating to the Tiwanaku Period including finely made ceramic vessels and gold and silver objects were recovered at the temple site Iñak Uyu on the Island of the Moon (figure 1b), supporting the hypothesis that the islands and the lake itself were the site of ritual pilgrimage (Bauer & Stanish, 2001:150). Tiwanaku and Inca ritual deposits that have been discovered on a ridge submerged in the lake just off the Island of the Sun (figure 1b) underline the enduring symbolic importance of the water as a separating and sactifying force in religious ceremony in the Andes. Through underwater archaeological salvage efforts at this offering place, Ponce Sanginés et al. (1962) and Reinhard (1992) have recovered the remains of numerous Tiwanaku metal objects, including a gold pendant with an engraving similar to the "Gateway God" at Tiwanaku, a gold beaker, an incised puma, as well as various Tiwanaku-style incense burners or incensarios (Bauer & Stanish, 2001:150). This artifact assemblage bears notable resemblance to those found at a number of excavated sunken court temples at sites thoughout the Titicaca basin. Specifcally, at Lukurmata (figure 1b) artifacts of gold, silver, copper and lapis lazuli along with prodigious amounts of fragmentary incensarios and hollow-base libation bowls (sahumarios) were uncovered during the excavation of the sunken court temple located there (Bennett 1936:493). The similarity of these assemblages presents a potential reference of the symbolic and ceremonial importance of Lake Titicaca in the sunken court temple form and strongly reinforces the conclusion that the islands and their surrounding waters were considered sacred places by the Tiwanaku polity.

Plazas Hundidas

The sunken-court temple or Plaza Hundida is taken to be a diagnostic form of Tiwanaku public architecture, with the *Templete Semisubterráneo* considered to be archetypical. (Bennett 1934; Ponce 1969). Although the so called sunken-court tradition has an enduring presence as components of earlier

highland ceremonial complexes such as at Chavín de Huántar, Qaluyu and Pukara (figure 1b), this particular architectural element achieved its highest degree of standardization and widest distribution in the south-central Andes during the Tiwanaku period, ca.250 -1100A.D (Goldstein 2005: 277). Usually accompanied by or paired with a distinct mound structure, Tiwanaku-attributed sunken courts show a considerable stylistic consistency as is to be expected between sites that share a common and centralized ceremonial ideology. The relationship and symbolic interplay between these two diametrically opposed architectural types, the Sunken Court and the raised platform, will be considered later in this paper, but first the sunken court form and the Semisubterranean Temple itself must be more carefully described.

Measuring approximately 28m by 26m with walls of finely cut sandstone blocks and a clay floor, the Templete at Tiwanaku has only one south facing entry via a staircase of superimposed stone slabs that lead the participant approximately 2.5m below the ground level (Goldstein 2005: 277, figure 5). Within the resulting open space, the greatest known concentration of Tiwanaku stone sculpture is found, with the massive and intricately carved 7 m tall Bennett Monolith and other stelae once rising from the centre of the sunken court (figure 6). Carved in sandstone, the Bennett Monolith, now housed in the Tiwanaku Museum, depicts an elaborately costumed figure that holds a snuff tablet for the ingestion of hallucinogenic substances in one hand, and a vessel known as a *kero* that is exclusively for the consumption of maize beer in the other. (Kolata 1993: 135-42.) A set of sculpted heads are incorporated into the walls as false-tenons (figures 7a/7b), adding to the assumption that the Templete may have been the collection point for sculptural huacas, or sacred objects representative of distinct chronological or regional styles (Burger 1995:180, Moore 1996:92).

At the time of its abandonment, among this collection was an Early Horizon and Late Formative (ca 400 B.C.) Yaya Mama-style “Bearded Stela 15, an indication of a possible long-term curation of sacred objects or perhaps a distinct tradition of capturing and displaying the huacas of subject populations as is known to have been practiced by the Inka (Rowe 1982:96) (figure8). There has even been a suggestion that the positioning of the stylistically diverse sculptures around the central Bennett monolith may have been a microcosmic representation of the various ethnic components of the expansive

Tiwanaku state (Kolata 1993:142). Expanding upon this concept of ethnic and social diversity at Tiwanaku, Couture has suggested that the tenon-heads themselves were representations of the mythic or founding ancestors of various functional social units or ayllus that are assumed to have comprised the state, objects that carefully manipulated the symbolic importance of the head in Tiwanaku iconography and ideology (Couture 2004).

Building in part on Couture's thesis, the speculative section of this chapter that follows was initially inspired by the position of these numerous carved faces. Directing their gaze toward the monolithic sculptures at the centre of the court, if these heads are representative of either real or mythic social groups in the Titicaca Basin, I suggest that the walls on which they are mounted are metaphorical shores of a microcosmic depiction of Lake Titicaca. Despite the enormous size of the lake, one can assume that the Tiwanaku and all culture groups that had direct or indirect contact with this body of water must have appreciated that it was finite area and had a contiguous and inhabited coastline. Whether these distant groups were known to each other by name through trade contact or by reputation alone based on origin myths, the physical and symbolic centrality of the lake must have been of profound importance to all groups living in this region. Having shown that Lake Titicaca was, and continues to be, of clear cosmological significance to the worldview of this region of the Andes, the following discussion will suggest how this may be manifested in the archaeological record through the construction of sunken court temples.

Semisubterranean Temple as Mimetic Lake:

Towering above the Templete Semisubterráneo at Tiwanaku is the Akapana (figure 2a:1), a seven tiered mound built in the form of one half of an Andean cross and topped with a sunken court (Kolata 2003: 183). Although the Templete Semisubterráneo, Kalasasaya and all other ceremonial buildings found at the core Tiwanaku predate the Akapana, the position of this charismatic monument dominates the ceremonial landscape at the site. According to Alan Kolata, the Akapana was constructed to serve as a physical metaphor of a sacred mountain and a mimetic representation of the Quimsachata Range to the south of Tiwanaku (figure 1b) (Kolata 1993; Kolata and Ponce 1992). Mimicking the natural

watercourses that run down from this range and supplied Tiwanaku with nearly all its irrigation and drinking water, the Akapana incorporated a complex system of subterranean drains and stone-lined channels that directed rainwater down from its upper terraces. This water could have easily have been directed to fill the large rectangular moat that surrounds the ceremonial district, creating an artificial island of sorts, perhaps as a miniaturized representation of the sacred Islands of the Sun and Moon that are surrounded by the sacred waters of Lake Titicaca. Imported bluish-green, water-worn pebbles from the Quimsachata range itself are incorporated into the construction fill of the structure, a feature that is thought to symbolically link the mound to the mountain. These stones have been suggested to serve as portable huacas or emblematic icons that "condensed in one material the symbolic essence of two Tiwanaku sacred elements: mountains and water" (Kolata 1993: 104).

As a comparative, cross-cultural aside, the similarities of the mountain mimesis suggested by Kolata to those known to exist in prehistoric Mesoamerica and many other cultures worldwide is worth noting here (Wheatley 1971, Eliade 1959. Specifically, for the Classic Maya, the pyramids that housed elite tombs were frequently decorated with plaster masks of *witz* monsters to clearly mark the structures as representations of mountains, *witz* being the Maya word for mountain or hill (Reilly 1999: 26). At Uaxactun, a Maya site from around 300 B.C., such a program of masks and hieroglyphs found on the façade specifically describes the pyramid as the Yax-Hal-Witz, the "First True Mountain" of their creation myth, which was the source of maize, the waters of fertility, and the location of the creation of human kind. These structures were also understood to be the location of ancestral power as well as portals to the supernatural underworld (Reilly 1999: 26). The plazas, around which the Maya erected their great pyramids were designated in the hieroglyphic texts by the term nab, the same used to identify the numerous lakes, swamps, and large sheets of still water that cover much of the tropical lowlands during the rainy season. Such still, watery surfaces, which so often are covered with water lilies and other aquatic vegetation, also were conceived by the Maya as portals to an underwater Otherworld. (Reilly 1999: 26).

Considering that the Aymara seem to share very similar sentiments to the Maya in terms of the symbolic importance of mountains and water, I suggest that in as much as the Akapana can be considered

a mimetic mountain, the Templete as a form of plaza can be considered a mimetic lake. Considering that the Akapana incorporates a sunken court at its peak that acts as a collection point and reservoir for seasonal rains, if those same rains were directed to fill the Templete, its truly subterranean nature would literally replicate a lake in miniature. From a ceremonial standpoint, it has been suggested that the water that was collected and controlled on the Akapana would serve not only to mimic the flow of life-giving water from the mountains, but to actually animate the mound, not unlike the circulation of blood through the body (Kolata 2003:184). For later Andean groups including the Inka, running water was frequently associated with a creative, vitalizing life force known in Quechua as camay which gave personality to sacred mountains and architecture alike (Taylor 1976, Couture 2004:135). Similar to the Akapana, a network of stone-lined drainage canal were uncovered at the Putuni Palace, an elite residence immediately to the west of the Kalasasaya and the Templete. Sediments from these canals contained traces of ritual deposits including sheet gold, fragments of sodalite, lapis lazuli and partially worked obsidian, speaking to the ceremonial importance of the water flowing underneath, through and around this structure (Couture 2004:135).

Similar watercourse-based manipulation of the concept of camay in ceremonial architecture has been suggested to have been employed at the site of Chavín de Huántar in the Peruvian highlands (figure 1a), a complex that predates the Tiwanaku apogee by at least 1000 years (Burger 1995:141). Noting that numerous channels and drains run though the extremely complex network of internal corridors and galleries at Chavín, Lumbreras experimentally tested the possibility that these conduits might have served as a sensory feature in the ritual process. After having 200 L of water poured through these channels while he stood inside the structure, Lumbreras noted that the resulting sound of rushing water through the structure made for a potentially powerful sensory experience, especially if under the influence of narcotics as is widely considered to be involved in the rituals thought to have taken place at Chavín (Lumbreras et al 1976). With these gallerias being entirely enclosed and internal spaces in this structure, a direct association to the subterranean is symbolically intensified with such a suggested incorporation of moving water.

An ethnographic consideration of the importance of telluric, chthonic, and aquatic components of the Andean worldview can be appreciated through the work of Joseph Bastien (1991) in his work on the contemporary Ayamara speaking Kaata, a highland Kallawaya group in the southern Andes. In his discussion of the complex set of metaphors that symbolically connect the regions of the human body to regions of mountains, Bastien explains that Mount Kaata in the Apacheta region is considered to be the Uma Pacha, the mythical place of both origin and return for people, animals, time and history. Bastien writes:

> "Kaatans associate uma with head and water, and pacha with space and time. The highland lakes of Apacheta are associated with the "eyes" (ñawi) of the mountain/body metaphor. During the Feats of All Colours, Apachetans perform rituals to these lakes which they symbolize as producing illas or reflections generative of humans and animals emanating from these lakes. The dead travel through the underground waterways up the three levels (of the mountains) to the highland lakes where they are born again."(Bastien, 1991:360)

In this case, the natural underground water channels that connects the mountains to the plain act as a bidirectional conduit for forces of fertility, death and regeneration, serving as a physical and conceptual connection between spatially and chronologically separate cosmological levels. Although the mountain peaks are *Urco* in position, the generative lakes within them are considered *Uma* (Umapacha) due to their temporal connection to the ancestors, and to the past. Confusingly, the flow from life in the valley which should be uma, to death and burial in the spatially and symbolically uma ground is followed by a transfer to the urco realm of the mountains and a return to the uma plain. Although the details and directionality of this particular spiritual journey are complex, it is clear that it is both aquatic and subterranean in nature and regardless of where water is found spatially, it retains a very basic uma characteristic. I argue that a very similar symbolic appreciation of water and the subterranean was made manifest in the Templete Semisubterráneo at Tiwanaku.

As much as the water-driven seasonal or annual ceremonies at the Akapana would instantiate symbolic concepts of fertility and the new, if by the same event the Templete were to temporarily fill with

water each spring, the creation of a miniature lake would serve as symbol of the past, of the regenerative association of the ancestors as represented by the tenon heads and the creation myth. If this were the case, the monoliths rising from the centre of the sunken court would simultaneously be a physical representation of the Islands of the Sun and Moon and a figurative and blatant depiction of Viracocha himself rising from the water. If these two events were to occur at once each rainy season, multiple symbolic dualities would be illustrated concurrently; the urco Akapana as a positive space for the generation of the new, and the uma Templete as the negative space for contemplation of the past, of the origins all things. Whether the Templete could actually fill with water to allow for such a stunning reenactment of the creation myth is questionable, but is worth consideration.

Immediately to the west of the Templete is the Kalasasaya, a platform mound which is seen as the original structural counterpart to the Semi-Subterranean Temple below (figure 2a/2b). A series of drainage spouts spring from the exterior stonework of this structure, clearly flowing into well defined open gutters or channels that encircle the platform. Considering the concerted efforts to ritualistically control water at the Akapana and Putuni Palace, it seems unlikely that this drainage system was built with purely functional purposes in mind. Depending on the direction and amount of water that would have filled these canals at the appropriate time of year, it would not be difficult to redirect water towards and into the Templete, where the compact clay floor would have served as an ideal water retaining barrier.

Adding yet another layer of symbolic duality to this proposed ceremonial use of the Templete is the incorporation of the previously mentioned Yaya-Mama style monolith known as ‘stela 15’ in the sunken court (figure 8a/8a/8c). The initial construction phase of the Templete is attributed by some scholars to be from the Yaya-Mama religious tradition that was pervasive across the Titicaca basin from 800 B.C. – A.D.300, which would make this one of the earliest components of the Tiwanaku ceremonial core (Chavez 2004:73). The presence of Stela 15 is the only remaining vestige of the original structure, as reconstruction and renovation of the space has made the sunken court distinctly Tiwanaku in style. The Yaya-Mama religious tradition takes its name from the Quechua terms for father (yaya) and mother (mama) in reference to the consistent depiction of male and female figures on opposite faces of the stelae

found at the ceremonial spaces attributed to this ritual federation such as that found at Taraco, Peru (figures 8d/8e) (Chavez 2004:73). The inherently dual organization of gender concepts would further subdivide the already extremely complicated symbolic meaning imbued in the Templete. Although Stela 15 is carved in Yaya-Mama style, the fact that it lacks a second oppositely gendered figure suggests that it is still a reference to the earlier religious tradition, but perhaps not to the strong elements of gender-based dual organization inherent to that tradition. Regardless of this fact, the strong gender-based notions of the Yaya-Mama ritual tradition can be argued to have been at play in the Templete due to the iconographic style of the carvings on Stela 15. This difference could even represent a stylistic intermediary between the earlier Yaya-Mama tradition and the later Tiwanaku-period stelae that depict singular, masculine figures such as the Bennett Monolith.

As described earlier, the concept of *urco* has strong masculine connotations and uma, feminine. This gender duality persists for the contemporary Macha studied by Platt, who provided him with a very cogent phrase to describe their religious tradition: *tukuy ima qhariwarmi*, "everything is man-and-woman". Mirroring the Aymara, for the Macha the spirits who inhabit the mountain peaks (*jurq'us*) are male whereas their wives (*warmi jurq'u*) are the springs of water that rise in the mountains and flow downward (Platt 1986:241). This trend of defining the natural world into divine couples includes the sun (*tata inti*, "father sun") and moon (*mama killa*, "mother moon") as well as the telluric *pachatata*, "earth father" and *pachamama* "earth mother". This last personification of the earth as mother is truly ubiquitous throughout the Andes, as it is in many cultures worldwide and is of particular importance to the potential symbolism of the Templete and the sunken court tradition.

In that the sunken court is a concave space through which ritual participants or actors were directed to move immediately evokes a number of *uma* sentiments. Primarily, an actor would be forced to change their vertical position in the world, required to descend to a lower level into the ground, and thus into physical and spiritual communion with the earth. This is place that one normally does not find themselves, a liminal space that no doubt brought to mind ideas connected to burial and the planting of seeds. With Pachamama as the fertile mother figure who gives birth to all things, humanity and crops

alike, a descent into her 'body' in the space of a sunken court could easily have been a rather literal procreative and reproductive symbol, simultaneously enacting both fertilization and a return to the womb. Such a symbolic return to a prenatal and undeniably liminal space would force the ritual participant to confront their own very corporeal origins as the offspring of mother earth herself. If, as I have suggested, that the overarching ceremonial purpose of the sunken court was in part a recognition of creation myths and cultural origins, the contemplation of the past would seem to be of primary importance to such ceremonies.

Kolata considers that the urban design at Tiwanaku is indicative of the underlying system of sacred geography at the site that is aligned with the solar path (Kolata 2003). Following the movement of the sun, the site was conceptually divided into two hierarchically ranked segments with distinct symbolic associations. Where the sun rises in the east over the distant peak of Mount Illimani, this area was embodied with higher prestige elements of upper, *urco,* and celestial ideas whereas where the sun sets over and into the lake in the west speaking to lesser prestige ideas concerning the lower, *uma* and chthonic (Kolata 2003: 180). This daily return of the sun to the lake is followed by its rising from the mountains the following morning, again potentially underlining the connection between the *uma* and *urco* by subterranean conduits through which the sun could easily have been thought to pass over the course of the night. If the daily solar journey ended in the *uma* region of the lake where it was originally created and sent into the heavens by Viracocha, the masculine Sun itself returns to the feminine, womb-like waters of Titicaca. Although this interpretation is entirely conjectural, considering the rather recurrent dualities presented in both ancient and modern Andean myths, elements of this reading could easily have stood as components of Tiwanaku cosmology that may have used the Templete Semisubterráneo to recreate and seasonally refocus a legitimizing ideology.

Having extrapolated my information in part from the ethnohistoric record, I mirror the work of a growing number of Andeanists who have interpreted archaeological patterns as reflecting dual organization. Such inferences are based on some form of paired construction, spatial division, or other architectural feature interpreted as evidence of dual social organizations. The preceding chapter, in its

concern with the sunken court form and the Templete Semisubterráneo in particular, has explored the similar premises of dual organization pertaining to one element of the symbolically multivocal use of ceremonial space at Tiwanaku. . Before quantitatively exploring and comparing examples of this particular ceremonial form in chapter 5, I must first present the rational and methods of Space Syntax Analysis that I have chosen to use in the following chapter.

Chapter 4: Introduction and discussion of Space Syntax Analysis

Structural approaches in archaeological theory have established that many ancient cities, particularly those that were central capitals, were built landscapes that instantiated and expressed key elements of the dominant social order. In efforts to analyze the architectural remains of ancient cultures without the filter of modern architectural conventions and Western concepts of spatial use, there is a clear need to develop a method by which the architecture of a given culture can be quantified and thus compared consistently throughout the corpus of research dedicated to that group. As will be discussed in the subsequent sections of this paper, my approach to this fundamental concern involves the application of particular elements of the suite of quantitative methods known together as 'space syntax analysis' to both ritual space in the monumental core of the ancient city as well as to the ritual and residential architecture in the Mollo Kontu sector that is peripheral to the sacred moated area at the centre of Tiwanaku .

Developed by sociologists Bill Hillier and Juliette Hanson, the space syntax method of analysis considers that the organization of space may reflect the social, economic and cultural characteristics of a society (Hillier and Hanson, 1984, Hillier, 1996). Space syntax analysis is a method by which the internal organization of a given building can be quantified and thus compared to others in a more removed and unbiased manner than by visual comparison and interpretation alone. By mapping distinct points in space on structural floor plans generated following excavation or survey, the relative interconnectedness and the ease of movement between rooms or distinct areas of the structure can be quantified, presenting a unique design signature that can be compared to other similarly mapped structures.

Although space syntax analysis has been applied to archaeological contexts since the early 1980s, such studies have exploited this potentially valuable tool to analyze and compare well defined and fully excavated architectural space. It is the prohibitive expense and considerable effort required to properly uncover buried architecture at large urban sites that limits the practicality of space syntax analysis for the archaeologist. With increased interest in the application of space syntax analysis to a variety of fields, a

number of computer programs and practical theories have been developed in recent years, mainly within architectural community. These same tools have been used retroactively by archaeologists seeking to define lost cultural ideals through the analysis of architectural remains. Increasingly applied to archaeological contexts, the following study joins a growing body of scholarship that attempts to retroactively apply the tools and concepts of space syntax analysis and its variants (Hillier and Hanson 1984; Hillier 1996). With initial and continuing exploitation in diverse areas of the Old World (Banning 1996; Banning and Byrd 1989; Bonanno et al. 1990; Cutting 2003; Fairclough 1992; Foster 1989; Laurence 1994; Plimpton and Hassan 1987; Smith, A.T. 1996; Perdikogianni 2003; Thaler 2005), New World archaeology has risen to adopt similar methodologies seeing increasing application in areas ranging from the Canadian Arctic (Dawson 2002), Mesoamerica (Hopkins 1987; Hohmann-Vogrin 2005; Robb 2007), and South America (Moore 1992,1996a, Czwarno 1989) with particularly strong emphasis in the American Southwest (Bradley 1992, 1993; Bustard 1996,1997; Cooper 1995, 1997; Potter 1998, Shapiro 1997, 1999; Van Dyke 1999).

Notably, Peter C. Dawson has applied this technique in his analysis of the snow houses of specific Central Inuit groups. Based largely on eyewitness accounts and oral traditions regarding group-specific snow house design, Dawson has been able to convincingly recreate the structural plans of the entirely temporary dwellings and correlate known social hierarchies to the spatial configuration of public and domestic architecture (Dawson, 2002). Similar studies by Sally M. Foster have investigated the relationship between spatial order and the social structure of fortified Early Iron Age settlements in Atlantic Scotland. Using a modified version of Hillier's space syntax analysis, Foster interpreted the patterns of relations between inhabitants and between inhabitants and strangers as they were reflected in the use of interior space in terms of the patterns created by boundaries and entrances (Foster, 1989).

Perhaps of greatest similarity to my own proposed research and subject matter, both in terms of the diversity and complexity of structures at a single site is a study that was conducted by Wendy Bustard at the Peubloan site of Chaco Canyon (Bustard, 1997). Published in the proceedings of the First

International Space Syntax Symposium in 1997, Bustard's project analyzed both ceremonial and residential structures in efforts to determine a temporal framework for their construction. Using SSA to quantify the complicated organization of 'great houses' in such a manner that they could be statistically compared to one another, Bustard was able to detect a shift in the way that various spaces within these structures were used that indicate site-wide functional changes in the importance of ritual activity over time (Bustard, 1997). With the architectural remains as Chaco Canyon fully excavated, exposed and documented archaeologically, this study began at a point one step closer to final interpretation than my own work at Mollo Kontu as will be discussed in detail later in this thesis.

The use of space syntax as developed by Hillier and Hanson in The Social Logic of Space (1984) provides a starting point for examining spatial configurations in built form. In particular, their gamma analysis (also called access analysis) is useful for identifying how spaces within a structure are arranged and related to one another, and how a building mediates the relationship between its occupants and visitors. The first part of such an analysis involves translating a building into an access graph, or "gamma map" in which each room is represented as a circle, with access between rooms represented as lines linking them together. The access graph can be "justified" by arranging it such that each room that is the same depth from the outside is depicted on the same level (figures 9a/9b).

Space syntax works on the assumption that the space around buildings is structured such that strangers can move about, but only inhabitants and certain visitors are allowed inside structures. Inhabitants have an investment of power and are the controllers, while visitors enter or stay as subjects of the system and are therefore the controlled (Markus 1993:13). Typically, the deeper spaces of a building are occupied by the inhabitants and the shallower spaces by visitors. The depth of an inhabitant and the degree to which visitors are allowed to penetrate into a structure are seen as indicators of their differing status within a building (Dovey 1999: 22). This allows us to examine the dimensions of publicity/privacy and segregation/ access in any given space. Obviously, the patterns generated by space syntax analysis

must be considered though the filter of the particular people using that space, an element that is both culturally specific and difficult to determine without living informants.

In examining the demarcation of public and private domains in Roman houses, mark Grahame (1997) notes that we should see public and private not as absolutes (i.e. inside is private; outside is public), but as a continuum operating along two dimensions. One interfaces the public world of strangers/visitors with the private world of the inhabitants, while the other interfaces the inhabitants with one another. The degree of privacy is a measure of power in that it controls the level of knowledge that others may have about oneself (Grahame 1997: 145). Examination of this phenomenon requires an understanding of how each space is integrated with the rest of the building. This can be achieved using the access graph of a building to calculate the following (Hillier and Hanson: 108-109):

1)Control value (CV): measures the degree of control a space exercises over its immediate neighbours. Each space in the building is assigned a value of 1, which is divided among each of the neighbouring spaces to which it is connected. These are totaled to give the control value of each space. The higher the CV, the more controlling the space is.

2)Mean Depth (MD): Measures how deep a space is relative to the other spaces in the building. MD = cumulative depth of each space / p – 1, where p is the number of points in the system.

3)Relative Asymmetry (RA): Measures how accessible a space is from other spaces or how well a space is integrated into the building's structure. The result is a value between 0 and 1 with values approaching 1 indicating lower accessibility. RA = 2(MD - 1)/k – 2, where MD is the mean depth of the system and k is the number of spaces in the system.

Space syntax is not an end unto itself and that further analysis is required to incorporate important elements of the built environment that communicate messages of power nonverbally. As mentioned in passing, Amos Rapoport (1990) has demonstrated, such messages are transmitted through the use of fixed-feature elements like ashlar walls, columns, thresholds and plastered floors, and semi fixed-feature elements such as doors, benches, hearths, wells and other furnishings and portable artifacts. Rapoport (1990:96-101) also discusses a third element of non-verbal communication: nonfixed-feature elements of

the built environment, such as the physical and verbal expressions of the building's occupants. It is the fact that these elements are not directly preserved in the archaeological record that the interpretive power of the method is considerably handicapped, and as I will argue later, perhaps not a valid tool for the archaeologist, at least in the current form in which it is used.

I will limit my discussion of the details of the mathematics involved and statistical basis of space syntax analysis to the cursory consideration above, not because it is unimportant, but because I have had relatively little contact with the inner workings of this method through the use of a computer program. Employing the DepthMap software developed at the University College London, simplified plan drawings of structures are processed so that the results of the various forms of spatial analyses are depicted as simple graphics that groups value ranges along a colour based scale, a fact that allows for intuitive visual comparisons between specific tests as will be explored in detail in the following chapter.

Theoretically, the methods and rational of space syntax analysis presents itself to archaeologists an incredible tool with great potential to clarify the internal dynamics of the ancient built environment. However, the computational nature of this technique seems to draws too heavily on culturally normative assumptions about how people interact with space. Although this is a major concern for any practical application of these methods, the information generated is still of considerable use as a viable tool to guide and inform interpretation, as will be attempted in the following comparative investigation of the Sunken Court form in the Andes.

Chapter 5: Quantitative Analysis of the Sunken Court Tradition in the Ancient Andes: Spatial Analysis using DepthMap 7.12.00d

The Andean region of South America served as the stage for the growth and development of a vast array of distinct yet strongly connected polities and culture groups in prehistory. Great efforts have been made to define and separate these groups along distinct chronological, ethnic and ideological lines through traditional archaeological analysis of their material remains resulting in a standardized, yet ever-expanding picture of Andean antiquity that is evident in the sheer volume of available literature. The present chapter will not dwell on academic debates concerning the interconnection and evolution of Andean polities across space and time, but will serve as an exploratory consideration of the latent signatures of culture that remains in their architecture, and how those spaces can be analyzed computationally. To this end, the following discussion will summarize the findings of comparative spatial analyses of eight examples of a ubiquitous architectural feature known as a Sunken-Court. Although this form of ceremonial architecture is found at sites across the Andes at nearly every chronological context, this particular study will look only at examples found at the sites of Chavín de Huantar, Chiripa, Pukara, Moquegua, Copacabana, Calaluna and Tiwanaku. With five of the eight sunken court plans analyzed in this study being attributed to the Tiwanaku culture, the remaining three sites were chosen as examples of early iterations of the sunken court tradition as points of comparison, namely Chavín de Huantar, Pukara and Chiripa (figures 1a/1b).

Known as the sunken-court tradition or Plaza Hundida tradition, the incorporation of large, flat-bottomed and shallowly subterranean spaces lined with masonry in ceremonial areas, these distinct areas allowed ritual participants to pass into and out of terra firma. First seen during the third millennium BC in northern Peru in a circular form with opposing staircases, there seems to have been a transition to more a rectangular shape during the Early Horizon at Chavín de Huantar, a style that persisted in the highlands of Bolivia and elsewhere in the Andes until the collapse of Tiwanaku at around AD 1150 (Moseley 2001:119). This repeated emphasis on sunken space as sacrosanct has been associated with certain Andean origin myths in which humanity ascends from an inner cavernous sphere, emerging from caves,

springs and holes in the ground (Goldstein 2005:58). In such a case, these sunken courts could easily have served as places where these mythic events could have been re-enacted, or alternatively where participants could have sought communion with Pacha Mama, mother earth, through physically descending into and out of her 'body' and realm. Because sunken plazas occurred in variable contexts associated with different architectural traditions, they have been inferred to reflect a distinct cult or set of beliefs that usually paired the negative space of the underground courts with the positive, elevated space of ritual mounds (Goldstein 2005:275).

The archaeological complex of Chavín de Huantar is located in the northern highlands of Peru and was an important center of one of the earliest Andean civilizations, standing as the stylistic culmination of a tradition of pyramids coupled with circular courts known throughout the Peruvian North-Central coastal region (Burger, 1995) (figure 10). Widely considered to be the site at which a long-standing and quintessentially Andean religious tradition was ideologically solidified by 800 BC, Chavín de Huantar was included in this study as an example of the assumed foundation of the sunken court tradition as it exists outside of the Titicaca basin area.

Located in the Titicaca Basin, the sites of Chiripa and Pukara precede the rise and cultural apogee of Tiwanaku while they are not the direct antecedents of Tiwanaku itself. The sunken courts found at each site serve this study as examples that are geographically and perhaps ideologically more closely associated with the particular sunken court tradition found at Tiwanaku. Located on the Taraco Peninsula on the southern shores of Lake Titicaca (figure 1b), the site of Chiripa dates to between 1400 and 850 BC with the platform mound that contains the sunken court under consideration here having first been built in approximately 1000BC, and largely remodeled to its current form between 600 and 100 BC (Hastorf 1999, Moseley 2001:156). Around the sunken-court found here are the 16 symmetrically arranged rectangular structures that open onto the central court area. Each of these adobe structures contains a complex of storage niches thought to have housed ceremonial paraphernalia (figures 16, 20a,21a,22).

On the other side of Lake Titicaca approximately 75km northwest of the lakeshore lies the site of Pukara, a civic and ceremonial centre first established around 400 BC which increasing regional

importance towards 100BC (figure 1b). Atop a massive hillside terrace built during this latter period is a rectangular sunken court with well finished stone walls that is surrounded on three sides by a series of single room structures reminiscent to those at Chiripa (Hastorf 1999, Moseley 2001: 158) (figure26).

The ceremonial complex at the Tiwanaku satellite site of Omo in the coastal Moquegua valley region of Peru (figure 1a) serves this study as an example of the influence of the Tiwanaku-style sunken court tradition outside of the immediate area of the site. Recognized as the only Tiwanaku-style platform mound built outside of the Titicaca Basin to date, the 120m long ceremonial complex rises in three tiers each forming a plaza, with the uppermost containing a sunken court surrounded by rectangular compartments (figures 35, 40, 41). Just outside of this terraced platform complex lay a large and dense residential area of ephemeral cane dwellings oriented around a number of open plazas (Goldstein 2005: 282).

By analyzing a number of Tiwanaku-style sunken court areas, the present study aims to define a more quantifiable and less interpretational understanding of Tiwanaku ceremonial design sentiments. One novel element of this study is in the choice to analyze a number of carved stone architectural models or maquetas attributed to the Tiwanaku culture that have been found both in satellite communities on the Copacabana peninsula, and the coastal valley sites near the city of Moquegua, Peru (figure 1a) (Goldstein, 2005:296). Housed in the Copacabana regional museum, the *maqueta* example thought to be from Copacabana itself is without clear provenance (figure 50), while the provenance of the Moquegua examples are more confidently known with the Omo M-10 *maqueta* (figure 45) found near a looted tomb in the Omo area in 1970s and the Calaluna M104A *maqueta* (figure 55) found during survey in the middle Moquequa Valley (Goldstein 2005: 294). Although the maquetas found outside of Tiwanaku have not been directly connected to specific architecture, the similarities to the ceremonial core or 'temple' found at the Omo M10 (figure 40) site at Moquegua suggests that these objects were carved to replicate a real space in miniature. The miniaturization of objects and monuments for ceremonial purposes was an enduring ritual practice in the prehistoric Andes, and is one that continues in contemporary Quechua and Aymara ceremonies (Goldstein 2005:296).

Practical and Theoretical Foundations of the DepthMap Program:

The original concept behind DepthMap developed from two strands of thought. One was isovist analysis (Benedikt, 1979), and the other space syntax (Hillier and Hanson, 1984). Benedikt created maps of properties of the visual field at points within plans of buildings. He drew contours of equal visual area within the plan and called the resulting map an `isovist field', believing that these maps would give an insight into how people navigate the actual building. Since closely packed contours would indicate a rapidly changing visual field, he reasoned that these would indicate decision points within the building. Independently, Hillier and Hanson developed the theory of space syntax in which they created various representations for the components of space, drew maps of these components, and crucially, the relationships of the components with each other. Within the present space syntax academic community, the representation that has become most used is the axial map. The actual mathematical derivation of an axial map is quite complex, but essentially it involves drawing a set of lines through the open space of an architectural plan. Hillier and Hanson then created an interesting twist to established theory at the time. They created a graph using the axial lines themselves as nodes, so that each line was considered connected to others that it intersected. From this graph, they calculated how well `integrated' each line was with respect to all the others in the graph, that is they calculated a measure of the average number of steps it takes to get from one line to any other within the axial map. The integration of axial lines is of particular interest to researchers as it correlates well with the number of pedestrians found to be walking along the axial line (Hillier et al., 1999).

Since Benedikt had theorized that isovist fields would correspond in some way to movement patterns of people and Hillier et al. had shown that the relationship between lines through the space does correspond with movement patterns within space, it was decided to combine isovist fields with space syntax to provide a measure of how well integrated isovists themselves are within a plan of an environment (Turner and Penn, 1999). The methodology was later formalized more simply as visibility graph analysis (VGA) (Turner 2001). In VGA, a grid of points is overlaid on the plan. A graph is then made of the points, where each point is connected to every other point that it can see. The visual

integration of a point is based on the number of visual steps it takes to get from that point to any other point within the system (Turner 2004). Various graph measures, not just integration, may be made. The idea was that all possible occupiable locations within the built environment would be categorized by their visual relationships to other occupy-able spaces through a continuous map. Due to its providence, it was hypothesized that VGA would give a good indication of how people might interact with space either moving through it (Desyllas and Duxbury, 2001) or standing, discussing or generally occupying it. DepthMap was the tool created to perform these analyses by Alasdair Turner and his team at the VR Centre for the Built Environment in the Bartlett School of Graduate Studies at the University College London.

Whether or not VGA actually succeeds in its aims is open to debate. For "people movement", a recent study has shown that other methods based on space syntax seem to correlate better with pedestrian count rates in cities (Turner, 2003), although an earlier result from a large department store was promising (Chapman et al., 1999). Regardless of the outcome of the debate, there does appear to be a promising avenue of research for modeling people movement which uses the visibility graph at its core, if not a direct measurement of the graph. Penn and Turner (2002) and Turner and Penn (2002) proposed an agent-based analysis with an underlying visibility graph. In this analysis, "agents" (automata within a computer representing people) are released into a plan of the environment and navigate using the visibility information directly available to them through the visibility graph. A simple method of path selection which approximates choosing the longest line of sight (Turner, 2005) is applied. The results of the analysis have correlated well with pedestrian movement both within a building environment (Turner and Penn, 2002) and within an urban environment (Turner, 2003). The agent-based analysis proposed by Penn and Turner has been produced as a plug-in module to DepthMap and will be employed in this study to compliment both VGA and axial analyses.

Research Questions and Hypothesis:

As mentioned above, the notable ubiquity of the sunken court tradition as a persistent and pan-Andean architectural element has fostered relatively little focused scholarship, with little more than an assumptive academic agreement that these spaces were of assumed ceremonial importance (Kolata 2003c, Moore 1996b). Most discussions seem to present basic descriptions of sunken courts at specific sites with only minimal comparison between sites. Clearly, such scholars are avoiding the potential pitfalls of suggesting a chronological and typological sequence for the sunken court tradition which would question the status quo. The goal of the current project was to utilize Alasdair Turner's DepthMap program to assess structural similarities in eleven architectural plans of sunken courts, specific elements of those plans, or suspected architectural models from six distinct areas or sites. This study will compare Visibility Graph Analyses (VGA), axial maps and agent-based modeling for each of these spaces to define the Sunken-Court Tradition at Tiwanaku in relation to both its satellite communities and the stylistic precursors thought to have served as an indirect influence. It is expect that the Tiwanaku sunken court style will show similarities to both the earlier and indirectly connected sunken courts of Chavín de Huantar, Pukara and Chiripa, and the later satellite communities, with the type-site of Tiwanaku itself as a clear intermediary stage between the two.

Methods:

Architectural drawings of each of the sites (figures 10, 15, 22, 26, 31, 35, 40, 45, 50, 55) were scanned from a variety of published sources (Moseley 2001, Kolata 2003, Goldstein 2006) and subsequently altered using Adobe Photoshop. This secondary manipulation was required to remove all text, cartographic conventions, as well as to simplify certain architectural elements such as thresholds and staircases. In many cases, conjectural walls and features were added as true walls and textures or patterns to denote surface quality were removed on the finished plans to simplify spatial analysis by DepthMap. These processed plans were then exported to Adobe Illustrator where the bitmap images were converted to vector lines through the "Live Trace" function and exported in the .DXF (Drawing Exchange Format)

file format as is required by DepthMap (figures 11, 16, 27, 31, 36, 41, 46, 51, 56). At this point, using the DepthMap program, a vectorized plan was overlaid with a grid suitable to the scale of the drawing, and all open spaces in the plan were marked and made distinct from the walls, other built features and closed spaces. This 'open' space serves as the area in which the various analytical techniques described above are executed by the program. As a starting point, Visibility Graph Analyses (VGA) were the first to be conducted for each plan, a process which is required for any subsequent agent-based analyses. After such agent-based analyses were run, the base plan was reloaded and a final axial map was generated. These three forms of analysis were conducted for every plan selected, allowing for visual comparison of structural form within and between the various sunken-courts considered here.

Results:

The figures attached serve as a reference of all resulting VGA, Axial and Agent-based analyses. For each site or plan detail that was analyzed, the published and vectorized plans are presented followed by each analysis in the above order. All plans are oriented north, and scales, where known are indicated on original plans. The collection of figures are arranged in chronological order of site construction and occupation, beginning with Chavín de Huantar (ca.800BC) (figures 10-14), followed by Chiripa(ca.600-100BC) (figures 15-25), Pukara (ca.400BC) (figures 26-30), Tiwanaku (ca.400BC-1100AD) (31-34) and finally the Moquegua – Omo M10 site (figures 35-44) and associated maquetas towards the latter part of the Tiwanaku period (figures 45-59) (Moseley 2001). The colours of the lines and fields seen in the following analyses serve to denote degrees of visibility, relative axial line integration and level of agent traffic. The spectral sequence of colours used (red, orange, yellow, green, blue, indigo, violet) are directly correlated to the specific quantitative scale of each of the analyses, aiding visual interpretation and comparison of structures. Admittedly, the following discussion of results relies heavily on these visual cues and thus essentially amounts to personal interpretation. However, due to the fact that the lines and colours fields generated are directly linked to unbiased quantitative measures performed by the DepthMap program, the interpretations made are potentially more meaningful and rooted in the actual orientation

and design of the structures and the spaces therein than undirected interpretation of the basic plans alone. This capacity to direct and support personal interpretation marks the true utility of the DepthMap program, and is so exploited in the following discussion. Each specific analysis type will first be considered independently across the entire suite of results followed by inter-analysis comparison and a final comprehensive interpretation of all results combined.

Discussion:

VISIBILITY GRAPH ANALYSIS:

The colour range specific to the VGA results is slightly counter intuitive, with red representing areas with the greatest average visibility, with decreasing visibility through the ROYGBIV spectrum down to the blue shades, not surprisingly, found in the most enclosed spaces. The greatest overall trend that becomes immediately apparent is the distinct difference between the pre-Tiwanaku sunken courts (figures 12, 17, 23, 28) and those afterward (figures 37, 42, 47, 52, and 57). It seems that the sunken court areas at pre-Tiwanaku sites have greater average visibility within the court area itself than in any of the Tiwanaku period complexes. The placement of structures around large courts at Chiripa, Chavin and Pukara creates an open space that can be seen more easily from anywhere within the bounding architecture. At Tiwanaku and Moquegua-Omo M10 (figures 32, 37, and 42) both of the court areas are entirely restricted although there is great internal variation in the VGA within the detail of the Omo M-10 maqueta plans (figure 47). Considering this basic difference, it appears that the earlier iterations treated the sunken court area as a more public, performative space whereas the Tiwanaku-period courts were small, private areas that restricted and controlled visibility, even once inside the temple structures.

AXIAL MAPS:

The most informative element of the axial maps are those lines shown in red, indicating that they are both the longest unbroken distances as well as the most interconnected and integrated lines between any two points on the plan. Similar to the results of the VGA processing discussed above, there seems to be a

distinct split between pre-Tiwanaku (figures13, 18, 24, 29) and Tiwanaku (figures 38, 43, 48, 53, 58) sites. The concentration of highly integrated axial lines in the earlier sites do not intersect with the sunken court area itself, and are universally found in the open areas surrounding the courts instead, an element that underlines the more open and public nature of these sites. In comparison, the Tiwanaku-period sunken courts and maqueta plans all show a very consistent concentration of highly integrated axial lines directly toward or into the rectangular sunken court areas (figures 48, 53, 58). Although each of these later plans are unique in organization, the overall orientation of space clearly stresses a central axis, as can be seen in the comparing the Tiwanaku and the Moquegua – Omo M10 sites (figures 38,43). The Tiwanaku axial plan has a very intense concentration of highly integrated lines that all end abruptly just in front of the sunken court itself (Fig.33). Although these lines do not extend in the court due to the orientation of its staircase towards the south, the Bennett monolith known to have stood at its centre in antiquity would have been clearly seen along this major east-west axis. Again, in repetition of the VGA results, it seems that restricted and directed sightlines and access toward the centre of the sunken courts is the primary concern in the Tiwanaku period.

AGENT ANALYSIS:

Admittedly, the agent-based analyses performed by DepthMap are fairly crude, with very few variables for the researcher to control, however, the results are telling nonetheless. To clarify the meaning of the colours seen in each of these maps, each agent leaves a trail in dark blue wherever they walk around and through the plan, and where paths overlap, the colour changes backwards through the spectrum. Red and yellow areas are thus the most highly trafficked, and universally seem to concentrate in the most open spaces in each plan. There seems to be a less distinct separation between pre-Tiwanaku and Tiwanaku period plans in this case. There is some similarity between the two plans of Chiripa (figures 19, 25) and the plan of Pukara (figure 30) with two rings of circulation, one around the court and another around the entire complex. This pattern supports the assumption that these spaces were more public in nature, with a visual focus on the sunken court, but relatively little access to that particular space. The plan of Chavin

(fig 14) departs from this trend somewhat in that there is relatively less circulation, yet the open plaza spaces from which clear views to a number of areas still show the highest traffic. At the other extreme, both Tiwanaku and Moquegua-Omo M10 (figures 34, 39) show minimal to no traffic in the court areas, again a very clear indication that those spaces were neither inviting nor easily accessed. The agent analyses of the reconstruction drawings from Moquegua – Omo M10 (figure 44) and the three maquetas (figures 49, 54, 59) show some similarity in that nearly all rooms surrounding the court and the courts themselves are well trafficked with a considerable amount of lateral movement where the plans allow. As well, amongst the three maqueta plans there is a strong indication that traffic would be greater through the central axis of the plan, which mimics the directionality of the axial maps discussed above. The fact that the temple section of the Moquegua – Omo M10 plan saw such little traffic when considered on a more global scale, and higher traffic when considered in isolation, adds to the understanding of Tiwanaku period sunken court temples as highly restricted sacred spaces that only a few privileged individuals would have access to.

Summary and Conclusion:

When considered as a whole, the results of this particular project support an interpretation that the sunken-court tradition in the ancient Andes saw at least one major functional shift which divides the various sunken courts into two distinct groups; pre-Tiwanaku and Tiwanaku. Although this differentiation is not at all ambiguous to the academic community, this project adds fodder to previous assumptions, bringing a new quantitative tone that further supports old interpretations. Interestingly, the most important finding of this study is in those analyses of the maquetas, and their undeniable similarity to Tiwanaku sunken court temples. It is true that they were already assumed to be connected to this culture due to their context and similarity to Tiwanaku design sentiments, but the results of these analyses provide a very convincing and strongly supported reiteration of this assumption. Overall, it seems that Tiwanaku period sunken court complexes were overwhelmingly concerned with the restriction of access and the direction of sightlines in a particular direction; straight towards the centre of the sunken court. It is clear that there

is a ideal form to these structures that instantiate a culturally specific concept. Although the ritual activities assumed to have taken part in these spaces remain conjectural, through the use of analytical programs such as DepthMap we are able to filter out contemporary biases and make more informed and supported arguments about the nature of ritual space in the past.

Of course, there are a number of significant assumptions inherent in the use of this computational method that are problematic. Looking specifically at the results from Tiwanaku as the site I am most personally familiar with of the sample considered here, there are a number of confounding issues that arise. Primarily, the drawing of the ceremonial core chosen for this study is highly simplified and based on the reconstructed architecture seen at Tiwanaku today. Acknowledging that the form presented here is not indicative of the details offered by the numerous excavations that have occurred in the area depicted, the plan drawing presented does not include every possible entrance and space thought to have existed at different points in the sites history. Notably, where entrances were not indicated at all in the plan used, the results of VGA, Axial and Agent analyses in turn completely ignore those spaces. Concerning the VGA and Axial analyses specifically, there is no evidence that the Semi-Subterranean Temple was visible from the centre of the Kalasasaya, although when actually standing at the site, the sunken court is very clearly visible through the eastern entrance to the platform.

This particular example highlights one of the greatest failings of the DepthMap program in that it treats all spaces analyzed in two dimensions only, ignoring the inherent three dimensionality of any built environment. By treating all two dimensional lines drawn on the plans as impenetrable blockages to visibility and movement, accordingly the results clearly do not fully reflect the true nature of the structures considered. As well, the program treats the rectangular boundaries or outer limits of each plan drawing in exactly the same way as it does walls, artificially enclosing the area of study that lead to results that are not representative of the space surrounding the structure. In almost every example considered, save for the conjectural *maqueta* analyses, the other structures considered are surrounded by other architectural features, such as the residential sector known to surrounds the Omo complex. In that

these other structures were not included in the simplified plans, they resultantly had no effect on the analyses creating a somewhat skewed consideration of these structures that ignore their surroundings.

As with any computational analytical method, the quality of the output data directly reflects the quality of the input data. Considering the level of architectural detail required by the DepthMap program in comparison to the extremely complex spatial data that varies over time in archaeological contexts, the applicability of this program to archaeology is limited, but only by the quality of the information known about a particular site and the specific questions being asked.

Chapter 6: Discussion of research field methods of spatial documentation at Mollo Kontu

With the analytical capacity of both traditional archaeological interpretation and quantitative methods presented in the preceding sections of this thesis, the following chapter will outline the theory and methods of the topographic and geophysical survey conducted in the Mollo Kontu sector of Tiwanaku as a starting point for the spatial analysis of the ceremonial Mollo Kontu mound and the residential area south of it. Through these two methods, I attempted to develop a map that visualizes all of the unexcavated architecture in these two areas so as to be able to apply the quantitative spatial methods discussed above. With clear evidence of a complex built environment of both a ceremonial and domestic nature at Tiwanaku from excavation, the overarching purpose of the research conducted was to provide greater large-scale appreciation of the relationship between the ritual elements found at the ceremonial core of Tiwanaku to the private ritual and domestic space of those settled in the residential periphery.

The following are the specific research questions that I took with me to the field to guide my survey and remained the core concerns during my analysis and interpretation of the results:

1) Does the pattern of residential occupation change with increased proximity to the Mollo Kontu mound which has assumed ceremonial importance? If so, are there any similarities in the organization of the structures surrounding this mound to the ceremonial district surrounding the Akapana Pyramid structure that the mound is assumed to have been constructed in emulation of?

2) To what degree are the residential structures at Mollo Kontu oriented to a site-wide plan, and if so, are there any distinct similarities between the residential and ceremonial areas of the site?

3) Are there similarities between the structure and orientation of individual houses within a single barrio and between barrios? Similarity would suggest a standardized building technique and thus some degree of common organization that reflects a strong and centralized social order. Differences would suggest either temporal differences in construction period, specialized functional design, or potentially reflecting

differences within or between culturally or ethnically distinct residential areas that reflect the population of Tiwanaku by groups of individuals once geographically separated.

Topographic Survey:

Assisted by Bridget Sandison of McGill University, in 2007 I created a high resolution topographic map of 16 hectares the Mollo Kontu study area using a Topcon Total Station (figure 60). Previous topographic surveys conducted as part of the *Proyecto Wila Jawira* in the 1980s and 1990s (figures 1a/1b) have left over 100 stationary datum points across the entire site of Tiwanaku including the Mollo Kontu sector (Kolata 2003). Although many of these datums have been destroyed or moved due to agricultural activity, enough of them were located in 2007 to establish an artificial grid over the entire study area. With this grid established, thousands of discrete topographic data points were collected at a rate of one point every meter or less and were compiled over the course of the field season and used to create a final topographic map using GIS software. Although this site grid has yet to be rectified to the officially recognized local and global geographic coordinate systems, with all excavation and survey utilizing this new grid, relative positions to the recognized grid can easily be determined and all measurements will eventually be rectified to the standard using global positioning technology. Serving as the base map for current and future excavations and surveys in the immediate area, the final map allowed for a much greater appreciation of minor topographic variations in the site, providing potential indications of sub-surface architecture as well as aiding in the decision as to where geophysical survey would be most fruitful.

Geophysical Survey:

Using this topographic map as a guide, an approximately one-hectare area surrounding the MK-M and MK-D excavation areas was targeted for magnetic survey using a Gem Systems GSM-19W Overhauser Gradiometer on loan from Ryan Williams of the Field Museum in Chicago (figure 61). With the help of work crews, a systematic surface collection of the survey area cleared any visible metallic

debris that would interfere with data collection, an aspect of magnetic survey that will be discussed below. This area was then divided into 29 discrete 20m by 20m study units (4 over the MK-M area and 25 over the MK-D area) each covering an area of $400m^2$. These survey units were accurately positioned using the Total Station with wooden stakes driven into the ground at the corners of each survey unit and each marked with the numerical coordinates of that point on the site grid. With the study area prepared, each survey unit was surveyed in both north-south and east-west directions at half-meter intervals as guided by marked tapes stretched between the corner stakes of each unit. The particular magnetometer model employed in this survey automatically collected magnetic readings at a rate of one reading per half-second while simultaneously recording an accurate GPS coordinate that located each data point in space. The resulting data was downloaded in batches to a field computer and following the removal of faulty or extraneous survey points, the data for each survey unit was compiled and saved as a single file. Once the data from all survey units had been collected and processed individually, the survey data from all areas was then compiled as another single master file and further processed to remove any overlapping or problematic data. The total collected data set was then processed and analyzed using ArcGIS software to create a map that visualizes the fluctuating magnetic signature of subsurface features across the survey area.

Presently, the increasing use of geophysical survey techniques in archaeological investigations has created powerful yet underdeveloped methodological avenues for the analysis of large scale urban sites. Primarily used as a prospection technique to guide subsequent excavation, the improved quality and diversity of available geophysical instrumentation is such that clearer definition of buried architectural remains is now becoming possible. As a non-destructive method to detect and visualize the remains of the built environment over large areas, geophysical survey in the form of magnetometry is a promising avenue of investigation which allows for a more global perspective of the spatial organization of an entire settlement. Geophysical prospection enhances our understanding of the subsurface remains at archaeological sites, including house foundations, boundary walls, drainage canals, wells, and tombs.

Since most of the ancient architectural remains are not visible on the surface at Mollo Kontu, geophysical prospection is an important means of obtaining information about the large-scale patterns of spatial organization. Based on magnetic properties of the archaeological features under consideration and their contrasts with the surrounding soils, one can obtain distributional information on the spatial organization of all remaining architecture but cannot clearly distinguish between distinct building phases and occupations at the ancient capital.

With previous tests and initial surveys using geophysical technique having already been conducted in the past few years at Mollo Kontu by Ryan Williams along with graduate students from Boston University, the value of this method of archaeological prospection and architectural visualization has been proven to be promising (Williams et al, 2007). In 2000, 2001, and 2004 Williams conducted a number of magnetic and other geophysical surveys over various areas of the site, initially in an experimental capacity to test the effectiveness of the instruments in the particularly harsh environment of the Bolivian altiplano, as well as in an exploratory archaeological prospection capacity (Williams et al, 2007, Vining et al, 2008) (figures 62a/b, 63a/b). During the 2006 season at Mollo Kontu, Eileen G. Ernenwein of the Center for Advanced Spatial Technologies (CAST) at the University of Arkansas conducted a very brief magnetic survey of a small section of the western portion of the study area (Ernenwein, 2006) (figure 64). The resulting data from all of these previous studies did produce geophysical maps with some indication of a number of distinct anomalies, but as can be appreciated from figures 62 a/b, 63 a/b and 64 , in no case were there strong indications of solid, linear architectural features.

Generally, geophysical surveys are all conducted in a similar manner regardless of the specific instrument used. Archaeo-geophysical data are typically acquired in area surveys composed of grids that range from 10 x 10m to 100 x 100m, with the 20 x 20m grid most commonly used. Ropes or tapes with meter marks , placed parallel to each other on the ground and separated by 1-2 m are used to form the internal grid lines that act as guides in each survey square (Kvamme, 2003). The specific instrument used

is moved along and between each pair of guides where measurements are acquired at meter or sub-meter increments and referenced with meter marks to ensure correct spatial positioning of the data. The result is a systematic matrix of measurements with rows paralleling the guides and columns representing the individual measurements in each row. Spatial resolution is controlled by the separation between individual transects paralleling the guides, the number of samples taken per meter, and the sampling capabilities of the technology employed (Kvamme, 2003). Sample spacing is a limiting factor that determines the size of archaeological features that can be resolved, with a general rule being that the interval between data points should be no greater than half the size of the smallest feature that is expected to be detected. For this reason, such techniques are not very useful in the detection of small individual artifacts, but most useful in detecting larger features such as hearths, large post-holes, storage pits, ditches, kilns, tombs, burials, and architecture of any kind.

In precisely the same way, the grid establishing method described above is applied to magnetometry surveys, systematically dividing a given area into survey squares of a specific size as discussed in my own methodology above. Magnetometers or gradiometers have been used to identify numerous buried anthropogenic features such as walls, pottery, bricks, roof tiles, fire pits, buried pathways, tombs, buried entrances and monuments (Klarich and Craig, 2001). Without delving too deeply into the technical, these instruments detect anomalies based on the fact that certain buried objects will have stronger magnetic fields than the surrounding matrix, appearing in the graphic results of such surveys as contrasts on a grey scale that indicates the strength of magnetic signature at each data point. By inference, any anomalies that appear in the graphic output can interpreted as indicating the presence of a potential archaeological feature. In many situations, distinct and continuous features such as walls will appear in the output with startling clarity, thereby allowing interpretation of the spatial organization of architectural remains under ideal conditions.

Eight principal phenomena contribute to the formation of magnetic anomalies within archaeological sites as collected and reported by Kvamme (2003) below:

1)Firing of the soil beyond the Curie point (660°C), whether purposeful (hearths, kilns) or accidental (a burned house), can intensify the local magnetic field owing to a property known as "thermoremanant magnetism".

2)Accumulations of fired artifacts such as ceramics or bricks.

3)Soils and sediments can vary in their magnetic susceptibilities, the ease with which they become magnetized when subjected to a magnetic field, such as the earth's main field. Magnetic susceptibility is related to the composition and concentration (mineralogy, size and shape) of magnetizable materials.

4)Due to natural processes that can include burning, surface soil layers become magnetically enhanced compared to buried soils. Responsible processes include weathering and chemical reactions that change certain iron compounds to more magnetic forms, and magnetotactic and other bacteria that can concentrate magnetic compounds. It is of special relevance to archaeology that extended human occupations tend to exacerbate this effect through the introduction of organic and fired materials into the topsoil. Paleosols tend to retain this effect.

5)The removal of magnetically enriched topsoil during the construction of ditches, house pits or other excavations causes a local lowering of the magnetic field over these features.

6)Accumulations of topsoil, such as occurs in mound or sod building constructions, berms adjacent to excavated ditches, or when storage or other pit features such as burials become filled, all create local increases in the magnetic field.

7)Rocks that might be employed in the construction of buildings or pavements might be more (e.g. igneous rock) or less (e.g., certain limestones) than surrounding soils.

8)Iron or steel artifacts markedly alter the earth's magnetic field, producing readily sensed anomalies and large magnetic measurements.

Although all eight of these phenomena were likely detected at Mollo Kontu, the latter two were of the greatest concern, the seventh as a desirable and sought after aspect, and the eighth as a potentially disruptive element. From excavation, we know that the ceremonial and residential architecture of Mollo Kontu have stone foundations on which adobe bricks would have been placed to form the walls thereby making magnetic survey ideal for the detection of buried architectural remains in this particular

situation. With a considerable amount imported andesite, an igneous rock with a very strong magnetic signature, used in both ceremonial and residential architecture, many sizable anomalies would be expected to be found.

Magnetometers measure the strength of the magnetic field over a specific point on the Earth's surface. This magnetic field contains many components including underlying geology, surface materials, and natural diurnal variations and the Titicaca Basin has one of the lowest mean values on the planet – approximately 26,000 nano-teslas (nT) (figure 65). In efforts to remove the effect of the above components and enhance highly local sources, two separate sensors are aligned vertically with a known separation to provide a measure of gradient measured in nT/m. (Breiner 1999; Klarich and Craig 2001; Kvamme 2003; Williams et al 2007). Due to the physical limitations of the earth's magnetic field strength, magnetic prospection is typically confined to the upper two meters of deposits although significantly large or magnetically distinct features can be detected at greater depths (Kvamme, 2003). Excavation at Mollo Kontu has proven that most of the residential architecture remains are generally present within 0.5 - 1 m of the surface, with only some features such as tombs and pits extending lower than that, thus theoretically all features yet uncovered should be detectable through magnetic survey.

Currently available magnetometers are sensitive to even minute magnetic differences and can take readings at a rate of eight to ten measurements per second, providing very high resolution output images. These instruments are relatively easy to use and given the open conditions of my study area, in theory, it would be possible to cover about 0.5- 1 ha (5000-10000m^2) per day, assuming that there are no technical or logistical difficulties (Kvamme, 2003). Although an enormous amount of ground can be covered by this technique, there are a number of potentially complicating issues that can slow the entire process down. The extreme sensitivity of these instruments requires that operators not to wear any metallic items, even zippers, buttons and rings, any of which can drastically alter the readings and skew the eventual results. For this same reason, any metallic refuse, even as small as nails, coins and bottle caps must be removed to provide as clear an image of subsurface magnetic signatures. The best way to ensure

that an area is relatively clear of metallic debris is to conduct a thorough sweep of the specific survey area in question either by traditional surface collection as was the case for my own study, or ideally, by using simple ferro-magnetic metal detector prior to magnetic survey.

With this capability to geophysically map large archaeological regions efficiently, rapidly, at high sampling densities, and at relatively low costs, new challenges in the design of archaeological research arise. Contemporary archaeo-geophysics is consequently much more inductive with a focus on the end-images and patterns therein (Benech, 2007). Ironically, this ability to collect and process tens of thousands of geophysical measurements at a time means that it is no longer practical to apply deductive reasoning to more than a few of the more interesting contexts in a large area survey. Nevertheless, the benefits of being able to locate, image, and document likely buried cultural features within large landscapes far outweighs this shortcoming and offers new and previously unrealized dimensions to a variety of pursuits in archaeology (Kvamme, 2003). Although my particular project was focused on the detection and visualization of architectural remains in particular, any and every magnetic anomaly was recorded and noted on the master map of the excavations and survey, potentially guiding the choice of future study areas.

A geophysical map is not an archaeological plan and it would be unreasonable to expect the precision of a traditional topographic plan of an excavated area from it. These two sources provide very different types of information, which cannot be treated in the same way. If we treat a geophysical map in the same way as an archaeological plan, the result will always be less reliable, and the essential and original contribution of the geophysical data will be neglected. It is more fruitful to focus on their complementary nature in order to provide a new vision of the archaeological site and renew thematic and methodological approaches (Benech, 2007). For better utilization of the geophysical map in archaeology, both geophysical and archaeological theory must be combined in a way that exploits the power that each can contribute to a particular research question.

Geophysical maps, even if they seem to be very clear, do not identify the plan of every structure individually but depict the combined and potentially over-laid vestiges of all structures that have ever existed at a given location. There are always numerous ambiguities, in particular concerning the limits of buildings, the shape and size of rooms, and the circulation inside the structures. In addition to these issues, there are problems posed by blocked doors which appear to be part of walls and alternatively, partially ruined walls which give the illusion of a passage on a geophysical map. Obviously these ambiguities could only be clarified through subsequent excavation. Ideally, if there were a number of anomalies with similar ambiguities, specific test-trenches should be excavated to more fully understand what was seen in the magnetic map. For my own particular study at Mollo Kontu, I tested of the resolution of the magnetic maps produced by overlaying the final results with the plan drawings of architecture produced during and after active excavation in MK-M and MK-D study areas. As with any archaeological application of geophysical magnetometry, the presence of metallic tools during active excavation such as wheelbarrows, shovels, picks, trowels and metallic refuse have considerable potential to skew the results of magnetic survey. Although great efforts were taken to remove the effects of these items both prior to survey and afterwards once the data was collected and analyzed, the issue must be appreciated as a considerable hindrance to the quality of the results collected.

The following chapter will discuss the results, analysis and potential interpretation of the magnetic and topographic surveys conducted at Mollo Kontu. Both the residential area (MK-D) and the Mound area (MK-M) results will be discussed separately, and will be utilize the elements of the hermeneutic and quantitative studies of the Sunken-Court presented in chapters 3 and 5 to guide interpretation of the features discovered in both areas. As well, the results from two experimental surveys in other areas of Mollo Kontu will be presented, serving to highlight the both the methodology used as well as to illustrate the limitations of geophysical survey in this particular context.

Chapter 7: Results and interpretation of topographic and geophysical surveys at Mollo Kontu

Analysis of Topographic Results: (Figure 60)

The topographic results indicate a number of interesting features across the 16 hectare area surveyed both in the vicinity of the Mollo Kontu Mound and in the residential area to the south. As indicated on the map reproduced here, the choice of a 0.2m contour interval allows for an appreciation of relatively subtle changes in topography. Although it would be possible to highlight every rise and depression in the area and suggest conjectural architecture or earthworks, in efforts to focus my analysis to the areas more intensively considered, I will limit my discussion here to those areas that were also covered by geophysical survey.

Mollo Kontu Mound Area Topographic Results and Analysis:

The mound itself is perhaps the most identifiable feature and is located nearly in the centre of the map (figure 60a). Clearly standing as a distinct rise in topography from its immediate surroundings, an area which is thought to have been a moat dug around the Mound (Couture 2003a), there is no clear indication of the walls known to surround the structure on the north and west sides, and assumed to continue on the east and south sides. With the mound located directly to the south of the Akapana in the ceremonial core, this structure is thought to mimic the much larger monument, and by extension the Quimsachata range and all of its symbolic connotations (Couture 2003: 225).

Directly to the east of this mound is a considerable depression in the land known locally as a qocha, shown in this map as a green area and is just one of a number of such surface features that are scattered throughout the Mollo Kontu sector. Overlooked by the early scholars who likely confused these depressions with natural features, it is now clear that *qochas* were deliberately constructed to act as reservoirs for agricultural and pastoral use (Flores Ochoa 1987, Erickson 1993, 1994, 2000, Albarracin-Jordan 2003: 108). Filling with water in the rainy season, these depressions are still sporadically used by contemporary cattle, sheep and llama herders as sources of water during the dry season. Considering that even the current archaeological excavations at Mollo Kontu tap into this supply of water to run the

paleobotanical flotation equipment, one can only assume that these very features were used in antiquity as well, holding perhaps a ceremonial importance beyond pure function.

Building her interpretation of the Mollo Kontu Mound from Kolata's model of the Akapana as sacred mountain and the presence of the deep moat surrounding the ceremonial core, Couture has previously discussed the possibility of a depression that surrounds the Mound to have served as a miniature, water-filled moat (Couture 2003: 215-216). Accepting that this feature was in fact a moat in antiquity, and considering the topography on the eastern side of the Mound, I would like to elaborate on Couture's interpretation and suggest that this channel directly connected with the *qocha*. If this were the case, then I suggest that when this *qocha* was seasonally filled with water, the Mound would have become an artificial island at the western end of an equally artificial miniature lake, with water flowing entirely around the mound, temporarily animating the structure (figure 60b). Returning to my suggestion that the sunken-court form was a direct reference to the symbolic importance of Lake Titicaca and the Island of the Sun as the mythic point of origin, I argue that any consideration of the ritual function of the Mollo Kontu Mound must also include the adjacent *qocha* as an integral part of the design of this clearly ceremonial area. Further underlining the potential ceremonial importance of this particular *qocha*, in 2006 when the previously mentioned flotation well was excavated into the base of the depression, a great deal of human bone was discovered, but due to the way the well was excavated, these remains were without clear context. This discovery suggests that the *qocha* itself may have served as a mortuary area in much the same manner as the mound itself, further linking these two distinct features as elements of a possible ceremonial complex.

Considering that the land around Mollo Kontu is naturally quite level and even, the presence of both large depressions and mounds in the same area begs the question of whether one is the result of the other. As perhaps the most basic way in which the physical environment can be controlled as a form of rudimentary architecture, the excavation of the ground and the mounding of the resulting earth can easily be appreciated as a very literal representation of positive and negative sides on either side of the taypi of the ground surface. If this particular *qocha* is the void that was left to create the Mollo Kontu Mound, this

could further support the suggested connection between mountains and lakes, that one is the vestige of the other, representing the same type of sacred space in both positive and negative forms, one accessible and continually visible, the other inaccessible and hidden from view. The level of the ground and the surface of the lake are considered the interface from which everything of value in the Andean worldview is related and interrelated, be they crops, mountains, ancestors or lakes. It seems very likely that the sunken-court tradition offered the ancient Andean groups who built them a space where such elemental cosmological concerns could be acknowledged, confronted and celebrated. Any future excavation in the immediate area of the Mound should take this question into serious consideration in the development of a research plan and the choice of excavation targets.

Mollo Kontu Residential Area Topographic Results and Analysis:

To turn to the topographic features of the residential sector to the southwest of the mound and *qocha*, the area surrounding the MK-D excavations is relatively level and even, with little indication of distinct features that clearly suggest the presence of architecture, despite the fact that we have uncovered architectural features through excavation in the area. The topographic map shows that the entire residential area (MK-D) is on a slight rise in the form of a roughly square plateau, with the land surrounding it sloping down on all sides (red lines in figure 60b). As can be seen towards the centre of this plateau is a U-shaped depression approximately 30m by 30m in dimension that is oriented north-south and extends from and is open to the north side of the plateau edge (blue lines in figure 60b). The eastern side of this depression is precisely in the location of the 2006 MK-E excavations (figure 4). As mentioned in the overview of *Proyecto Ja'cha Marka* excavations presented earlier, the excavation at MK-E uncovered a finely-cut andesite block measuring nearly 1m in all three dimensions. Although conjectural, in that this particular andesite block is thought to be circumstantial evidence of a nearby monumental structure due to the quality of its manufacture, it is possible that the associated U-shaped depression is in fact the remains of such a monument. If this were the case and considering that this

topographic feature is in fact a depression, it is possible that this potential monument may be a sunken-court of some form.

Note on the Analysis of Geophysical Results: (Figures 66a/b, 67a/b, 68a/b)

Prior to my analysis and interpretation of the results of the magnetic maps produced at Mollo Kontu, I must first clarify the meaning of the various colours depicted in figures 66-68. As indicated in the legends of the magnetic maps themselves, the range of colours shown represent the average strength of the magnetic field at a particular place in the survey area. The magnetic data that was collected as individual points during survey was interpolated by the ArcGIS software thereby producing a map of the varying intensity of the magnetic field across the site. It is where this variation fluctuates drastically in a small area that is indicative of a magnetic anomaly. Quite simply put, where low magnetic readings (shown here in green) are directly beside or very close to high magnetic readings (shown here in white), this indicates the presence of a significant magnetic anomaly that can be assumed to be some form of subterranean feature of possible archaeological significance.

Mollo Kontu Mound Area Geophysical Results and Analysis:

The magnetic survey conducted over the Mollo Kontu Mound covered an 50m by 60m area that included the western wall excavated in 1990 and 1991, the north wall excavated in 2007, as well as unexcavated southern and eastern areas of the feature. Considering that the soil used to back-fill the excavation areas should have similar magnetic properties of unexcavated ground, the magnetic anomalies shown as closely positioned and highly contrasting dark and light areas of the magnetic maps seem to correlate well with known architectural features when the two maps are overlaid (figure 66b). The magnetic results show signatures of previously excavated architecture, shown in red in figure 66b, as well as supporting the suspected continuation of the wall to the east and south sides. Interestingly, the magnetic results from the south side suggest that the wall there could include an entrance or ramp towards the centre of the mound. The magnetic anomalies detected show that this south wall seems to extends into the mound instead of surrounding it as on the west, north and suspected to be the case on the eastern side.

Such an entrance or passage feature on the south side of the Mound would directly face the Quimsachata range, presenting a symbolic aspect of the monumental design that would lend a great deal of support for the qualities of mountain mimesis suggested for the Akapana pyramid by Kolata (1993, 2003) and by Couture (2003a) for the Mollo Kontu Mound itself.

Another noteworthy aspect of this possible south-facing feature is in that it diverges from the largely east-west orientation of the majority of the monumental structures in the ceremonial core of Tiwanaku proper. As mentioned earlier, this overall orientation has been suggested by Kolata (2003) to be of cosmological significance, reflecting and revering the daily path of the sun across the sky. Only in the Semi-Subterranean Temple is this orientation not followed, an aspect of its construction that may be a reflection of the fact that it predates all other ritual spaces in the ceremonial core. This deviation could reflect an earlier ritual tradition that focused ritual concern on the peaks of the Quimsachata Range as they are source of the water that sustained Tiwanaku's considerable agricultural fields, and by extension ensured the reproduction of Tiwanaku society (Couture 2003a:224). The suggested southern facing "entrance" feature seen in the magnetic map of the Mound could reflect a return to this earlier ritual tradition, abandoning the reverence of the solar-path seen in the ceremonial core. Couture's analysis of the ceramic assemblage from the Mollo Kontu Mound suggest that the structure was used and potentially occupied in the Late Tiwanaku IV(AD 600-800) phase, thereby concurrent to the active occupation and use of the Akapana pyramid prior to its assumed ritual abandonment in the Late Tiwanaku V (AD 1000-1300) phase (Kolata 2003: 189). Only through future excavation of the south face of the Mound will we be able to establish if the architectural design of this structure drastically diverged from the site-wide ceremonial orientation. If this were the case, some serious questions would be raised as to the unique nature of ritual practice at the Mollo Kontu Mound, and of the ideology of the inhabitants of the Mollo Kontu sector who may have seen this structure as sacred.

Looking again to the magnetic results of the Mound, there is very strong and linear magnetic anomaly that cuts across the southeastern corner of the Mound in a northwest-southeast direction (figure 66a/b). Considering the intensity of this anomaly, it is indicative of a very large single piece of highly

magnetic material, perhaps indicating the presence of a monumental andesite sculpture or architectural feature once atop the mound, but presently toppled over and deeply buried on that side. Alternatively, this anomaly could also represent a dense collection of smaller andesite blocks that would be expected if there were a channel running from the summit of the mound into the adjacent qocha to the East. (figure 60). Given the distinct lack of preserved architecture on the surface of the mound, this potential canal feature would be particularly important to the understanding of the occupation sequence and function of the mound prior to abandonment. In either case, whether this particular anomaly is evidence of a canal or stone monolith, this unusual feature is of considerable interest and should be directly investigated as part of any future excavations at the Mollo Kontu Mound.

Mollo Kontu Residential Area Geophysical Results and Analysis:

With information about what the magnetic signature of cobblestone foundations of adobe walls should look like from the Mollo Kontu Mound survey, the approximately 1 hectare magnetic survey area in the residential sector around the MK-D excavations returned interesting but not very clear indications of the architecture known to be in the area (figures 67a/b, 68a/b). As be discussed in detail below, all stages of excavation in the MK-D study area uncovered wall foundations whose roughly north-south orientation closely matched those of the other residential contexts at Tiwanaku (Augustine *et al* 2009). As mentioned, following the completion of excavation and back-filling of MK-D, a magnetic survey was conducted over the closed units as an experimental control to test the resolution of the magnetic readings collected throughout the survey area in comparison to known architectural features (figure 67a/b). Survey in this area showed that wall foundations are magnetically 'visible' to a degree, although the resolution is poor thereby making clear differentiation of architecture from other features difficult. By overlaying these the results with the plan drawings of known architecture from the MK-D excavations we can see that the magnetic results are relatively indistinct, but do overlap with known architecture in a very general way. Although clear architectural features are not immediately apparent in these results, based on the magnetic

signature of known walls, a hypothetical interpretation of the general MK-D excavation area (figure 67b), and by extension the entire 1 hectare survey area is possible (figure 68a/b). When considered as a whole, the magnetic map of this area suggests an overall trend towards two distinct orientations of potential architectural features, an aspect of the construction history of this area of the Mollo Kontu sector that is confirmed by the excavations at MK-D (Augustine *et al* 2009).

As can be seen, the magnetic results in all areas are rather indistinct thus the placement of all hypothetical architecture is highly interpretive and not particularly elucidating in terms of the organization of urban space at MK-D. Figure 68b illustrates the ambiguity of the results and the assumed spatial complexity of suggested architecture. Although there are nearly no distinct and recognizable discrete and repeated patterns that would suggest the presence of rooms and compounds per se, as mentioned these results do suggest that there are two different overall alignments of the features, differentiated by colour in figure 68b.

Through detailed stratigraphic excavation at MK-D, the preliminary findings of Augustine, Mattox and Paye report that there were at least five major occupation phases based on sequences of domestic architecture (Occupations I-V, with V being the earliest) , with ceramics data indicating that all five were likely occupied during the Tiwanaku IV or V periods, ca.AD 500-1150 (Augustine et al 2009). As would be impossible to detect from the magnetic data, the thick north-south wall that is associated with Occupation V seems to have been leveled off during the construction of the main north-south wall of Occupation IV, with this new wall built almost directly on top of the older foundations. This pattern of razing segments of older walls to incorporate new components while extending existing walls seems to be a recurrent pattern throughout the Occupation IV phase, reflecting building practices that seem to retain the original alignment of the area. The ambiguous transition between Occupations IV and III is marked by the destruction of secondary walls in combination with intensive pit digging that suggest a distinct shift in terms of the activities undertaken within the structures. In support of the shift of orientation seen in the magnetic data, within Occupation III and II phases, smaller wall foundations that diverge from the

generally orthogonal layout of MK-D were uncovered. These changes in spatial practice were associated with noticeable variation in material practices in Occupation II, exemplified by a number of pits that cut through major compound walls of Occupation III. Such disregard for earlier construction phases during the later occupations leads the excavators to deduce that the spatial practices that had dominated the earlier occupations were effectively abandoned and had little to no bearing on Occupation II domestic space (Augustine et al, 2009).

Considering that the stone foundations of the earliest occupations were found at the relatively shallow depth of approximately 50cm from the present ground surface, it is entirely possible and very likely that earlier construction materials were reused by later inhabitants in the erection of new buildings. Keeping this potentially complicating factor in mind, one must also accept that the MK-D area and much of what was the residential periphery of Tiwanaku had been under intensive agricultural cultivation until the relatively recent protection by the Bolivian archaeological authorities, the Unidad Nacional de Arqueologia. With both manual and mechanical plowing easily reaching the upper archaeological contexts, there is no doubt that stone alignments have been considerably disturbed and displaced throughout the study area, thereby effectively hampering any spatial interpretation through either geophysical survey or even excavation to a degree. Accepting that the entire area is likely to have been highly disturbed over time, it is not unreasonable to assume that contemporary metallic items such as broken ploughshares, tools and refuse could easily be incorporated into the soil matrix, further skewing the magnetic readings collected. Above all, the final confounding limitation to this particular study comes about in the above mentioned peculiar and uniquely low ambient magnetic field of this area of the world, a fact that directly affects the resolution of magnetic maps and thus spatial intelligibility.

Experimental excavations:

MK-F: Located just west of the mortuary area excavated in 2006 and 2007 known as MK-A, this 4m x 4m test excavation was selected based on the presence of an anomaly that was assumed to be a large tomb

considering its proximity to the mortuary context (figure 4). Although the anomaly found was of considerable strength, upon excavation, a large, highly disturbed ash pit was encountered at a depth of over 1m, with a very poorly preserved burial located nearby. It is questionable whether the burial itself was detected by the magnetometer, or whether the burials in this area are of such a high density that an excavation unit of any size in this general area would likely encounter both ash pits and burials. A second possibility would be that the magnetic signature of such deep ash and refuse pits combines to actually create strong anomalies, which would be considerably problematic to the interpretation of magnetic results across the site. Considering the amount of ashy refuse pits known to be in the habitation contexts at Mollo Kontu, any magnetic survey would be compromised, with the linear magnetic signatures of architectural features potentially masked by the magnetic signature of the soil matrix in which it is found.

MK-G: Again, a selective test of the capacity of the magnetometer, but in close proximity to the residential area. After initial survey, a linear magnetic anomaly to the west of the MK-D excavation area was targeted, and a 2m x 4m unit was excavated (figure 4). At the bottom of this unit was a relatively small and incomplete alignment of worked andesite and sandstone blocks oriented in a north-south direction identical to that of the earlier occupation levels within MK-D. This second test excavation serves to legitimize the effectiveness of the readings at all areas of the site, lending support to the hypothetical plans produced thereafter.

Now widely used as an initial prospection technique to guide subsequent excavation there are a small but growing number of studies that attempt to make greater use of the potentially rich spatial data that come about through various geophysical survey techniques (Benech 2007, Neubauer 2004). The following section of this thesis will discuss the discuss the possibility of using the results of this particular magnetic survey as a foundation for quantitative spatial analysis in both the ceremonial space of the Mollo Kontu Mound as well as in the residential sector of the site.

Chapter 8: Synthesis of examples and practical investigations and concluding discussion of the value of spatial syntax analysis in archaeology

The use of maps produced through the application of geophysical survey techniques as a starting point for spatial analysis has incredible potential as it provides continuous and homogeneous documentation of settlements at a scale that is logistically infeasible for traditional archaeological survey and excavation. Although geophysical survey is quickly becoming standard practice in Andean archaeology as an initial, pre-excavation prospection technique, subsequent space syntax analysis of those findings has yet to have been applied anywhere in the New World, with only minimal application elsewhere (Benech 2007).

With his analysis of the Hellenistic and Roman site of Doura-Europos in Syria, Christophe Benech provided the first instance of an analytic methodology that follows geophysical survey with SSA interpretation of results, and serves as a partial inspiration for my own study. With a number of significant limitations inherent to my survey at Mollo Kontu which will be discussed below, Benech's innovative and thorough analysis of two housing blocks was made possible through a number of crucial advantages. With a strongly orthogonal 'Hippodamian plan', the urban organization of Dura-Europos is well established and full housing blocks have been completely excavated. This wealth of comparative and complete architectural and spatial data from archaeological excavation is only further supported by the availability of classical literature and sound architectural history of the period, providing a considerably more solid foundation on which to apply space syntax to geophysical results than is presently possible in the Andes. From the geophysical perspective, the magnetic environment in the Near East has a much higher mean value (nearly double at ~45,000 nT, see figure 65) than is found in the Bolivian *altiplano*, a fact which allows for much more nuanced magnetic readings and thus higher resolution magnetic maps (Breiner 1999). Despite the relatively ideal conditions at Doura-Europos, by his own admission, Benech states that "A complete study would involve taking into account all excavated and surveyed dwelling units of Doura-Europos and the layout of streets in order to obtain a concerted vision of the organization of the public and private space of the city" (Benech 2007). As such, it is clear that truly nuanced spatial

analysis of an ancient urban context would require both complete excavation and a perfectly preserved site, two conditions that were not met at Mollo Kontu and are seldom the case at any archaeological site.

The natural and situational conditions at Mollo Kontu and Tiwanaku in general seem to resist any attempt to geophysically define detailed information on the form of ritual space at the Mound, and even less nuanced data on the spatial organization of the residential area. As such, any attempt at applying a form of space syntax analysis using the DepthMap software would rely on the extremely conjectural interpretations of the magnetic maps produced following my survey. With the hypothetical architecture suggested in these interpretive maps being based on the already very indistinct indications of known architectural features, any quantitative spatial analysis of this hypothetical architecture would be essentially meaningless and accordingly, will not be considered in this thesis. Quite apart from the technical difficulties experienced with this equipment in the field, the extremely complex construction and depositional history of this particular archaeological case presents perhaps one of the worst-case scenarios for the application of a combined geophysical and space syntactic methodology. However, this limitation provides a unique opportunity to critically examine the value of applying space syntax analysis to archaeology. The results of this particular case study prompts a discussion of the need for an archaeologically focused variant of space syntax analysis that makes pointed efforts to consider and address the limitations and strengths inherent to archaeology as a field to which such a quantitative method would have enormous potential.

The obvious and numerous limitations of analyzing ruined and incomplete architecture of any context is only further hampered in the New World by the ideological, aesthetic and symbolic disconnect that contemporary academics inherently face in contemplating the ancient built environment of the Americas. To do so is to "run the risk of forcing the interpretive enterprise beyond the limits of credulity, as there is an almost insuperable cognitive gap between the archaic, agrarian mind and the mind of the industrial world: they inhabit and are engaged by separate realities" (Kolata, 1993, 95). Although this basic inadequacy is reiterated in some capacity by nearly every archaeological study exploiting space

syntax analysis, there comes a point when the absolute value of these methods as a tool to consider past social organization must be seriously questioned and perhaps abandoned.

As a critical consideration and synthesis of the two-part consideration of the monumental and ritual space of the Sunken-Court form presented earlier, the concluding portion of this thesis will make use of my research at Mollo Kontu as case study. Referring to the results of both studies presented here, I will discuss the seemingly insurmountable limitations in analyzing architectural and social organization on the urban scale in both completely and partially excavated built environment from antiquity. Although there have been a number significantly broad excavations in a number of areas of Tiwanaku, when considered in the context of the enormous area once covered by the city, there is still a relatively minimal appreciation of the overall urban organization of the site. As such, the basic requirement of space syntax analysis to have definitive and distinct spatial information about architecture is lacking. As was presented earlier, the study at Mollo Kontu attempts to address this issue through the use of geophysical prospection techniques to define the now invisible ancient built environment. This section will serve as consideration of the failings inherent to relying on overly technical and quantitative methods and calls for the development of a considerably different variant of space syntax analysis that would be more appropriate to the largely interpretive field of prehistoric New World archaeology.

After applying qualitative access analysis techniques of space syntax analysis to the prehistoric Anatolian sites of Çatalhöyük and Haçilar, Marion Cutting (2003) offers a pointed and very realistic set of basic guidelines for the archaeologist hoping to pursue space syntax analysis as an investigative avenue :

1) Space syntax analysis is most effectively used where inside or outside spaces are differentiated by permanent walls and partitions rather than by movable elements such as screens or furnishings, or changes in floor level and repeated patterns of behavior that leave no physical record.

2) The technique requires a minimum level of information about connected spaces both inside and outside buildings, with clear entrances, complete buildings and open spaces and complete settlements – or at least blocks of buildings.

3) The more spaces the better - two-roomed buildings yield less informative numerical results than building with five or more rooms.

4) Given that the configuration of the upper storey affects the value of the ground-floor spaces, and that upper storeys seldom if ever survive archaeologically, it is important at least to know the location of the link between ground floor and upper levels.

5) It is not worth attempting to use access analysis as a quantitative technique when there too much information is missing, for example, roof-top activity and movement patterns on roof-top entrance sites. Access analysis cannot be used to create data that no longer exist within the archaeological record. (Cutting 2003, 18).

Considering this list, and the ambiguous nature of spatial data available at nearly every archaeological site the world over, it begs to ask why so many archaeologists have gravitated to space syntax analysis and its variants? Quite obviously, the overwhelming archaeological desire to catalogue, typify, organize, order and thus 'understand' the ancient past seizes the opportunity to quantitatively define the social, seemingly without the influence of contemporary ideology. This is not to suggest that any researcher adopts the numerical output of space syntax analysis as anything more than a potentially illuminating foundation on which to lend support to interpretation. By all means, the fundamental theories from which space syntax analysis proliferates today in architectural, urban planning and sociological capacities have continuously improving and nuanced application and value. However, these innovations have left archaeologists to independently create a pastiche of ideas and methods with which they then attempt to use to force incomplete and extremely complicated data sets into some semblance of an interpretation.

Only relatively recently has space syntax analysis seen a concerted effort to incorporate elements of human perception and cognition, an aspect that one would assume to be of fundamental importance to what is essentially the study of human behaviour in response to space, and the reflexive relationship between society and the spaces they design. As Bafna (2003) states: "On the whole there is still a lack of an overarching theory that proposes a systematic social effect of the visual information available to a situated observer. In the absence of such a theory, the empirical work done on behavioural effects of

isovists has not reported large successes despite displaying frequent technical innovation and methodological sophistication." (Bafna 2003: 26).

The very concept of developing an overarching definition of a "systematic social effect of visual information" is perhaps closer to the mark in terms of potential archaeological application, but such a generalization would again force the archaeologist to bend temporally distant and often largely unknown ideology into an ill-fitting model based on the present. Any form of an archaeologically specific space syntax analysis system would have to rely on a ideologically and environmentally specific set of variables that could be tailored to the particular case at hand. Cues would have to be taken from both artefactual evidence and ethnographic comparison as is often the case in nearly all archaeological interpretation, such as the study of the Sunken-Court form presented earlier. Such a flexible and malleable form of space syntax would depart from the scientific and into the experiential and phenomenological, creating a quasi-qualitative, quasi-quantitative system of thought that if developed, could lend support to interpretation of the remains of the built environment. A starting point for such a method can be seen in the ongoing research by Alexei Vranich in the experiential aspects of monumental structures at Tiwanaku with particular focus on the direction and control of movement through ritual space at the site (Vranich 1999, 2009).

Primarily, there would need to be less emphasis on connectivity of built spaces abandoning the importance of access analysis and relative 'depth' considering the enormous variability and socially specific understanding of physical and abstract concepts of boundaries and the use of space. The very idea of "bounded space" implies and instantiates distinctly contemporary and arguably geopolitically-based concepts of territoriality or ownership of a space and everything that lies within defined limits (Tuan 1977: 4). For instance, symbolic concepts of colour change in surface decoration, light quality, superposition, subterranean elements, the presence of controlled watercourses and spaces with unmarked ritual or historic meaning, are all "bounding" elements that go unconsidered by space syntax analysis. Even with isovist and axial line analyses that take some consideration of human visual

perception, the situational and culturally specific understanding and response to a particular built environment is not considered in present studies. As an example of the fallibility of the equating increased "depth" with exclusiveness and restriction through access analysis is in the argument that perhaps it is was the ability to see into such "deep", restricted space that could very easily have been the intention of the social architects assumed to control the built environment.

As Cutting makes explicit in her discussion of the power of using space syntax analysis as a "tool to think with", she proposes the use of access analysis in a non-quantitative way that "enables the internal layout of individual buildings and the relationship between groups of buildings to be studied and compared in ways that are overlooked by descriptions of room sizes, the distribution of features and the proportion of built to non-built space." This line of though it continued when Cutting states that "Where the archaeological data are sufficient about room functions, thinking in terms of access analysis can highlight repeated associations between certain activities, access and privacy"(Cutting 2003, 18). This sort of flexible and creative application is exactly how archaeologists should approach space syntax analysis. Any new archaeologically specific form of analysis that may develop in future should adopt a largely non-quantitative although rational and systematic methodology that is entirely sympathetic to what is both known and assumed about to the society being considered.

It is precisely this type of yet to be designed analytical system that research at Tiwanaku could benefit. If a wider area of the Mollo Kontu Mound and the residential sector were fully excavated which led to a clear understanding of the construction sequences of both spaces, only then could space syntax analysis be a viable option. Full excavation of the Mound and its associated *qocha* would provide a detailed understanding of the spatial configuration of this clearly ceremonial area, which would allow quantitative analysis. If further excavation could clearly demonstrate that bounded residential compounds were in fact the base residential unit at Mollo Kontu, then interpretations could be made based on the orientation and interconnection between these barrios and the ceremonial core or in relation to local topography and natural landmarks such as distant mountain peaks. In such a hypothetical case the use of

geophysical data to determine at least the location of barrio structures and general orientation would be valuable. Although currently available space syntax techniques such as DepthMap could be applied to the results from both the Mollo Kontu Mound and the residential, it is not a question of whether space syntax analysis could be applied to draw some form of numerically supported interpretation, it is a question of whether it should be applied at all in its current form. Although there are many confounding components to this mode of analysis, there is a distinct need to create a new system dedicated to the spatial and interpretive eccentricities of archaeological contexts and the types of data collected therein.

Above all, it seems that in studying archaeological plans, both field and research archaeologists must make efforts in not only considering the space of an excavated or surveyed area, but must attempt to understand the nuanced elements of place, understanding that real people would have carried out their daily lives in and around ancient buildings and settlements. To disregard the concept of place in the analysis of an archaeological space is to ignore the experience and the habitus of the participant observer. It is though a combined consideration of how people may have interacted with each other and moved through and between public and private built and non-built space that creates a place out of a space. By quantitatively studying individual buildings or collections of buildings is to consider one tiny element of a once very dynamic place and thus work within a social vacuum that by no means could possibly reflect how a society once functioned. Despite the seemingly cold quantitative gaze of space syntax analysis, the current form used by archaeologists is based on overly generalized value judgments as to the structure and operation of human societies both past and present that specific custom and ideology are seldom if ever considered.

As presented in chapter 3, a close consideration of the ideological setting in which a particular architectural feature was used is of utmost importance in the interpretative investigation of that space. The quantitative analysis of the Sunken-Court tradition presented clearly demonstrates that the interpretive power of such methods is limited and should only be exploited as technique used to help answer specific theoretical questions rather than as a technique in search of a question. In this way, earlier geophysical

investigations at Mollo Kontu were used as a method to detect buried architectural features and guide excavation, and did not carry with it any specific questions about the use of the space it was attempting to detect (Vining *et al* 2008). It was only through excavation that such questions could be asked, questions that never again looked to the results of the geophysical survey after the excavation began. In that my own survey was conducted following excavation, therefore guided by it, the technique and attempted analysis applied was utilized with a particular question in mind, while using the preliminary results of excavation to validate and test the method itself. It is perhaps the scale of the questions I had originally asked that are at issue, with the answers arguably beyond the scope of archaeology altogether, and most definitely left unanswered by the particularly problematic, albeit potentially promising techniques employed to address them by the present study.

Ian Hodder argues "…archaeologists are better equipped at studying specific moments and daily rhythms than larger scale processes...it is the human scale which is the stuff of archaeology, it is the larger scale which is more distanced from archaeological material" (Hodder 2000: 31). By intently looking at the mundane activities and residues of daily life, archaeological investigation gradually builds a hypothetical understanding of ancient ideology from the most ephemeral and fleeting material signifiers of practice. Although architectural elements of the built environment seem to contain concrete messages inscribed indelibly in the material record, they must also be appreciated as being constructed at particular moments in time for specific purposes, as the social meaning of temples, monuments, house form, settlement organization or urban planning do not stay the same. In essence, regardless of the scale at which an ancient culture is considered, even with the most complete and pristine archaeological contexts such as at Pompeii that are supported by a wealth of supporting evidence, the habitus of those who created and used such space is forever lost. Even when a complete image of the cultural "text" lies before us to be "read" archaeologically, we are and will remain to be, functionally illiterate if archaeologists continue to concentrate on speculative analyses of the high-level meanings of ancient cities and buildings.

In their extensive and critical synthesis of current research on New World states and empires,

Michael E. Smith and Katharina J. Schreiber make explicit that in the absence of written texts, empirical analysis is much more amenable to the study of Rapoport's middle-level and lower-level meanings. It is at these lower-levels of meaning that the built environment actually "communicates messages about access, movement and visibility, participating in a recursive relationship with actions and behaviour" (Smith and Schreiber, 2006: 14). They directly mention that in the study of currently fashionable topics such as spatiality and spatial practice, agency models, ethnicity and gender, the pace at which new theory is being developed "...is moving too fast for data to follow, leading to speculative and ungrounded interpretations" (Smith and Schreiber, 2005: 190). By relying too heavily on the literature from cultural anthropology and social theory, contemporary archaeologists are perhaps limiting the quality of their interpretations. Clearly there is a need to devote significant effort to the development of distinct concepts and methods that are tailored to the nature of the archaeological record

With much, if not all human activity being entirely situational, archaeological investigations must acknowledge that the most important and telling aspects of practice cannot be grasped outside the specific context in which it originally occurred. As Bell states, "when abstracted from its immediate context, an activity is not quite the same activity. Practice may embody determinative influences deriving from other situations, but practice is not the mere expression or effect of these influences" (Bell, 1992:81). In attempting to evaluate the nature of accepted social practice at ancient Mollo Kontu through the definition of a spatial grammar on the residential scale, my own study stands as testament to the need to focus on more concrete and knowable dimensions of the past while informed and directed by our knowledge of the high-level meaning of the culturally specific cosmology, worldview and fundamental philosophical systems. By looking at material remains of any culture in such a sweeping, all encompassing manner that bypasses individual agency and the capacity for change over time, so much of that culture is lost in the details overlooked. Bourdieu explicitly states that "The *habitus* – embodied history, internalized as a second nature and so forgotten as history – is the active presence of the whole past of which it is the product", making it difficult if not impossible to unpack the vestiges of practice from the built

environment (Bourdieu 1980:56). Although there is an overwhelming urge to functionalize and categorize human behaviour, the complex and variable nature of human activity is one that above all must be accepted as being as dynamic as it is situational, as Margaret Lock so aptly states "[it is]…a fluid, contestable entity comprising sets of practice, ideas, imagination, and discourse, much of it barely available to consciousness" (Lock 2002:46).

By exploiting technical quantitative techniques to consider specific theoretical questions, this project neither reached too far into the purely theoretical, nor did it merely quantify a simple data set without any attempt at meaningful interpretation. By exploiting relatively new practical and theoretical techniques, this project ultimately serves as a case study of some of the challenges that the application of modern technologies to traditional archaeological questions pose. Geophysical prospection techniques simultaneously open exciting new methodological avenues while potentially diminishing the investigative resolution inherent to full scale excavation. It is through the creative combination of conventional and emergent techniques that studies such as this demonstrate that it is in the limitations of geophysical survey and spatial analysis that they are the most useful. The methods used in this study not only serve in prospection and documentation capacities, but must be appreciated as powerful comparative techniques that can actively question and direct archaeological interpretation of the built environment of past cultures.

Works Cited:

Albarracin-Jordan, J. 1996. Tiwanaku Settlement System: The Integration of Nested Hierarchies in the Lower Tiwanaku Valley. Latin American Antiquity 7(3): 183-210.

- 2003.Tiwanaku: A Pre-Inka, Segmentary State in the Andes. In Tiwanaku and its Hinterland: Archaeology and Paleoecology of an Andean Civilization, vol. 2: Urban and Rural Archaeology, A.L.Kolata ed. Washington: Smithsonian Institution Press. pp. 95-111.

Augustine, J.M.F., Mattox, C.W., and S. Paye. 2009. Residential Excavations at Sector D: The Production and Destruction of Space and the Political Stakes of Alterity. Paper presented at the annual international meeting for the Society for American Archaeology, Atlanta, 2009.

Bafna, S. 2003. Space Syntax: A Brief Introduction to its Logic and Analytical Techniques. Environment and Behaviour 35: 17-28.

Bandelier, A. 1911. The Ruins of Tiahuanaco. Proceedings of the American Antiquarian Society 21, part 1.

Bastien, J. 1978. Mountain of the Condor: Metaphor and Ritual in an Andean Allyu. St. Paul: West Publishing.

- 1991. The Mountain/Body Metaphor Expressed in a Kaatan Funeral. In Tombs for the Living: Andean Mortuary Practices. Edited by T. Dillehay. Pp.355-378.Washington:Dumbarton Oaks.

Bauer, B. 1991. Pacariqtambo and the Mythical Origins of the Inca. Latin American Antiquity 2(1):7-26.

Bauer, B., Stanish, C. 2001. Ritual and Pilgrimage in the Ancient Andes. Austin: University of Texas Press.

Banning, E.B. 1996. Houses, Compounds and Mansions in the Prehistoric Near East. In People Who Lived in big Houses: Archaeological Perspectives on Large Domestic Structures, Monographs in World Archaeology 27. edited by G. Coupland and E.B. Banning. Pp.165-185. Madison: Prehistory Press.

Banning, E.B., and B.F. Byrd. 1989. Alternative Approaches for Exploring Levantine Neolithic Architecture. Paleorient 15:154-160.

Bell, Catharine. 1992. Ritual Theory, Ritual Practice. Oxford: Oxford University Press.

Benedikt, M L, 1979. To take hold of space: Isovists and isovist fields. Environment and Planning B: Planning and Design 6(1) 47-65.

Benech, C. 2007. New Approach to the Study of City Planning and Domestic Dwellings in the Ancient Near East. Archaeological Prospection 14 :87-103.

Bennett, W.C. 1934. Excavations at Tihuanaco. Anthropological papers of the American Museum of Natural History. 35(3). pp.361-493. New York: American Museum of Natural History.

- 1936. Excavations in Bolivia. Anthropological Papers of the American Museum of Natural History. 34(4):329-508. New York: American Museum of Natural History.

Berryman, C.A., Knudson, K.J., Simon, S.K., Wilson, S.L., and D.E. Blom. 2009. A Multidisciplinary Approach to Human Skeletal Analysis at Mollo Kontu, Tiwanaku (Bolivia). Paper presented at the annual international meeting for the Society for American Archaeology, Atlanta, 2009.

Bonanno, A.T., Gouder, T., Malone, C., and S. Stoddart. 1990. Monuments in an Island Society: The Maltese Context. World Archaeology 22(2): 189-205.

Bourdieu, P. 1973. The Berber House: Swahili Space and Symbolic Markers. In Rules and Meanings, edited by M.Douglas. pp 98-110. Harmondsworth : Penguin.

- 1977. Outline of a Theory of Practice. Cambridge : Cambridge University Press.

- 1980 [1990]. *The Logic of Practice.* Translated by R.Nice. Stanford: Stanford University Press.

Bouysse-Cassagne, T. 1986. Urco and Uma: Aymara Concepts of Space. In Anthropological History of Andean Polities. J.Murra, N.Wachtel and J.Reve eds., Cambridge: Cambridge University Press. pp.201-227.

Bradley, B. 1992. Excavations at Sand Canyon Pueblo. In The sand Canyon Archaeological Project, edited by W.D. Lipe. Occasional Paper 2, pp. 79-91. Crow Canyon Archaeological Center, Cortez, Colorado.

- 1993. Planning, Growth, and Functional Differentiation at a Prehistoric Pueblo: A Case Study from SW Colorado. Journal of Field Archaeology 20:23-42.

Breiner, S. 1999. Applications Manual for Portable Magnetometers. San Jose: Geometrics.

Bruno, M., Ramos-Fernandez, M. 2009. Plant Remains from Residential and Mortuary Contexts at Mollo Kontu, Tiwanaku. Paper presented at the annual international meeting for the Society for American Archaeology, Atlanta, 2009.

Burger, R.L. 1995. Chavin and the Origins of Andean Civilization. London: Thames & Hudson.

Bustard, W. 1996. Space as Place: Small and Great House Spatial Organization in Chaco Canyon, New Mexico, A.D.1000-1150. Ph.D diss., University of New Mexico, Albuquerque.

- 1997. Space, Evolution and Function in the Houses of Chaco Canyon. In First International Space Syntax Symposium Proceedings

Capoche, L. 1959 [1585] Relación general de la villa imperial de Potosi. Madrid: BAE.

Chapman, D, Kontou, F, Penn, A, Turner, A, 1999. Automated viewshed analysis for configurational analysis of retail facilities. In Proceedings of the 19th International Cartographic Conference, Ottawa, Canada.

Chavez, S.J. 2004. The Yaya Mama Religious Tradition as an Antecedent of Tiwanaku. In Tiwanaku: Ancestors of the Inca. M. Young-Sanchez, ed., Lincoln: University of Nebraska Press.pp70-95.

Cobo, B. 1984 [1653] History of the Inca Empire: An Account of the Indian's Customs and their Origin Together with a Treatise on Inca Legends, History and Social Institutions. R. Hamilton, trans. Austin: University of Texas Press.

Cooper, L. 1995. Space Syntax of Chacoan Great Houses. Ph.D dissertation, University of Arizona.

- 1997. Comparative Analysis of Chacoan Great Houses. First International Space Syntax Symposium Proceedings Vol 2. edited by B. Hillier. pp. 22.1-22.12. London: The Bartlett School of Graduate Studies, University College London.

Couture, N.C. 1992. Excavations at Mollo Kontu, Tiwanaku. Unpublished M.A thesis. Chicago: University of Chicago.

- 2002. *The Construction of Power: Monumental Space and Elite Residence at Tiwanaku, Bolivia* (2 volumes). Unpublished Ph.D dissertation. Chicago: University of Chicago.

- 2003a. Ritual, Monumentalism, and Residence at Mollo Kontu, Tiwanaku. In Tiwanaku and its Hinterland: Archaeology and Paleoecology of an Andean Civilization, vol. 2: Urban and Rural Archaeology, edited by A. Kolata, pp.202-225. Washington: Smithsonian Institution Press.

- 2003b. Monumental Space, Courtly Style, and Elite Life at Tiwanaku. In Tiwanaku: Ancestors of the Inca, edited by M. Young-Sanchez.pp.126-149. Lincoln: Denver Art Museum and University of Nebraska Press.

- 2004. Monumental Space, Courtly Style and Elite Life at Tiwanaku. In Tiwanaku: Ancestors of the Inca, edited by M.Young-Sanchez. Pp.126-136. Lincoln:University of Nebraska Press.

- 2005. Description of the Proposed Research Program. Social Sciences and Humanities Research Council of Canada- Grant Application.

- 2008. Talking Heads and the Grateful Dead. Paper presented at the annual international meeting for the Society for American Archaeology, Atlanta, 2008.

Couture, N.C. and Sampeck, K. 2003. Putuni: A history of Palace Architecture at Tiwanaku. In Tiwanaku and its Hinterland: Archaeology and Paleoecology of an Andean Civilization, vol. 2: Urban and Rural Archaeology, edited by A.L. Kolata. pp 226-263. Washington: Smithsonian Institution Press.

Couture, N.C., Blom, D and M. Bruno. 2008 - *Proyecto Arqueologico Jach'a Marka, Informe de Investigaciones Realizada en 2008.*Project report for submission to the Bolivian National Archaeological Authority (UNAR).

Couture, N.C., Blom, D and M. Bruno. 2007 - *Proyecto Arqueologico Jach'a Marka, Informe de Investigaciones Realizada en 2007.* Project report for submission to the Bolivian National Archaeological Authority (UNAR).

Couture, N.C., Blom, D and M. Bruno. 2006 - *Proyecto Arqueologico Jach'a Marka, Informe de Investigaciones Realizada en 2006.* Project report for submission to the Bolivian National Archaeological Authority (UNAR).

Couture, N.C., Blom, D and M. Bruno. 2005 - *Proyecto Arqueologico Jach'a Marka, Informe de Investigaciones Realizada en 2005.* Project report for submission to the Bolivian National Archaeological Authority (UNAR).

Couture, N.C., Blom, D and M. Bruno. 2001 - *Proyecto Arqueologico Jach'a Marka, Informe de Investigaciones Realizada en 2001.* Project report for submission to the Bolivian National Archaeological Authority (UNAR).

Créqui de Monfort, G. de. 1906. Fouilles de la mission scientique française a Tihuanaco. Ses recherches archaéologiques et ethnographiques en Bolivie, au Chili en dans la République Argentine. Proceedings Internationaler Amerikanisten Kongress 2:531-550.

Cutting, M. 2003.The Use of Spatial Analysis to Study Prehistoric Settlement Architecture. Oxford Journal of Archaeology 22(1): 1-21.

Czwarno, R.M. 1989. Spatial patterning and the investigation of political control: the case from the Moche / Chimu area. In The Nature of Wari: A Reappraisal of the Middle Horizon period in Peru, BAR International Series 525, edited by R.M. Czwarno, F.M. Meddens and A. Morgan. pp.115-145. Oxford: B.A.R.

Dawson, P.C. 2002. Space syntax analysis of Central Inuit snow houses. Journal of Anthropological Archaeology 21(4): 464-480.

Desyllas, J, Duxbury, E, 2001. Axial maps and visibility graph analysis, in Proceedings of the 3rd International Symposium on Space Syntax, Atlanta. edited by B. Hillier. pp 27.1-27.13. London: The Bartlett School of Graduate Studies, University College London.

Dovey, K. 1999. Framing Places: Mediating Power in Built Form. London: Routledge.

Durkheim, E., Mauss, M. 1963 [1903]. Primitive Classification. Chicago: University of Chicago Press.

Durkheim, E. 1965 [1915] The Elementary Forms of Religious Life. Chicago: University of Chicago Press.

Eliade, M. 1959. The Sacred and the Profane: the Nature of Religion. New York: Harcourt, Brace and World.

Erickson, C.L. 1993. Social Organization of Prehistoric Raised Field Architecture in the Lake Titicaca Basin. In Economic Aspects of Water Management in the Prehispanic New World: Research in Economic Anthropology, Supplement 7, JAI Press, edited by V. Scarborough, and Isaac, B, pp.369-426. Stamford:JAI Press.

Erickson, C.L. 1994. Methodological considerations for Andean Field Systems. In *The Archaeology of Garden and Field.* Naomi F. Miller and Kathryn L. Gleason, Eds. University of Pennsylvania Press, Philadelphia.pp.111-152.

Erickson, C.L. 2000. The Lake Titicaca Basin: A Precolumbian Built Landscape. In *Imperfect Balance: Landscape Transformations in the Precolumbian Americas.* D.L Lentz, Ed. Columbia University Press, New York. pp. 311-356.

Ernenwein, E.G. 2006. Mollo Kontu Magnetic Gradiometry Survey, 2006. Survey Report. Fayetteville: The Center for Advanced Spatial Technologies, University of Arkansas.

Escalante, J. 2003. Residential Architecture at La K'arana In Tiwanaku and its Hinterland: Archaeology and Paleoecology of an Andean Civilization, vol. 2: Urban and Rural Archaeology, edited by A. Kolata, 316-326. Washington: Smithsonian Institution Press.

Fairclough, G. 1992. Meaningful Constructions – Spatial and Functional Analysis of Medieval Buildings". Antiquity 66:348-366.

Fisher, Kevin D. 2006. Messages in Stone: Constructing Sociopolitical Inequality in Late Bronze Age Cyprus. In Space and Spatial Analysis in Archaeology, edited by E.C Robertson, J.D.Seibert, D.C.Fernandez and M.U. Zender. Calgary: University of Calgary Press. Pp.123-131.

Flores Ochoa, J. 1987. Cultivation in the *Qocha* of the South Andean Puna. In *Arid Land Use Strategies and Risk Management in the Andes. A Regional Anthropological Perspective.* (D.L. Browman, Ed.). Westview Press, Boulder, Colorado. pp.271-96.

Foster, S.M. 1989. Analysis of Spatial Patterns in Buildings (Access Analysis) as an Insight Into Social Structure: Examples from the Scottish Atlantic Iron Age. Antiquity 63:303-314.

Giddens, A. 1979. Central Problems in Social Theory. London: Macmillan Press.

- 1984. The Constitution of Society: Outline of a Theory of Structuration. Berkeley: University of California Press.

Goldstein, P. 2005. Andean Diaspora: The Tiwanaku Colonies and the Origins of South American Empire. Gainsville:University of Florida Press.

Grahame, M. 1997. Public and Private in the Roman House: The Spatial Order of the Casa del Fauno. In Domestic Space in the Roman World: Pompeii and Beyond. edited by R. Laurence, and A.Wallace-Hadrill, Journal of Roman Archaeology Supplementary Series No.22. pp.137-164.

Gregory, D and Urry, J. 1985. Social Relations and Spatial Structures. Basingstoke: Macmillan.
Haas, J. 1985. Excavations of Huaca Grande: An Initial View of the Elite of Pampa Grande, Peru. Journal of Field Archaeology 12(4):390-409.

Haas, J, S. Pozorski, and T. Pozorski. 1987. The Origins and Development of the Andean State. New York:Cambridge University Press.

Hastorf, C. 1999. "An introduction to Chiripa and the site area. In *Early settlement at Chiripa, Bolivia: research of the Taraco archaeological project*. Contributions of the University of California,
57 Berkeley: University of California, Archaeological research facility.

Hall, E. T. 1966. The Hidden Dimension. Garden City :Doubleday Anchor.

Healan, D. M. 1993. Urbanism at Tula from the Perspective of Residential Archaeology. In *Prehispanic Domestic Units in Western Mesoamerica: Studies of the Household, Compound and Residence*, edited by R. S. Santley and K. G. Hirth, pp.105-119. CRC Press, Boca Raton, Florida.

Hillier, B and J. Hanson. 1984. The Social Logic of Space. Cambridge: Cambridge University Press.

Hillier, B. 1996. Space is the Machine: A Configurational Theory of Architecture. Cambridge: Cambridge University Press.

- 1999. The hidden geometry of deformed grids: or, why space syntax works, when it looks as though it shouldn't. Environment and Planning B: Planning and Design, 26:169-191.

Hodder. I, and R. Preucel 1996. Material Symbols. In Contemporary Archaeology in Theory, edited by I. Hodder and R. Preucel, pp. 299-314. Oxford: Blackwell.

Hodder, I. 2000. Agency and individuals in long-term processes. In Agency in Archaeology, eds. M.A. Dobres and J.E. Robb. pp.21-33. London: Routledge.

Hohmann-Vogrin, A. 2005. Space Syntax in Maya Architecture. Edited by Bill Hillier. 5th International Space Syntax Symposium, pp. 279-292. Delft: Bartlett School of Graduate Studies, University College London

Hopkins, M. 1987. Network Analysis of the Plans of Some Teotihuacan Apartment Compounds. Environment and Planning B 14:387-406.

Janusek, J.W. and A.L. Kolata. 2003. Pre-Hispanic Rural History in the Katari Valley. In Tiwanaku and its Hinterland: Archaeology and Paleoecology of an Andean Civilization, vol. 2: Urban and Rural Archaeology, edited by A.L.Kolata. pp. 129-171.Washington: Smithsonian Institution Press.

Janusek, J. W. 2003. The Changing Face of Tiwanaku Residential Life: State and Local Identity in an Andean City. In Tiwanaku and its Hinterland: Archaeology and Paleoecology of an Andean Civilization, vol. 2: Urban and Rural Archaeology, edited by A. Kolata, pp.264-295. Washington: Smithsonian Institution Press

- 2004. Identity and Power in the Ancient Andes: Tiwanaku Cities through Time. New York: Routledge.

- 2008. *Ancient Tiwanaku.* Cambridge: Cambridge University Press.

Klarich, E and N Craig. 2001. Geophysical Survey in the Lake Titicaca Basin: Uncovering Elite Domestic Architecture at Pucara, Peru. Paper presented at the annual international meeting for the Society for American Archaeology. New Orleans, 2001.

Kolata, A.L., and C. Ponce Sangines. 1992. Tiwanaku: The City at the Center. In The Ancient Americas: Art from Sacred Landscapes, edited by R. Townsend. pp.317-335. Chicago: Art Institute of Chicago.

Kolata, A.L. 1993. The Tiwanaku: Portrait of an Andean Civilization. Cambridge: Blackwell.

- 2003a. The Proyecto Wila Jawira Research Program. In Tiwanaku and its Hinterland: Archaeology and Paleoecology of an Andean Civilization, vol. 2: Urban and Rural Archaeology, edited by A.L.Kolata. pp.3-17. Washington: Smithsonian Institution Press.
- 2003b. The Flow of Cosmic Power: Religion, Ritual, and the People of Tiwanaku. In Tiwanaku: Ancestors of the Inca, edited by M. Young-Sanchez, pp. 96-125. Lincoln: Denver Art Museum and University of Nebraska Press.

- 2003c. Tiwanaku Ceremonial Architecture and Urban Organization. In Tiwanaku and its Hinterland: Archaeology and Paleoecology of an Andean Civilization, vol. 2: Urban and Rural Archaeology, edited by A.L.Kolata. pp. 175-201.Washington: Smithsonian Institution Press.

Kuper, H. 1972. The Language of Sites and the Politics of Space. American Anthropologist 74(3): 411-425.

Kvamme, K.L. 2003. "Geophysical Surveys as Landscape Archaeology." American Antiquity (2003): 435-457.

Laurence. R. 1994. Roman Pompeii, Space and Society. Routledge: London.

Lawrence, D.L. and S.M. Low. 1990. "The Built Environment and Spatial Form." Annual Review of Anthropology (19):453-505.

Lefebvre, H. 1991. The Production of Space, trans. D. Nicholson-Smith. Oxford: Blackwell.

Lewis, R. B and Stout, C. (Eds) 1998. Mississippian Towns and Sacred Spaces: Searching for an Architectural Grammar. Tusca Loosa: University of Alabama Press.

Lock, M. 2002. Twice Dead: Organ Transplants and the Reinvention of Death. Berkeley: University of California Press

Lumbreras, L.G., C. Gonzalez, and B. Lietaer. 1976. Acerca de la Funcion del Sistema Hidraulico de Chavin. Investigaciones de Campo No. 2. Museo Nacional de Antropologia y Arqueologia, Lima.

Markus, T.A. 1993. Buildings and Power: Freedom and Control in the Origin of Modern Building Types. London: Routledge.

McGuire, R. H. and M. B. Schiffer. 1983. "A Theory of Architectural Design". Journal of Anthropological Archaeology 2:227-303.

Meddens, F.M., Branch, N. P., Pomacanchari, C.V., Riddiford,N., and R. Kemp. 2008. High Altitude *Ushnu* Platforms in the Department of Ayacucho Peru, Structure, Ancestors and Animating Essence. In *Pre-Columbian Landscapes of Creation and Origin*. Ed. J.E. Staller. Springer. pp. 315-356.

Moore, J. D. 1992. Pattern and Meaning in Prehistoric Peruvian Architecture: The Architecture of Social Control in the Chimu State. Latin American Antiquity. 3(2) 95-113.

- 1995. The Archaeology of Dual Organization in Andean South America: A Theoretical Review and Case Study. *Latin American Antiquity* 6(2):165-181.

- 1996a. Architecture and Power in the Ancient Andes: The Archaeology of Public Buildings. Cambridge: Cambridge University Press, 1996.

- 1996b. The Archaeology of Plazas and the Proxemics of Ritual: Three Andean Traditions. American Anthropologist 98(4): 789-802.

- 2003. Life Behind Walls: Patterns in the Urban Landscape on the Prehistoric North Coast of Peru. In *The Social Construction of Ancient Cities,* edited by M.S mith.pp. 81-102. Washington: Smithsonian Books.

- 2005. *Cultural Landscapes in the Ancient Andes: Archaeologies of Place.* Gainesville: The University of Florida Press.

Moseley, M, 2001. The Incas and their Ancestors: The Archaeology of Peru. London: Thames & Hudson.

Murra, J. 1968. An Aymara Kingdom in 1567. Ethnohistory. 15:115-151.

Neubauer, W. 2004. GIS in Archaeology – the Interface between Prospection and Excavation. Archaeological Prospection 11:159-166.

Parker Pearson, M and Richards, C. 1994. Architecture and Order: Approaches to Social Space. New York: Routledge.

Parsons, J.R. 1968. An Estimate of Size and Population for the Middle Horizon Tiahuanaco, Bolivia. American Antiquity 33(2):243-245.

Penn, A, Turner, A, 2002. Space syntax based agent models. In Pedestrian and Evacuation Dynamics, edited by M. Schreckenberg, S. Sharma . pp 99-114. Heidelberg: Springer-Verlag.

Perdikogianni, I. 2003. Heraklion and Chania: A study of the evolution of their spatial and functional patterns. 4th International Space Syntax Symposium. London: Bartlett School of Graduate Studies, University College London, pp.19.1-19.20.

Plimpton, C.L., and F.A. Hassan. 1987. Social Space: A Determinant of House Architecture. Environment and Planning B 7:439-449.

Platt, T. 1986. Mirrors and Maize: The Concept of Yanantin among the Macha of Bolivia. In Anthropological History of Andean Polities. Edited by J. Murra, N. Wachtel and J. Reve. pp.228-259. Cambridge: Cambridge University Press.

Ponce-Sanginés, C. 1962. Tiwanaku: Descripción sumaria del templete semisubterráneo. Academia Nacional de Ciencias de Bolivia, La Paz.

- 1971. Replica a Gasparini. Pumapunku. 5: 69-83.

- 1972. Tiwanaku: Espacio, Tiempo y Cultura. Los Amigos del Libro, La Paz.

Ponce Sangines, C., Reinhard, J., Portugal, M., Pareja, E., & Ticlla, L. 1992. Arqueologia subacuatica en el Lago Titikaka. La Paz: Editorial La Palabra Producciones.

Posnansky, A. 1945. Tiahuanacu: The Cradle of American Man (2 vols). New York: J.J.Augustin.

Potter, J. 1998. The Structure of Open Space in Late Prehistoric Settlements in the Southwest. In Migration and Reorganization: The Pueblo IV Period in the American Southwest. edited by K.A. Spielmann. Anthropological Research Papers 51:137-153. Tempe: Arizona State University.

Rapoport, A. 1988. Levels of Meaning in the Built Environment. In Cross-Cultural Perspectives in Non-Verbal Communication, edited by Fernando Poyatos. Toronto: C.F Hogrefe.

- 1990. The Meaning of the Built Environment: A Nonverbal Communication Approach. 2nd ed. Tucson: University of Arizona Press.

Reilly, F.K. 1999. Mountains of Creation and Underworld Portals: The Ritual Function of Olmec Architecture at La Ventana, Tabasco. In Mesoamerican Architecture as a Cultural Symbol, edited by J.K. Kowalski. pp.14-39.Oxford: Oxford University Press.

Reinhard, J. 1992. Underwater archaeological research in Lake Titicaca, Bolivia. In Ancient America: Contributions to New World Archaeology, edited by N. J. Saunders. pp. 117-143. Oxford: Oxbow Books.

Rivera Casanovas, C. 2003. "Ch'iji Jawira: A Case of Ceramic Specialization in the Tiwanaku Urban Periphery". In Tiwanaku and its Hinterland: Archaeology and Paleoecology of an Andean Civilization, vol. 2: Urban and Rural Archaeology, edited by A. Kolata, pp.296-315. Washington: Smithsonian Institution Press

Robb, M. H. 2007. The Spatial Logic of Zacula, Teotihuacan. 6th International Space Syntax Symposium, Istanbul, edited by Bill Hillier. pp.62.1-62.16. London: Bartlett School of Graduate Studies, University College London.

Rowe, J. 1982. Inca Policies and Institutions Relating to the Cultural Unification of the Empire. In The Inca and Aztec States, 1400-1800, edited by G. Collier, R. Rosaldo, and I. Wirth. pp93-118.New York: Academic Press.

Sarmiento de Gamboa, P. 1908 [1572] History of the Incas. London: The Hakluyt Society.

Shapiro, J. 1997. Fingerprints in the Landscape. Space Syntax First International Symposium. edited by Bill Hillier. pp. 21.1-21.21. London: Bartlett School of Graduate Studies, University College London.

- 1999. Mud, Messages, And Museum Spaces. Space Syntax Second International Symposium. Brasilia, edited by Bill Hillier. pp.42.1-42.12. London: Barlett School of Graduate Studies, University College London.

Smith, A.T. 1996 Imperial Archipelago: The Making of the Urartian Landscape in Southern Transcaucasia. Ph.D dissertation, University of Arizona. UMI Dissertation Services, Ann Arbor.

Smith, M. E., and K. J. Schreiber. 2005. New World States and Empires: Economic and Social Organization. *Journal of Archaeological Research* 13(3): 189-228.

- 2006. New Worlds States and Empires: Politics, Religion and Urbanism." *Journal of Archaeological Research* 14(1): 1-52.

Smith, M. E. 2007 . Form and Meaning in the Earliest Cities: A New Approach to Ancient Urban Planning. *Journal of Planning History* 6(3):3-47.

Squier, E.G. 1877. *Peru: Incidents of Travel and Exploration in the Land of the Incas.* New York: Harper Brothers.

Staller, J.E. 2008. Dimensions of Place: The Significance of Centers to the Development of Andean Civilization: An Exploration of the *Ushnu* Concept. In *Pre-Columbian Landscapes of Creation and Origin*. Ed. J.E. Staller. Springer. Pp. 269-314.

Stross, B. 2008. Representation, Memory, and Power: Pre-Columbian Landscapes of Creation and Origin. In *Pre-Columbian Landscapes of Creation and Origin*. Ed. J.E.Staller. Springer. Pp.357-378

Taylor, G. 1976. Camay, camac, et camasca dans le manuscript quechua de Huarochiri. *Journal de la Societe de Americanistes.* 63:231-243.

Tilley, C. 1984. Ideology and the legitimation of power in the Middle Neolithic of Southern Sweden. In Ideology, Power and Prehistory, edited by D.Miller and C.Tilley. pp. 111-146. Cambridge: Cambridge University Press.

Thaler, U. 2005.Narrative and Syntax: new perspectives on the Late Bronze Age palace of Pylos, Greece."5th International Space Syntax Symposium, Delft, edited By B. Hillier. pp.323-338. London: Bartlett School of Graduate Studies, University College London.

Tuan, Y. 1977. Space and Place: The Perspective of Experience. Minneapolis: University of Minnesota Press.

Turner, A, Penn, A, 1999. Making isovists syntatic: Isovist integration analysis. In Proceedings of the 2nd International Symposium on Space Syntax Brasilia Vol. 3, edited by Bill Hillier. London: Barlett School of Graduate Studies, University College London.

Turner, A, Penn, A, 2002. Encoding natural movement as an agent-based system: an investigation into human pedestrian behaviour in the built environment. Environment and Planning B: Planning and Design 29(4):473-490.

Turner, A, 2001. DepthMap: a program to perform visibility graph analysis. In Proceedings of the 3rd International Symposium on Space Syntax, Atlanta, edited by Bill Hillier. London: Barlett School of Graduate Studies, University College London.

- 2003. Analyzing the visual dynamics of spatial morphology. Environment and Planning B: Planning and Design 30(5) 6570-676.

- 2004. DepthMap 4 – A Researcher's Handbook. London: Bartlett School of Graduate Studies, University College London.

- 2005. Choosing a place to go or a direction to follow: The syntax the agent sees. In Proceedings of the 5th International Symposium on Space Syntax, Delft, edited by Bill Hillier. London: Bartlett School of Graduate Studies, University College London.

Turner, V. 1967. Betwixt and Between: the Liminal Period in Rites de Passage. In The Forest of Symbols: Aspects of Ndembu Ritual. pp.93-111. Ithaca: Cornell University Press.

Uhle, M. 1912. Gúia general ilustrada de Tiahuanaco e Isla de la Sol y de la Luna. Revista Chilena y Geografía 6: 467-479.

Urton, G. 1981. At the Crossroads of the Earth and Sky: an Andean Cosmology. Austin: University of Texas Press.

- 1993. Moieties and Ceremonialism in the Andes: The Ritual Battles of the Carnival Season in Southern Peru. In El Mundo Ceremonial Andino, edited by L. Millones and Y. Onuku, pp. 117-142. Osaka: Museo Nacional de Ethnologia.

Vallieres, C., Arratia, E., and Mendoza, V. 2009. What does zooarchaeology bring to the Tiwanaku table? Paper presented at the annual international meeting for the Society for American Archaeology, Atlanta, 2009.

Van Dyke, R.M. 1999. Space Syntax Analysis at the Chacoan Outlier of Guadalupe. American Antiquity 64 (3): 461-473.

Van Gennep, A, 1960 [1909]. The Rites of Passage. University of Chicago Press, Chicago.

Van Gijseghem, H and K.J. Vaughn. 2008. Regional integration and the built environment in middle-range societies: Paracas and early Nasca houses and communities. Journal of Anthropological Archaeology 27: 111-130.

Vining, B., Williams, P.R., Blom, D., and N.C.Couture. 2008. Hacia una imagen del espacio social en Tiwanaku: Perspectivas por medio metodo geofisicos en el altiplano Boliviano. In Arquelogia de las Tierras Altas, Valles Interandinos y Tierras Bajas de Bolivia: Memorias del Congresso de Arquelogia de Bolivia. Edited by. C. Rivera Casanovas. La Paz: Institutos de Investigationes Anthropologicas y Arqueologias, Universidad Mayor de San Andres.

Vranich, A. 1999. Interpreting the Meaning of Ritual Spaces: The Temple Complex of Pumapunku, Tiwanaku, Bolivia. Ph.D dissertation, University of Pennsylvania. UMI Dissertation Services, Ann Arbor.

- 2009. Space and Identity. Paper presented at the annual international meeting for the Society for American Archaeology. Atlanta, 2009.

Wheatley, P. 1971 The Origins and Character of the Ancient Chinese City: Volume II The Chinese City in Comparative Perspective. London: Aldine Transaction.

Williams, P.R., Couture, N. C, and D. Blom. 2007. “Urban Structure at Tiwanaku: Geophysical Investigations in the Andean Altiplano." In Interdisciplinary Contributions to Archaeology: Remote Sensing in Archaeology, edited by James Wiseman and Farouk El-Baz. Pp.423-441. New York: Springer.

Computational Program:
UCL DepthMap 7.12.00d

Program by Alasdair Turner
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Bartlett School of Graduate Studies
University College London, Gower Street, London, WC1E 6BT

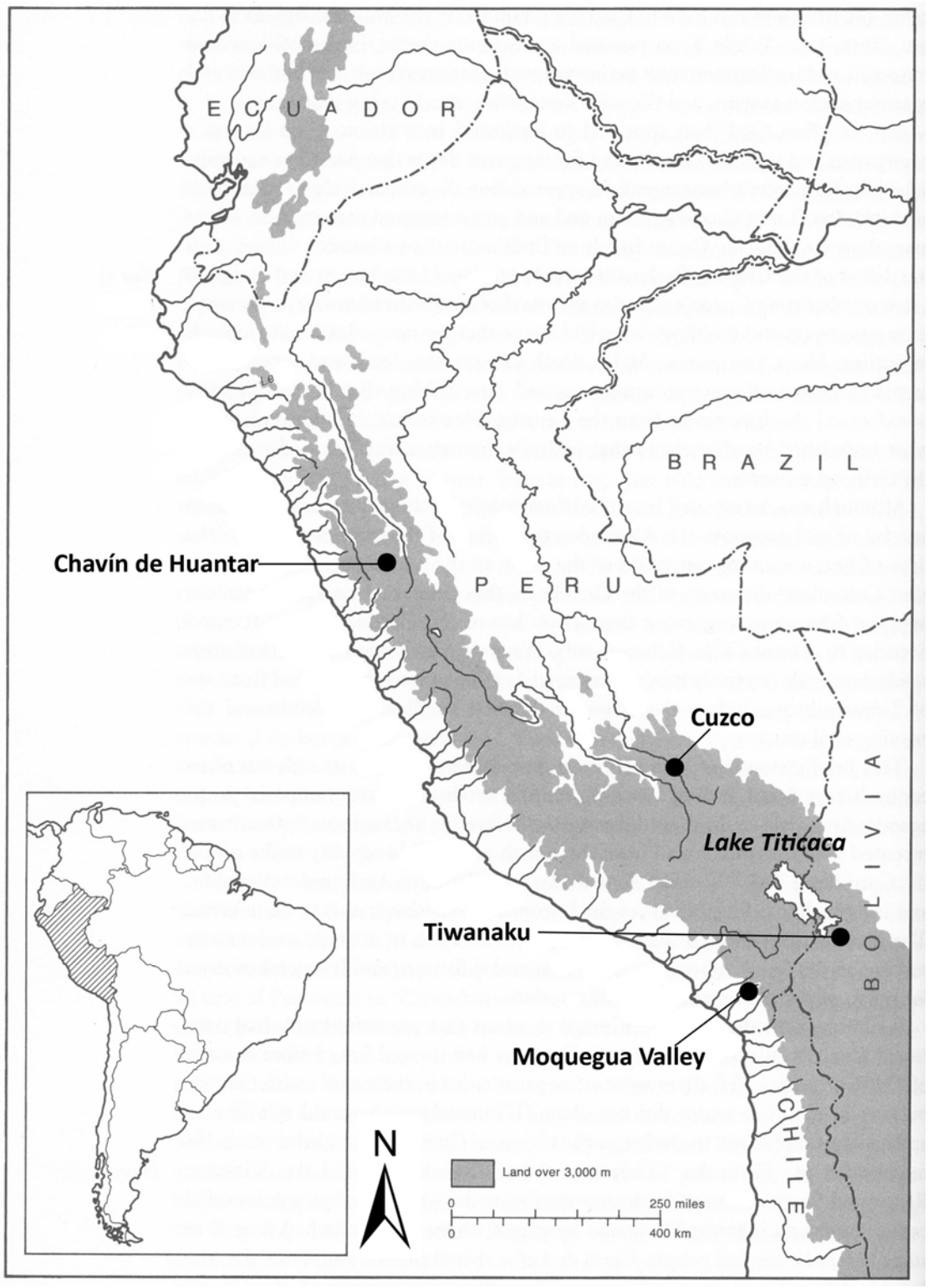


Figure 1A: Map of South America showing location of Tiwanaku and those sites outside the Lake Titicaca Basin mentioned in the text (Adapted from Moseley 2001).

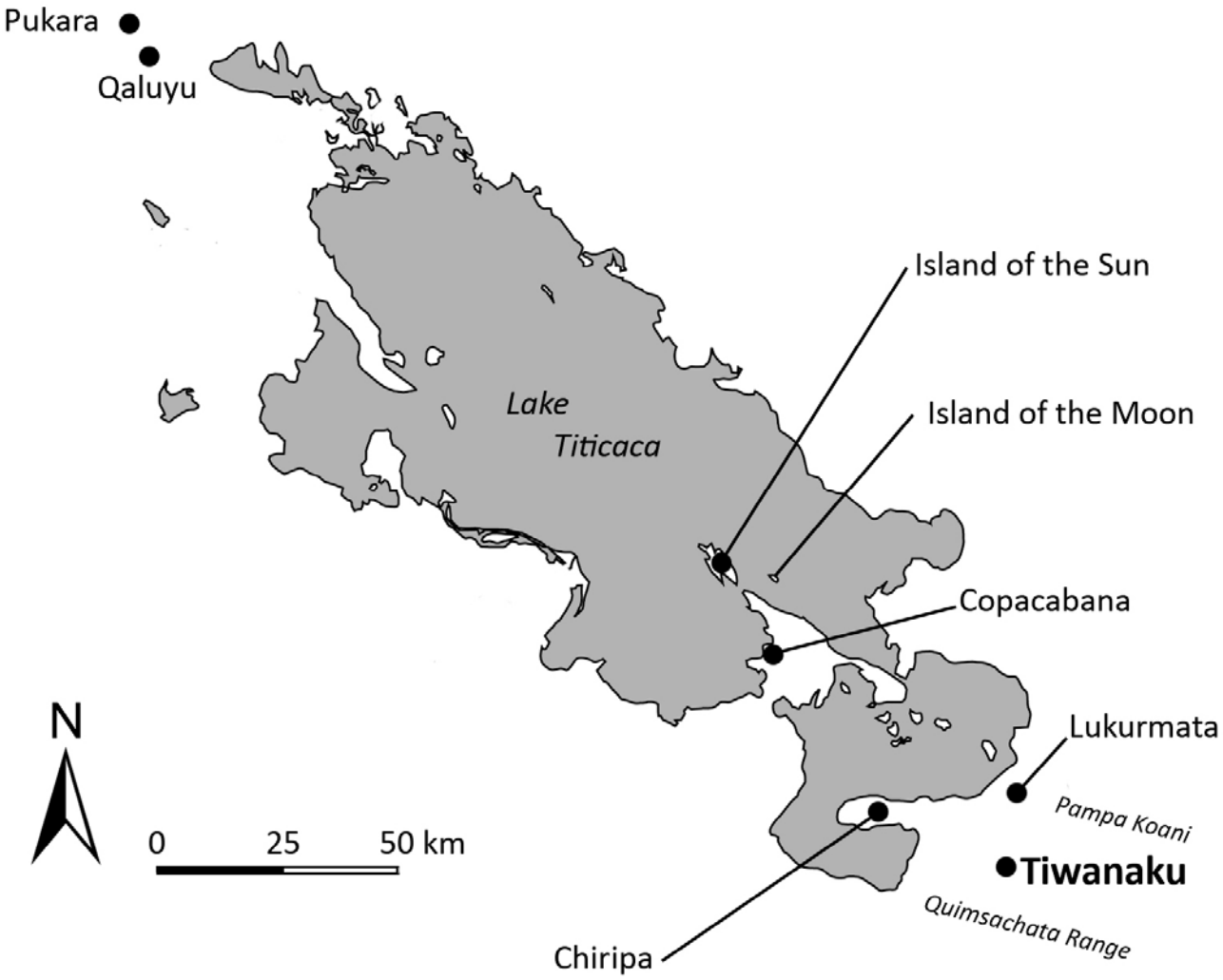


Figure 1B: Location of Tiwanaku and all other sites and features in the Lake Titicaca Basin mentioned in the text.

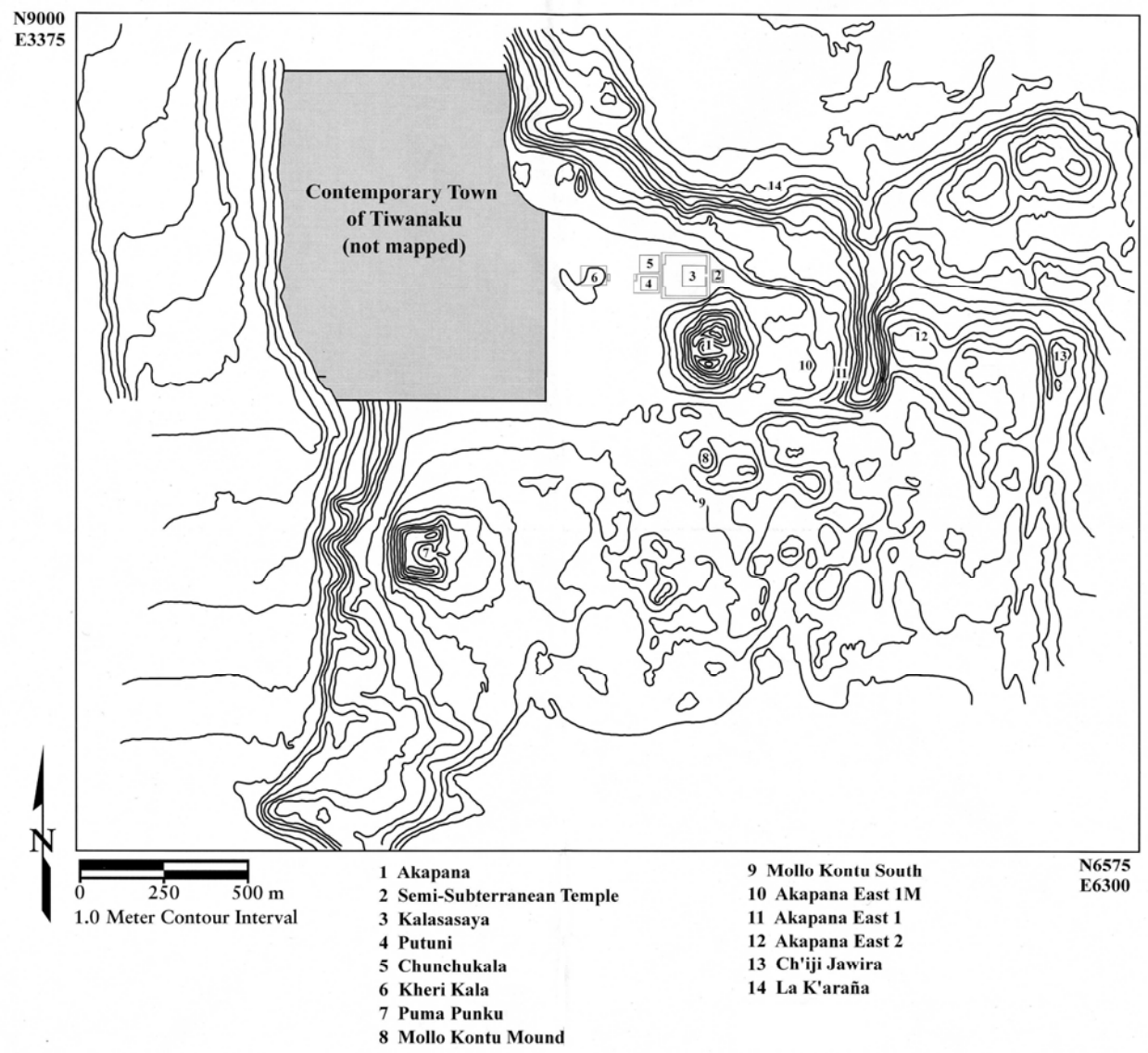


Figure 2A: Topographic map of the site of Tiwanaku and environs with the location of monumental architecture and excavation areas mentioned in the text (Adapted from Kolata 2003)

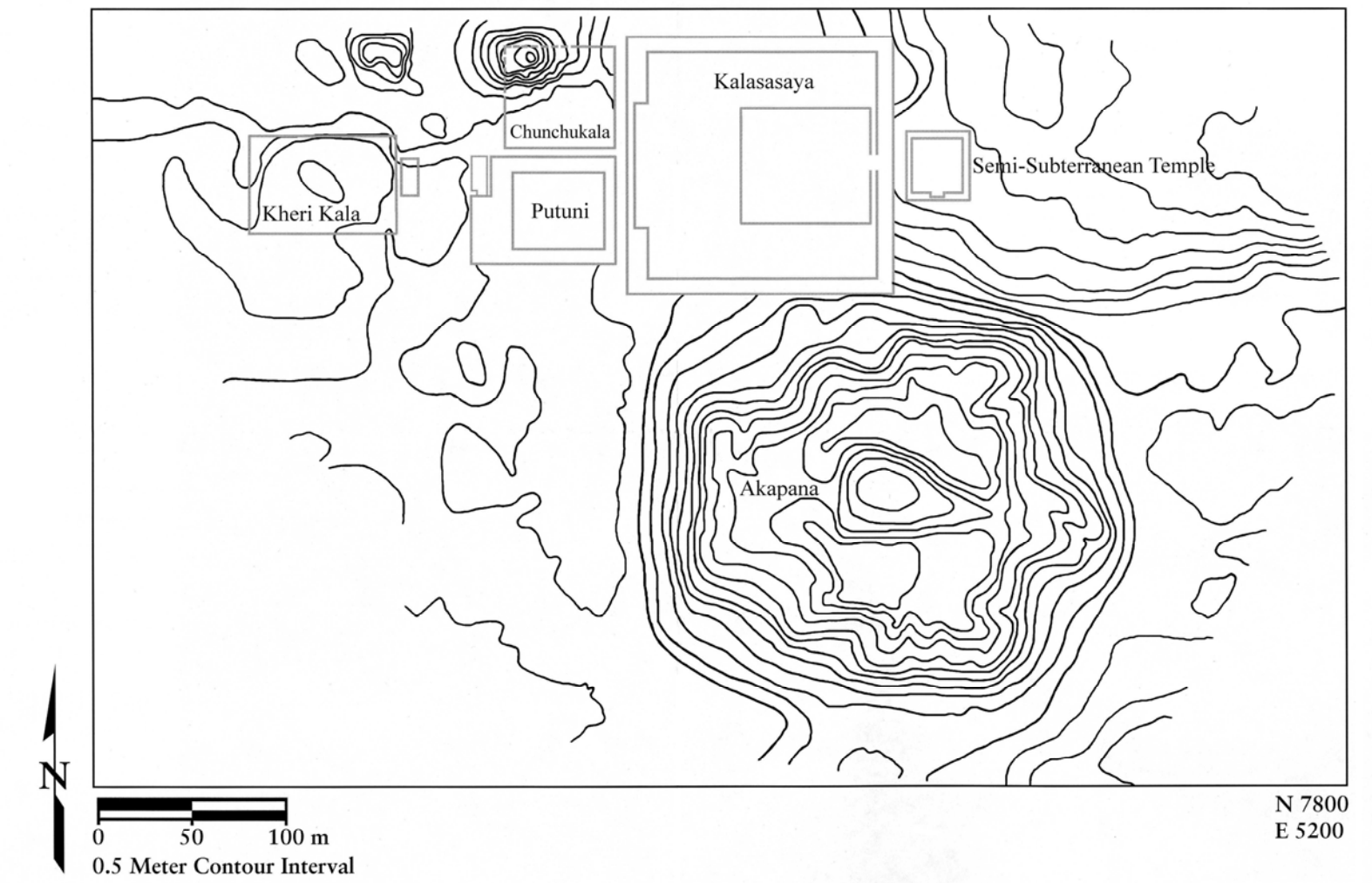


Figure 2B: Detail of Figure 2A showing the location of monumental architecture in the central ceremonial district of Tiwanaku. (Adapted from Kolata 2003).

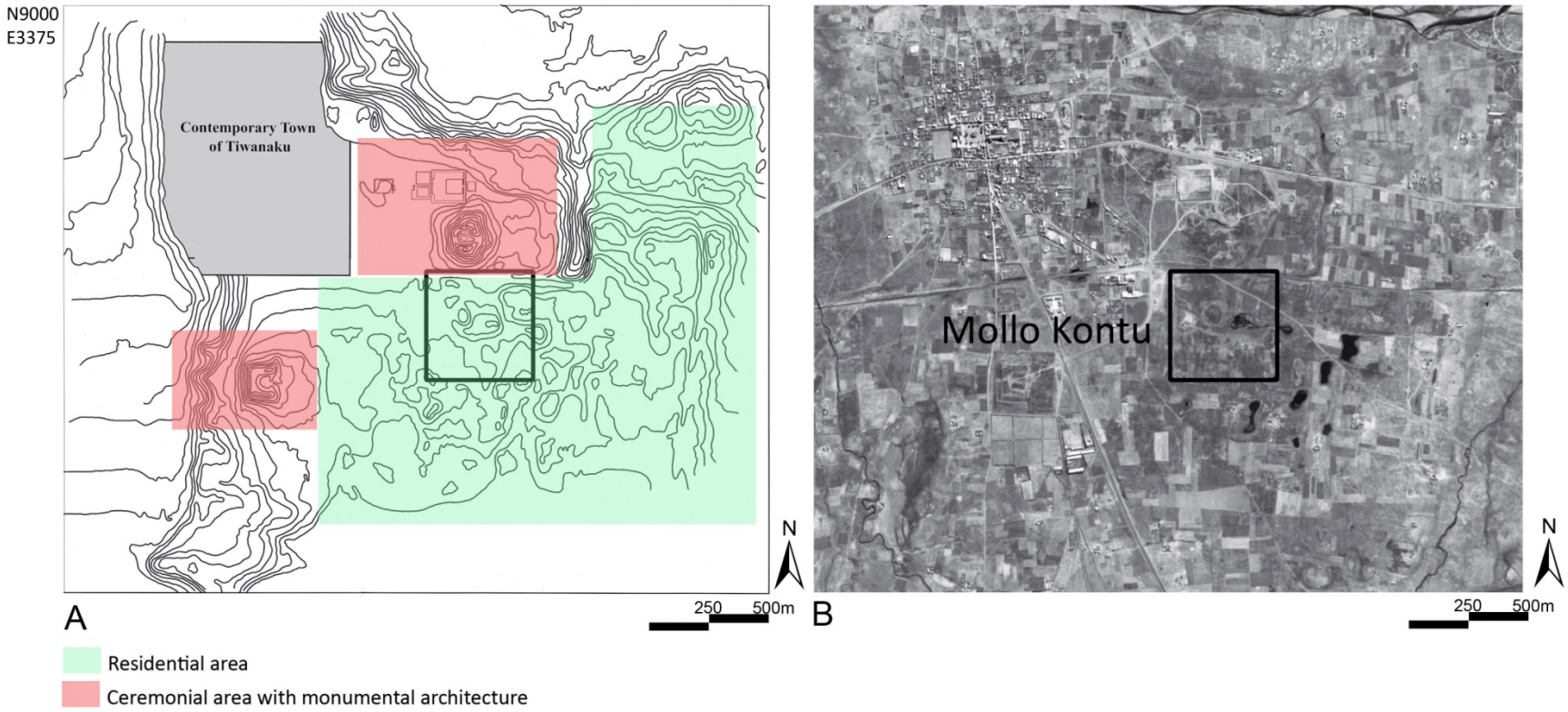


Figure 3A: Location of residential and ceremonial districts at Tiwanaku with the Mollo Kontu sector marked by an open black square (Adapted from Kolata 2003).

Figure 3B: Arial photograph of the same area of Tiwanaku shown in figure 3A with the Mollo Kontu sector marked bay an open black square (Adapted from Google Earth).

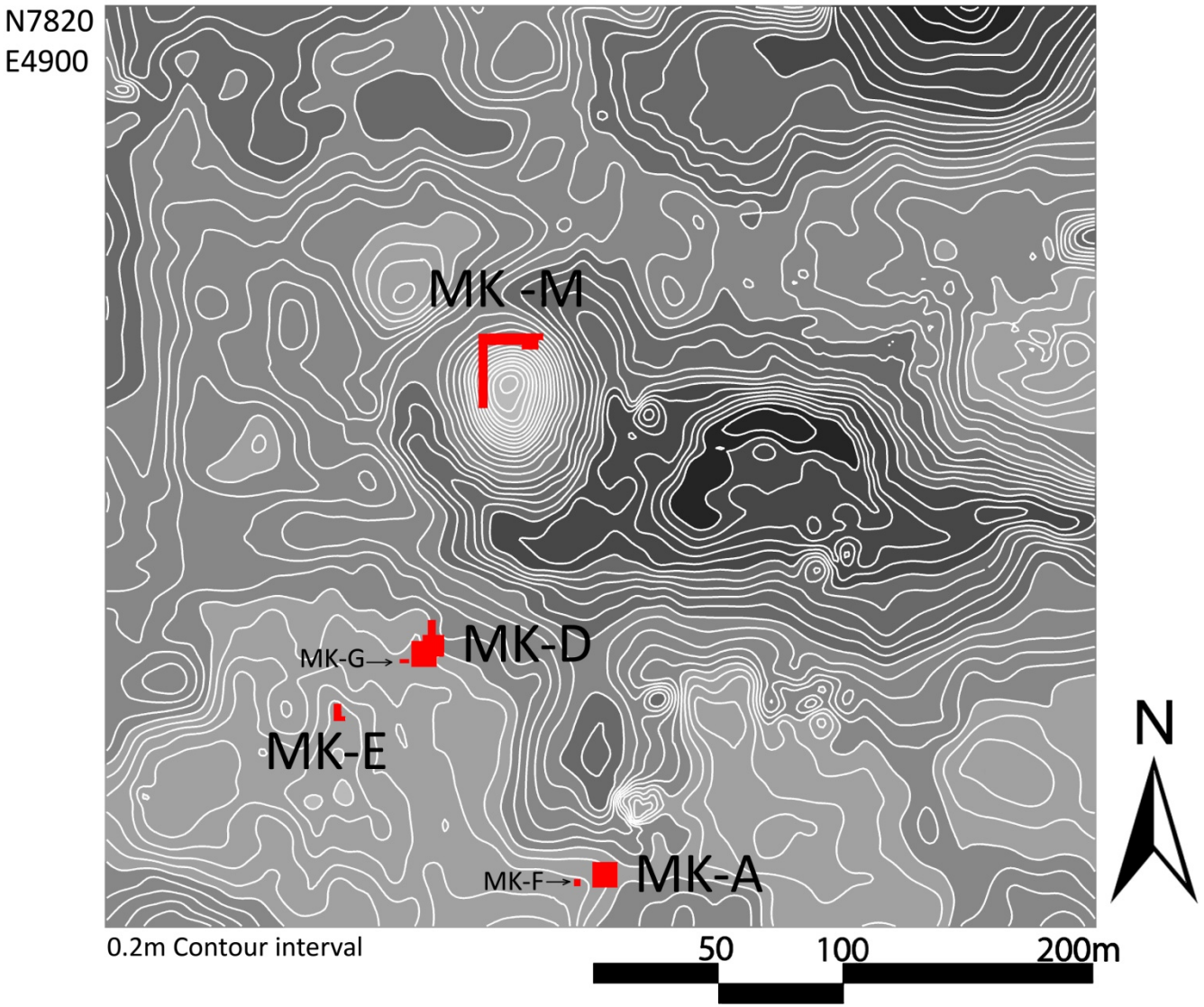


Figure 4: Simplified contour map of the Mollo Kontu sector as demarcated in figures 3A and 3B showing the relative location of all *Proyecto Ja'cha Marka* excavation areas discussed in the text.

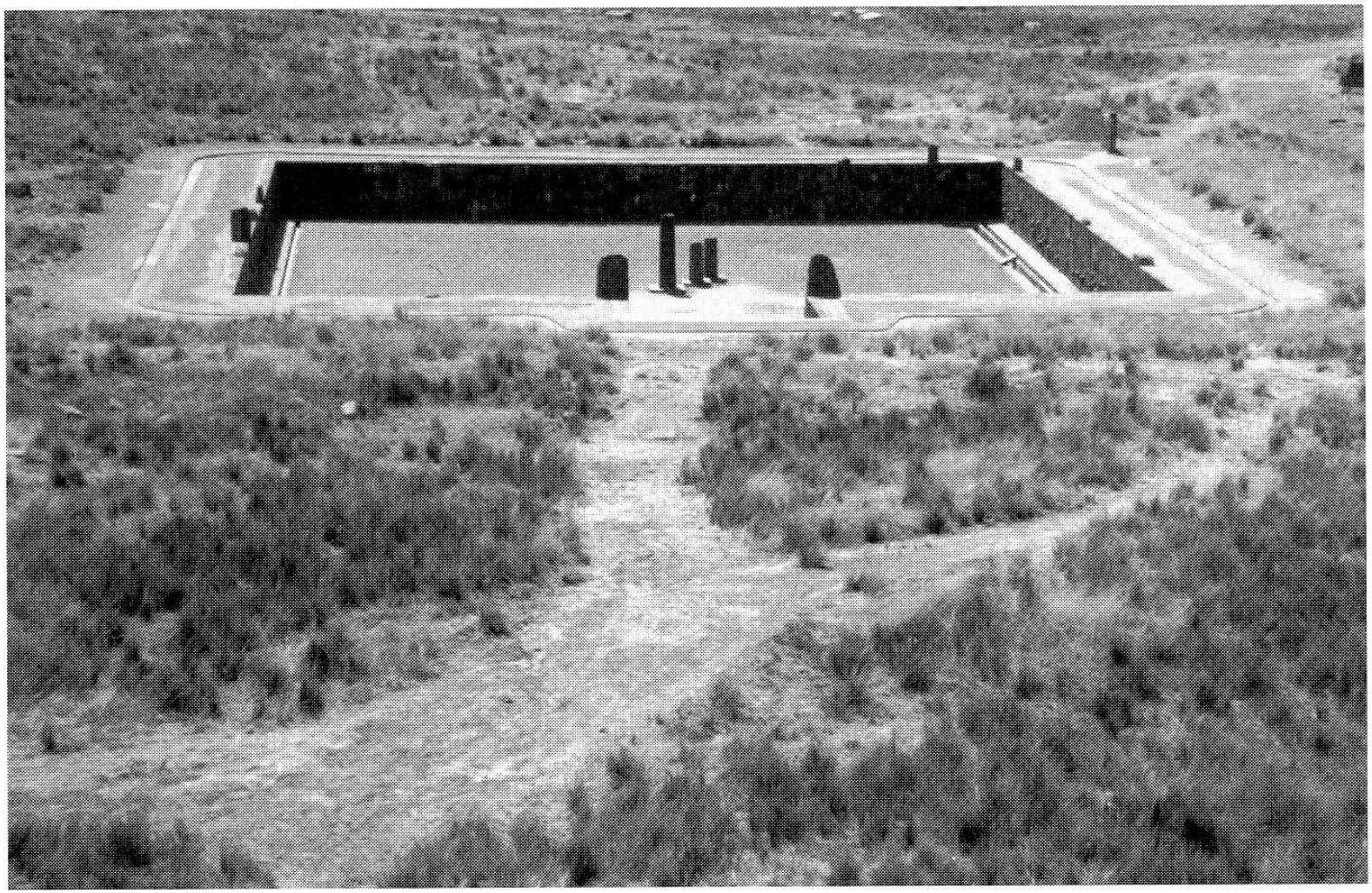


Figure 5: The Semi-Subterranean Temple at Tiwanaku as viewed from the base of the Akapana looking due north (Adapted from Goldstein 2005)

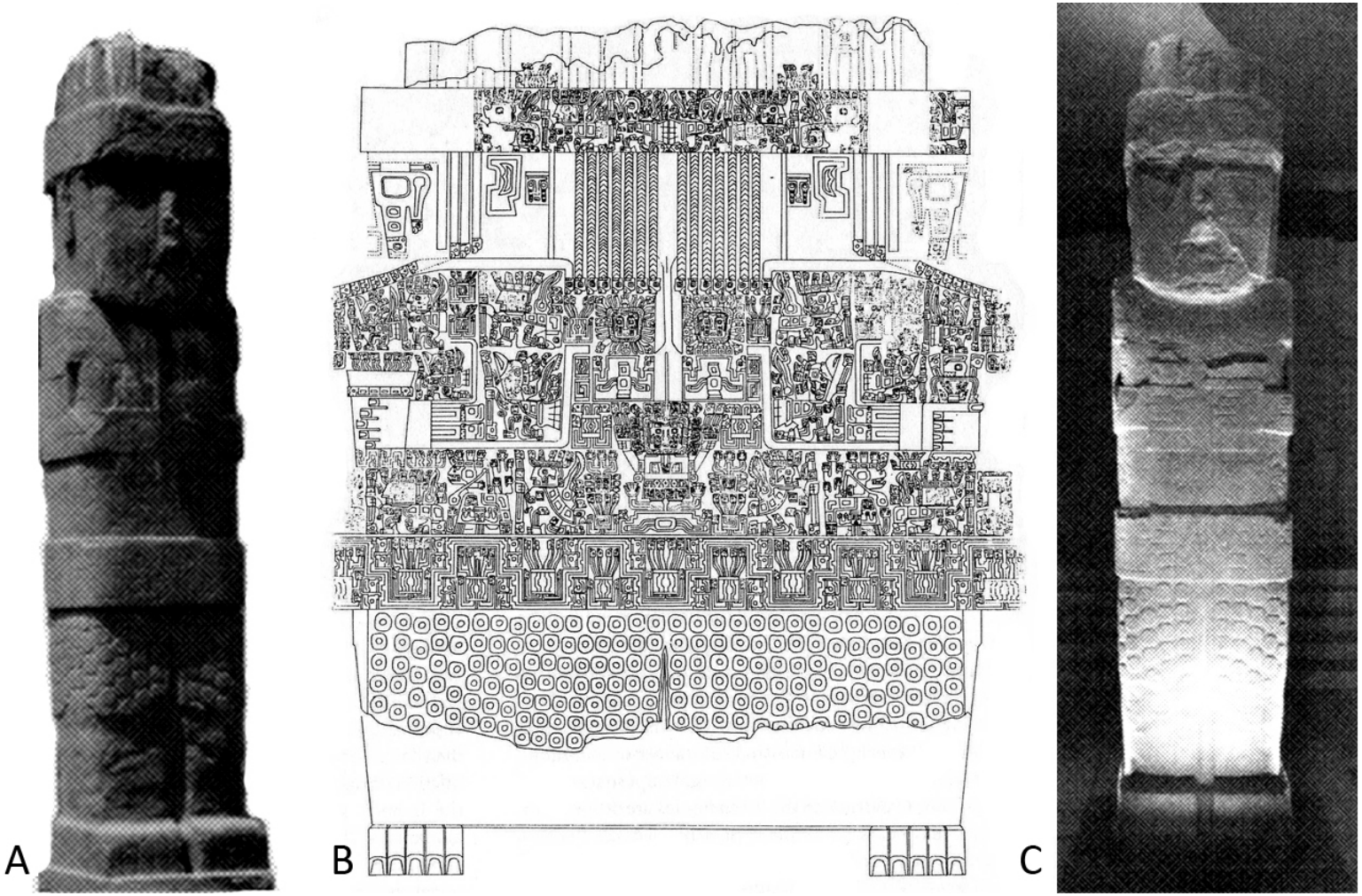


Figure 6A: The Bennett Monolith showing the front and right side (Adapted from Goldstein 2005).

Figure 6B: Roll-out drawing of the carvings veering the surface of the Bennett Monolith (Adapted from Kolata 2003).

Figure 6C: The Bennett Monolith viewed from the front as photographed at the Tiwanaku Archaeological Museum (Adapted from Janusek 2008).

Figure 7A: Western wall of the Semi-Subterranean Temple at Tiwanaku (photo by the author).

Figure 7B: Detail of a collection of tenon head sculptures found on the walls of the Semi-Subterranean Temple at Tiwanaku (photo by the author).

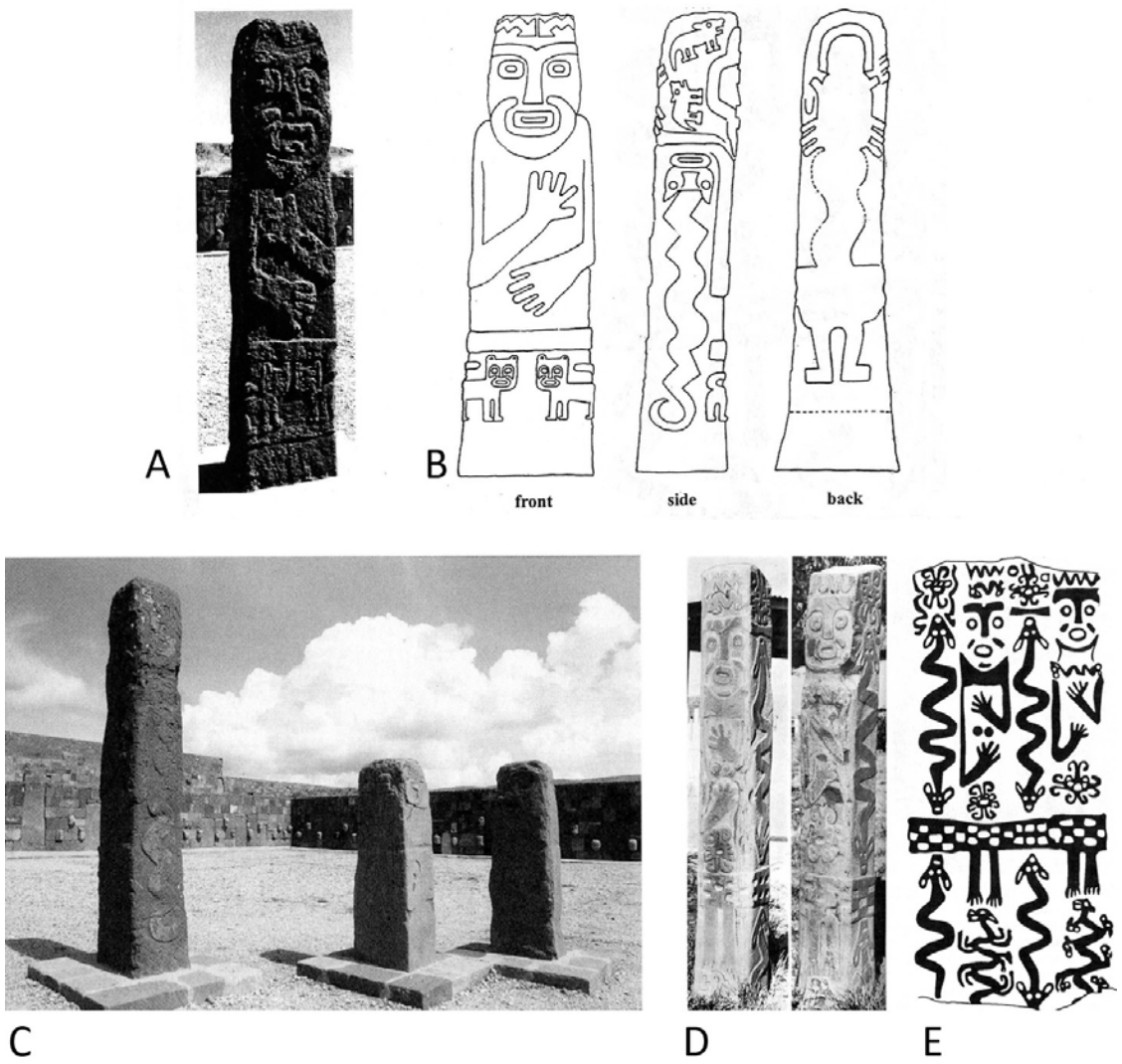


Figure 8A: Photo of Stela 15, or the "Bearded Stela" from the Semi-Subterranean Temple (Adapted from Couture 2002: Fig. 4.20)
Figure 8B: Line drawing of the "Bearded Stela" from the Semi-Subterranean Temple (Drawing from Bennett 1934: Fig. 32)
Figure 8C: Collection of stelae on display in the Semi-Subterranean Temple at Tiwanaku, with the Yaya-Mama style "Bearded Stela" on the far left (Adapted from Janusek 2008).
Figure 8D: The Taraco Yaya-Mama Stela, front and back views (Adapted from Janusek 2008).
Figure 8E: Roll-out drawing of the Taraco Yaya-Mama Stela surface carving (Adapted from Janusek 2008)

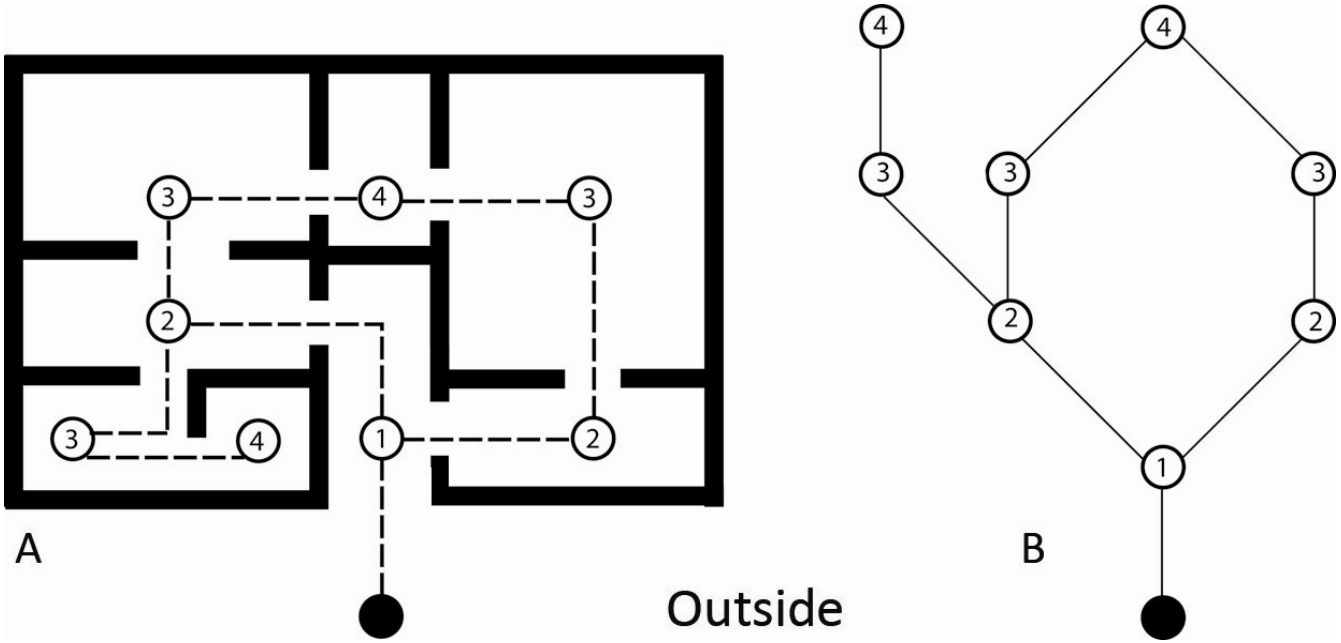


Figure 9A: Simplified access graph of a hypothetical architectural configuration. Rooms are marked with numbered nodes, each number representing the step-depth from the outside of the structure (drawing by the author)

Figure 9B: Justified access graph of the same structure depicted in figure 9B (drawing by the author).

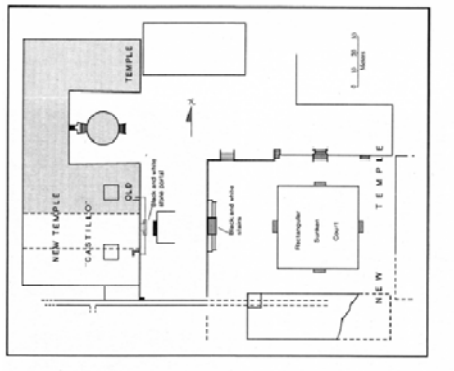


Figure 10: Chavín de Huántar – Published Plan (adapted from Moseley 2001)

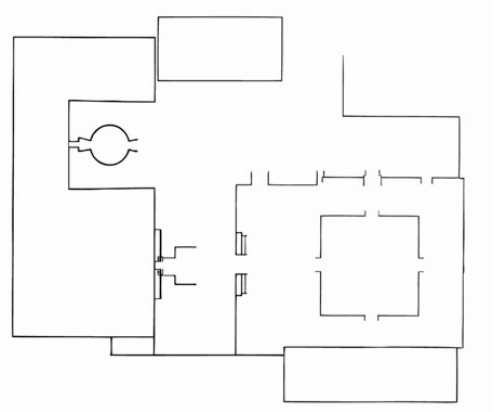


Figure 11: Chavín de Huántar – Simplified vector drawing

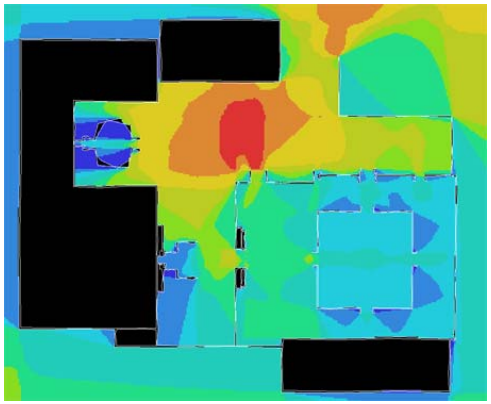


Figure 12: Chavín de Huántar – VGA

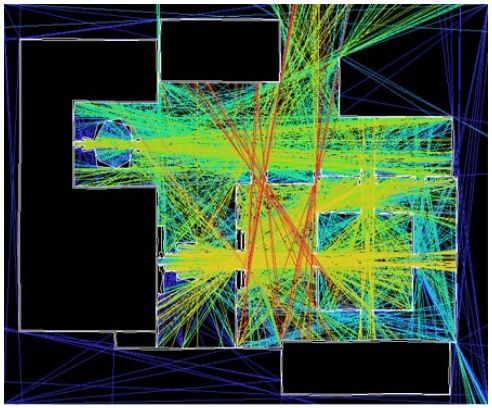


Figure 13: Chavín de Huántar – Axial analysis

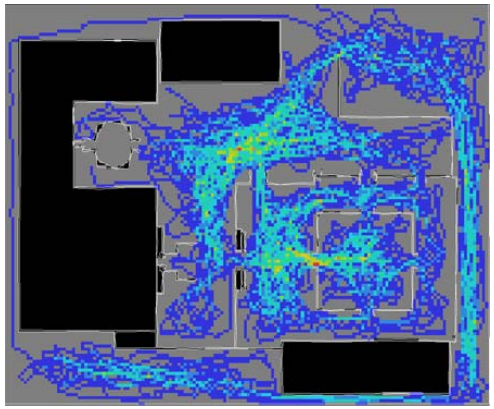


Figure 14: Chavín de Huántar – Agent analysis

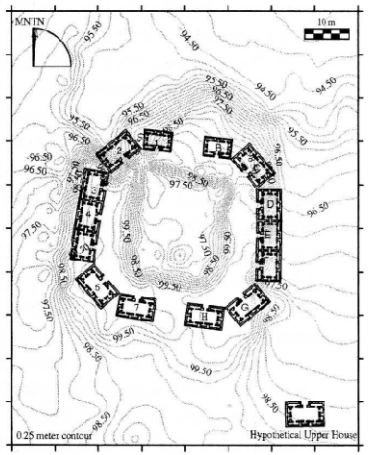


Figure 15: Chiripa – Published plan (adapted from Moseley 2001)

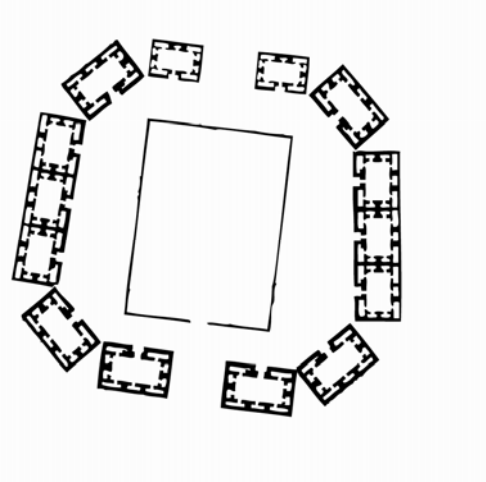


Figure 16: Chiripa – Simplified vector drawing

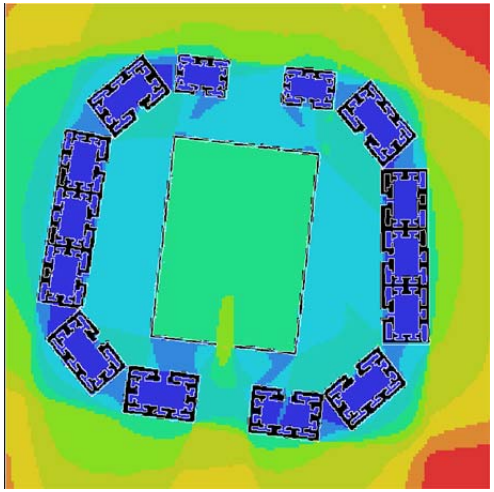


Figure 17: Chiripa – VGA

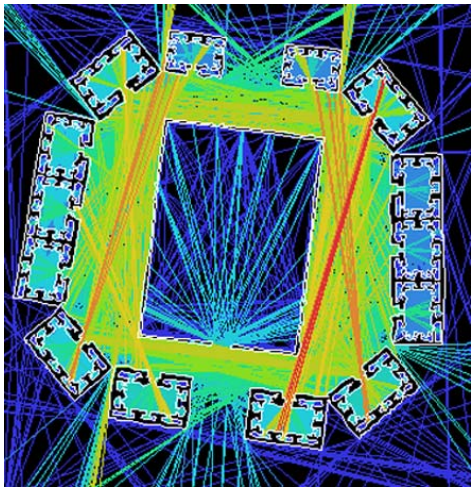


Figure 18: Chiripa - axial analysis

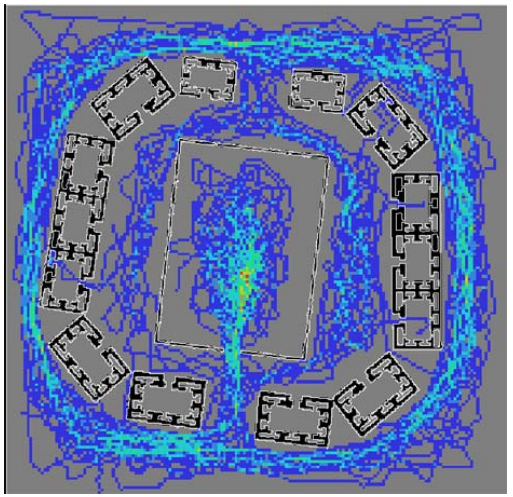
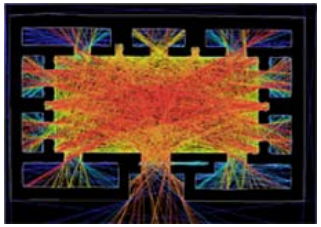


Figure 19: Chiripa – agent analysis

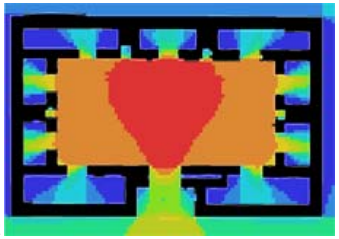
a

Figure 20a: Chiripa –Structural detail: simplified vector drawing



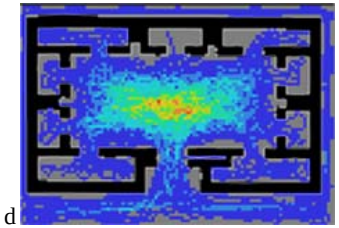
b

Figure 20b: Chavin – Structural detail: Axial Analysis



c

Figure 20c: Chiripa – Structural detail: VGA Analysis

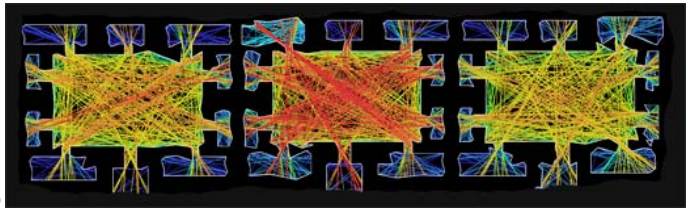


d

Figure 20d: Chiripa -Structural detail: Agent Analysis

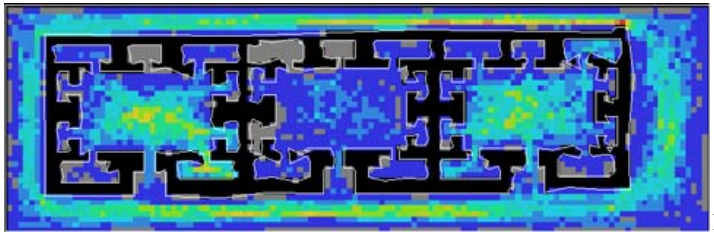
a

Figure 21a: Chiripa compound structure VGA



b

Figure 21b: Chiripa compound structure axial analys



c

Figure 21c: Chiripa compound structure agent analysis

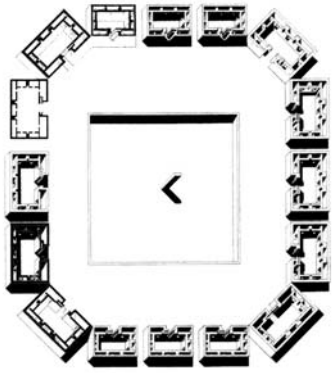


Figure 22: Chiripa – Idealized reconstruction plan (adapted from Moseley 2001)

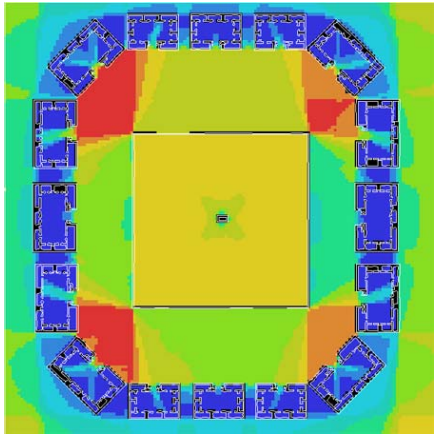


Figure 23: Chiripa – Idealized reconstruction plan VGA

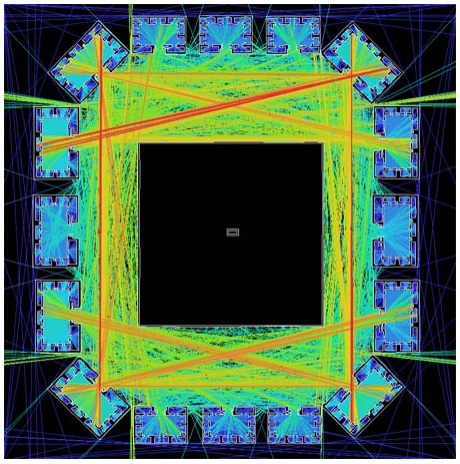


Figure 24: Chiripa – Idealized reconstruction plan axial analysis

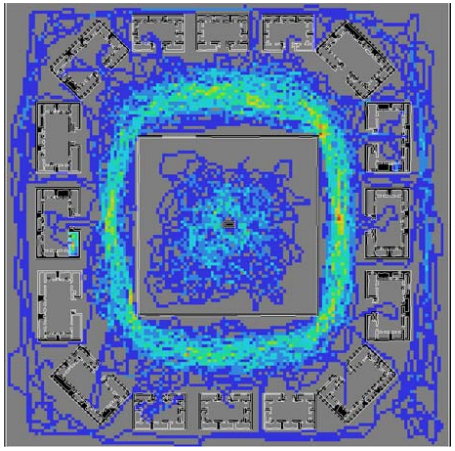


Figure 25: Chiripa – Idealized reconstruction plan agent analysis

Figure 26: Pukara – Published plan (adapted from Moseley 2001)

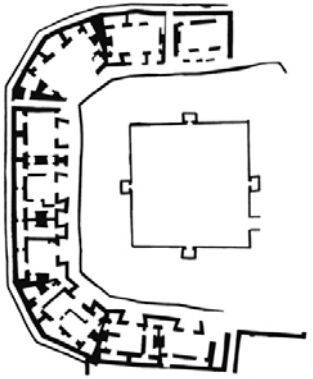


Figure 27: Pukara – Vectorized plan

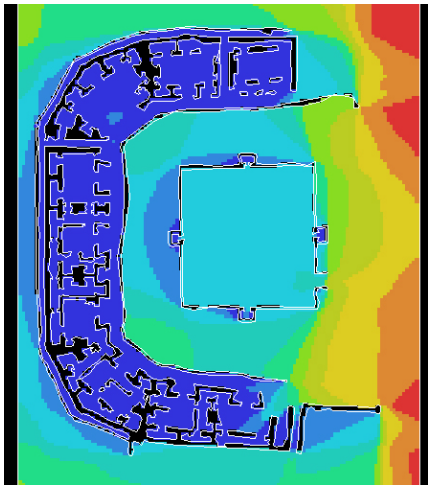


Figure 28: Pukara – VGA

Figure 29: Pukara – Axial analysis

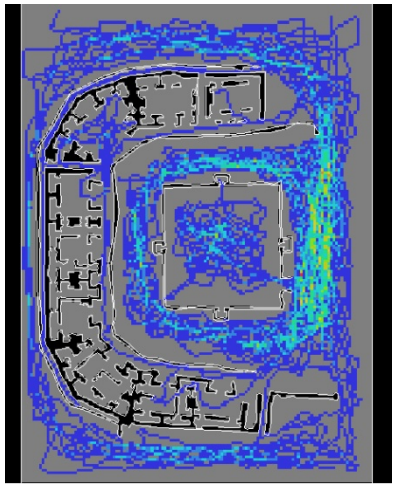


Figure 30: Pukara - Agent analysis

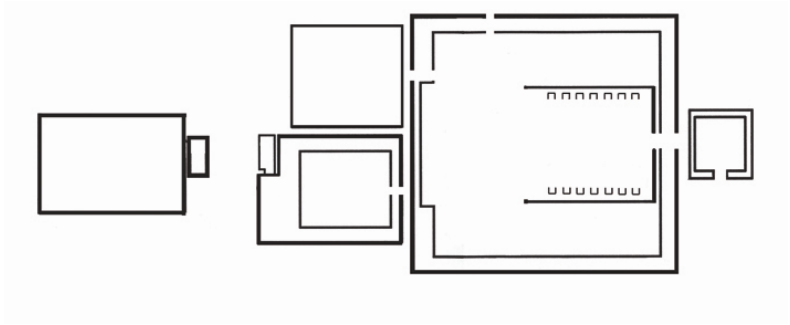


Figure 31: Tiwanaku – Vectorized plan from (adapted from Kolata 2003)

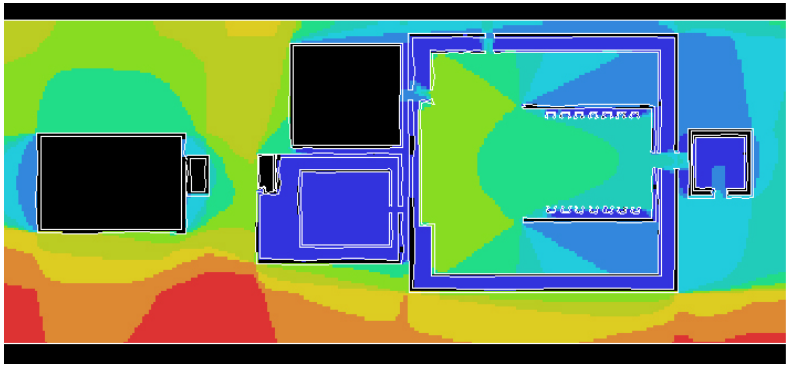


Figure 32: Tiwanaku - VGA

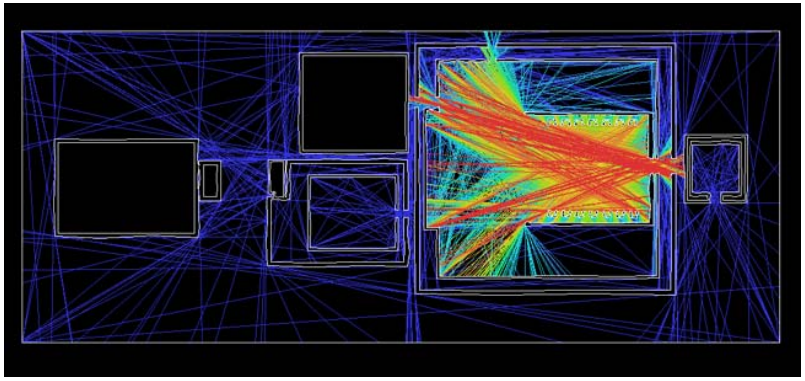


Figure 33: Tiwanaku – axial analysis

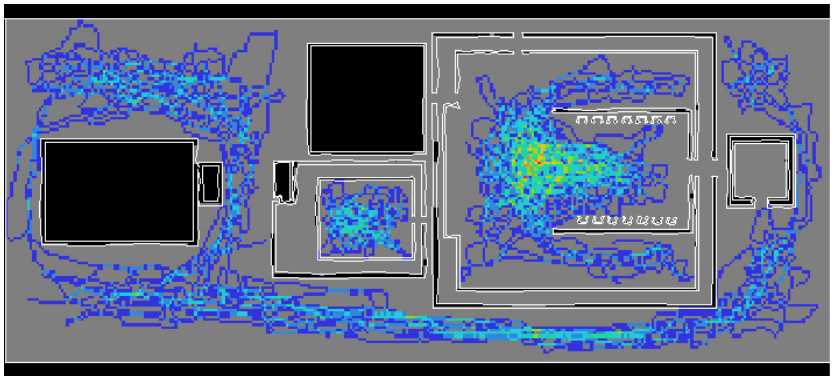


Figure 34: Tiwanaku – agent analysis

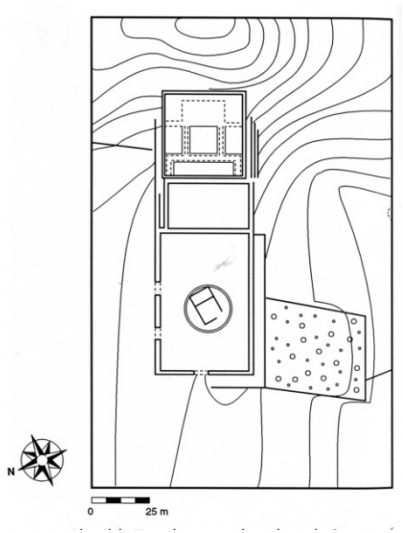


Figure 35: Moquegua- Omo M10 published plan (adapted from Goldstein 2005)

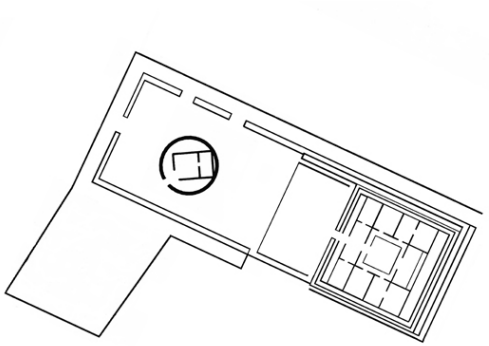


Figure 36: Moquegua- Omo M10 vectorized composite plan

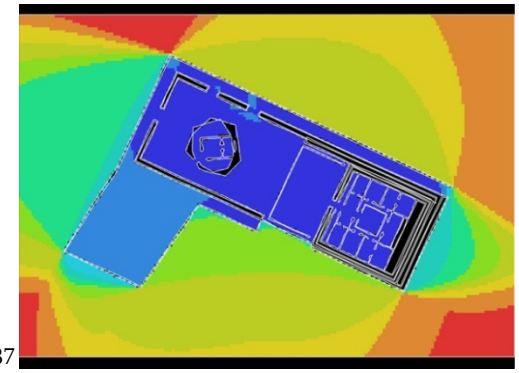
Fig.37 

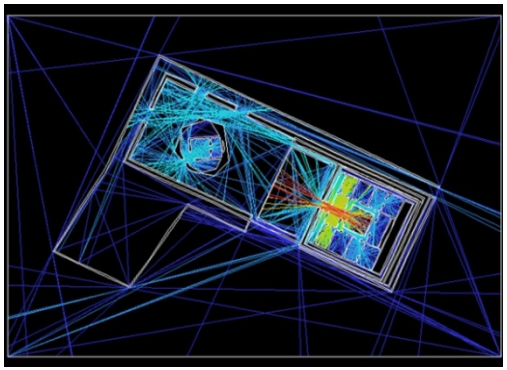
Fig.38 

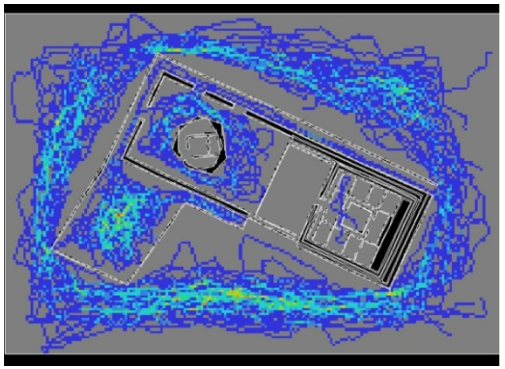
Fig.39 

Figure 37: Moquegua- Omo M10 vectorized composite plan - VGA

Figure 38: Moquegua- Omo M10 vectorized composite plan – axial analysis

Figure 39: Moquegua- Omo M10 vectorized composite plan – agent analysis

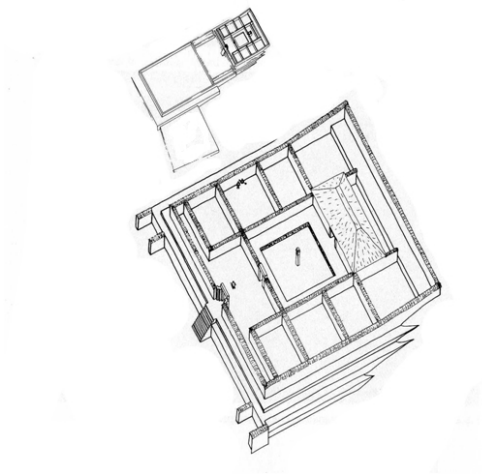


Figure 40 Moquegua- Omo M10 temple reconstruction (adapted from Goldstein 2005)

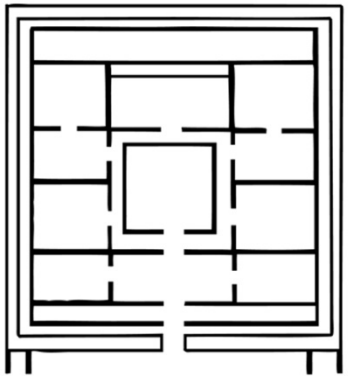


Figure 41: Moquegua- Omo M10 temple reconstruction vectorized plan

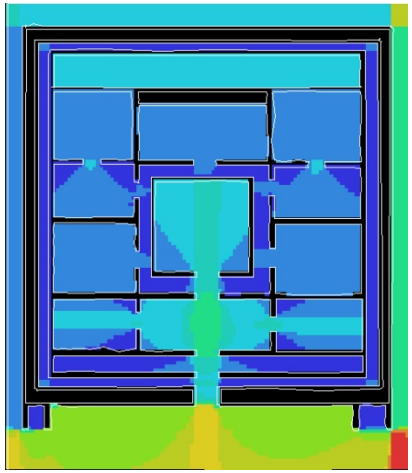
Fig.42 

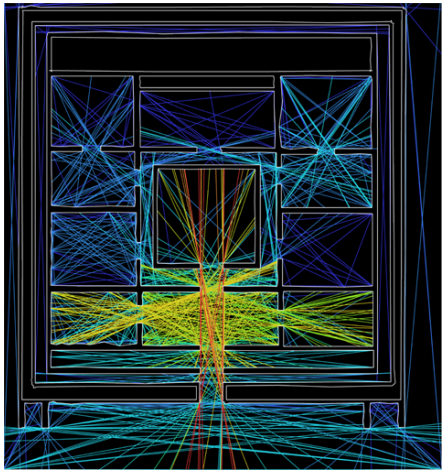
Fig.43 

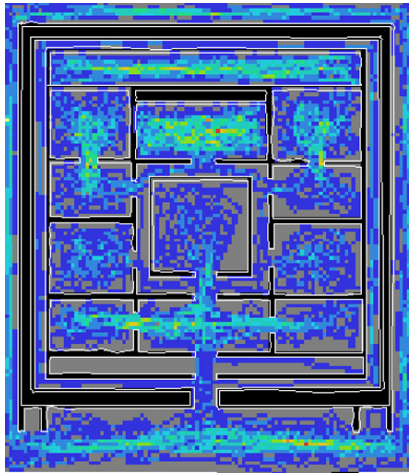
Fig. 44 

Figure 42: Moquegua- Omo M10 temple reconstruction VGA

Figure 43: Moquegua- Omo M10 temple reconstruction axial analysis

Figure 44: Moquegua- Omo M10 temple reconstruction agent analysis

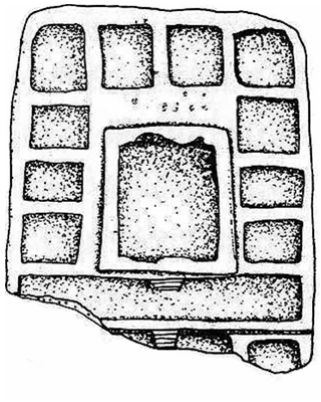


Figure 45: Moquegua – Omo M10 *Maqueta* drawing (adapted from Goldstein 2005)

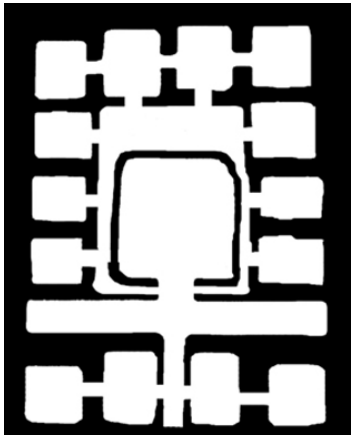


Figure 46: Moquegua – Omo M10 *Maqueta* vectorized plan interpretation

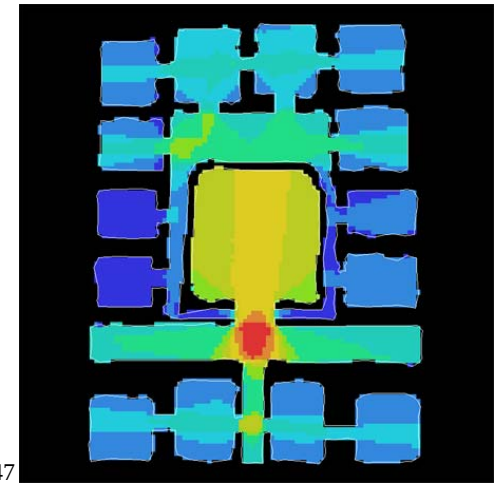
Fig.47 

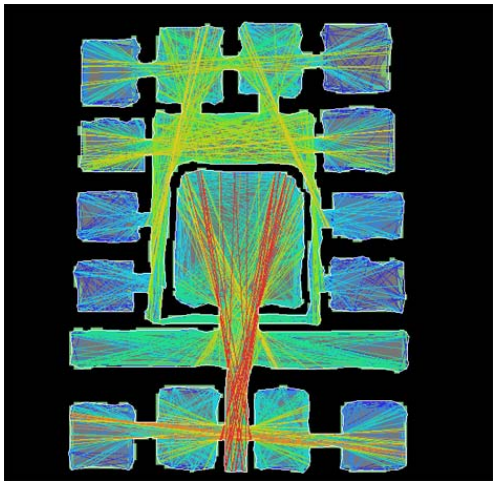
Fig.48 

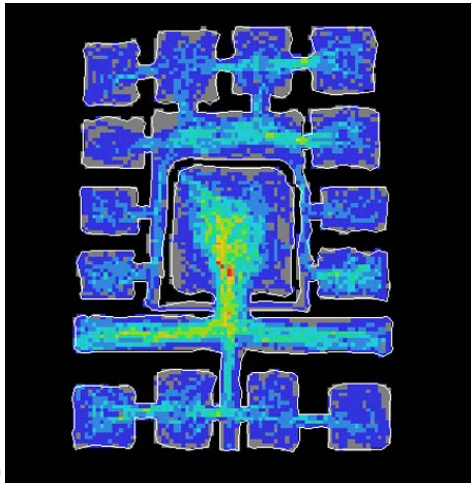
Fig.49 

Figure 47: Moquegua – Omo M10 *Maqueta* VGA

Figure 48: Moquegua – Omo M10 *Maqueta* axial analysis

Figure 49: Moquegua – Omo M10 *Maqueta* plan interpretation agent analysis

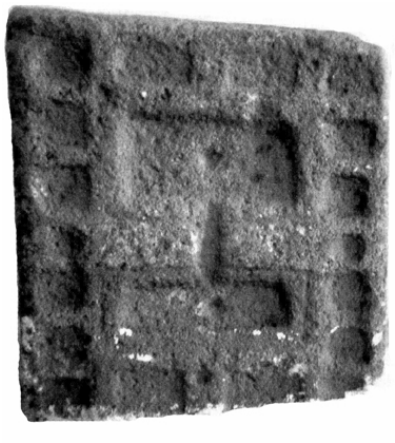


Figure 50: Copacabana *Maqueta* photograph (adapted from Goldstein 2005)

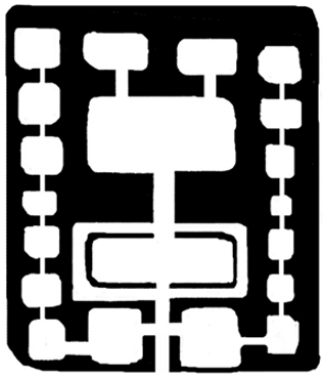


Figure 51: Copacabana *Maqueta* vectorized plan interpretation

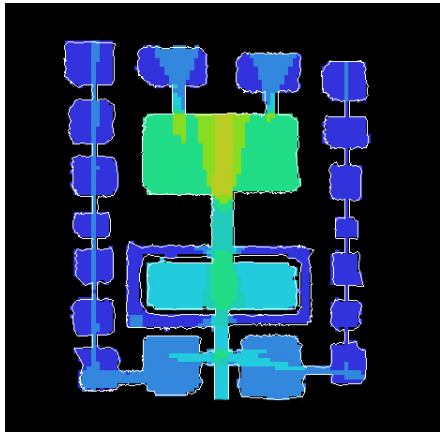
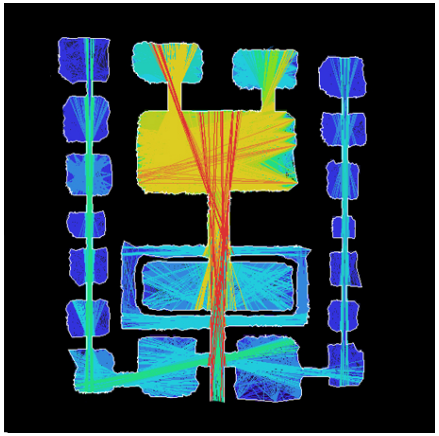
Fig.52 

Fig.53 

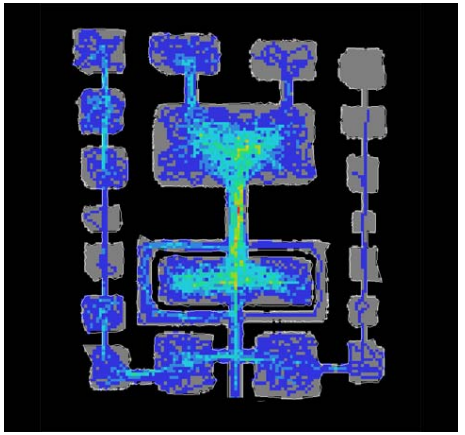
Fi. 54 

Figure 52: Copacabana *Maqueta* plan interpretation VGA

Figure 53: Copacabana *Maqueta* plan interpretation axial analysis

Figure 54: Copacabana *Maqueta* plan interpretation agent analysis

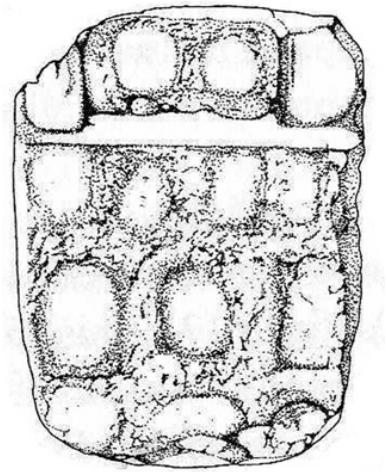


Figure 55: Calaluna M104A *Maqueta* drawing (adapted from Goldstein 2005)

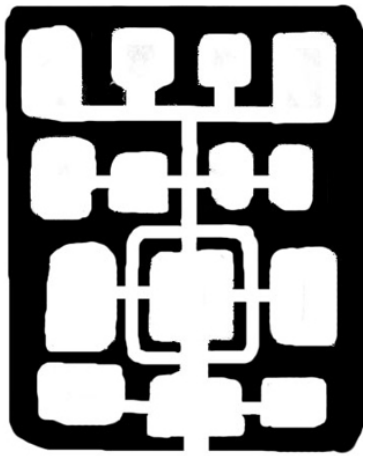


Figure 56: Calaluna M104A *Maqueta* vectorized plan interpretation

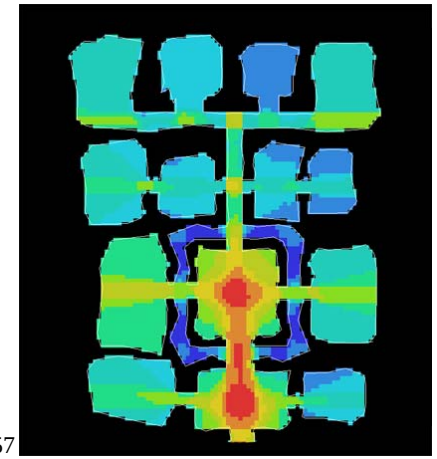
Fig.57 

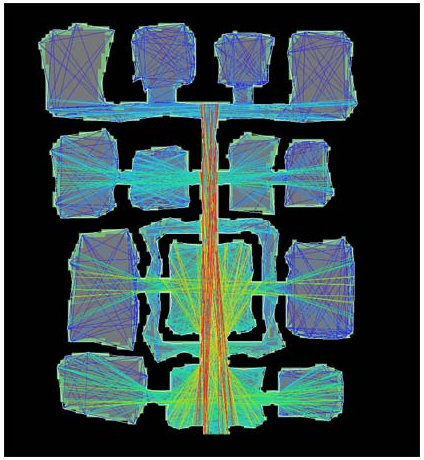
Fig.58 

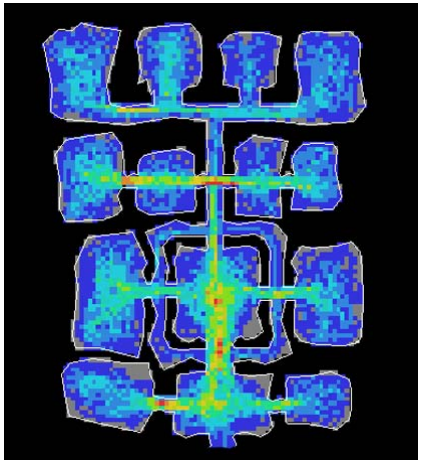
Fig.59 

Figure 57: Calaluna M104A *Maqueta* plan interpretation VGA

Figure 58: Calaluna M104A *Maqueta* plan interpretation axial analysis

Figure 59: Calaluna M104A *Maqueta* plan interpretation agent analysis

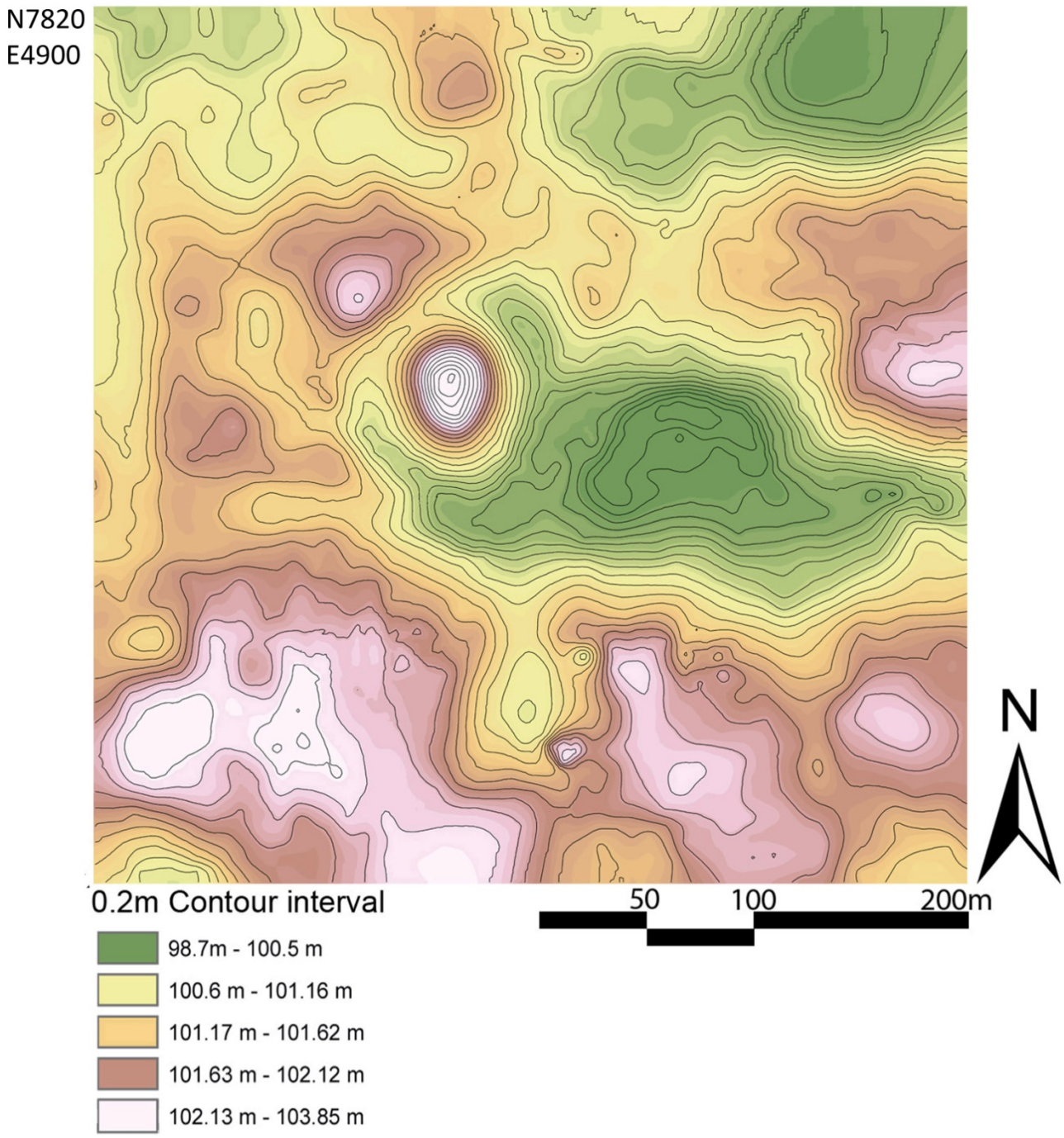


Figure 60a: Topographic map of the Mollo Kontu sector at Tiwanaku in 2007.

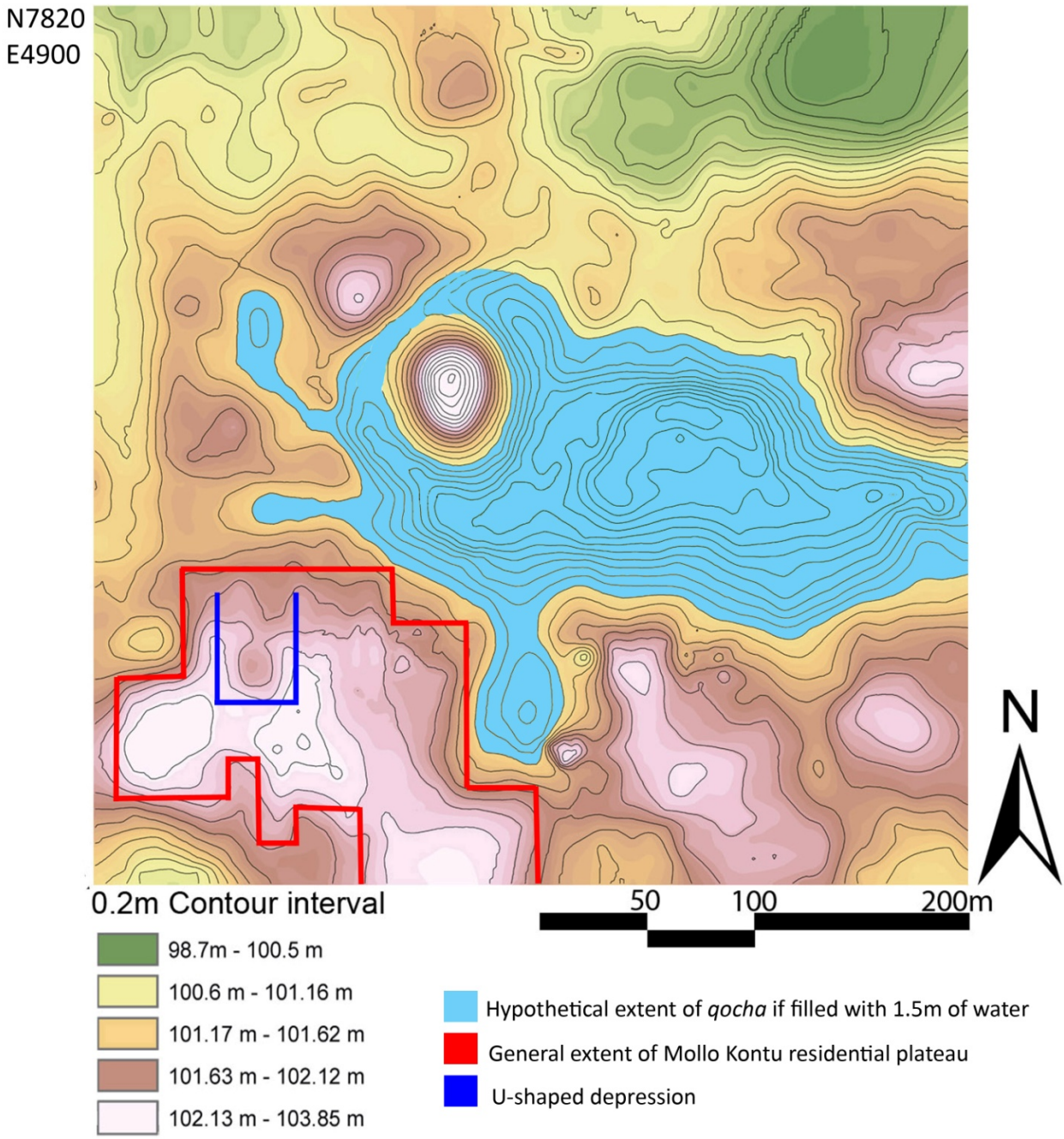


Figure 60b: Topographic map of the Mollo Kontu sector at Tiwanaku in 2007 with overlay of possible organization of moat and qocha if filled with water in antiquity as well as possible location of major topographic features discussed in the text.

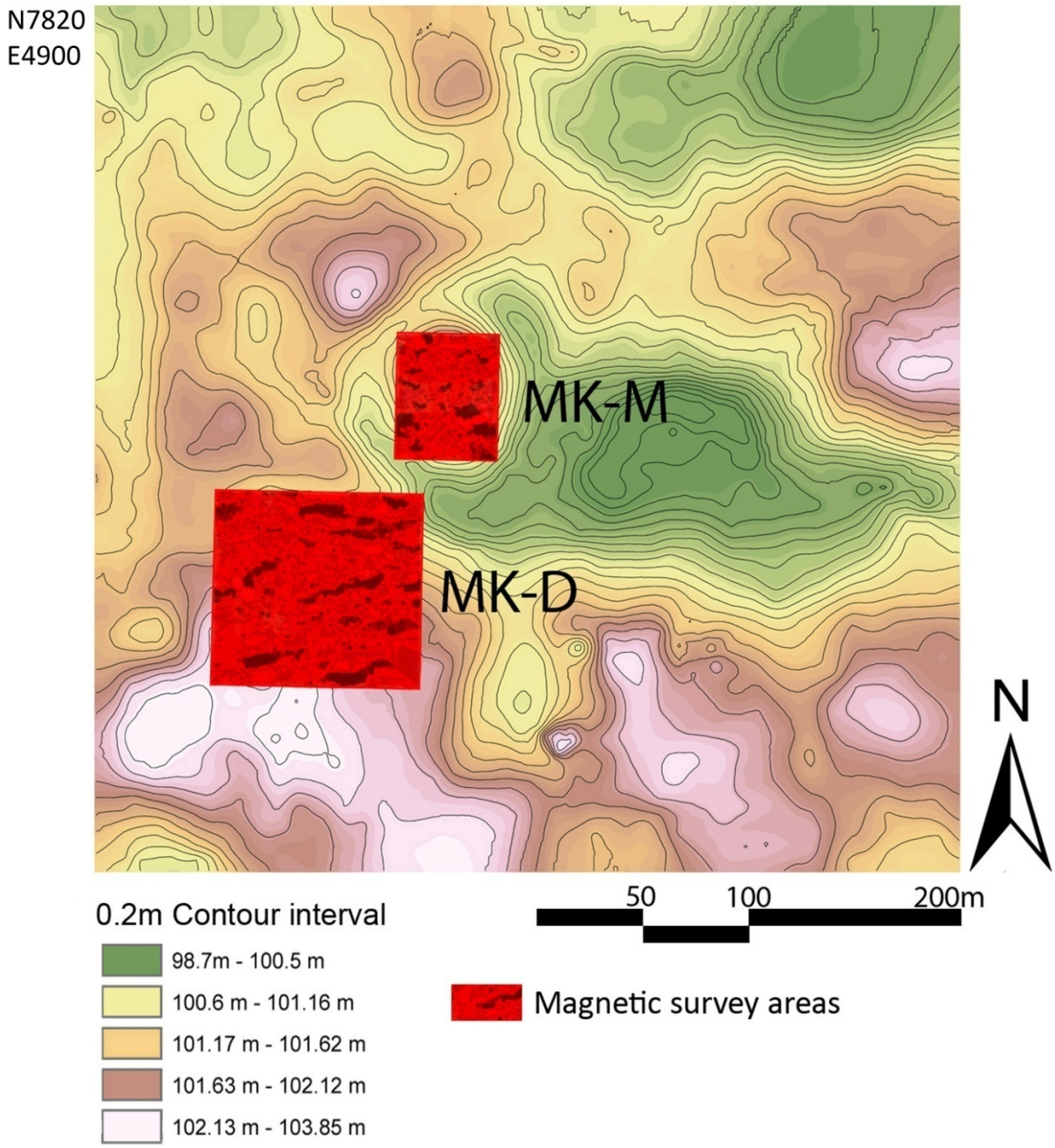


Figure 61: Topographic map of the Mollo Kontu sector at Tiwanaku in 2007 overlaid with the locations of the 2008 magnetic gradiometry survey areas.

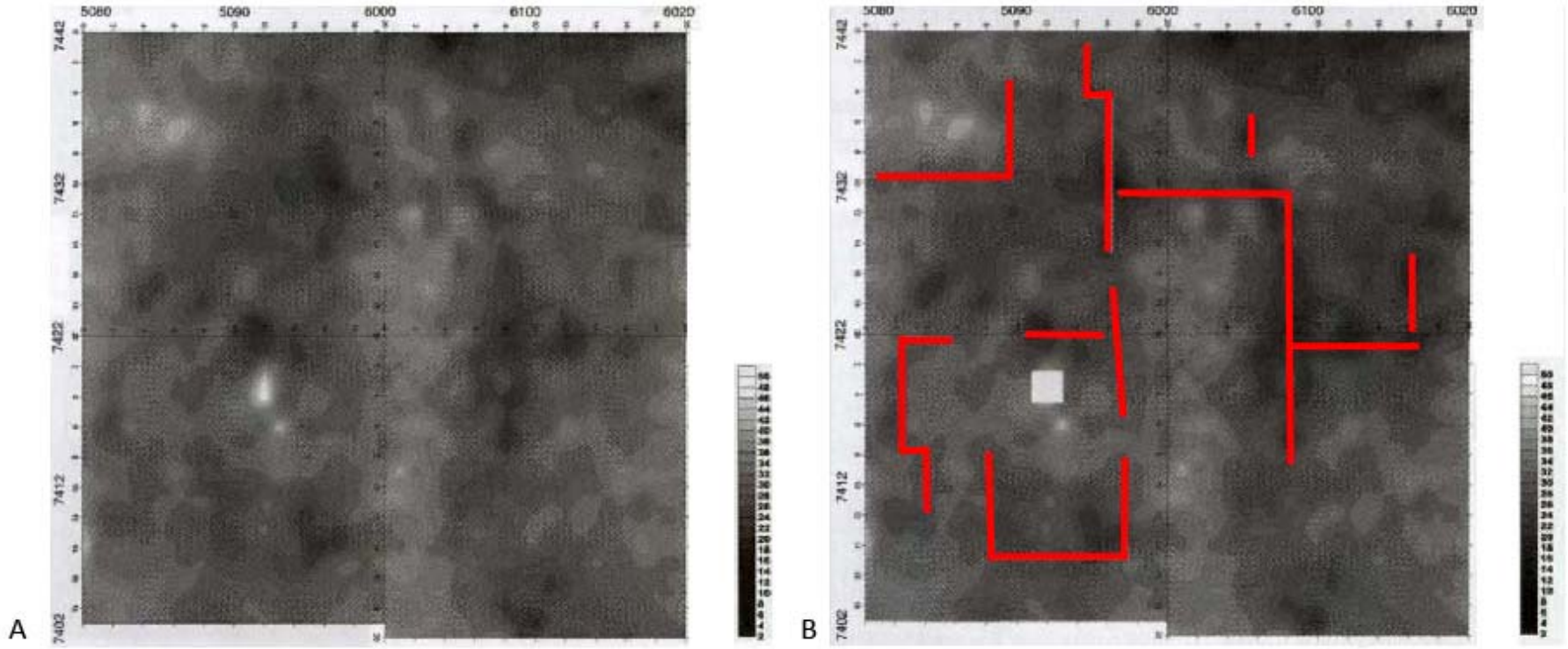


Figure 62A: Map of the results of 2004 electrical resistivity survey in the Mollo Kontu residential area(adapted from Vining *et al* 2008)

Figure 62B: Map of the results of 2004 electrical resistivity survey in the Mollo Kontu residential area showing position of hypothetical architecture as interpreted by Vining *et al* (adapted from Vining *et al* 2008)

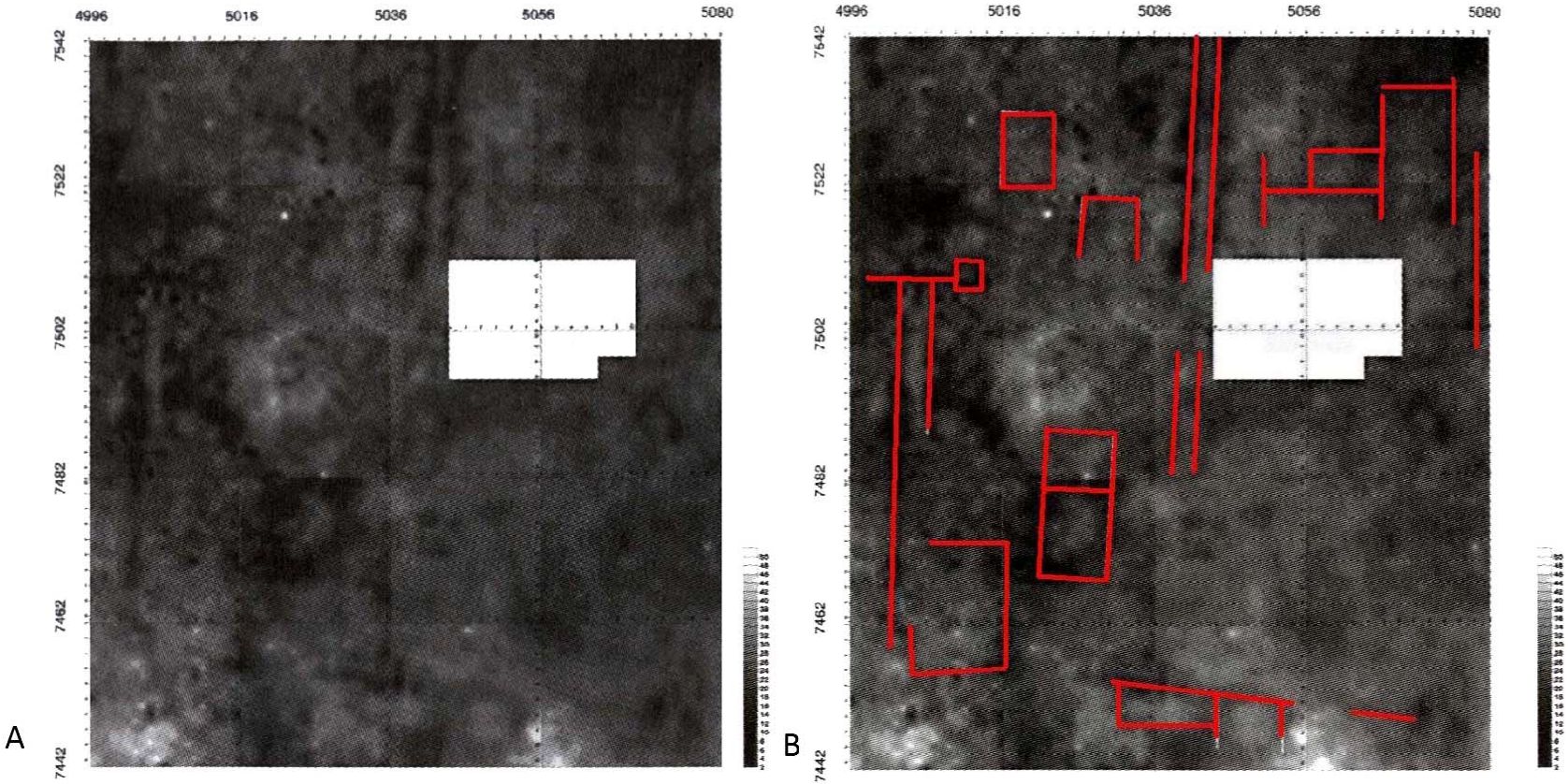


Figure 63A: Map of the results of 2004 magnetic gradiometry survey in the Mollo Kontu residential area(adapted from Vining *et al* 2008)

Figure 63B: Map of the results of 2004 magnetic gradiometry survey in the Mollo Kontu residential area showing position of hypothetical architecture as interpreted by Vining *et al* (adapted from Vining *et al* 2008)

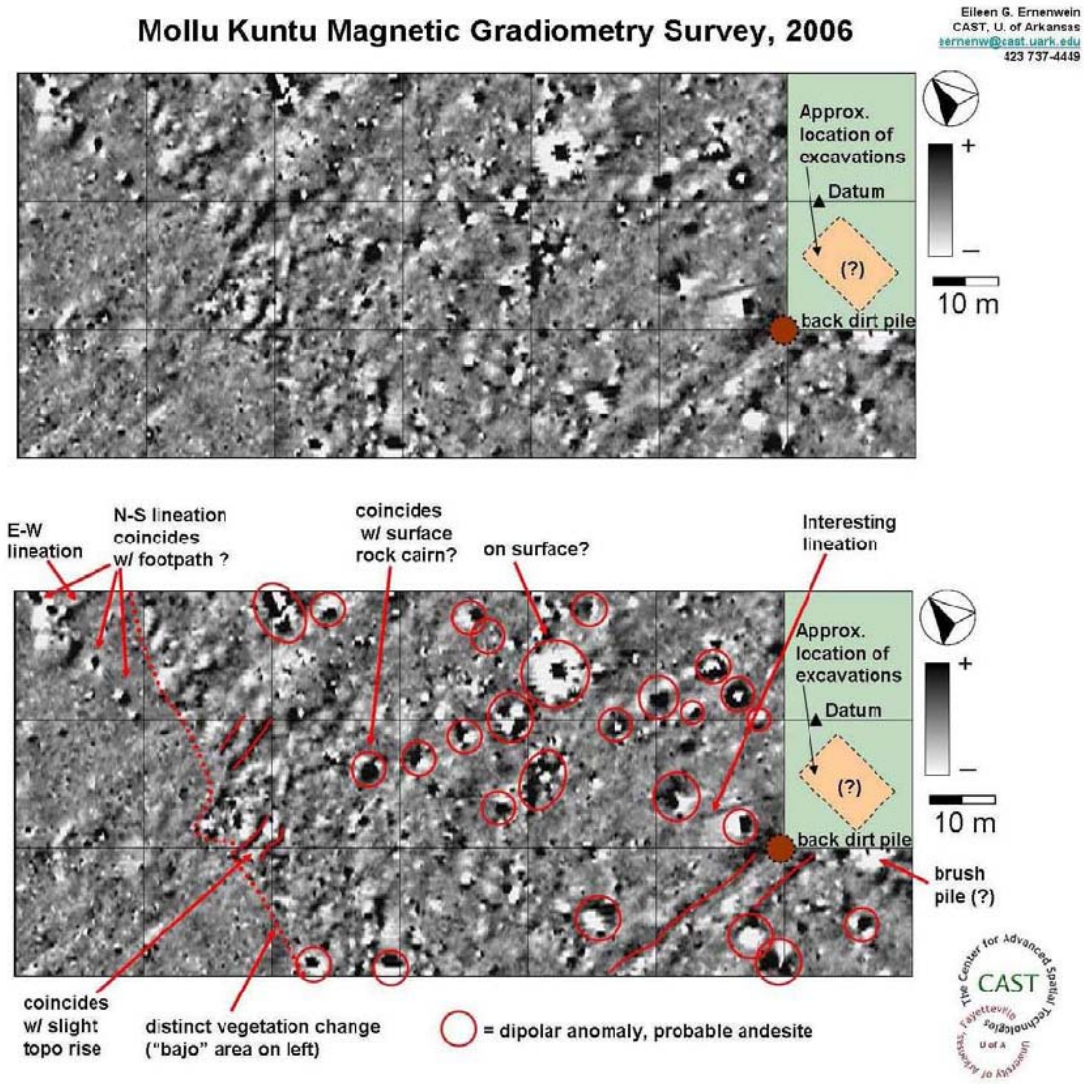


Figure 64: Map of the results of 2006 magnetic gradiometry survey west of the MK-E excavations in the Mollo Kontu residential area (top) with an overlay showing location of magnetic anomalies (bottom) as interpreted by Ernenwein (adapted from Ernenwein 2006).

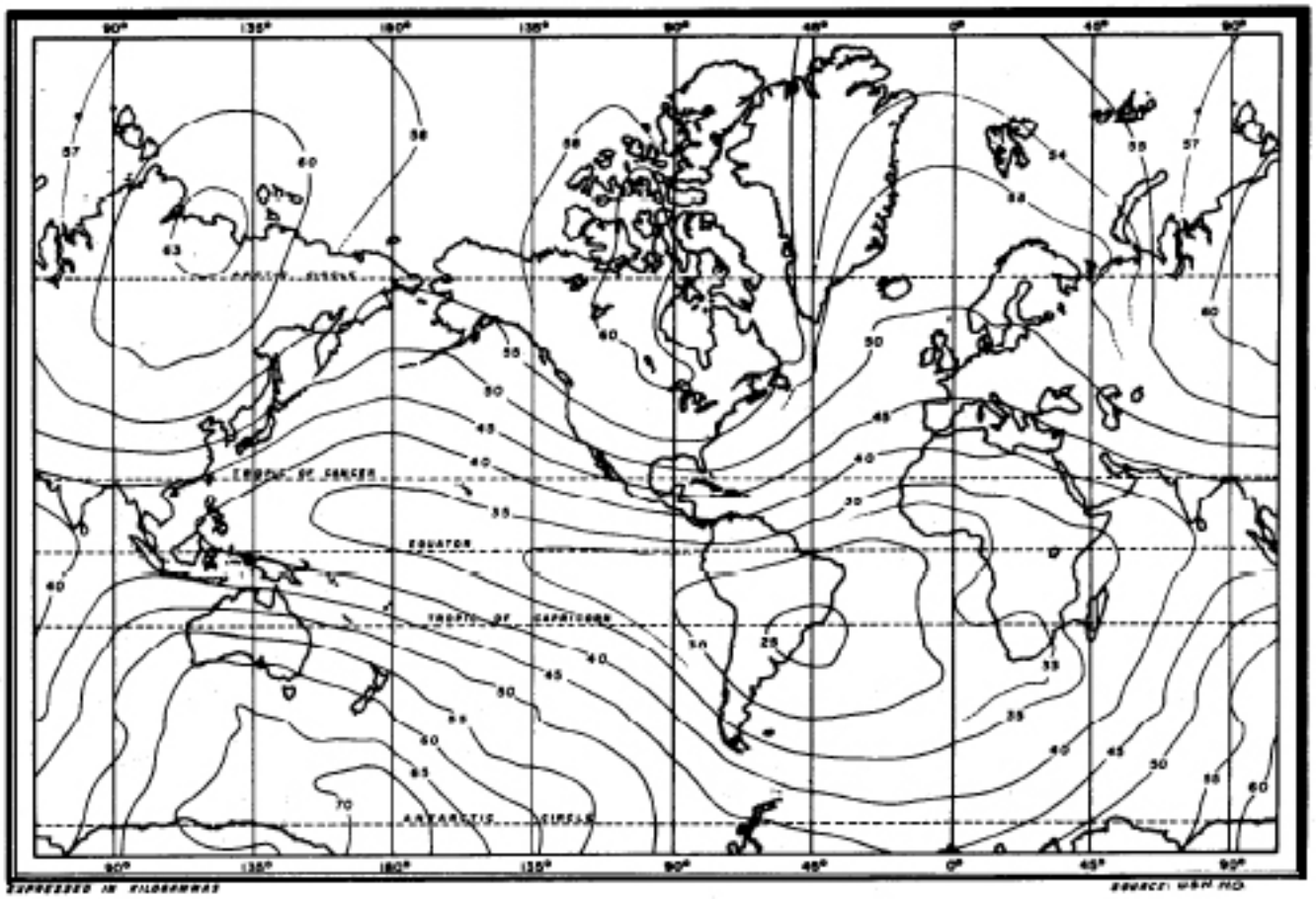


Figure 65: Map of the total intensity of the Earth's magnetic field, values expressed in kilogammas (adapted from Breiner 1999).

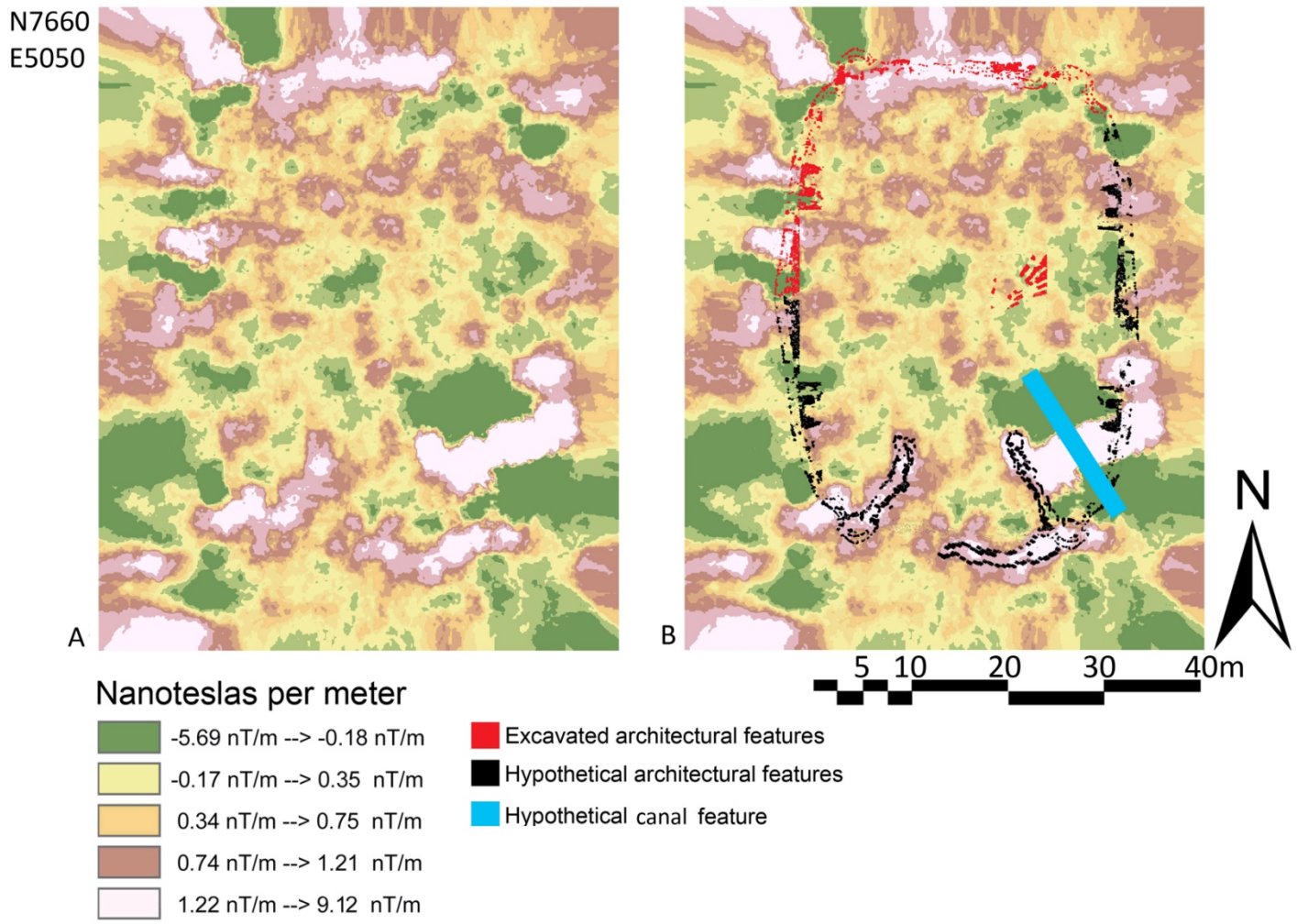


Figure 66A: Map of the results of the 2008 magnetic gradiometry survey of the Mollo Kontu Mound.

Figure 66B: Map of the results of the 2008 magnetic gradiometry survey of the Mollo Kontu Mound overlaid with a map of known and hypothetical architectural features..

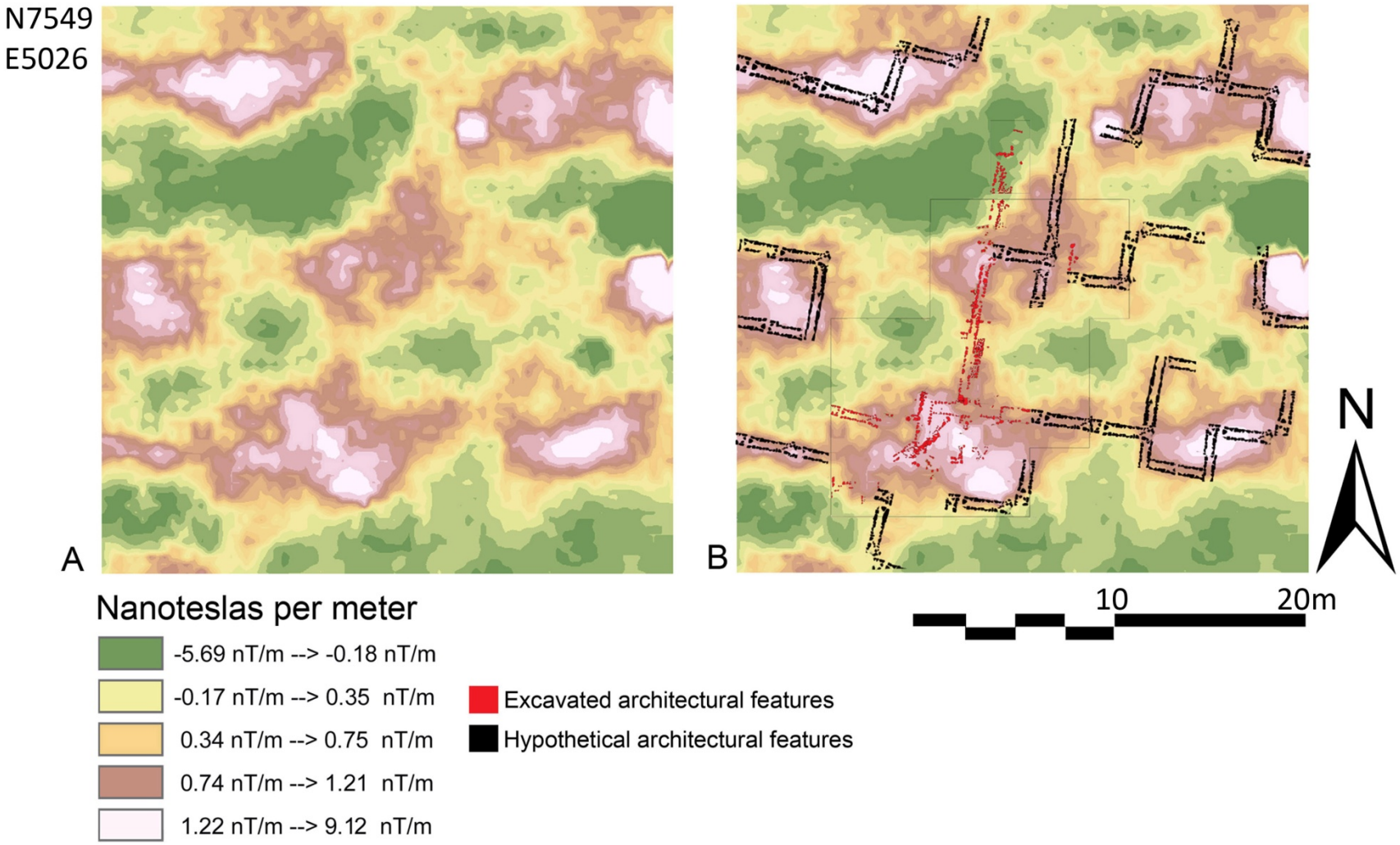


Figure 67A: Map detail of the results of the 2008 magnetic gradiometry survey of the Mollo Kontu residential area in the immediate area of the MK-D excavations.

Figure 67B: Map detail of the results of the 2008 magnetic gradiometry survey of the Mollo Kontu residential area in the immediate area of the MK-D excavations overlaid with a map of known and hypothetical architecture

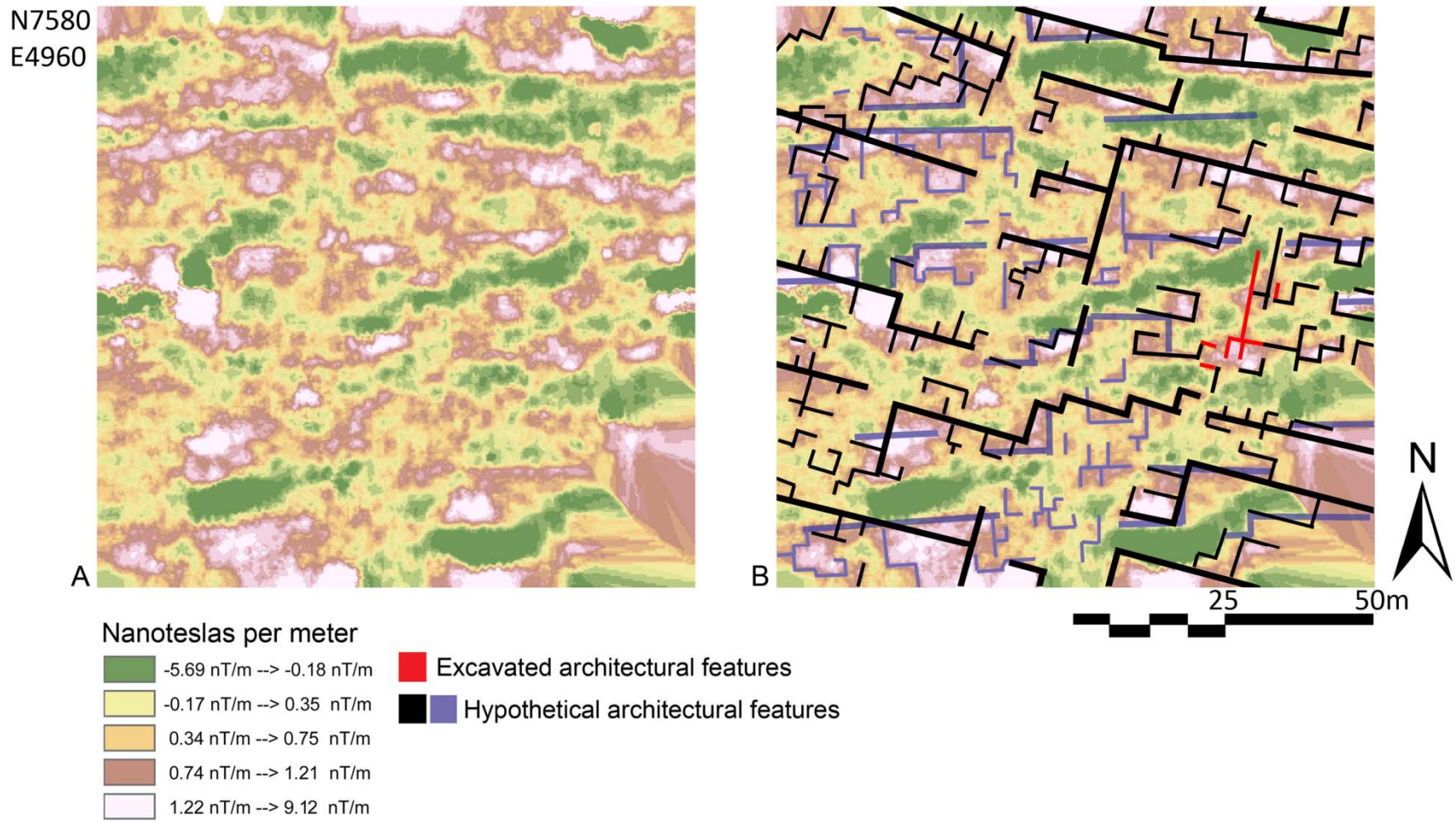


Figure 68A: Map of the results of the 2008 magnetic gradiometry survey of the Mollo Kontu residential area.

Figure 68B: Map of the results of the 2008 magnetic gradiometry survey of the Mollo Kontu residential with a map of known and hypothetical architecture.