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INFORME: TIWANAKU AKAPANA MOUND FLOTATION SAMPLES

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Introduction

In the center of the site of Tiwanaku, soil samples for flotation were collected from several areas of the Akapana mound, by Drs. Linda Manzanilla and Maria Renée Baudoin during the 1988-89 field seasons. While several dozen samples were recovered, at this time only 21 have been floated, 17 from 1989 and 4 from 1988. The strategy selected for our first phase of paleoethnobotanical analysis has been threefold, 1) to analyze at least some samples from all areas, 2) to focus on domestic areas of the site, and 3) to work only with samples where information concerning cultural contexts, field notes, etc., were available. The samples chosen from the Akapana mound excavations were from areas that were thought to contain in situ deposits. Only samples with uncontaminated contexts were utilized. We included very few samples from areas that are fill from the construction of the mound, as these are not likely to contain primary depositions of materials that would be as culturally meaningful. Keeping these parameters in mind, we have analyzed 17 of the samples from the mound, all but one are from the 1989 season. Fifteen of the samples were from the Akapana Superior Norte area of the mound, from a large camelid offering. The other two samples are from fill from the mound.

Methods

Field methods

Botanical samples were processed using a motorized flotation system, modified from the SMAP machine design first published by Watson in 1976. Because the charred materials have a lower specific gravity than water, they float on the water's surface and can be poured off. Our machine is built from a a 55 gallon oil drum as a water container, that is used to separate charred plant remains from the site matrix. Water is pumped into the system from below, and is moved upward in the drum by a submerged shower head. Inside the drum is a removable inner bucket, with a mesh bottom that the soil samples are poured into once it is partially submerged in the machine. The bottom mesh catches rocks, artifacts, and bones that do not float. This material that is caught is termed the "heavy fraction". It is dried, and the cultural material larger than 2 mm is removed and analyzed. In 1989 and 1990 we used brass cloth in the bottom of the inner bucket, with an aperture of 0.5mm.

The charred plant remains on the surface of the water are poured off through a spout into fine-meshed chiffon. This material, termed the "light fraction", was allowed to dry, and then packaged for shipment to the University of Minnesota's archaeobotany laboratory.

Approximately 20 samples were processed per day. Each day we added 50 charred poppy seeds to a randomly selected sample to act as a check on the flot machine (see Wagner 1982, 1988). Poppy seeds are used in the Americas because they are not native (and hence will never occur in prehistoric deposits), and they are small in size (ca. 0.4 x 0.6mm). These features allow poppy seeds to act as a measure of the amount of small seeds that are lost or recovered. The average recovery rate for 1989-90 was 93.4% (46.7), indicating that most material from the samples was being recovered.

Laboratory methods

Analysis of the charred plant remains from the light fraction started with removing carbon, bones, and fish scales from the floted matrix (mainly modern plant roots and soil). Lab analysis was done using low power (6-25X) stereoscopic microscopes with fiber optic light sources. Trained lab personnel extracted the charred plant remains from the samples, and made some preliminary identifications of plant taxa. H. Lennstrom checked all charred material removed from the samples and also scanned the remaining matrix for any identifiable plant parts that might have been missed. In addition she was responsible for the final identifications made of the charred plant parts. The identifications were made with the aid of Dr. Hastorf's South American reference collection of seeds, pressed plants, tubers, and wood in the lab. Material from each flot was examined two times, systematically, under the microscope. For ease of sorting, the samples were split using 2mm, 1.18mm, 0.5mm, and 0.3mm geologic sieves, keeping materials of the same size together in a separate tray. All charred material greater than 2 mm was pulled and identified, while wood was not removed from the <2 mm portion of the light fraction, as it is known to be too small for identification purposes (Asch and Asch 1975). Other plant material down to 300 microns was collected and identified. In some cases, when charred plant remains were particularly dense, it was not possible nor necessary to examine the entire sample. We used experimental results from Lennstrom's (1991a) work with Peruvian flot samples which found that a 10-25% sub-sample could be used to represent the sample as a whole, if the sample contained several thousand plant fragments and had a total volume of over 0.5 liter of charred botanical remains. Samples were split using a riffle box, so that the sub-samples were divided without bias (Pearsall 1989).

Each sample was recorded on a data sheet, containing information on its provenience, type of sample, cultural context, volume of flot sample, amount of sample analyzed, counts of all the plant taxa that could be identified, and counts of those items that could not be identified. For recording, counts were chosen over weights as some of the seed taxa are very small, and their weights are negligible. Seed fragments and whole seeds were recorded by count. Material from the heavy fractions was identified in the same manner, and tallied on the same data sheet as the light fraction.

Information was transferred from the data sheets into data files on floppy disks that were then loaded onto the mainframe computer. The mainframe used is an IBM 4381 available at the University of Minnesota's St. Paul computer center. Data analysis was carried out using the SAS statistical package (SAS Institute 1985a; 1985b; 1985c; 1985d). This system was chosen for several reasons. First, it had the capability of managing a very large dataset, and provided the types of summary, parametric, and non-parametric statistics which were of interest. Also, it had an attached graphics package that allowed the plotting of publication quality graphics, without having to transfer data to another system.

Sorting strategies for archaeobotanical material in the lab

Because time and money are always in high demand in the lab there are several different strategies that can be used when sorting and identifying archaeobotanical material to maximize data collection while minimizing time expended. Other considerations are the goals of the study at hand, the quality of the collection and recovery techniques used to retrieve botanical material, and the overall quality of archaeological information available for the interpretation of the materials.

Below are sorting schemes devised especially for flotation samples, where the study of domesticates is the main focus.

Strategy 1: Complete sort

In the best of all possible worlds it is nice to be able to sort out and identify all prehistoric material from a sample. It is especially desirable because a single flot sample is already only a small sample of any given archaeological context, and one wants as complete a picture as possible. In our case, one would sort out, and identify all charred material, except <2mm wood, which is usually unidentifiable. All bones and other animal and artifactual materials are pulled out and given to appropriate specialists.

This type of strategy gives RATIO level data, with exact counts (and/or weights) entered onto the computer. Descriptive statistics such as RELATIVE PERCENTAGES, DENSITIES, UBIQUITIES, and DIVERSITIES can be generated from this type of data.

This strategy is the most labor intensive, and can be redundant when you work past the point of diminishing returns, ie, you get the exact same values by sorting entire sample that you would by making estimates based on some fraction of the whole (50%, 25%, etc).

Strategy 2: Sample splitting

In this strategy time is saved by splitting (by weight) some or all of the sample. It is usually done to one of the smaller fractions separated by the geologic sieves, eg, 100% of the material that is >2mm is sorted, while 50% of all material <2mm is sorted and all counts of the identified specimens are doubled. The decision to split a sample should be based on the following guidelines. The average amount of time spent on a sample is about 2 1/2 hours, including sorting and identifying light and heavy fractions, as well as material recovered from the sieves in the field. The two main factors that are considered are both the volume of the charred sample, and the density of the seeds. The desired amount of material to be sorted from each size fraction of the sample is enough to fill one of the sorting trays (in a thin layer, as when ready for sorting). If a brief scan of even this amount appears to contain hundreds of seeds, it should be split again. A rule of thumb that has proven effective for the 1986 Pancán (Perú) material was never to let the sorted portion fall below 1.0g or 12.5% (Lennstrom 1991a). In these samples it was found that this was approximately the point of diminishing returns for very dense samples such as those from burnt stores of crops, where seeds and tuber densities per 6-liter of soil averaged in the thousands. That is, if at least these 12.5% or 1.0g of each size fraction was sorted the estimates of total densities and taxa diversity were found to be insignificantly different than if the whole sample had be sorted. We noted on the form which fractions were split, what percentage was sorted, and the weight of the material prior to sorting. Of course, special circumstances may occur, and less may be sorted without losing accuracy.

Trials with a 0.3mm geologic sieve show that very, very few seeds will pass through this mesh size. Another time saving measure in dusty samples is not to sort the material that is less than 0.3mm. If bones and fish scales are too numerous, they can be left in the remains while noting their occurrence and/or abundance can be put on the data sheet. If very small lumps are overabundant one can leave those <1.18mm (with no distinctive characteristics, such as a surface) in the remains.

As with the complete sort, one gets RATIO level data, and can generate RELATIVE PERCENTAGES, DENSITIES, UBIQUITIES, and DIVERSITIES. Because actual counts are estimated this type of data can be used in comparison with that of Strategy 1 with no conversion.

This method is a good time saver, especially for samples that are quite homogeneous. Drawbacks are that diversity may be lost, and rare species are either missed or over represented.

(Strategies 3 and 4 , designed by the University of Minnesota Archaeobotany Lab (Lennstrom and Hastorf 1989), were not used with the Wila Jawira materials)

Strategy 5: Complete sort >0.5 mm
After working with the 1986-90 Bolivian material we found that the samples were full of a lot of dust, minute unidentifiable charcoal fragments, taking approximately 6-7 hours each to sort. We felt this was too much time to spend on a single flot sample. We were also somewhat uncomfortable with material that was less than 0.5 mm (500 microns), as the bottom mesh inside the flot machine is only 0.5mm, and there is a possibility that anything smaller than that could be a contaminant from some other samples. This type of exchange through the "inner bucket" mesh is known to happen, as it occasionally happened with the modern poppy tracers when this mesh had too large an aperture in 1982-6.
Tests with the Bolivian material showed that the percentage of differing small taxa are not at all the same from sample to sample, so there is unfortunately no systematic way of calculating the amount of material that will be missed by not sorting material between 0.5 and 0.3 mm. At least there did not seem to be taxa that would be completely missed, except sometimes UNK 264 and 190. Taxa that are most likely to lose a substantial number of seeds in the final tally include are Small Poaceae, *Nicotiana*, and *Juncus*.
This strategy gives ratio level data, so that densities, relative percentages, diversity, ratios, and ubiquities can be generated, though small taxa may be under represented.

Strategy 6: Sample splitting, sorting only >0.5mm
This is a combination of strategies 5 and 2, where a fraction of the sample may be sorted, and no material less than 0.5 mm is checked. We used this procedure on extremely large, and dense samples. As with all the other strategies discussed here, ratio level data is obtained, and densities, relative percentages, diversity, ratios, and ubiquities can be calculated. Again, what will be lost are some of the small taxa, and some degree of accuracy.

For the 17 samples from the Akapana mound, we used only strategy 1.

<u>Quantification of Akapana mound samples</u>

In this section we report the different plant taxa recovered from the Akapana mound samples and three different quantification schemes used to help interpret the botanical remain (DENSITY, UBIQUITY, and RELATIVE PERCENTAGES). Density is expressed as the number of seeds (or seed fragments) per liter of site matrix. This standardizes the counts of material, so that samples of differing original volume can be compared (Pearsall 1989; Popper 1988). Also, each taxon can be considered independently, and density values seem least biased when comparing samples of different original soil volume (see Lennstrom 1991b).
Ubiquity is expressed as a percentage, and is calculated as the percentage of samples which contain each taxon (Hubbard 1975; Popper 1988). For example, if maize is identified in 10 of 30 samples it has a ubiquity value of 33%. The advantage of ubiquity scores is that each taxon is considered separately, and the amount of each does not affect the others. Also, the amount of each taxon in a sample does not affect the ubiquity value, so that 1 or 1000 of the same seed in a single sample carries the same weight.

The third quantification method we present is relative percentage (Popper 1988). These values are expressed as the percentage each taxon makes up relative to the number of items in an individual sample, and is displayed as a pie diagram. The advantage of this scheme is that all taxa can be considered simultaneously, and the relative proportions of taxa from different samples can be compared, regardless of the original volume of the sample, or the density of charred plant remains.

<u>LIST OF PLANT TAXA: Akapana mound samples from 1988-9: N=17 (Mostly from the Akapana Sup. North camelid ofrenda)</u>

Plant remains from the Wila Jawira botanical samples were commonly identified to the family level, and sometimes to genus. When referring to plants by scientific names authorities (initials) are usually cited when the taxon is first mentioned in the text. For example *Zea mays* L. indicates that Linnaeus named the species (for complete list see appendix) Genera (eg: *Chenopodium*) are always capitalized, and underlined, or italicized. The second part of the species name is also put in italics, or underlined, but is always lower case (*Chenopodium quinoa*). The addition of "spp." following the genus name indicates that it might be represent by one or more species, but we cannot determine which one(s). When two species from the same genus are referred to in succession the genus is usually abbreviated to a single letter for the second species.

Large (>1.18mm) *Chenopodium* spp. (seeds) Probably domesticates: either <u>quinoa</u> (*Chenopodium quinoa*) or <u>cañiwa</u> (*C. pallidicaule*). Food source.
Small (<1.18mm) *Chenopodium* spp. (seeds) Possibly domesticates: either <u>quinoa</u> (*Chenopodium quinoa*) or <u>cañiwa</u> (*C. pallidicaule*). Food source
Lumps (Unidentifiable charred plant fragments, in this case especially, they might be tubers or other fragments of domesticates.) Possible food source.
Small Poaceae (seeds) Grass family. Possibly used as fodder, fuel, or in construction. This can also be found in dung.
Large Poaceae (seeds) Grass Family, likely *Stipa* spp. or *Festuca* spp. Possibly used as fodder, fuel, or in construction.
Wild Leguminosae (seeds) Fabaceae-Bean family. Common weed, possible fodder. This can also be found in dung.
Verbena spp. (seeds). Common weed.
Malvaceae (seeds) Mallow family. Common weed. This can also be found in dung.
Relbunium spp. (seeds) A plant used in S. America for red dye.
Cyperaceae (seeds) Sedge family, often associated with wetlands. Many industrial purposes: mats, boats, roofing, etc.
Unknown 224 (seeds) Possibly a mint family)
Unknown 263 (seeds)
Amaranthus spp. (seeds) Usually a weedy annual; found in disturbed habitats, possible casual food source.
Unknown 270 (seeds)
Nicotiana spp. (seeds) These are likely of a type of tobacco which grows wild/feral in the area today, though we cannot distinguish them from more tropical domesticated species at this time.
Zea mays (maize) kernels
Zea mays cob fragments
Unidentifiable seeds

Tubers, (food) likely *Solanum* spp. (potato).
Wood and twig fragments-Fuel, construction, tools.
Dung-Fertilizer and/or fuel.

APPENDIX: RAW DATA
CODES USED FOR WILA JAWIRA COMPUTER INPUT:

IDNO = This is used for identification in the botanical lab
SITE
CUADRA
NIVEL = level
SPECIMEN = the bag number assigned in the field
UNIDAD1 = The North unit designation
UNIDAD2 = The East unit designation
RASGO = feature
FLOTNUM = The flot number assigned in the field
FLOTVOL = Volume of sample in liters (as collected in the field)
LFPICK = Weight of carbon sorted out of the sample
COLLTYPE = whether sample is BULK (101) or PINCH (102). Screen material (1/4") is 201
CULTCONT = Three digit code for cultural context of sample. Check raw data sheet for definitions. This information is taken directly from tags on samples and/or field notes.
CARD/CRD/CRDNO/CARDNO = These are for data loading (ignore).
BOXSIZE= Size of storage box used for sample
YEAR= Year sample collected

Taxa names refer to different identifiable plant parts:

LRGCHENO = *Chenopodium* spp. L. seeds larger than 1.18 mm
SMLCHENO = *Chenopodium* spp. seeds smaller than 1.18mm
LUMP = Unidentifiable fragment of charred plant tissue
SPOACEAE = Small Grass family seeds (Poaceae)
LPOACEAE = Large Grass family seeds (Poaceae)
WILDLEG = Wild seeds from the Bean family (Leguminosae or Fabaceae)
SCIRPUS = *Scirpus* spp. L. Seeds of tortora reeds
VERBENA = *Verbena* spp. L.
PLANTAGO = *Plantago* spp. L.
MALVACEA = Mallow family (Malvaceae)
RELBUN = *Relbunium* spp. Hook.
MPOACEAE = Medium Grass family seeds (Poaceae)
RUBUS = *Rubus* spp. L.
CYPERAC = Sedge family (Cyperaceae)
CRUCIFER = Mustard family (Cruciferae or Brassicaeae)
UNK224 = Unknown seed #224
POTAMOG = Pondweed, *Potamogeton* spp. (Tourn) L.
CEREUS = *Cereus* spp. Mill.
UNK263 = Unknown seed #263
MODPOPPY = Modern poppy seeds added as check on flot machine
MODUMBELL = Modern Umbelliferae seeds added as check on flot machine
AMARANTH = *Amaranthus* spp. L.
UNK270 = Unknown seed #270
UNK242 = Unknown seed #242
COMPOSIT = Sunflower family (Compositae or Asteraceae)
UNK265 = Unknown seed 265
LABIATAE = Mint family
KAINYA = Aymara name, scientific name unknown

UNK261 = Unknown 261
JUNCUS = *Juncus* spp. L.
UNK248 = Same as *Rubus* spp.
CARYOPHL = Caryophyllaceae (Pink family)
UNK266 = Unknown 266
SOLANAC = Solanaceae seeds (Nightshade family)
NICOTIAN = *Nicotiana* spp. L.
SISYRINC = *Sisyrinchium* spp. L.
ZEAKERN= *Zea mays* L. kernels
ZEAEMBR = *Zea mays* embryos apart from kernels
COBCUP = *Zea mays* cob and cob fragments
CAPSICUM = *Capsicum* spp. L. Chili peppers
DOMLEGUM = Domesticated legumes exact genus unknown
POLYGON = Polygonaceae (Knotweed family)
OXALIS = *Oxalis* spp. L.
UNK202 = Unknown seed 202 (probably Borage family, Boraginaceae)
OENOTHER = *Oenothera* spp. L.
LSOLANAC = Large seeds of Nightshade family, possibly *Solanum* spp.
UNK271 = Unknown 271
UNK235 = Unknown 235
PORTULAC = *Portulaca* spp. L.
UNK201 = Unknown 201
TRITHORD = *Triticum* spp. L. (Wheat) or *Hordeum* spp. L. (Barley) both introduced by the Spanish from the Old World
CACTUS = Cactaceae, exact genus unknown
UNIDSEED = Seeds too poorly preserved to identify to family level
TUBER = Domesticated tubers, exact taxon not identifiable
WOODCT = Count of wood fragments
WOODWT = Weight of wood fragments in grams
TWGBRNCH = Twig and branches (showing nodes)
STALK = Stalks
DUNG = Animal dung, type undefinable
LLAMADNG = Camelid dung
CUYDUNG = Cuy dung
WIRAKOA = Aymara name, leaves used in *Pachamama* rituals
LEAVES = Leaves, exact taxon unknown
TRITRACH = *Triticum* spp. or *Hordeum* spp. rachis
SORTTYPE = Number refers to sorting strategy used in the laboratory, see preceding pages
FAUNAL = 0= No bones or fish scales; 1= Bones and/or fish scales present

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QUANTIFICATIONS:
Akapana Sup. Norte
(This does not include the 2 samples from other areas of the mound, as they were probably fill, but did not have specific contextual information.)

All Akapana Sup. Norte samples together n=15

Average density of crop plants (#/liter of site matrix)

Maize	Tubers	Large *Chenopodium*	Small *Chenopodium*
0.09	0.56	0.09	2.60

Ubiquity of crop plants (# of samples containing taxon)

Maize	Tubers	Large *Chenopodium*	Small *Chenopodium*
20.0%	46.7%	26.7%	100.0%
(3)	(7)	(4)	(15)

Samples by cultural context:

Camelid ofrenda (n=10)

Average density of crop plants

Maize	Tubers	Large *Chenopodium*	Small *Chenopodium*
0.08	0.57	0.10	2.35

Ubiquity of crop plants

Maize	Tubers	Large *Chenopodium*	Small *Chenopodium*
10.0%	50.0%	30.0%	100.0%
(1)	(5)	(3)	(10)

Level below wall (n=4)

Average density of crop plants

Maize	Tubers	Large *Chenopodium*	Small *Chenopodium*
0.14	0.68	0.11	3.38

Ubiquity of crop plants

Maize	Tubers	Large *Chenopodium*	Small *Chenopodium*
50.0%	50.0%	25.0%	100.0%
(2)	(2)	(1)	(4)

Relative Percentages of entire flot sample contents. (Relative percentages of different plant groups (eg; crops only, weeds only, identifiable materials only) can be generated from raw data. For diagrams see following sheets.)

FLOT NUMBER 4035
AKAPANA West
n=46

Malvaceae	46%	(21)
Lrg Grass	17%	(8)
Charfrag (lumps)	7%	(3)
Wood	15%	(7)
Unidentified seeds	11%	(5)
Other	4%	(2)

FLOT NUMBER 4058
AKAPANA Sup. N.
n=61
Camelid offering (context=419)

Chenopodium	21%	(13)
Char frags	20%	(12)
Large Grass	2%	(1)
Wood	21%	(13)
Wild Legumes	8%	(5)
Unidentified seeds	10%	(6)
Small grass	18%	(11)

FLOT NUMBER 4066
AKAPANA North B.
n=75

Chenopodium	20%	(15)
Char frags	11%	(8)
Other	8%	(6)
Wood	32%	(24)
Unidentified seeds	5%	(4)
Small grass	24%	(18)

FLOT NUMBER 4070
AKAPANA Sup. N.
n=186
Camelid offering (context=419)

Char frags	73%	(136)
Chenopodium	8%	(14)
Other	6%	(12)
Wood	8%	(14)
Small grass	5%	(10)

FLOT NUMBER 4086
AKAPANA Sup. N.
n=40
Camelid offering (context=419)

Char frags	23%	(9)
Chenopodium	15%	(6)
Wood	15%	(6)
Wild legumes	13%	(5)
Unidentified seeds	10%	(4)
Small grass	20%	(8)
Sedge	5%	(2)

FLOT NUMBER 4098
AKAPANA Sup. N.
n=340
Camelid offering (context=419)

Char frags	34%	(115)
Chenopodium	12%	(39)
Other	8%	(28)
Wood	18%	(60)
Wild legumes	9%	(31)
Unidentified seeds	6%	(20)
Small grass	15%	(47)

FLOT NUMBER 4100
AKAPANA Sup. N.
n=104
Camelid offering (context=419)

Char frags	27%	(28)
Chenopodium	17%	(18)
Other	9%	(9)
Wood	10%	(10)
Wild legumes	10%	(10)
Unidentified seeds	13%	(14)
Small grass	14%	(15)

FLOT NUMBER 4102
AKAPANA Sup. N.
n=74
Camelid offering (context=419)

Char frags	34%	(25)
Chenopodium	14%	(10)
Nicotiana	1%	(1)
Wood	12%	(9)
Wild legumes	8%	(6)
Unidentifiable seeds	18%	(13)
Small grass	14%	(10)

FLOT NUMBER 4112
AKAPANA Sup. N.
n=150
Camelid offering (context=419)

Char frags	45%	(68)
Chenopodium	8%	(12)
Other	5%	(8)
Wood	11%	(17)
Wild legumes	7%	(10)
Unidentified seeds	8%	(12)
Small grass	15%	(23)

FLOT NUMBER 4115
AKAPANA Sup. N.
n=29
Camelid offering (context=419)

Char frags	7%	(2)
Chenopodium	14%	(4)
Twigs	3%	(1)
Wood	24%	(7)
Wild legumes	7%	(2)
Unidentified seeds	14%	(4)
Small grass	31%	(9)

FLOT NUMBER 4116
AKAPANA Sup. N.
n=89
Camelid offering (context=419)

Char frags	39%	(35)
Chenopodium	9%	(8)
Other	9%	(8)
Wood	30%	(27)
Small grass	12%	(11)

FLOT NUMBER 4119
AKAPANA Sup. N.
n=463
Level below wall (context=623)

Char frags	71%	(330)
Chenopodium	5%	(24)
Other	9%	(41)
Wood	15%	(68)

FLOT NUMBER 4134
AKAPANA Sup. N.
n=251
Level below wall (context=623)

Char frags	43%	(109)
Chenopodium	9%	(23)
Other	5%	(12)
Wild legumes	6%	(16)
Wood	18%	(45)
Unidentified seeds	6%	(14)
Small grass	13%	(32)

FLOT NUMBER 4139
AKAPANA Sup. N.
Level below wall (context=623)
n=142

Char frags	16%	(23)
Chenopodium	11%	(15)
Other	6%	(9)
Wild legumes	6%	(8)
Wood	46%	(65)
Unidentified seeds	8%	(11)
Small grass	8%	(11)

FLOT NUMBER 4148
AKAPANA Sup. N.
Camelid offering (context=419)
n=674

Char frags	88%	(593)
Other	6%	(38)
Wood	6%	(43)

FLOT NUMBER 4163
AKAPANA Sup. N.
Fill from ceramic vessel (context=498)
n=28

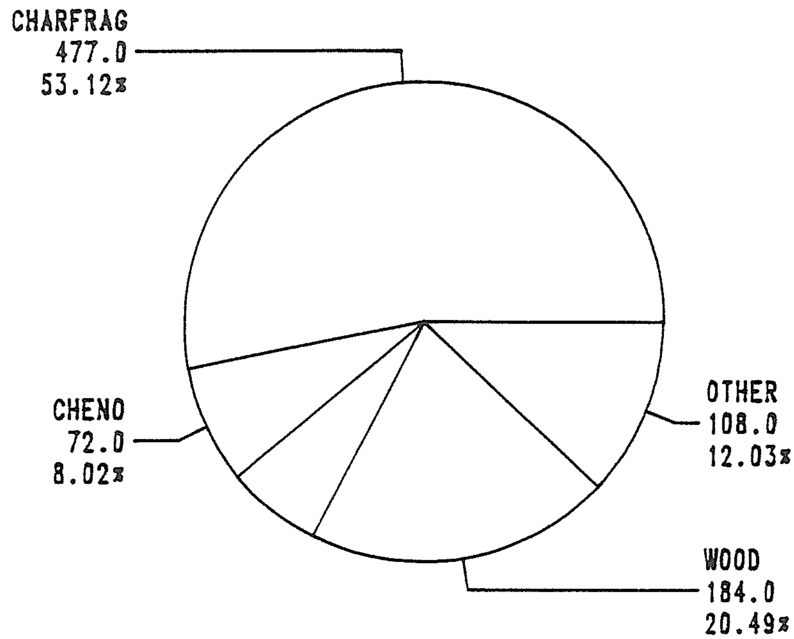
Char frags	18% (5)
Chenopodium	14% (4)
Malvaceae	11% (3)
Wild legumes	4% (1)
Wood	21% (6)
Unidentified seeds	11% (3)
Small grass	21% (6)

FLOT NUMBER 4321
AKAPANA Sup. N.
Possible level below floor (context=690)
n=42

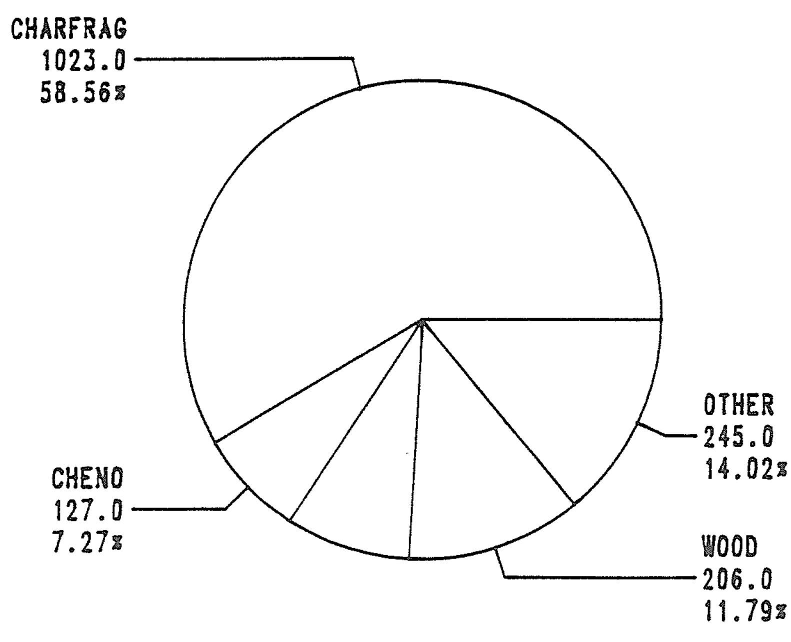
Char frags	36% (15)
Chenopodium	24% (10)
Other	15% (6)
Wood	14% (6)
Small grass	12% (5)

Akapana Mound
Sup. N.

CONTEXT = FILL (Nivel base muro)

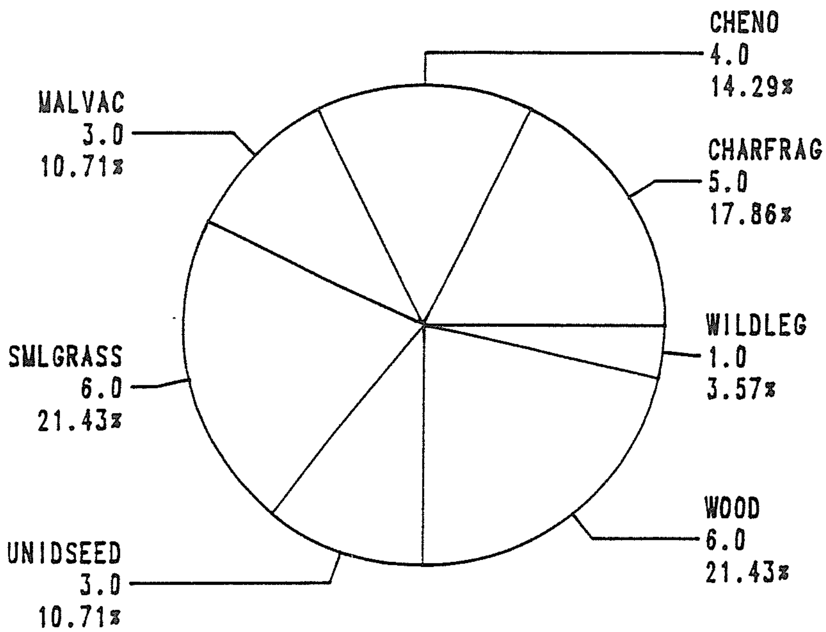


CONTEXT = OFRENDA

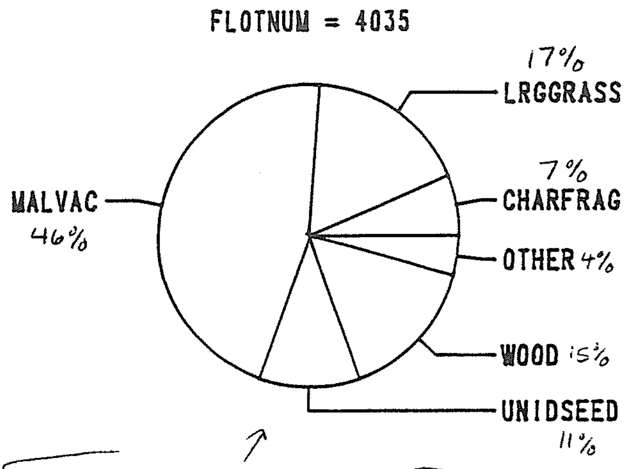


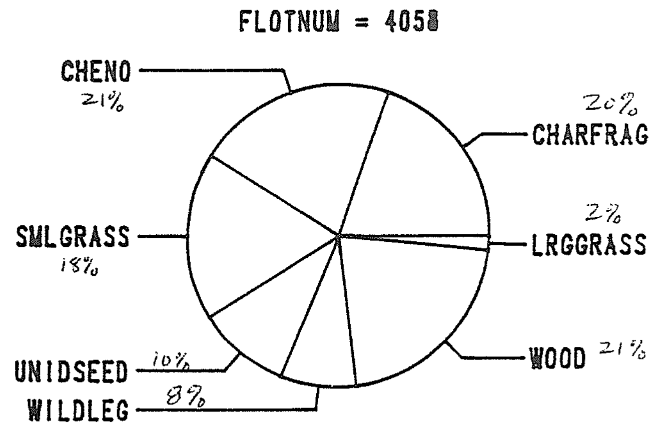
AKAPANA MOUND
Sup. No.

CONTEXT = POTFILL



AKAPANA
MOUND





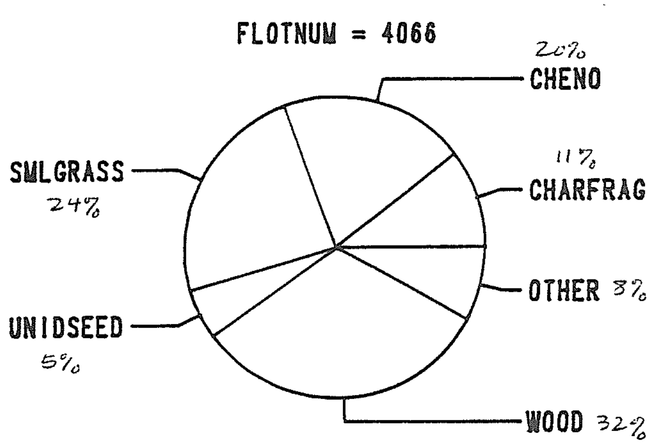
AKAPANA-
WEST
(NO CONTEXT)

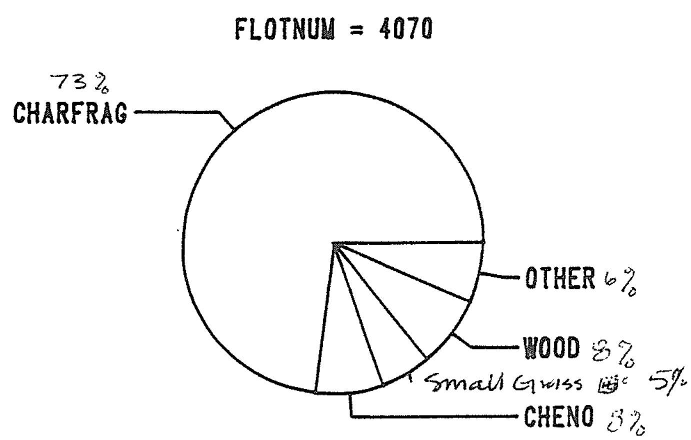
LLAMA
OFFERINGS

NO
CONTEXT

AKAPANA
NORTH
"B"

ARAPANA

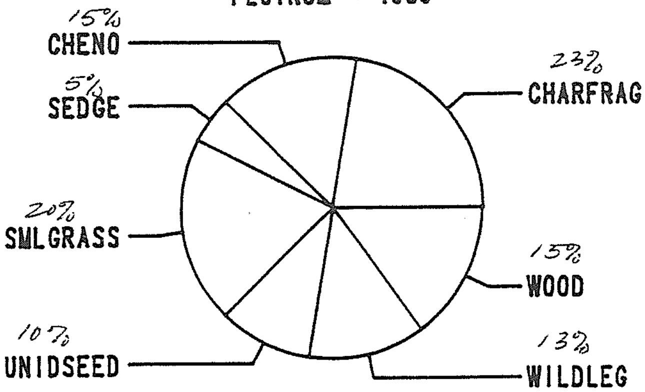




LLAMA
OFFERING

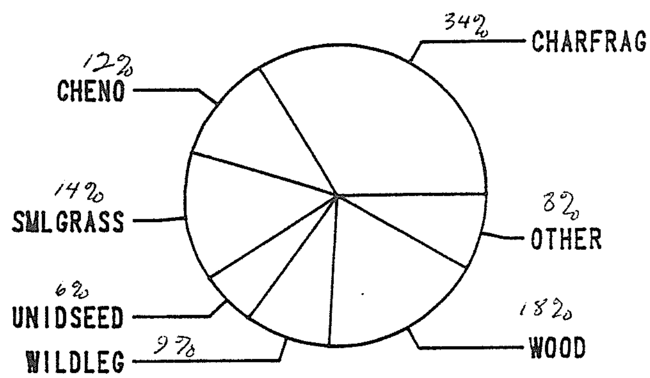
AKAPANA MOUND

FLOTNUM = 4086



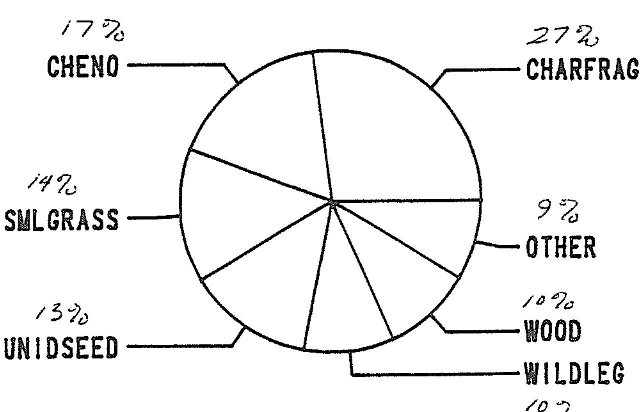
Llama Offering

FLOTNUM = 4098



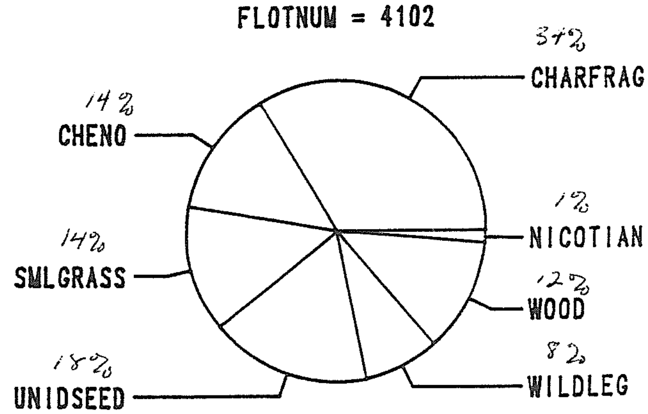
Llama offering

FLOTNUM = 4100



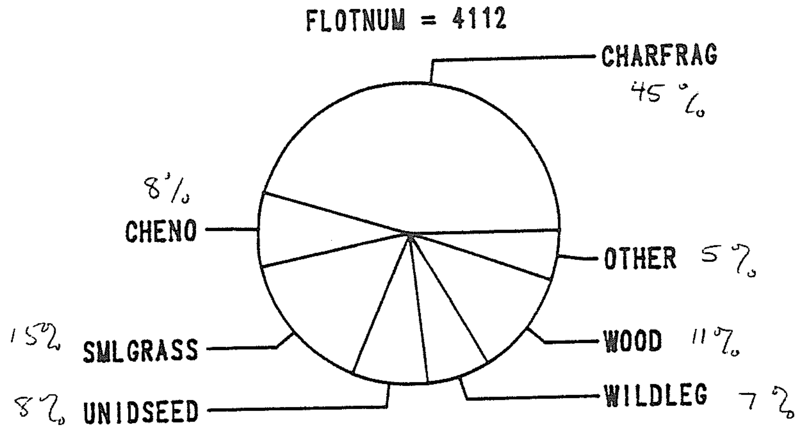
Llama offering

FLOTNUM = 4102



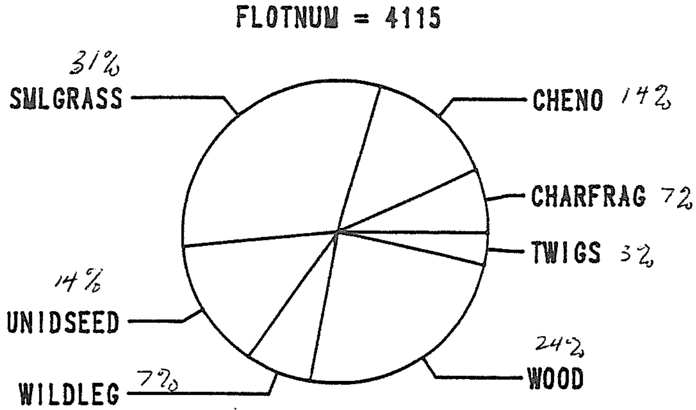
Llama offering

AKAPANA MOUND

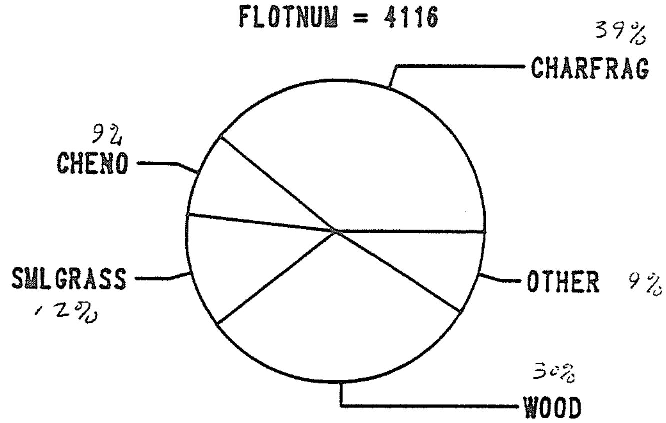


LLAMA OFFERING

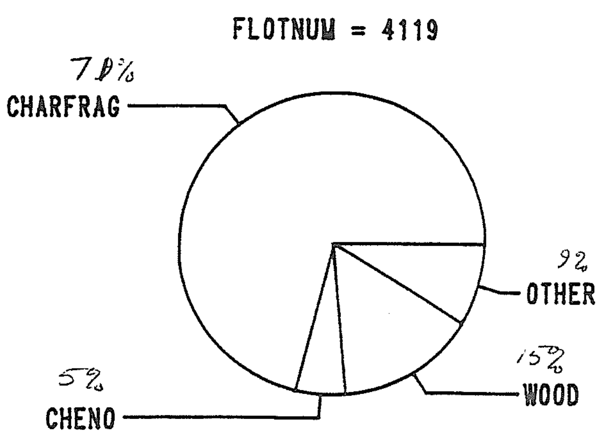
Akapana Mound



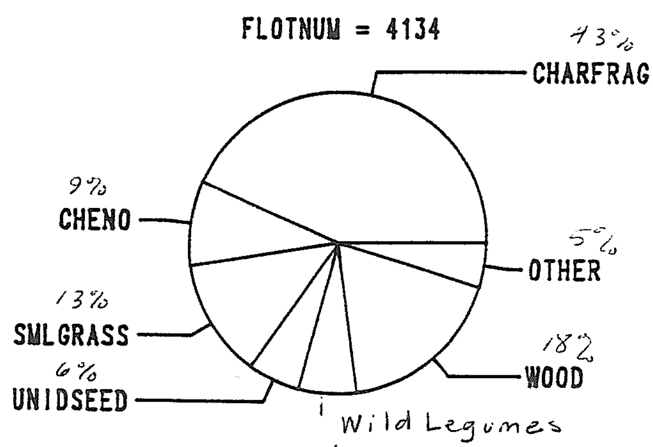
Llama offering



Llama offering



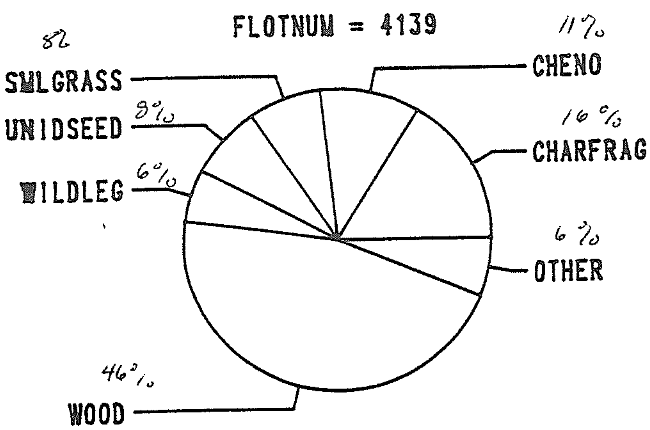
File under structure



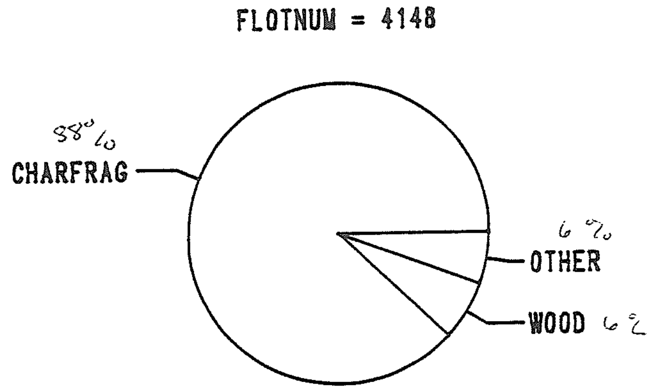
File under structure

Sup. Norte

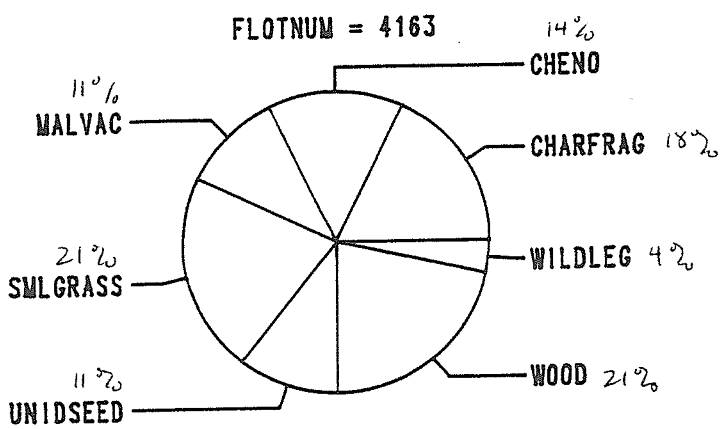
Tiwanaku: Akapana Mound (Linda's)



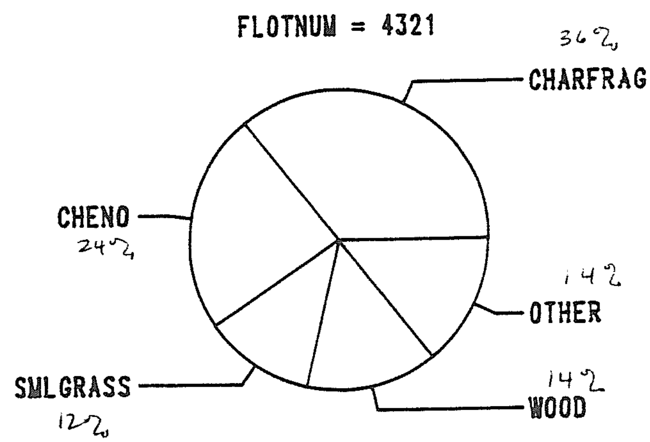
Construction fill under structure



Llama offering



Fill from ceramic vessel



Possible Fill

INTERPRETATION OF AKAPANA PLANT REMAINS

Samples analyzed from the main Akapana mound are mostly from a room that was filled with camelid bones, interpreted as a ritual offering. The contents of the Akapana mound samples are slightly different than most of the others collected from occupation areas of Tiwanaku. Tubers (quite likely potatoes) are far more common than they are in living areas close to the mound, in the valley sites, and at Lukurmata. There are also denser concentrations of large (1-3mm), unidentifiable plant remains. These "lumps" of charred plant material are most likely eroded domesticates, because the pieces are too large to be derived from wild plant seeds. In this case the co-occurrence of tubers and charred fragments suggests that the latter may also be domesticated tubers. This is especially notable, as this is the crop Kolata (1986) has posited as a major food source that could have been produced on raised fields constructed in the area during the later Tiwanaku periods. That they should be intentionally included in a ritual offering, along with camelids, hints at a possible key role in Tiwanaku life. Interestingly, maize remains are denser in residential areas close to the mound (KK'araña, AK-East, AK-East2, Chiji Jawira, and Putuni) than they are in the offering.

Other differences include slightly smaller proportions of wild seeds and *Chenopodium* than other samples. Several of the wild seeds were probably included and charred unintentionally. An explanation of this difference may be that these taxa may be deposited most often during routine household activities that were lacking in the *ofrenda*.

There is a consistent, substantial proportion of wood in each sample. It may be that it was used as fuel to burn the offering, or that it represents remains of some type of construction.

The samples from the camelid offering were recorded as two different cultural contexts. Ten samples were listed in the notes as from the ofrenda proper, and 4 were described as "nivel base muro". We thought the latter might have represented some type of construction fill, as it came from below the walls of the structure. Yet, the botanical remains are nearly identical to that material from the ofrenda samples, and there may be no need to separate the two deposits (N=15).

Another context recorded was the fill from a ceramic vessel within the ofrenda. The plant remains recovered from this sample do not appear to be qualitatively different than those in the rest of the offering, and we suggest that they were probably not intentionally included inside the vessel. Instead, the vessel fill probably came from the fill of the ofrenda.

One sample of construction fill from the western side of the mound offers a hint of unintentionally deposited material (Flot 4035). The sample is fairly sparse, as would be expected in fill used in construction. There were no domesticates found in this sample, instead there is a high proportion of Malvaceae (mallow) and grass seeds, which are common wild plants found in samples from all sites in the region.

```
                        S                                              C    C  L  S      S L      P M    M    C
                        P      U     U           F    F                O    U  R  M      P P W S V L A    P    C R   P
            C           E      N     N           L    L    L           L    L  G  L      O O I C E A L  R O  Y U U O C U
            U      N    C      I     I     R     O    O    F           L    T  C  C      A A L I R N V  E A R P C N T E N
   I   S    A      I    I      D     D     A     T    T    P           T    C C H  H   L  C C D R B T A  L C U E I K A R K
O  D   I    D      V    M      A     A     S     N    V    I           Y    O A E  E   U  E E L P E A C  B E B R F 2 M E 2 C
B  N   T    R      E    E      D     D     G     U    O    C           P    N R N  N   M  A A E U N G E  U A U A E 2 O U 6 R
S  O   E    A      L    N      1     2     O     M    L    K           E    T D O  O   P  E E G S A O A  N E S C R 4 G S 3 D

 1 3551 TIW AKW  1CD 03124 N7962 E4975 9        4035 1.8 0.7 101    . 1 .  .   3  1 8 . . . . 21 . . . . . . . . . . 2
 2 3552 TIW AKSN 3F  13416 N8014 E5098 R11C1CS  4102 5.7 0.7 101 419 1 . 10  25 10 .  6 . . . . . . . . . . . . . . 2
 3 3553 TIW AKSN 3F  13426 N8014 E5098 R11C1NE  4115 3.2 0.7 101 419 1 .  4   2  9 .  2 . . . . . . . . . . . . . . 2
 4 3554 TIW AKSN 3G  13456 N8014 E5098 R11C1NE  4100 5.7 1.4 101 419 1 . 18  28 15 . 10 . . .  3 1 0 0 2 . . . . . 2
 5 3555 TIW AKSN 3G  13465 N8014 E5098 R11C1CN  4058 5.0 1.7 101 419 1 3 10  12 11 1  5 . . . . . . . . . . . . . . 2
 6 3556 TIW AKSN 3G  13480 N8014 E5098 R11C1SE  4116 5.7 3.5 101 419 1 .  8  35 11 .  3 . . .  3 . . . . . . . . . 2
 7 3557 TIW AKSN 3J  14012 N8014 E5096 R11C1SW  4119 5.7 2.3 101 623 1 . 24 330  9 .  8 . 1 0  1 . . . 3 . . . . . 2
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 9 3559 TIW AKSN 3D  15425 N8014 E5100 R17C3SW  4321 5.7 0.8 101 690 1 . 10  15  5 .  1 . . .  1 1 . . . . . . . 1 2
10 3560 TIW AKSN 3G  14087 N8018 E5096 R11C2EX  4163 1.9 0.7 101 498 1 .  4   5  6 .  1 . . .  3 . . . . . . . . . 2
11 3573 TIW AKSN 3I  13566 N8014 E5096 R11C1SW  4148 5.7 4.3 101 419 1 .  3 593  2 .  5 . . . . . . . . . . . . . . 2
12 3574 TIW AKSN 3F  13427 N8014 E5098 R11C1SE  4086 2.1 0.8 101 419 1 .  6   9  8 .  5 . . . . . . . 2 . . . . . 2
13 3575 TIW AKSN 3J  13600 N8014 E5098 R11C1SE  4139 4.4 2.2 101 623 1 2 13  23 11 1  8 . . .  1 1 . . 4 0 1 . . . 2
14 3576 TIW AKNB 4CD 12576 N8050 E5026 27       4066 2.1 0.9 101    . 1 . 15   8 18 1  2 . . .  2 . . . . . 1 . . . 2
15 3606 TIW AKSN 3F  13412 N8014 E5096 R11C1NW  4098 6.3 1.1 101 419 1 1 38 115 47 1 31 0 1 . 10 . . . 4 . . . . 1 2
16 3607 TIW AKSN 3G  13471 N8014 E5096 R11C1SW  4070 5.0 1.8 101 419 1 1 13 136 10 .  4 . . . . . . . 2 . . . . . 2
17 3608 TIW AKSN 3G  13468 N8014 E5098 R11C1CS  4112 6.3 1.3 101 419 1 . 12  68 23 1 10 . . .  . 2 . . 1 . . . . 1 2

  M M A     C   L         C     N S       C D         O L     P   T     U           T     L       T S
  O O M     O   A         A   S I I Z Z   A O   P     E S     O   R     N           W     L C W   R O   B     L   S
  D D A U U M U B K U J U R U O C S E E C P M   O O U N O U U R U I C C I    W  W   G     A U I L I R F O     R   M
  P U R N N P N I A N U N Y N L O Y A A O S L C L X N O L N N T N T A A D  T O  O   B S   M Y R E T T A X     G   L
  O M A K K O K A I K N K O K A T R K E B I E R Y A K T A K K U K H C R S  U O  O   R T D A D A A R T U S Y   L   L
O P B N 2 2 S 2 T N 2 C 2 P 2 N I I E M C C G D G L 2 H N 2 2 L 2 O T D E  B D  D   N A U D U K V A Y N I E   U   U
B P E T 7 4 I 6 A Y 6 U 4 H 6 A A N R B U U U N O I 0 E A 7 3 A 0 R U N E  E C  W   C L N N N O E C P A Z A   M   M
S Y L H 0 2 T 5 E A 1 S 8 L 6 C N C N R P M M O N S 2 R C 1 5 C 1 D S O D  R T  T   H K G G G A S H E L E R   P   P

 1  . . . . . . . . . . . . . . . . . . . . . . 3 . . . . . . . . . . . . 4  5  .  7 0.1 1 . . . . . . . . . 1 1 S 88 .   .
 2  . . . . . . . . . . . . . . . 1 . . . . . . 3 . . . . . . . . . . . . 4 13  .  9 0.1 . . . . . . . . . . 1 1 S 89 .   .
 3  . . . . . . . . . . . . . . . . . . . . . . 3 . . . . . . . . . . . . 4  4  .  7 0.1 1 . . . . . . . . . 1 1 S 89 .   .
 4  . . . . . . . . . . . . . . . . . . . . . . 3 . . . . . . . . . . . . 4 14  1 10 0.1 2 . . . . . . . . . 1 1 M 89 .   .
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 7 42 . . . . . . . . . . . . . . . . . . . . . 3 . . . . . . . . . . . . 4  8 11 68 0.9 . . . . . . . . . . 1 1 M 89 3 327
 8  0 0 1 1 . . . . . . . . . . . . . 1 . . . . 3 . . . . . . . . . . . . 4 14  4 45 0.7 . . . . . . . . . . 1 1 M 89 .   .
 9  . . . . . . . . . . . . . . . . . 2 . . . . 3 . . . . . . . . . . . . 4  .  .  6 0.1 . . . . . . . . . . 1 1 S 89 .   .
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16  . . . . . . . . . . . . . . . . . . . . . . 3 . . . . . . . . . . . . 4  5  1 14 0.1 . . . . . . . . . . 1 1 M 89 1 135
17  . . . . . . . . . . . . . . . . . . . . . . 3 . . . . . . . . . . . . 4 12  3 17 0.3 . . . . . . . . . . 1 1 M 89 1  67
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Cultcont:
419 = Camelid offering
498 = Vessel fill
623 = Level below wall
690 = Possible level below wall

LAB COPY

INFORME: LOWER TIWANAKU VALLEY SURVEY SITES

H. Lennstrom, C. Hastorf, and M. Wright
Archaeobotany Laboratory Report #22
University of Minnesota
May, 1991

Introduction

Flotation samples were recovered from five sites in the lower Tiwanaku Valley survey area by Juan Albarracín-Jordan in 1990. These included one Formative period site, Allkamari (TLV 174 & 179), three from the Tiwanaku IV/V periods, Iwawe (TLV 150), Guaqui (TLV 55), and Obsidiana (TLV 109), and one Early Pacajes (LIP) site, Pukara (TLV 23).

The strategy selected for our first phase of paleoethnobotanical analysis has been threefold 1) to analyze at least some samples from all areas, 2) to focus on domestic areas of the site, and 3) to work only with samples where information concerning cultural contexts, field notes, etc., were available. The samples selected from these five sites were completed during the fall of 1990, when the lab plan was to sort approximately 30-40% of all samples from usable contexts (ie: not mixed, disturbed, or undocumented). Of the 165 samples floted from the 5 lower valley sites 53 samples were completed. This is approximately 40% of all usable contexts. Flotation forms containing vital cultural information were available for all the flots in the fall of 1990 so the selection of our subsample could be made using contextual information. Samples were selected so that our subsample represented the overall contextual content of each individual site, and that some of each context type would be represented.

Sample size (site matrix prior to flotation) was small and varied a great deal, with average bag sizes ranging from 1.1 liters at Iwawe to 5.1 l at Allkamari. This disparity causes distortion in quantification schemes, as some apparent differences may simply be a function of small and irregular sample sizes. Further, comparisons between this material and Tiwanaku habitation areas are difficult, as the latter averaged between 5 and 7 liters. For these reasons quantifications must be examined carefully, and DENSITIES are known to be more reliable than UBIQUITIES (Lennstrom 1991b).

Methods

Field methods

Botanical samples were processed using a motorized flotation system, modified from the SMAP machine design first published by Watson in 1976. Because the charred materials have a lower specific gravity than water, they float on the water's surface and can be poured off. Our machine is built from a a 55 gallon oil drum as a water container, that is used to separate charred plant remains from the site matrix. Water is pumped into the system from below, and is moved upward in the drum by a submerged shower head. Inside the drum is a removable inner bucket, with a mesh bottom that the soil samples are poured into once it is partially submerged in the machine. The bottom mesh catches rocks, artifacts, and bones that do not float. This material that is caught is termed the "heavy fraction". It is dried, and the cultural material larger than 2 mm is removed and analyzed. In 1989 and 1990 we used brass cloth in the bottom of the inner bucket, with an aperture of 0.5mm.

The charred plant remains on the surface of the water are poured off through a spout into fine-meshed chiffon. This material, termed the "light fraction", was