Mobile GIS for Excavations in Andean Archaeology



The Good, Bad, & the Ugly

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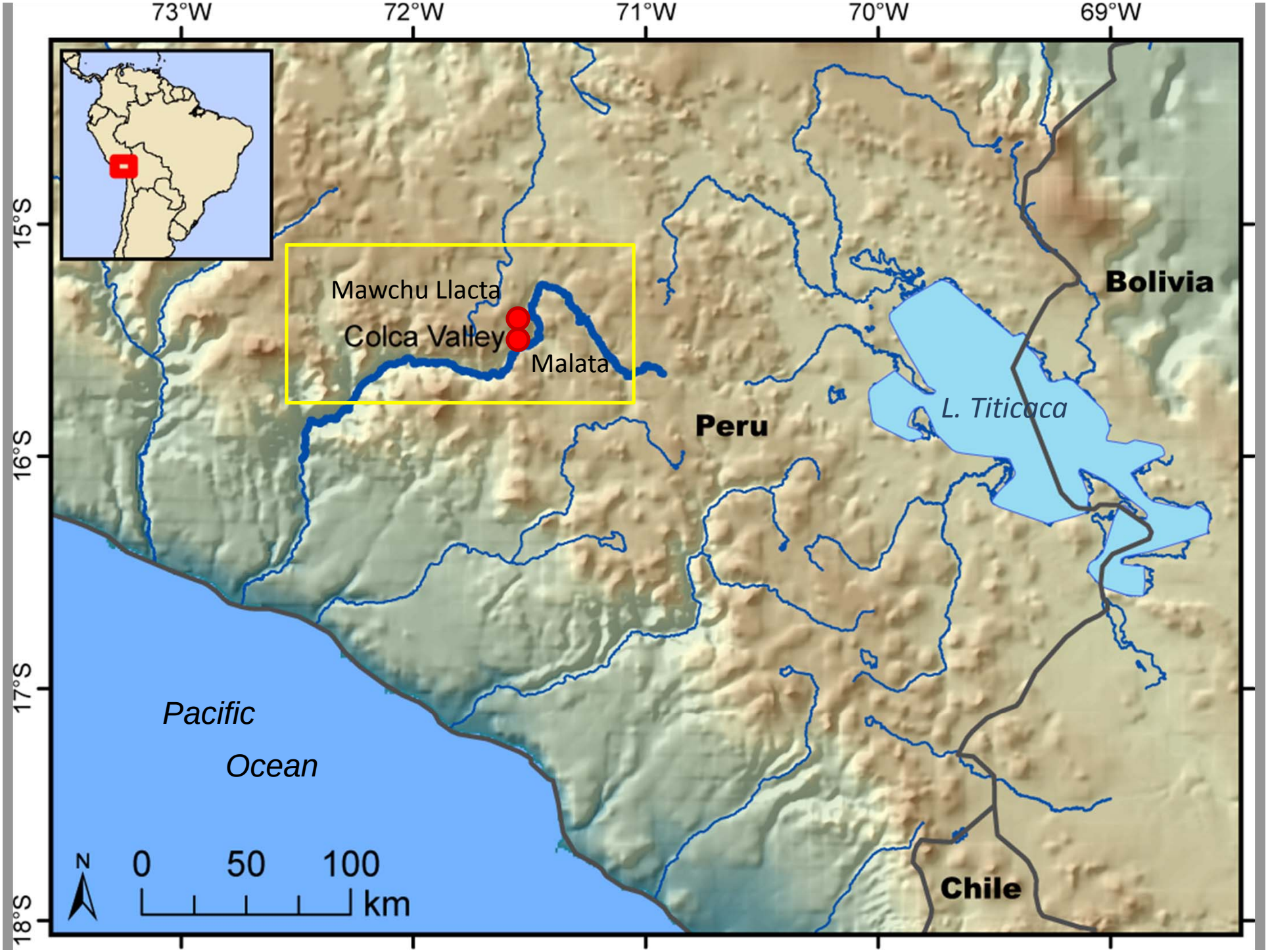
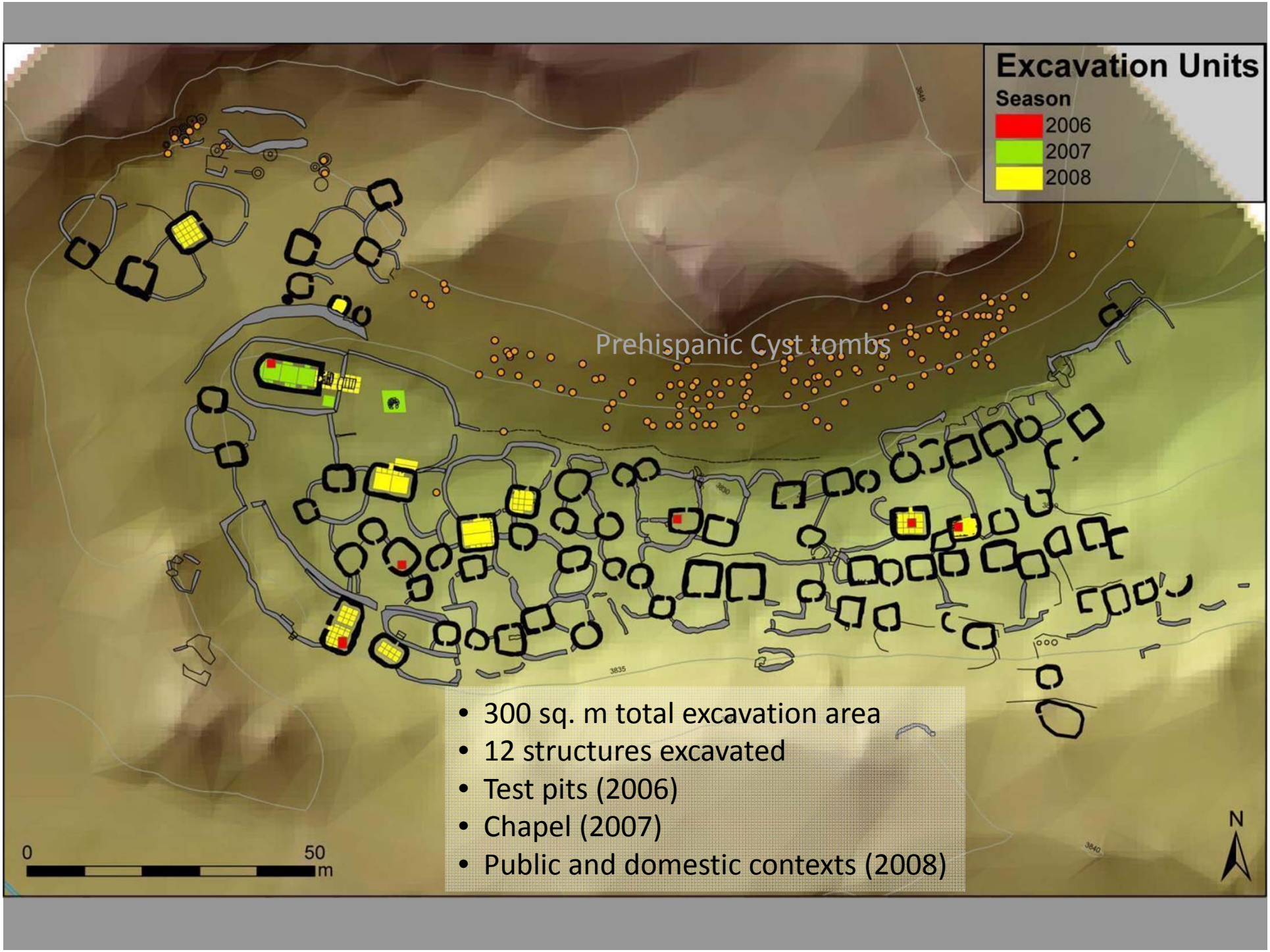
Outline

- Brief overview of two mobile GIS systems for excavation/survey in the Andes
- ArcPad-based system for excavation (2006-2008) at an early colonial mission
- iPad-based mobile GIS for architectural survey (and eventual excavation) at a large planned colonial town


73°W
72°W
71°W
70°W
69°W
15°S
16°S
17°S
18°S
Mawchu Llacta
Colca Valley
Malata
Peru
Bolivia
L. Titicaca
Pacific
Ocean
Chile
N
0
50
100
km

Case Study 1: Excavations at Malata

- Terminal prehispanic / early colonial settlement (mission)
- Three seasons of excavations (2006-2008)
- ArcPad-based mobile GIS (Tripcevich and Wernke 2010 [*J. of Field Archaeology*])


Excavation Units
Season
2006
2007
2008
Prehispanic Cyst tombs
• 300 sq. m total excavation area
• 12 structures excavated
• Test pits (2006)
• Chapel (2007)
• Public and domestic contexts (2008)
0
50
m
N

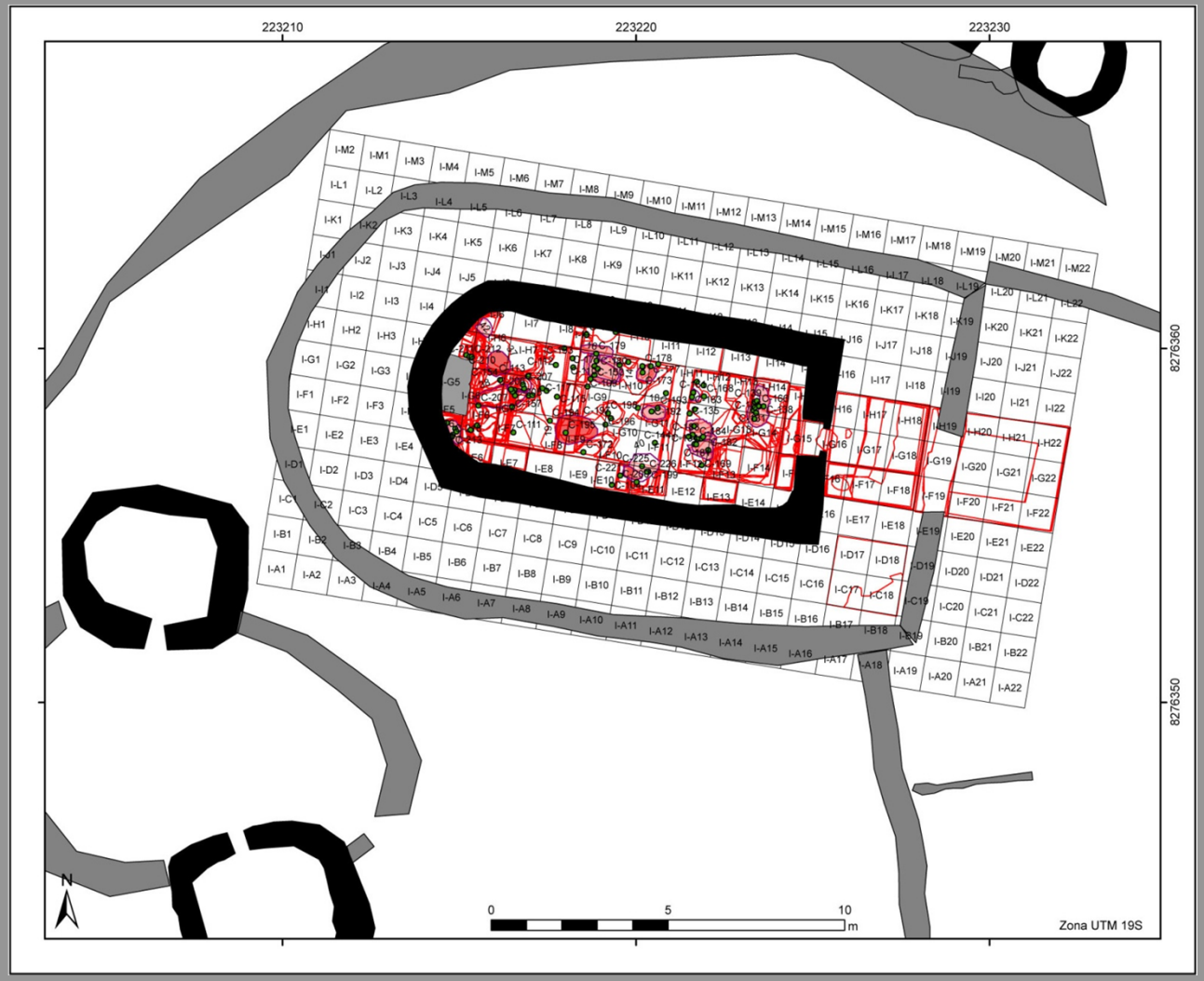
Mapping & GIS Strategy

- Vector- & raster-based representations
  - Vectors: total station / on-screen plotting
  - Rasters: photomapping via PAP (Pole Aerial Photography)
- Attribute registry & data synchronization via customized ArcPad (running on Pocket PCs)
- Six excavation crews

File/Provenience System for Photomapping

- Given standing architecture, a series of grids were established around structures/areas to be excavated
- Each grid was denoted with Roman Numeral
- Grid cells coded by letter/number (letter N-S, number E-W)
- Within a Grid, excavation “Units” (e.g., a 4 x 4 m excavation area) were denoted by SW and NE cells
- Thus, a hierarchical provenience system: Grid>Unit>Cell (E.G. IV/C12-F15/C13)

E.G. Grid I (Chapel Excavations)



Within each excavation unit, cultural unit of provenience was called a “locus” (each with unique ID code)

Photomapping

Photomap Image Archival System

- Hierarchical directories:
- C:\GIS_DATA
  \S_America_Atlas
  \Peru
  \Colca
  \Malata
  \Malata_photomaps
  \Grid_I
  \Unit_F6_H8
  \1075_1076_0197.jpg

ArcPad Form (Tabs)

Surface_a

Locus | Spatial

Locus Num, 1198
Locus Subtype: Prepared floor
Subtype Conf.: Medium
Archit. Context: Burial
Units (A1-B2): F9
Excavator: EML
Start Date: 8/ 2/2007
End Date: 8/ 1/2007

Surface_a

Locus | Spatial

Locus Above: 1151
Locus Below:
Subdatum SD-:
Volume (L): 88

Depths

Top: 0 Bottom: 0

Hand measurements

Top Bottom

Total Station Measurements

Top Bottom Perimeter

Surface_a

Spatial | Soil | Co

Munsell Hue: 7.5YR Value / Chroma: 4 / 3
Soil Type: Silty Clay
Soil Texture: Compact
Sort and Grain: 3 WellSort Fine

Surface_a

Soil | Col1 | Col2

Bag Inventory - Page 1

Ceramics 11
Lithics 17
Groundstone 3
Metal 1
Glass 0
Shell 1
Botanical 12

Surface_a

Col1 | Col2 | Phol

Bag Inventory - Page 2

Animal Bone 1
Human Bone 4
Other 1
Other (descr)

Sample Inventory

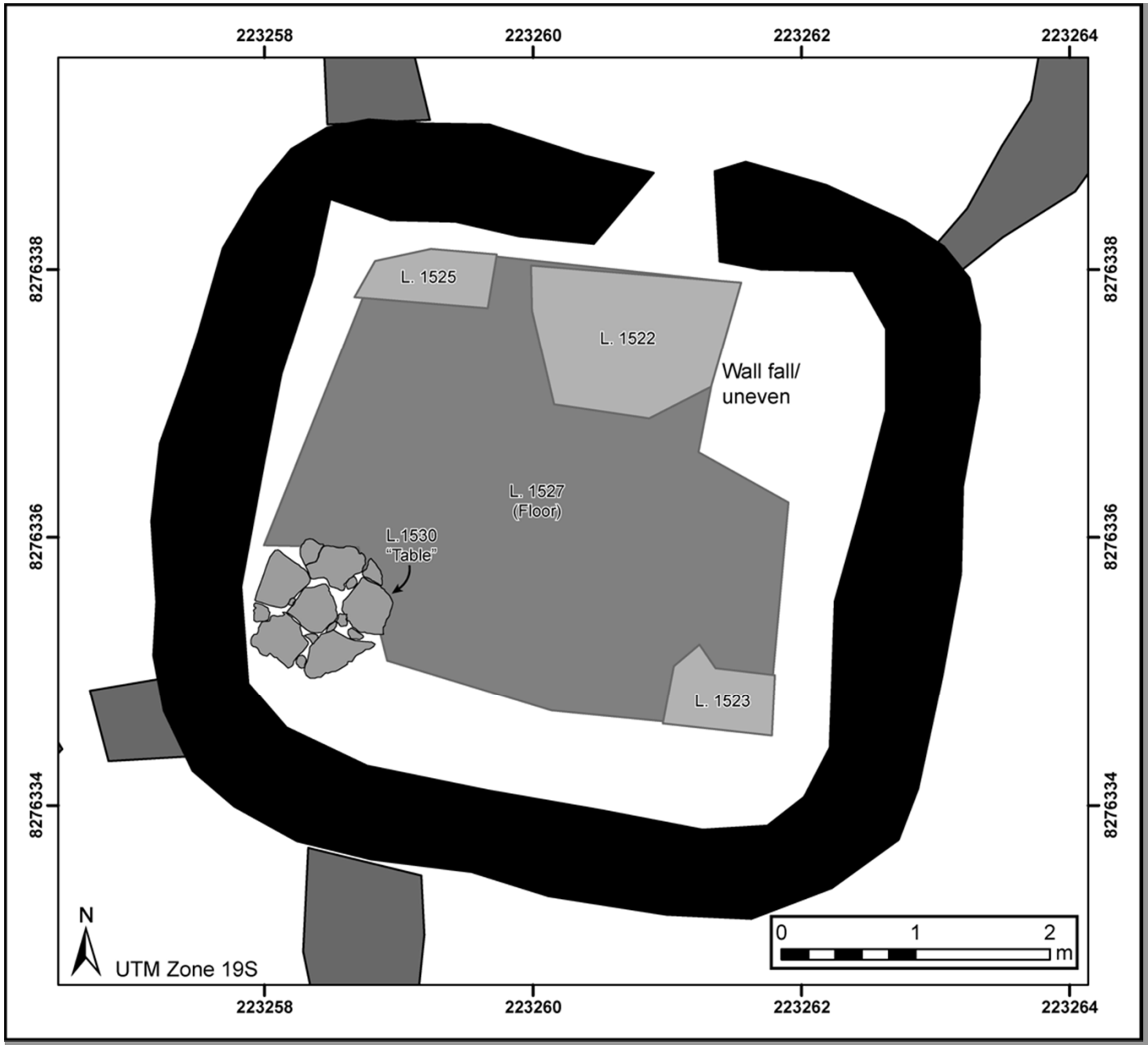
Carbon 4
Soil 1
Wall Stucco 2

Surface_a

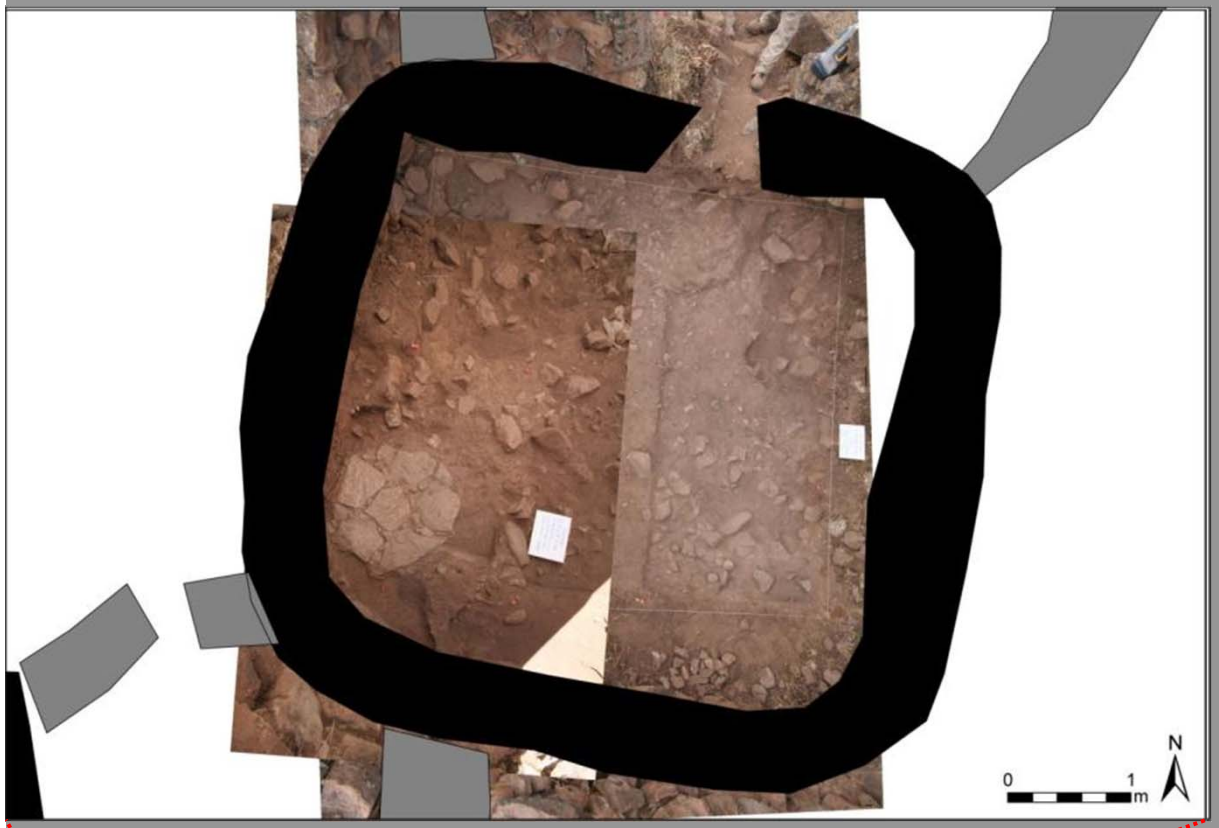
Photos-Notes | Picture

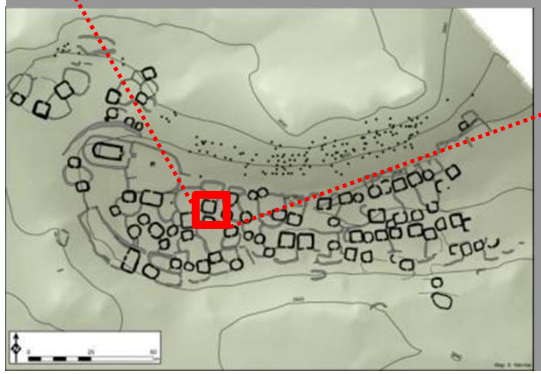
Photo Numbers (#-#,#,#)
1124-1131,1136

Digital Notes
Interior burnt earth of 1192
Need TSPT.



Structure 004





Structure 28

Photomap: Extended supine adult in front of altar platform

The Good

- Drastically cut down data entry during evenings/weekends. Attribute tables basically ready for analysis.

- Speed: photomapping quickly captures imagery (compared to plotting with total station)

- More data, better documentation: raster & vector maps for all contexts

The Bad

- Notetaking hindered by interface
- Length of forms (though not long on paper) led some crew chiefs to rush through some parts
- Lack of one-to-many relationships limited functionality (especially for photos, Harris Matrix relations)
- Georeferencing of PAP images not possible in ArcPad. Must be done centrally (ArcMap) and later distributed
- Form editing/data synchronization cumbersome

The Ugly

- No integration with total station (junk geometry drawn on screen, later replaced in ArcMap)
- Clunky Windows Mobile interface
- Screens not very readable in bright sunlight
- Not a true 3D system. A series of plan views. Profiles still done on paper.

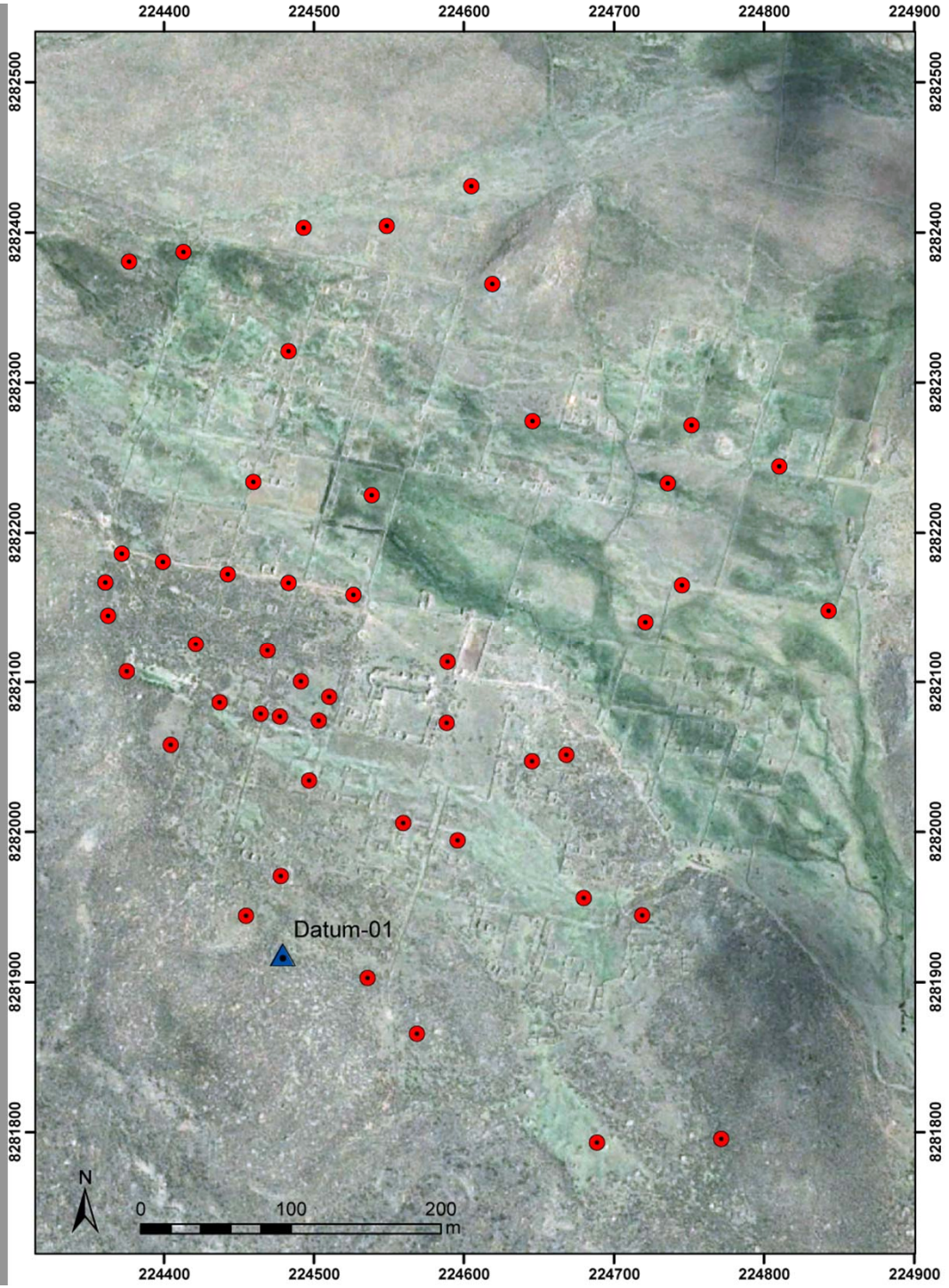
Case Study 2: Survey and Excavations at Mawchu Llacta

Mapping & GIS Strategy

- Establish ground control points
- Fly UAV over site (frame rate = 0.5 sec)
- Mosaic/orthorectify imagery via Agisoft Photoscan
- Digitize & record attributes for structures/walls/features/lichenometry on iPads via Garafa GISPro
- Four survey crews

GCPs

- N = 53


224400
224500
224600
224700
224800
224900
8282500
8282400
8282300
8282200
8282100
8282000
8281900
8281800
Datum-01
N
0
100
200
m

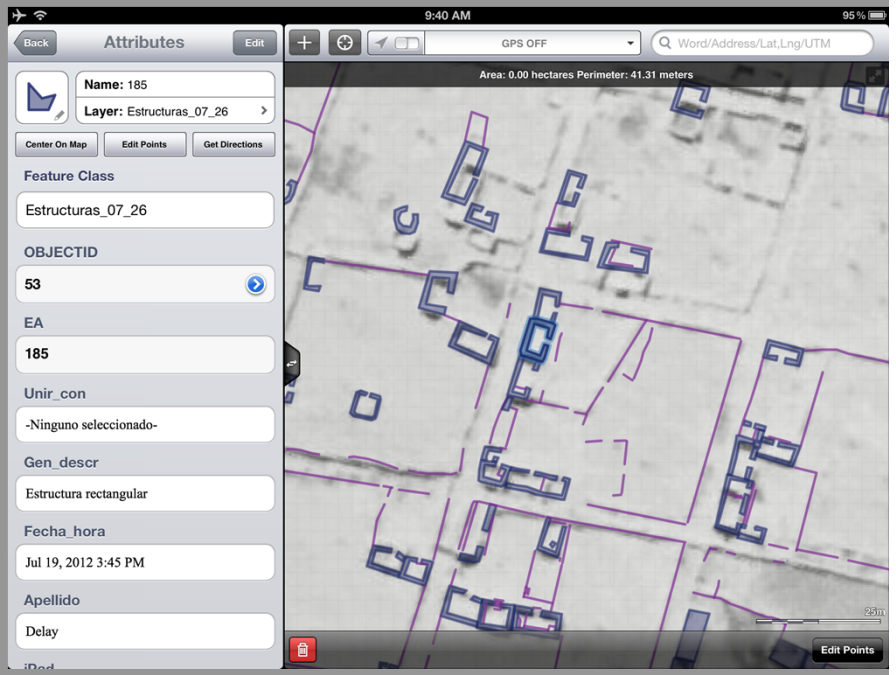

Mon July 17
Llacta

UAV Video

UAV Video 2

Sample (Low Res) Section of Mosaic

GISPro


9:40 AM
95 %
Back
Attributes
Edit
GPS OFF
Word/Address/Lat,Lng/UTM
Area: 0.00 hectares Perimeter: 41.31 meters
Name: 185
Layer: Estructuras_07_26
Center On Map
Edit Points
Get Directions
Feature Class
Estructuras_07_26
OBJECTID
53
EA
185
Unir_con
-Ninguno seleccionado-
Gen_descr
Estructura rectangular
Fecha_hora
Jul 19, 2012 3:45 PM
Apellido
Delay
25m
Edit Points


10:08 AM
91 %
Back
Attributes
Edit
Muro 1 casi no conserva su altura, muro 5 ha colapsado en el centro pero conserva vano parcialmente
Forma
Cuadrangular
Forma_desc
Esq_ext_fo
Angular-ligada
Esq_int_fo
Redondeada
Rasgo_piso
no
Divisiones
0
Division_1
Temp_const
Colonial temprano
GPS OFF
Word/Address/Lat,Lng/UTM
Area: 0.00 hectares Perimeter: 41.31 meters
25m
Edit Points

The Good

- Interface is much better
  - Still, for longform notes, I still think there is no substitute for pen and paper in the field
- Flexible. New attributes and dropdown menu items could be added by users in the field.
- Allows for georeferencing of images in the field, on screen (will be very useful for excavations)

The Bad

- No automated synchronization. We had to manually keep track of which teams had which batches of codes
- Also means that once data is synchronized and converted to shapefile, input form is lost and any edits must be manually tracked
- It’s iOS (locked down, difficult)
- It’s expensive ($300 per iPad)

The Ugly

- No desktop application. Loss of data forms when exporting to shapefile
- Notes that exceeded 255 characters were truncated (!)
- Projection problems (UTM nomenclature is different, and the projection changes slightly between GISPro/ArcMap)

Concluding Thoughts

- A successful FAIMS will require at least five capabilities:
- Minimal interface impedances, GUI, touch-based
- Flexible, field editable DB design w/ “any to any” capabilities
- Image management w/geo-/orthorectification
- Direct, live link w/total stations, other field instruments
- Easily managed data sync system

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