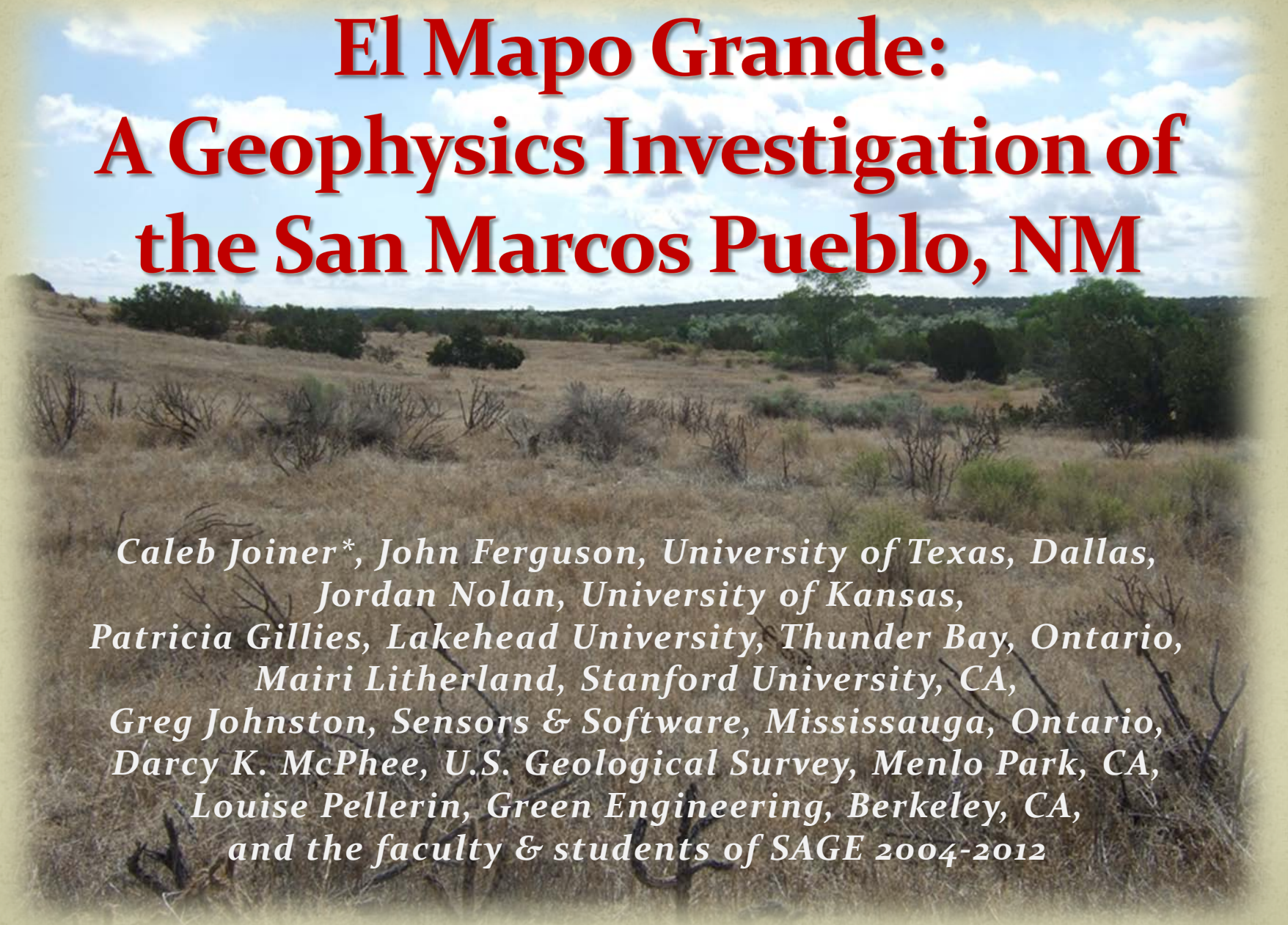
El Mapo Grande: A Geophysics Investigation of the San Marcos Pueblo, NM



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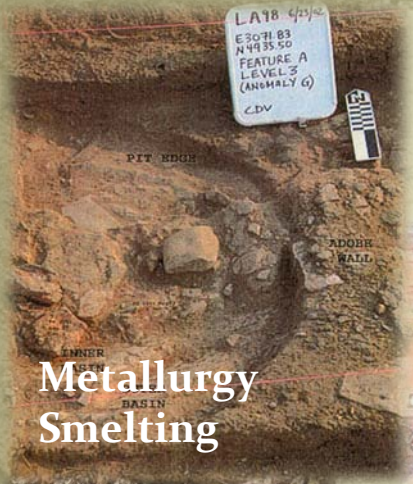
Summer of Applied Geophysical Experience
- SAGE -

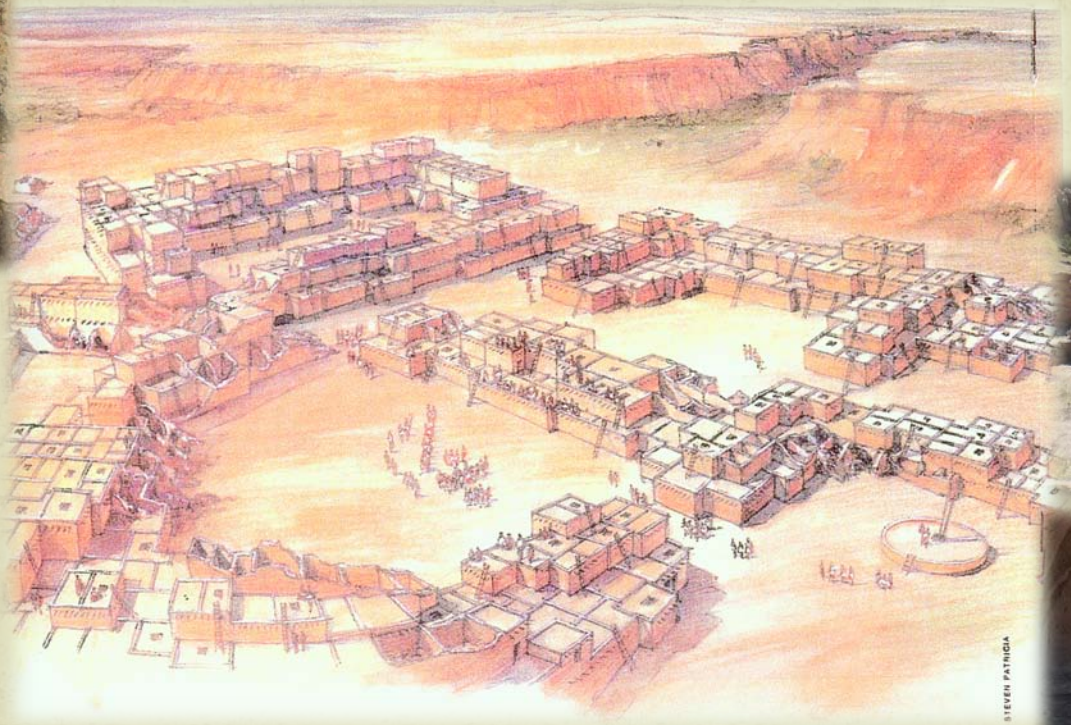
SAGE is a ~4 week research and education program in exploration geophysics for graduate and undergraduate students and working professionals, based in Santa Fe, New Mexico, U.S.A.

San Marcos Pueblo has been studied by SAGE since 2004. Ground Penetrating Radar (GPR), magnetic and electromagnetic (EM) data were acquired on 30m by 30m quadrangles tiling most of a 150m by 150m area, El Mapo Grande, along with seismic refraction across the complex.

San Marcos Pueblo History



Metallurgy
Smelting



Kiva

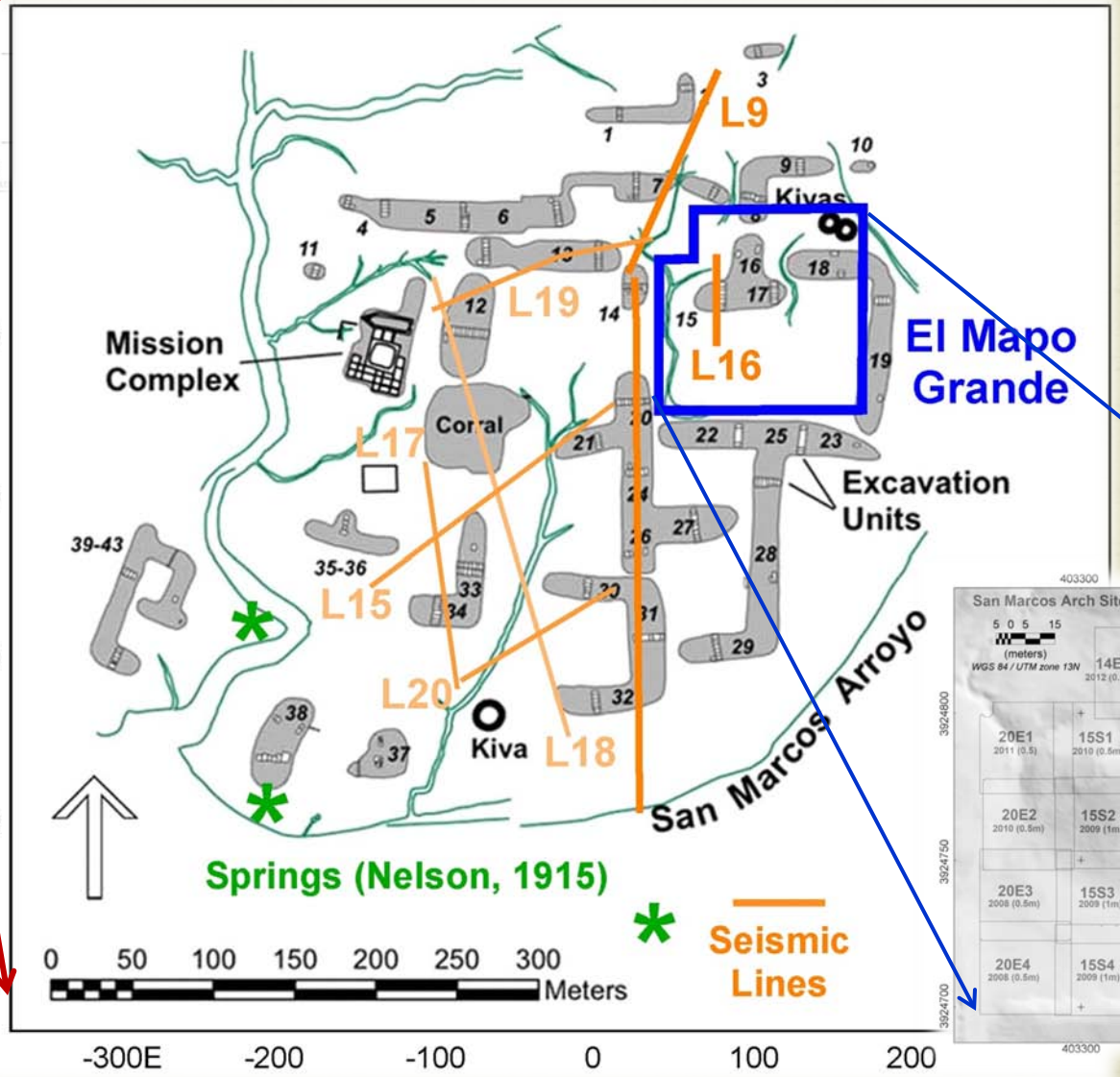
Extensive trading in turquoise, copper & lead-glazed pottery

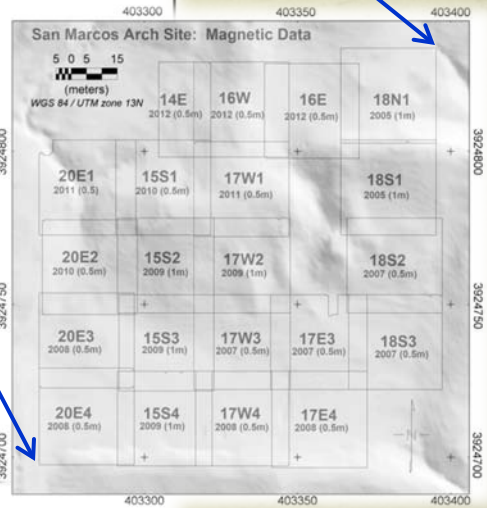
Occupied for more than 400 years until Pueblo Revolt (1680)

Site of Franciscan mission (1630-80)

The bulk of the archaeological record remains buried & intact

El Mapo Grande





Magnetics

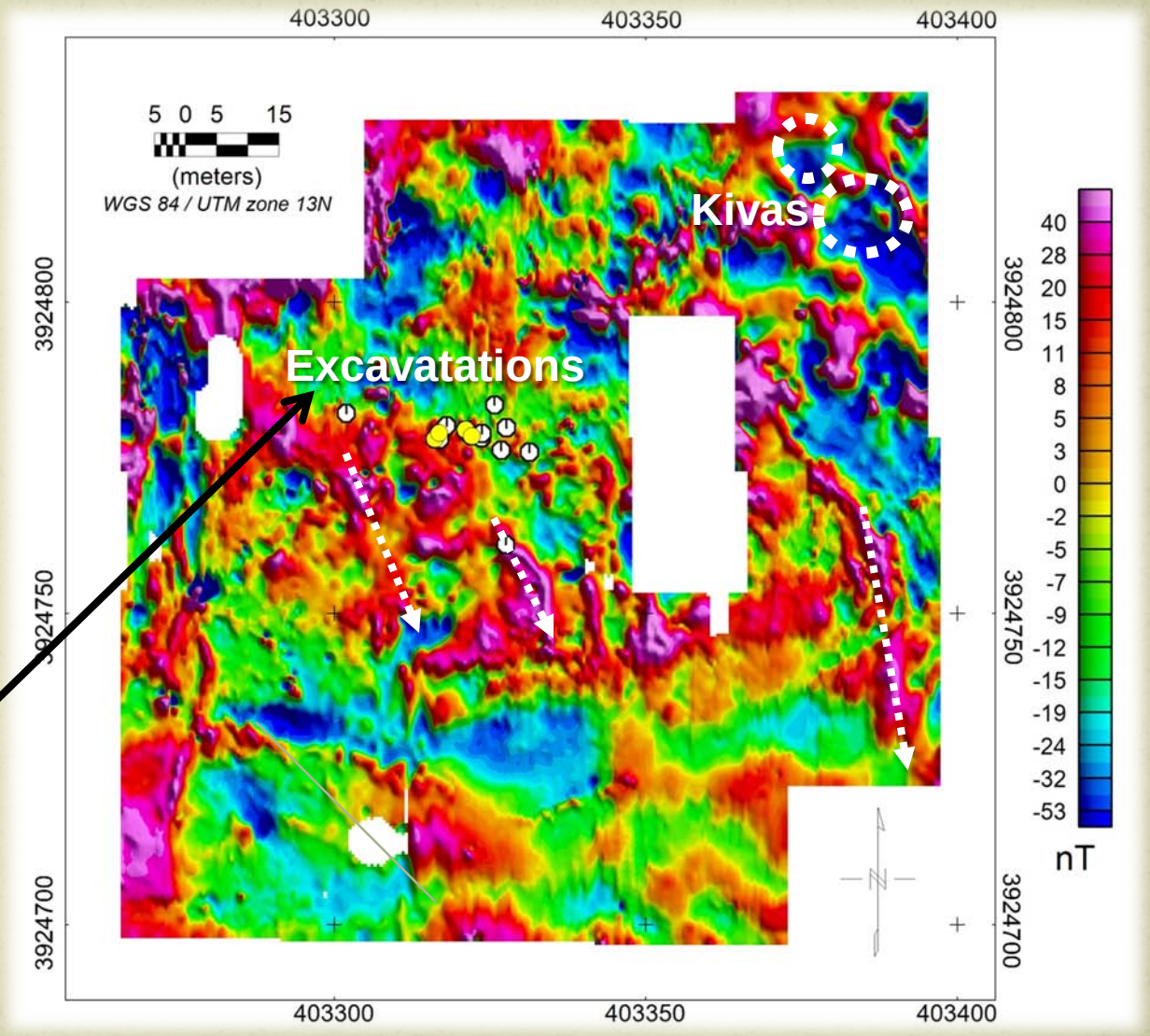
- Geometrics Cesium vapor magnetometer
- 0.5 m line spacing
- Residual field and vertical derivative maps
- Both geological and archaeological (cultural & metallurgic) features are delineated

(metallurgic excavation. Ramenofsky, 2003)

Magnetics: Residual Field

Lows:
NE circular anomalies - kivas

Highs:
Hill-slope erosion channels & plumes of debris washed down from the metallurgical sites excavated by UNM



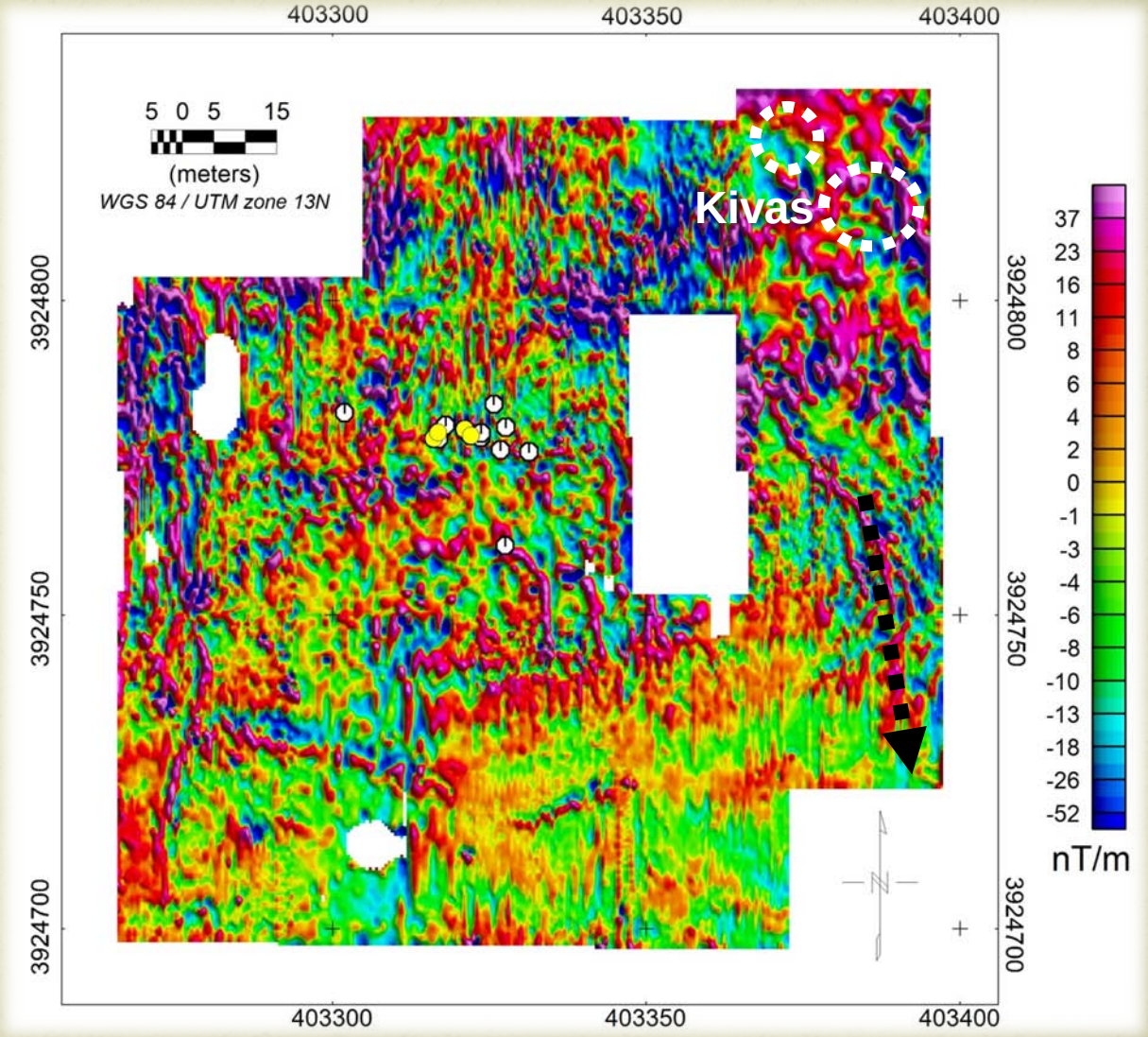
Magnetics: Vertical Derivative

Shallow Features:

Lineations in the plaza

Down topo gradient flow path

Kivas



Electromagnetic (EM)

Geonics EM31 – 2 instruments:

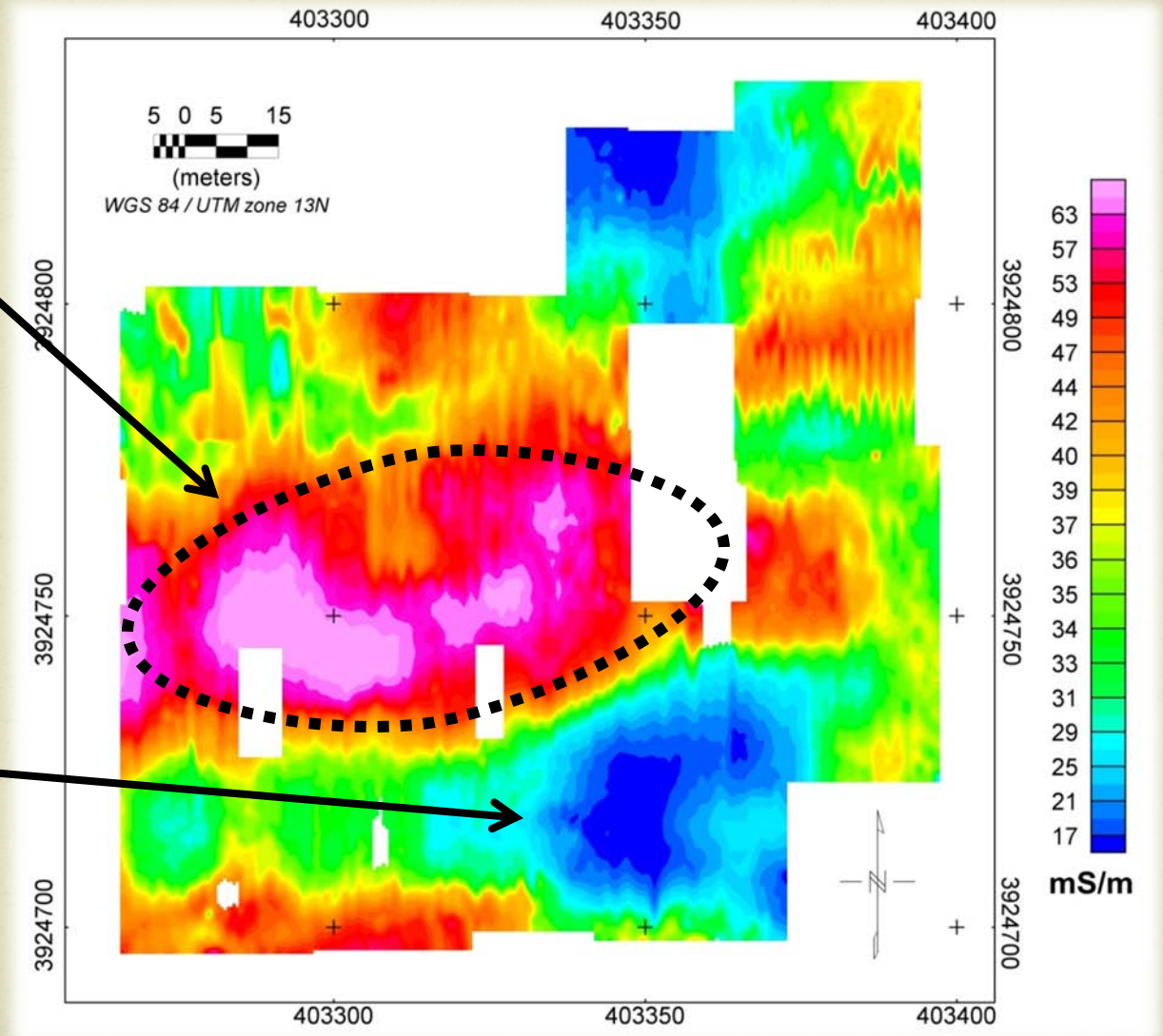
- **MK2=3.67m Tx-Rx Separation**
- **SH=2m Tx-Rx Separation**

- **Vertical Magnetic Dipole**
- **Frequency 9.8kH**
- **1m line spacing**

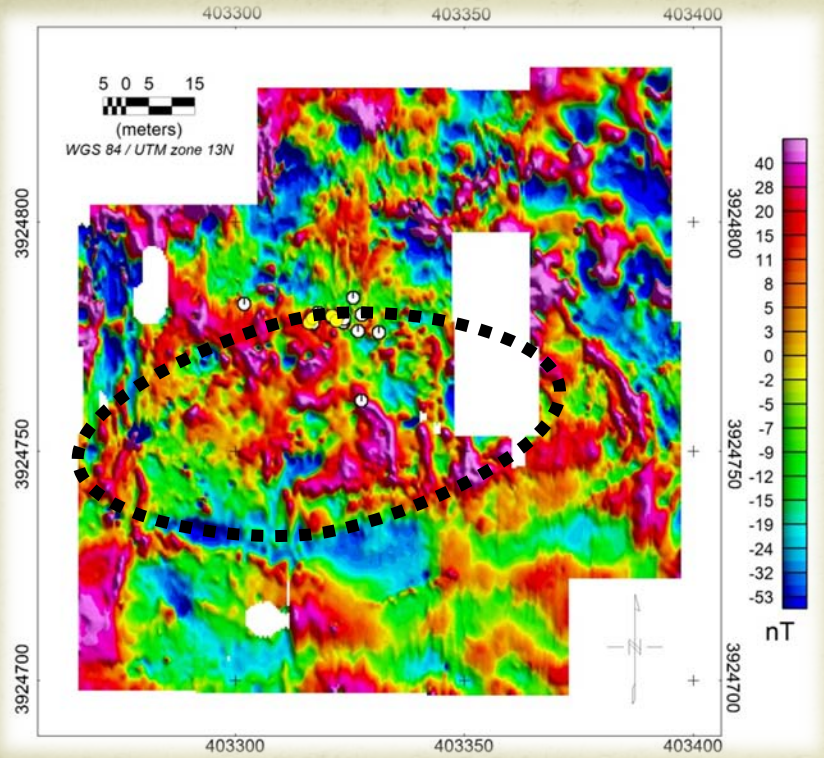
Apparent Ground Conductivity

High conductivity: slope below room blocks 15, 17 and 18

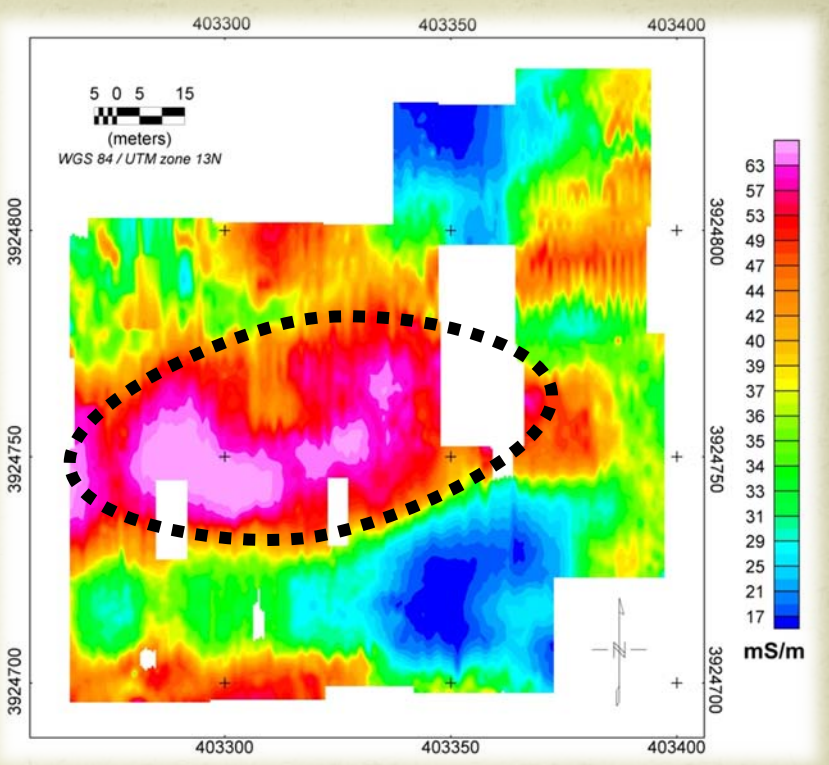
Low conductivity: correlates with post 1680 plaza sedimentation



Magnetics



Conductivity

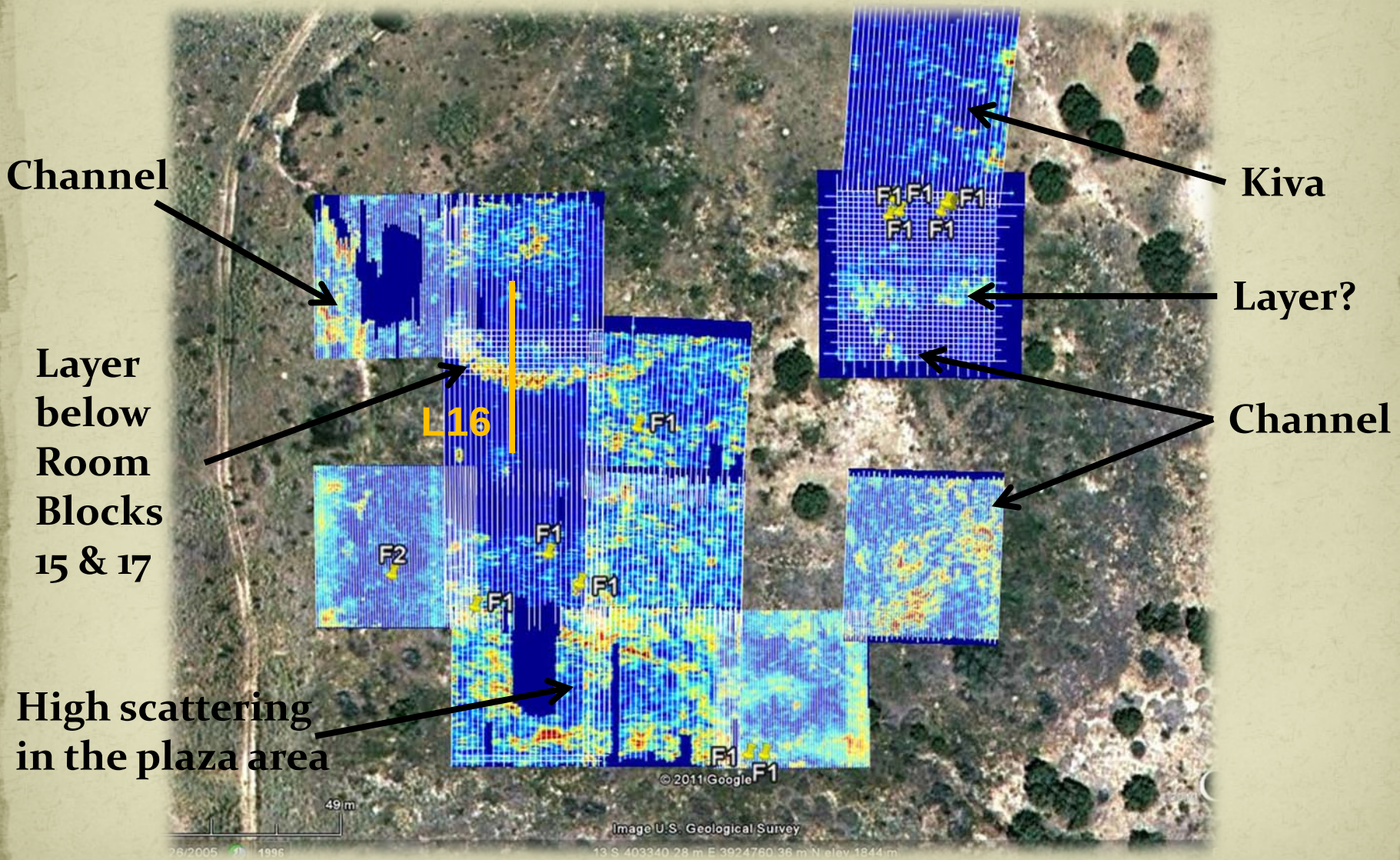


The high-conductivity zone correlates with the zone of generally high magnetic response

GPR

- Sensors & Software Noggin 250 system
- 0.5 & 1.0 m line spacing
- Higher amplitudes in warmer colors and lower amplitude in cooler colors
- Due to conductive nature of site, no significant reflections > 1.5 m
- Depths < 0.5 m noisy with very near-surface rubble
- Amplitude depth slice of reflections at 1-1.01 m show significant features (walls & floors?)

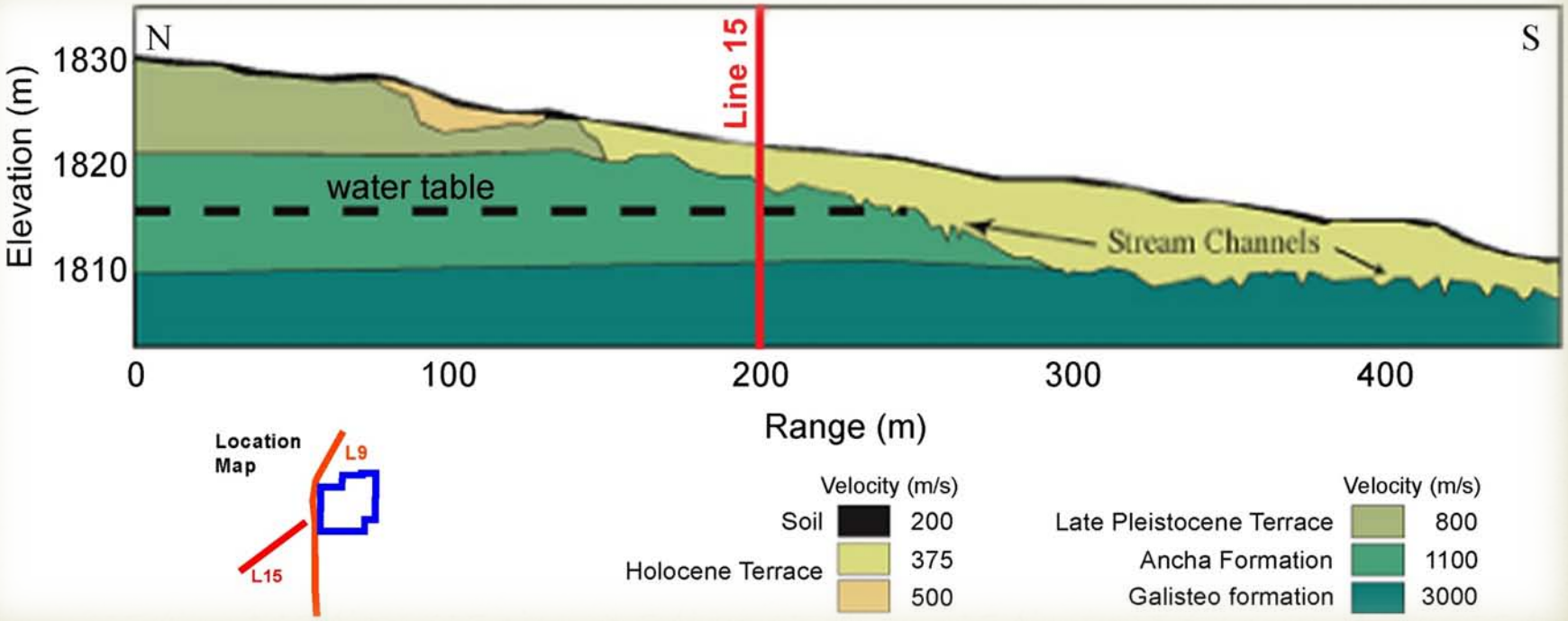
GPR – 0.5 to 1 depth m



Refraction Seismic

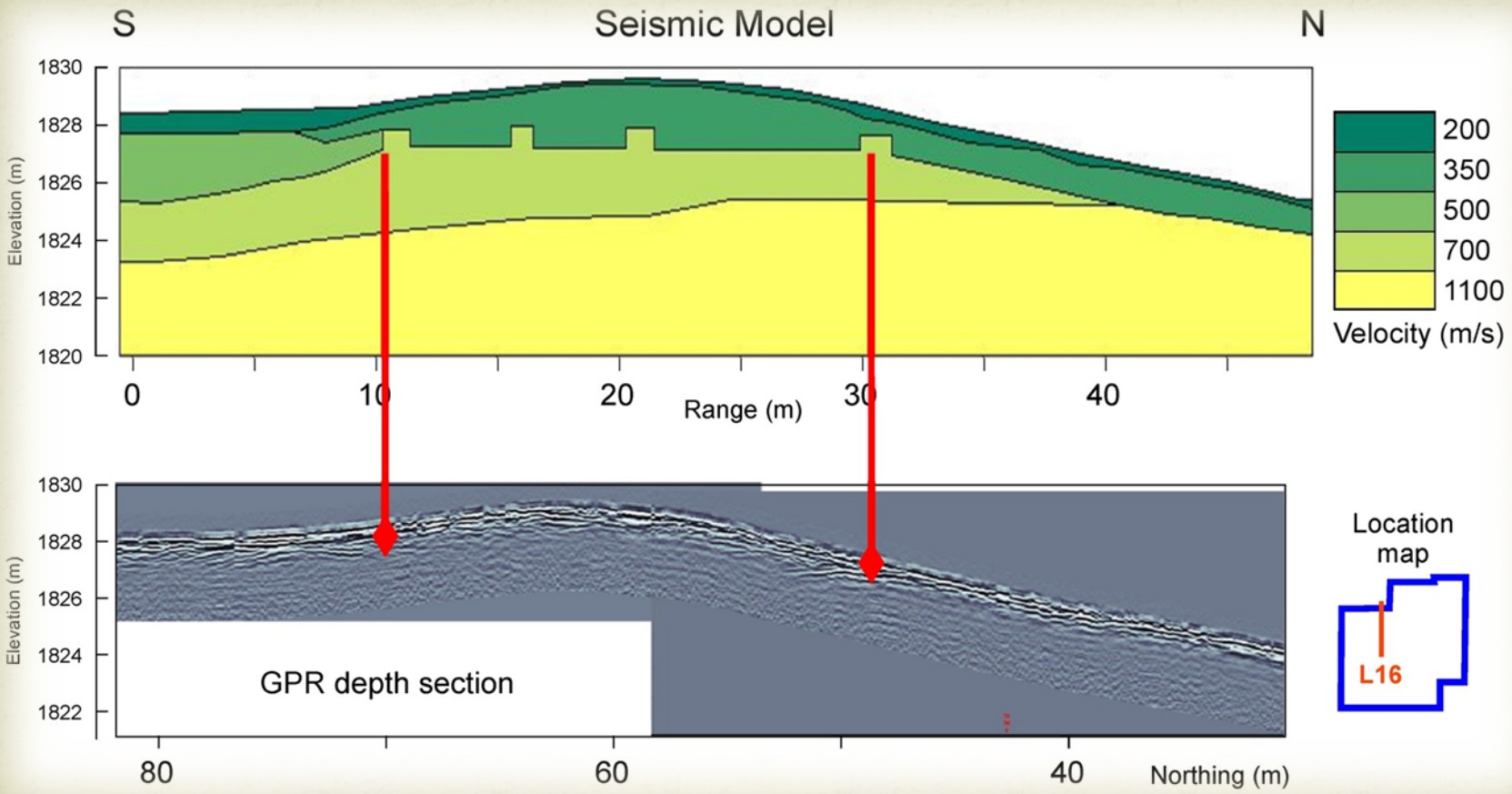
- Seismic data were recorded with a 48 channel system
- 0.5m geophone interval
- Vertical hammer source with 3m spacing

Seismic Line 9



Seismic modeling define geology; Line 9 is a representative cross-section across the site

Seismic L16 & GPR



- **Pleistocene terraces (green layers) overlying unsaturated Pliocene Ancha formation (yellow layer)**
- **Possible archaeological features are detectable in the travel times & GPR depth section**

Conclusions

- **Two room blocks interpreted as rock pavements floors in GPR & seismic data not previously described.**
- **Seismic data valuable in interpretation of geology**
- **Apparent conductivity related to slope below room blocks & plaza**
- **Metallic debris delineated in the magnetic data represent a newly observed feature likely to be connected to Colonial-era metallurgical activity.**
- **Layers depicted in GPR & magnetics**

Acknowledgements

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