Late Quaternary Stratigraphy and Dating at the Waco Mammoth Site: Environmental Reconstruction and Interpreting the Cause of Death

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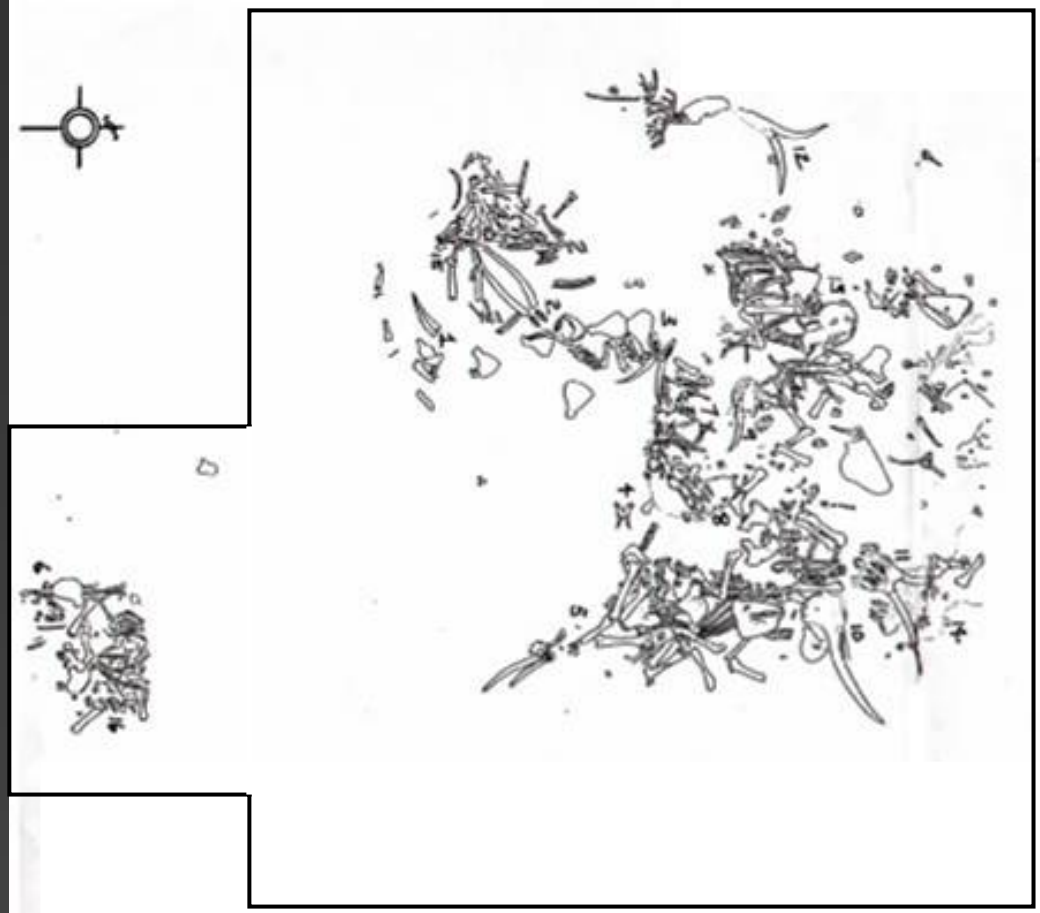
The Waco Mammoth Site

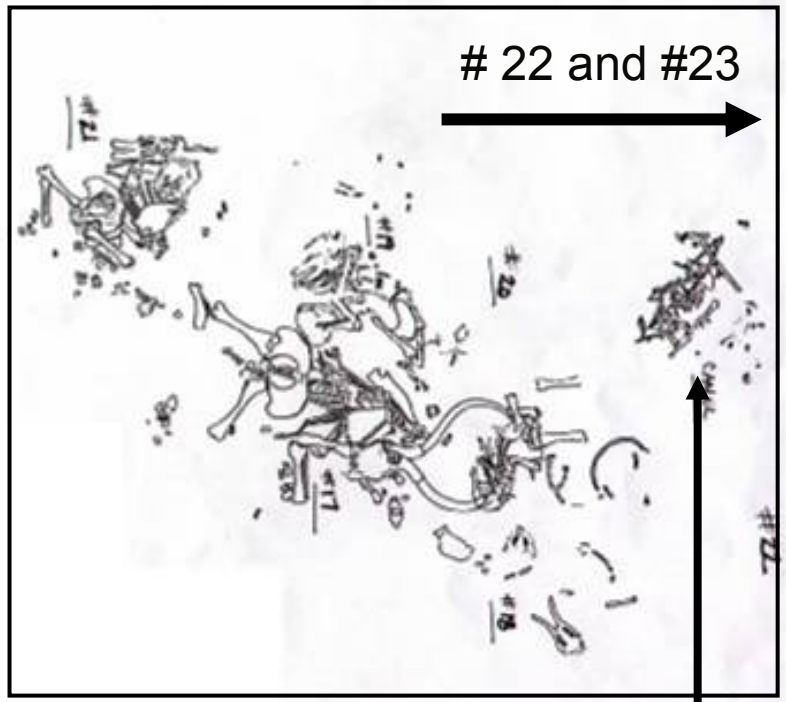
Discovery 1978
By: Paul Barron and Eddie Bufkin

Bones determine to be Columbian Mammoths (*Mammuthus columbi*)
*David Lintz, Strecker Museum, Baylor University, Waco, TX

Phase I (1978 – 1987)



Phase II (1990)



Objectives

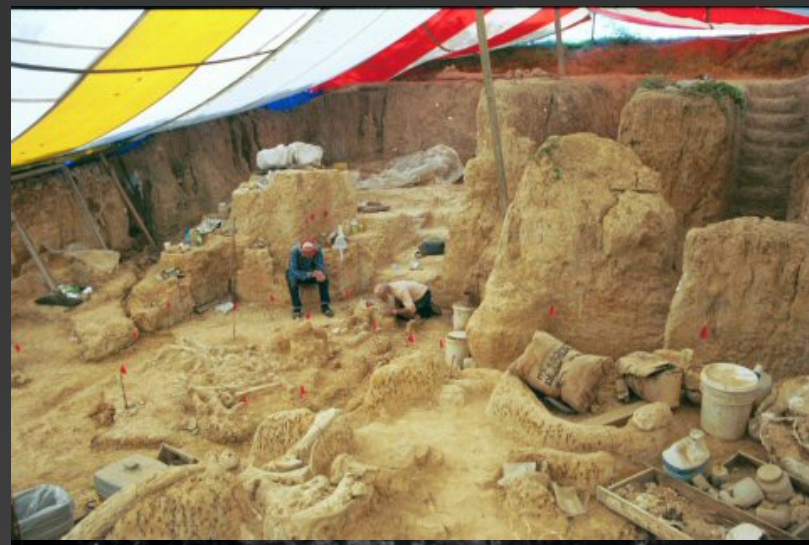
Environmental and Geologic Setting

Other Columbian Mammoth Sites

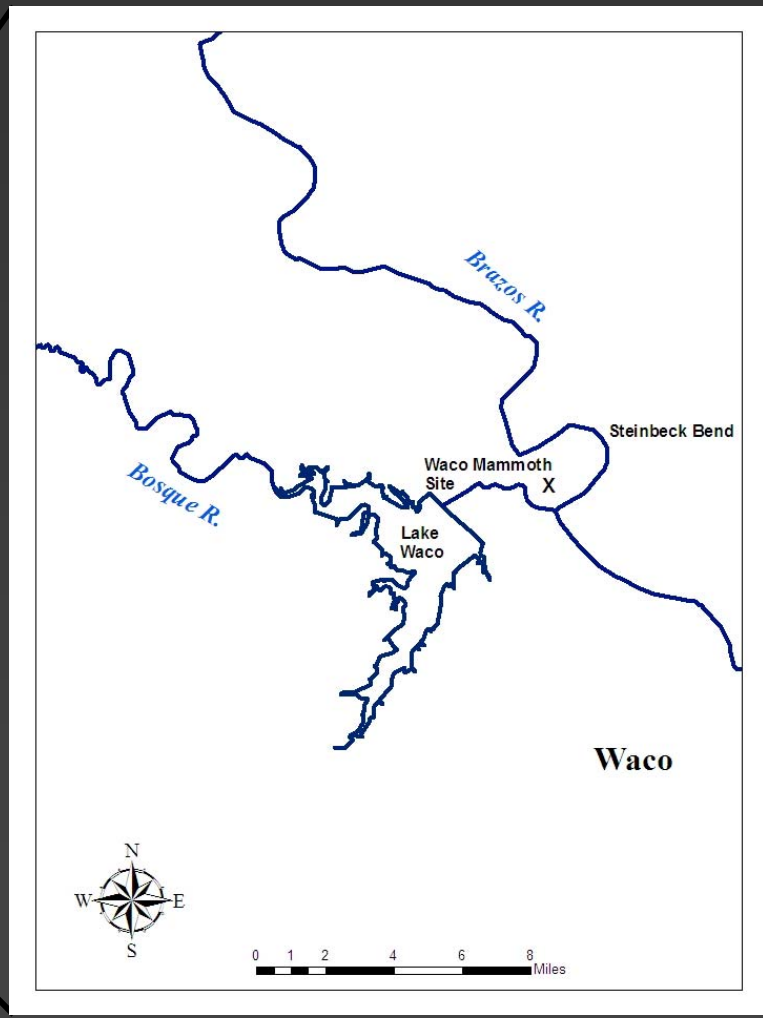
Previous Research at the Mammoth Site

Current Research

Anticipated Research



The Waco Mammoth Site Geology



Other Mammoth Sites

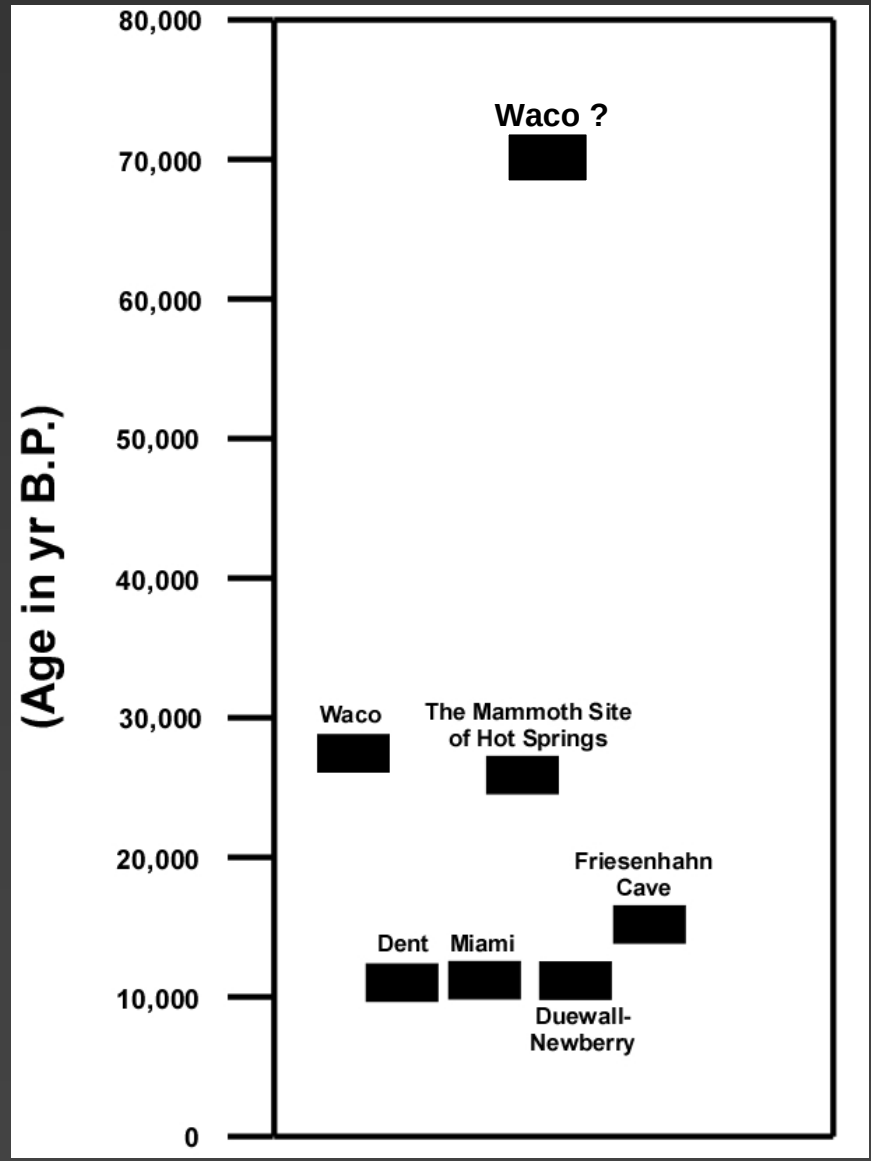
Duewall-Newberry Site –
Brazos County, Texas

Friesenhahn Cave Site –
Bexar County, Texas

Miami Site –
Roberts County, Texas

Dent Site –
Weld County, Colorado

The Mammoth Site of
Hot Springs –
Fall River County, South Dakota



Previous Research

- Two Major Phases of Excavation
  - Phase 1 (1978-1987)
  - Phase 2 (1990)
- Standard Radiocarbon
  - Age = Approximately **29,000** yr B.P.
    (Haas, SMU,1997)
- Uranium/Thorium Dating of Tooth Enamel
  - Age = Ranging from **71,000** to **73,000** yr B.P.
    (Mckinney, SMU, 1990)
- Optically Stimulated Luminescence Dating
  - 4 Ages = Ranging from **65,000** to **73,000** yr B.P.
    (Foreman, UIC, 2004)

Standard Radiocarbon Dating

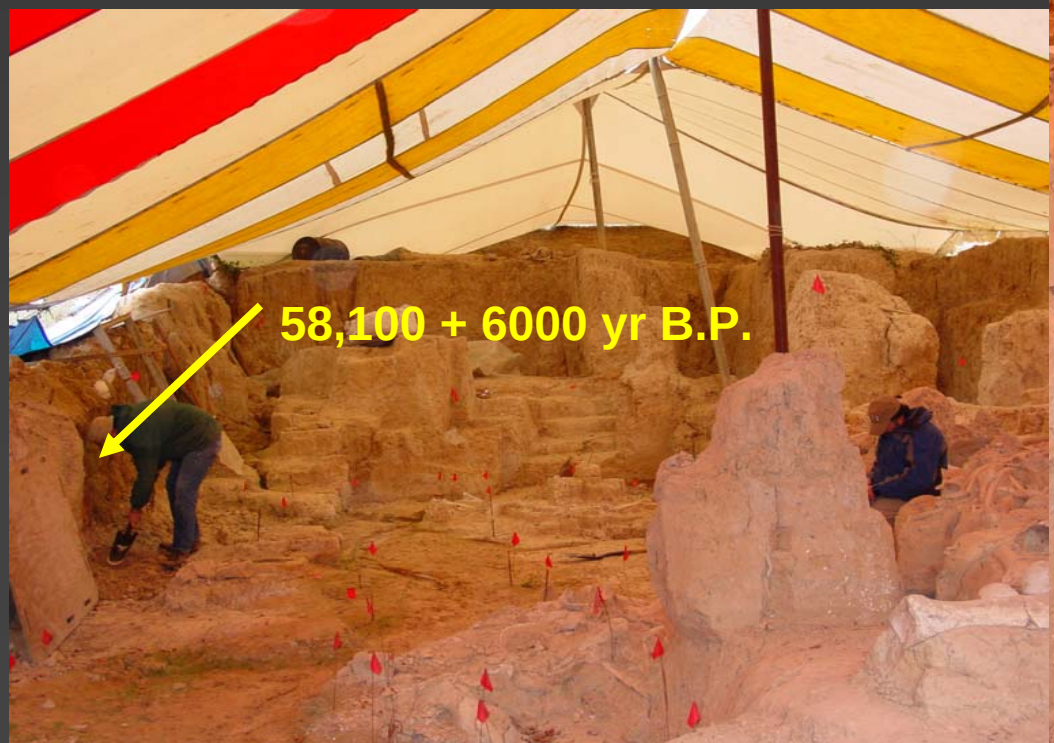
- Dating Conducted by Dr. Herbert Haas, Southern Methodist University, Texas
  - Sample taken from bone apatite
  - Insufficient collagen for dating
  - Produced a fractionation corrected age of 28670 ± 720 yr B.P.

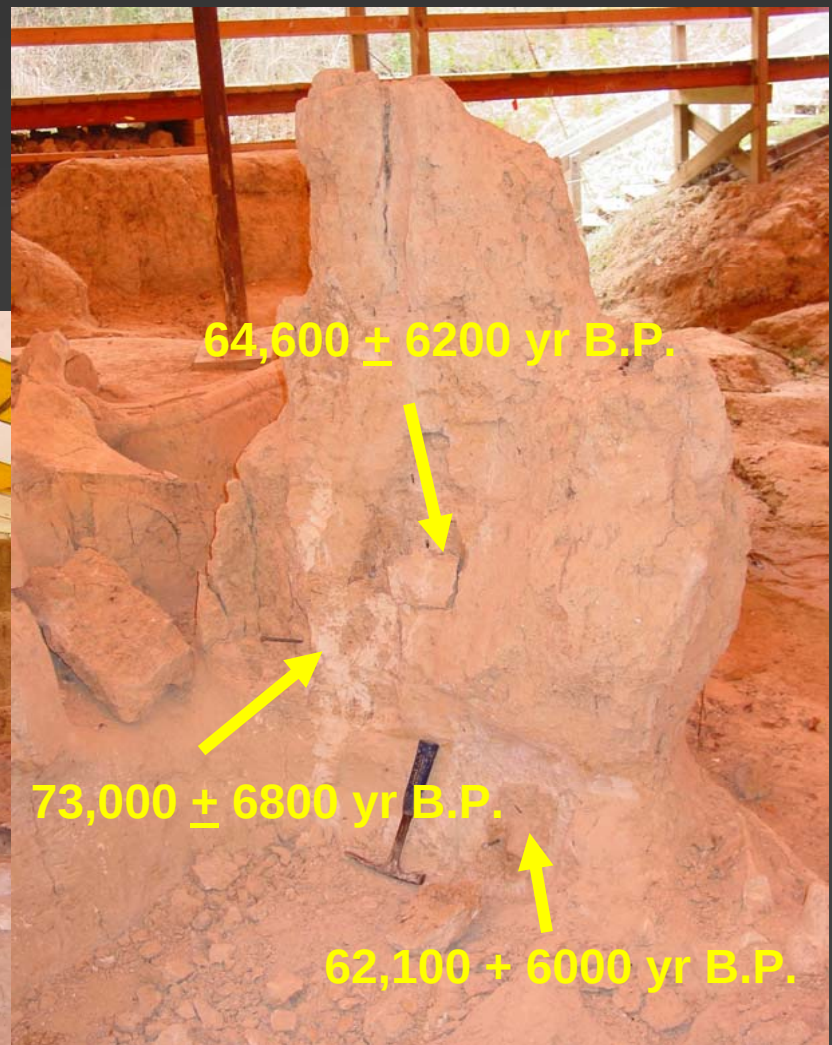
Uranium/Thorium Dating

- Performed by Curtis Mckinney, Southern Methodist University in 1990
  - Age retained from extracted Tooth enamel
  - Produced two ages:
    - 70,924 yr B.P.
    - 73,442 yr B.P.

Optically Stimulated Luminescence (OSL) Dating

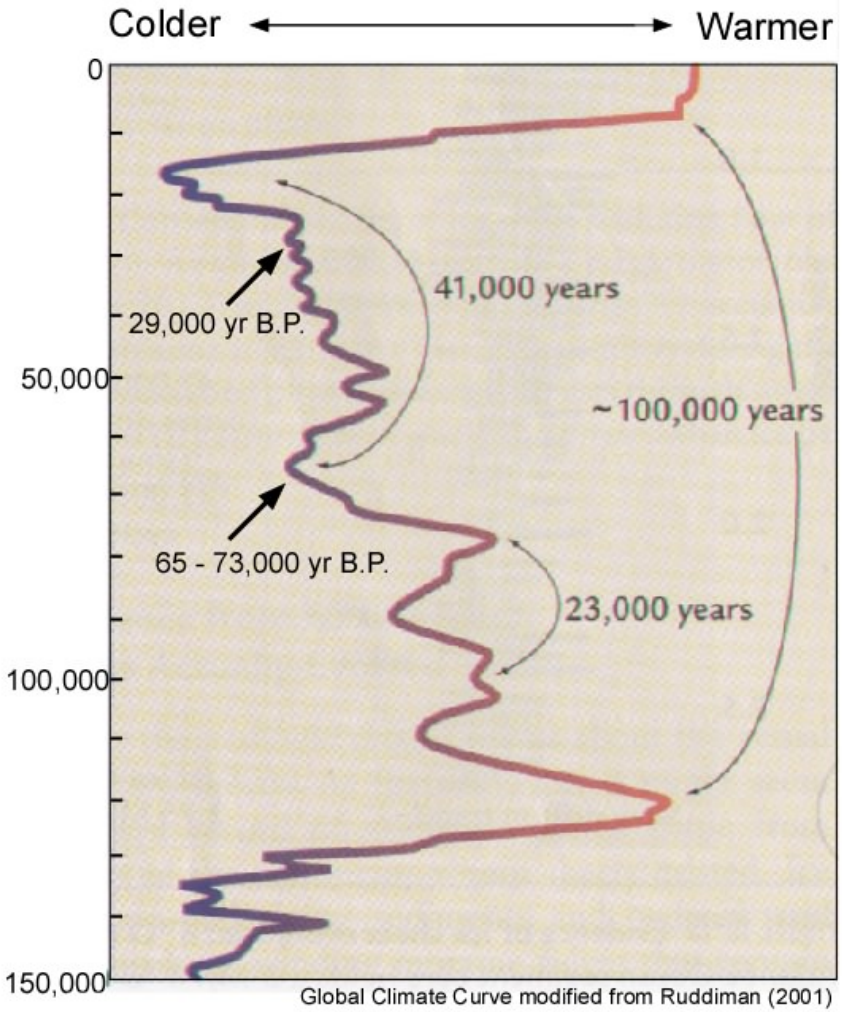
***Sandy alluvial sediments can produce accurate ages if in an environment suitable for (OSL)**
(Steve Foreman, University of Illinois-Chicago)





Climate Comparison

(29,000 yr B.P.) Slightly **Warmer** period during the Wisconsinan glaciation, before last glacial maximum 21,000 Yr B.P.



Global Climate Curve modified from Ruddiman (2001)

(65 to 73 kayr B.P.) **Marine Oxygen Isotope Stage 4**, during the *Wisconsinan glaciation*, an age range when temperatures reached levels nearly as low as during the last glacial maximum 21,000 yr B.P.
Ruddiman (2001)

Previous Research

Single Herd/Sudden Death

Naryshkin (1981) – Lithologic Interpretation

Fox et al. (1992) – Preliminary Investigations

Hilliard (1997) – Stratigraphy and Soils

Hoppe, K. (2003) - $\delta^{13}C$ and $\delta^{18}O$ Analyses

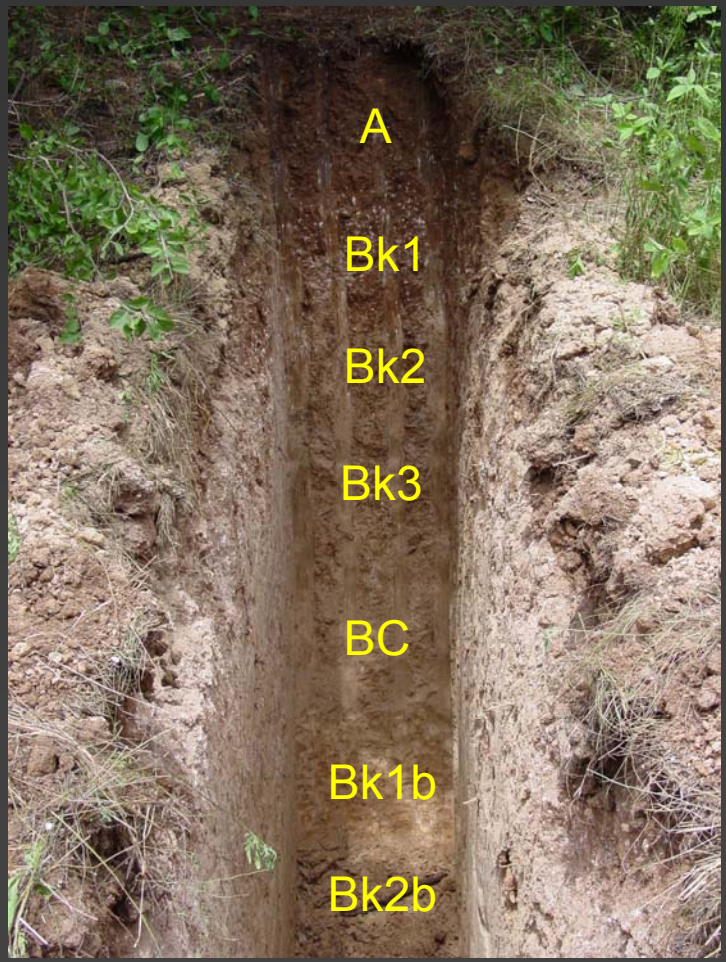
Current Research

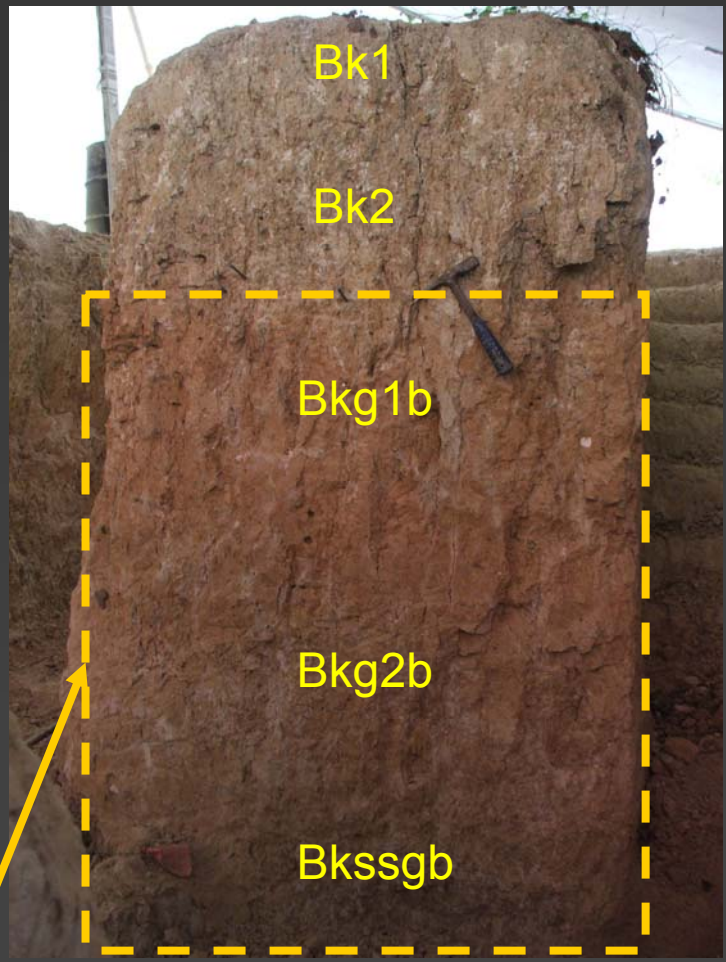
Soil Profile Descriptions
- Wall Profiles
- Test Trenches

Stratigraphy
- Test Trenching
- Coring/Auguring

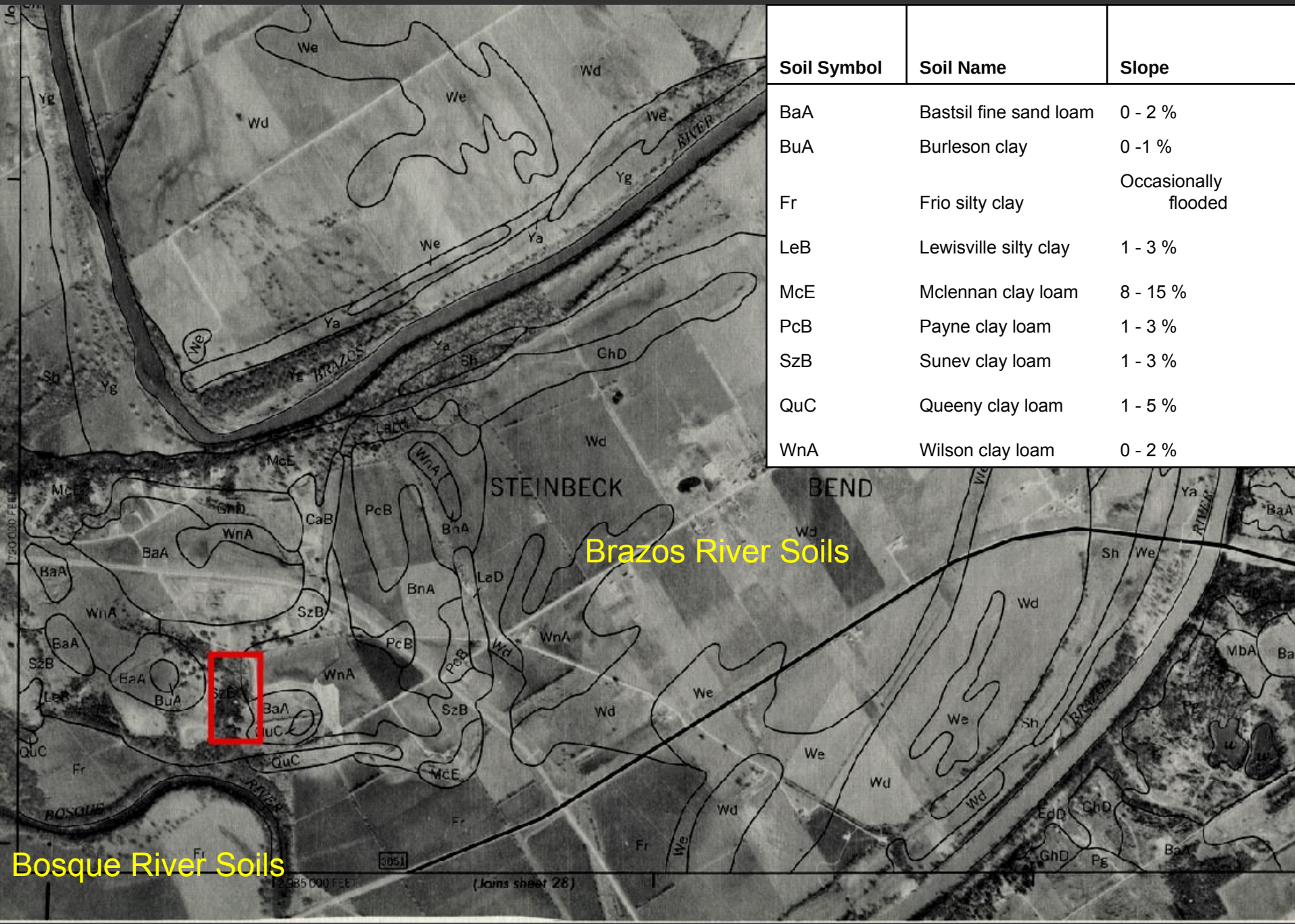
Sampling
- Sediment
- Thin Section
- Isotopic Analysis

Soil Descriptions



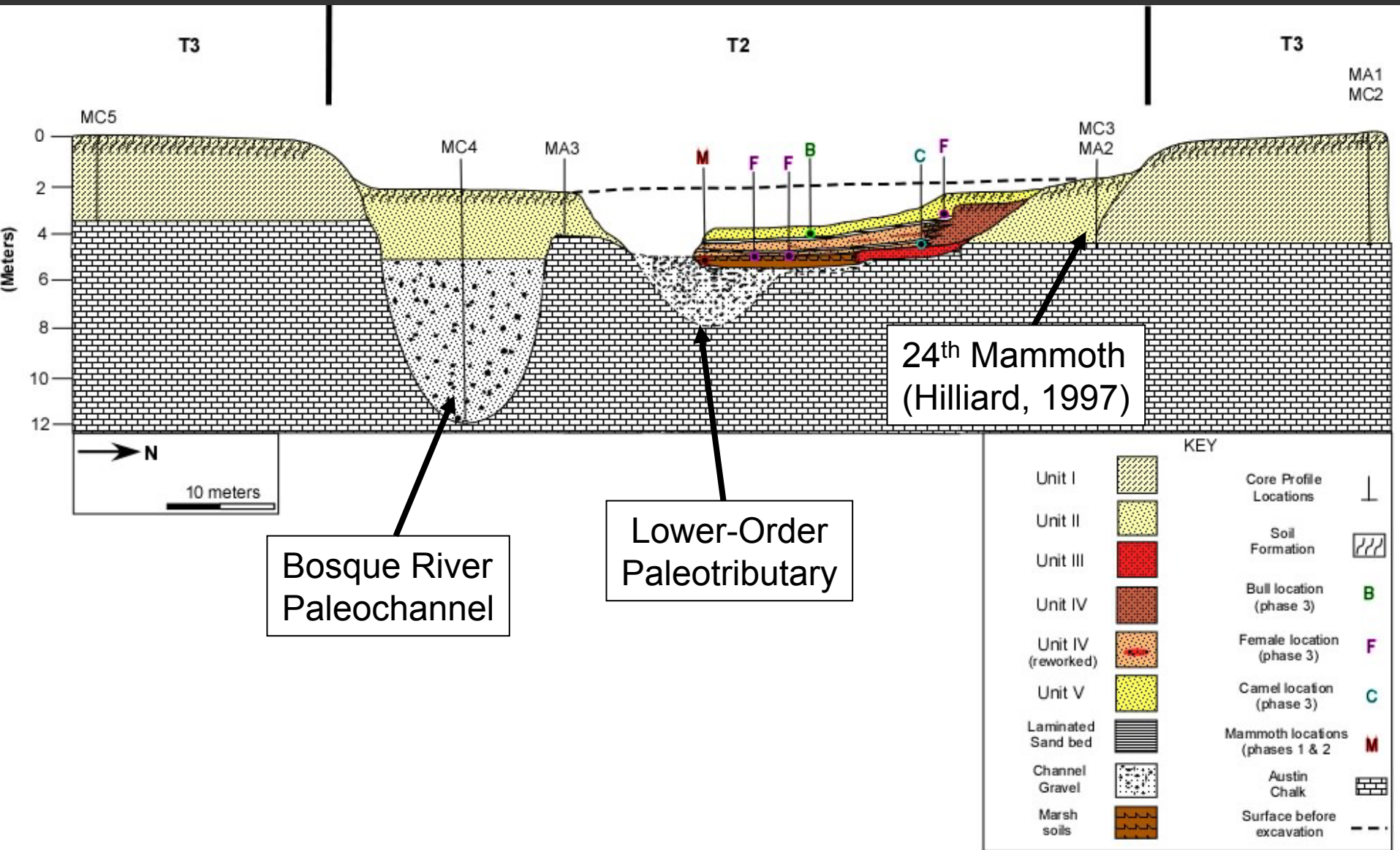


Buried Soil (Paleosol)

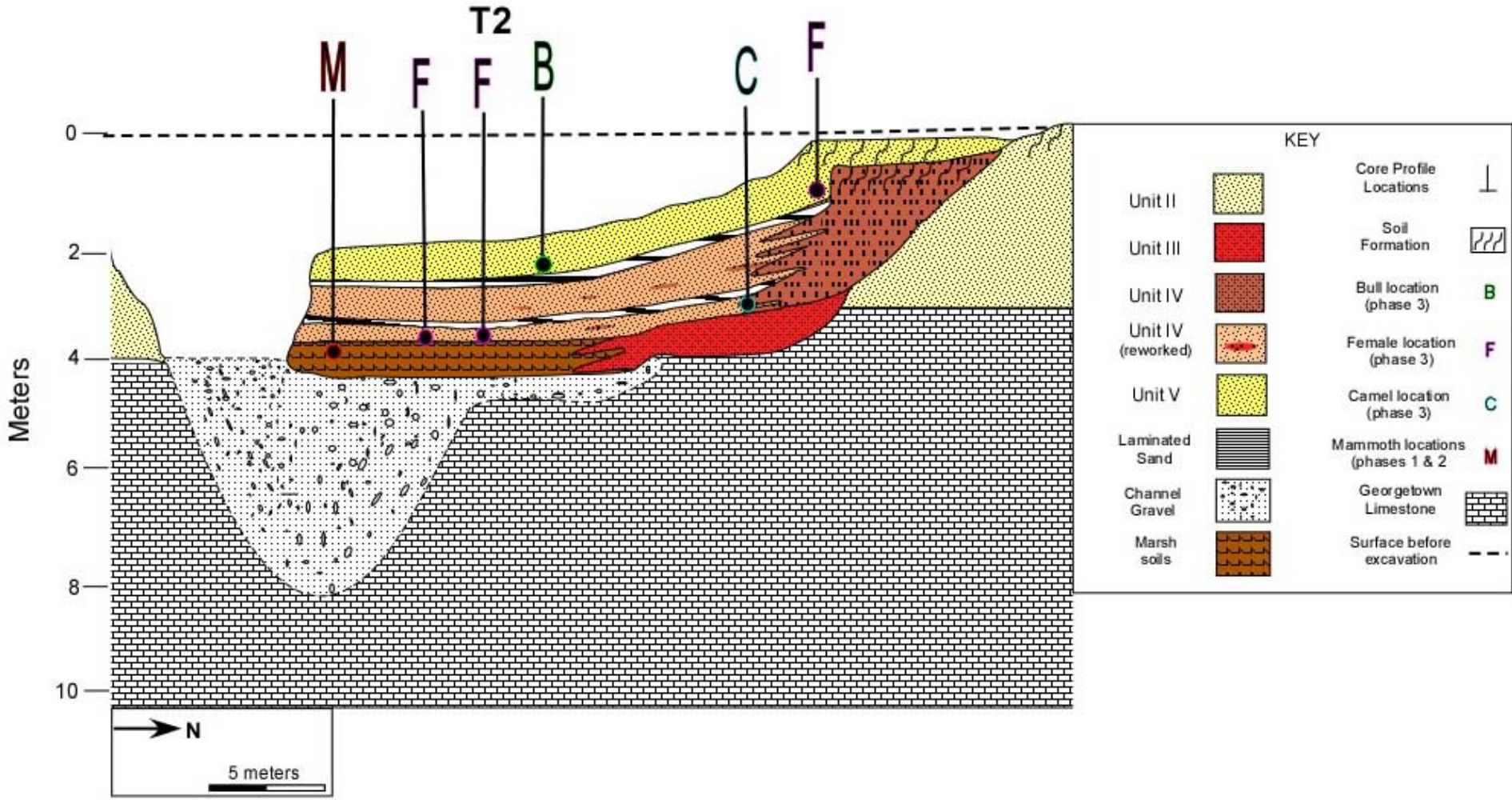


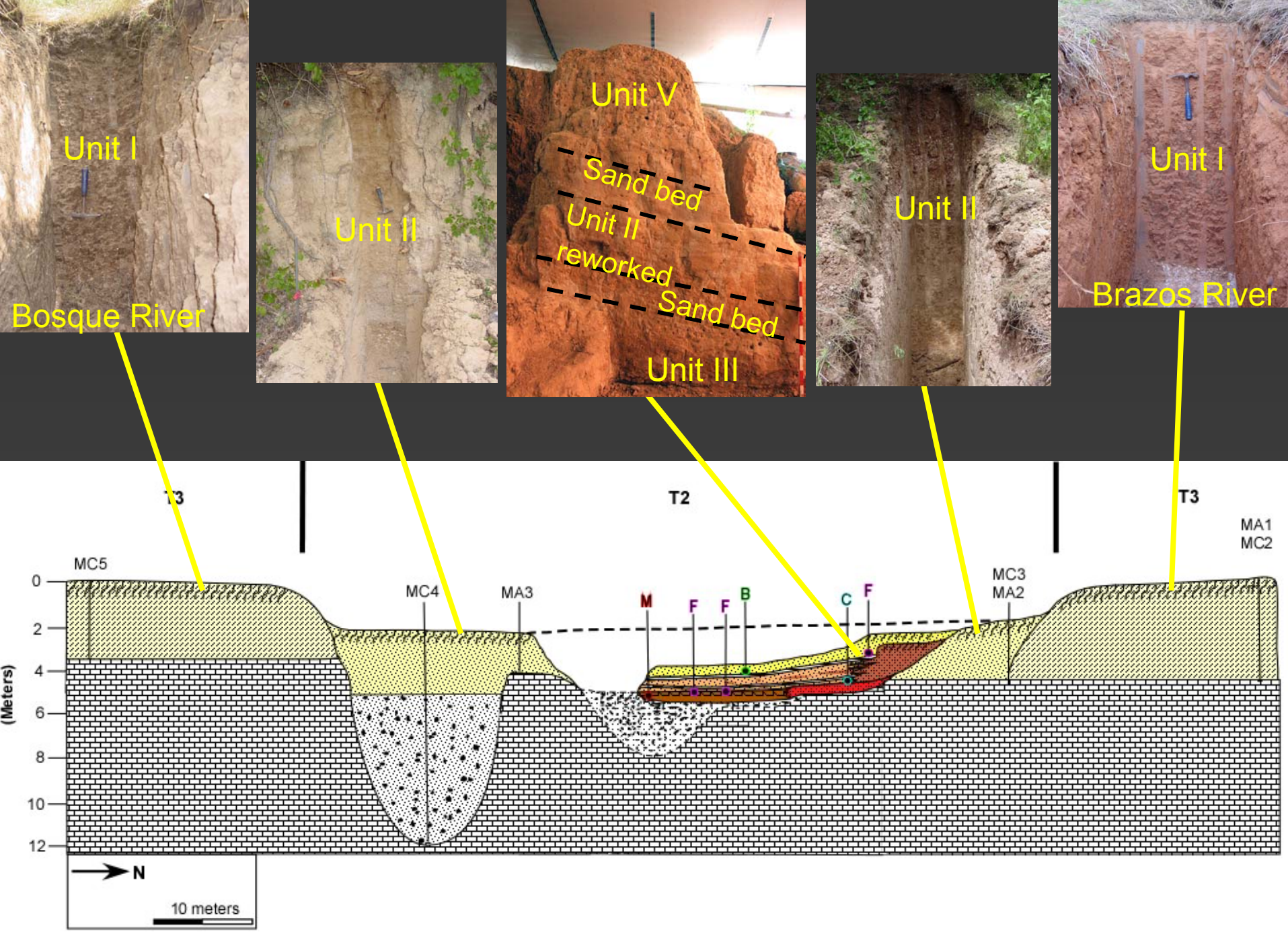
Soil Symbol	Soil Name	Slope
BaA	Bastsil fine sand loam	0 - 2 %
BuA	Burleson clay	0 -1 %
Fr	Frio silty clay	Occasionally flooded
LeB	Lewisville silty clay	1 - 3 %
McE	Mclennan clay loam	8 - 15 %
PcB	Payne clay loam	1 - 3 %
SzB	Sunev clay loam	1 - 3 %
QuC	Queeny clay loam	1 - 5 %
WnA	Wilson clay loam	0 - 2 %

Stratigraphic Cross-Section



Stratigraphic Cross-Section




Unit I
Bosque River
Unit II
Unit V
Sand bed
Unit II reworked
Sand bed
Unit III
Unit II
Unit I
Brazos River
T3
T2
T3
MA1
MC2
MC5
MC4
MA3
MC3
MA2
M
F
F
B
C
F
0
2
4
6
8
10
12
(Meters)
N
10 meters

Conclusions ?

- Site much older than previously thought
  65,000 to 73,000 yr B.P. vs 29,000 yr B.P.

- Positions of mammoths within the stratigraphy places uncertainty as to whether a single or multiple death event occurred

Anticipated Research

- More Soil Descriptions
  - 10 to 15 additional vertical profile descriptions
- Thin Section Analysis (Micromorphology)
  - To determine micro-stratigraphic and pedologic history
- Additional OSL Dating
  - Correlation of laminated sand beds within site
- Isotopic Analysis
  - $\delta^{18}O$ analysis of carbonate nodules to determine paleo-temperature
  - Using $\delta^{13}C$ to determine C3/C4 plant ecosystems (using simplified mixing equation), allowing for paleo-climate interpretation