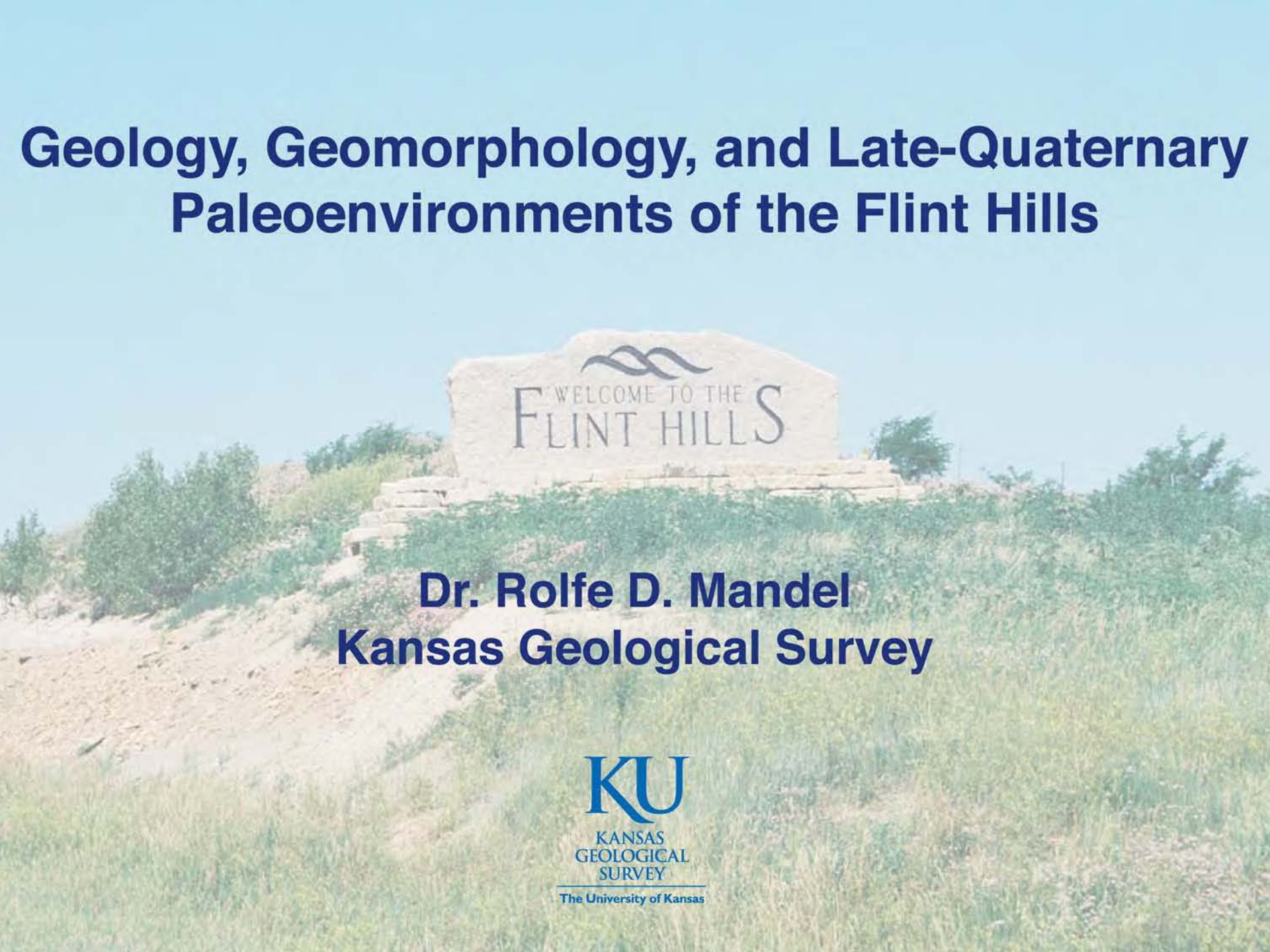
Geology, Geomorphology, and Late-Quaternary Paleoenvironments of the Flint Hills



Dr. Rolfe D. Mandel
Kansas Geological Survey

KU
KANSAS GEOLOGICAL SURVEY
The University of Kansas

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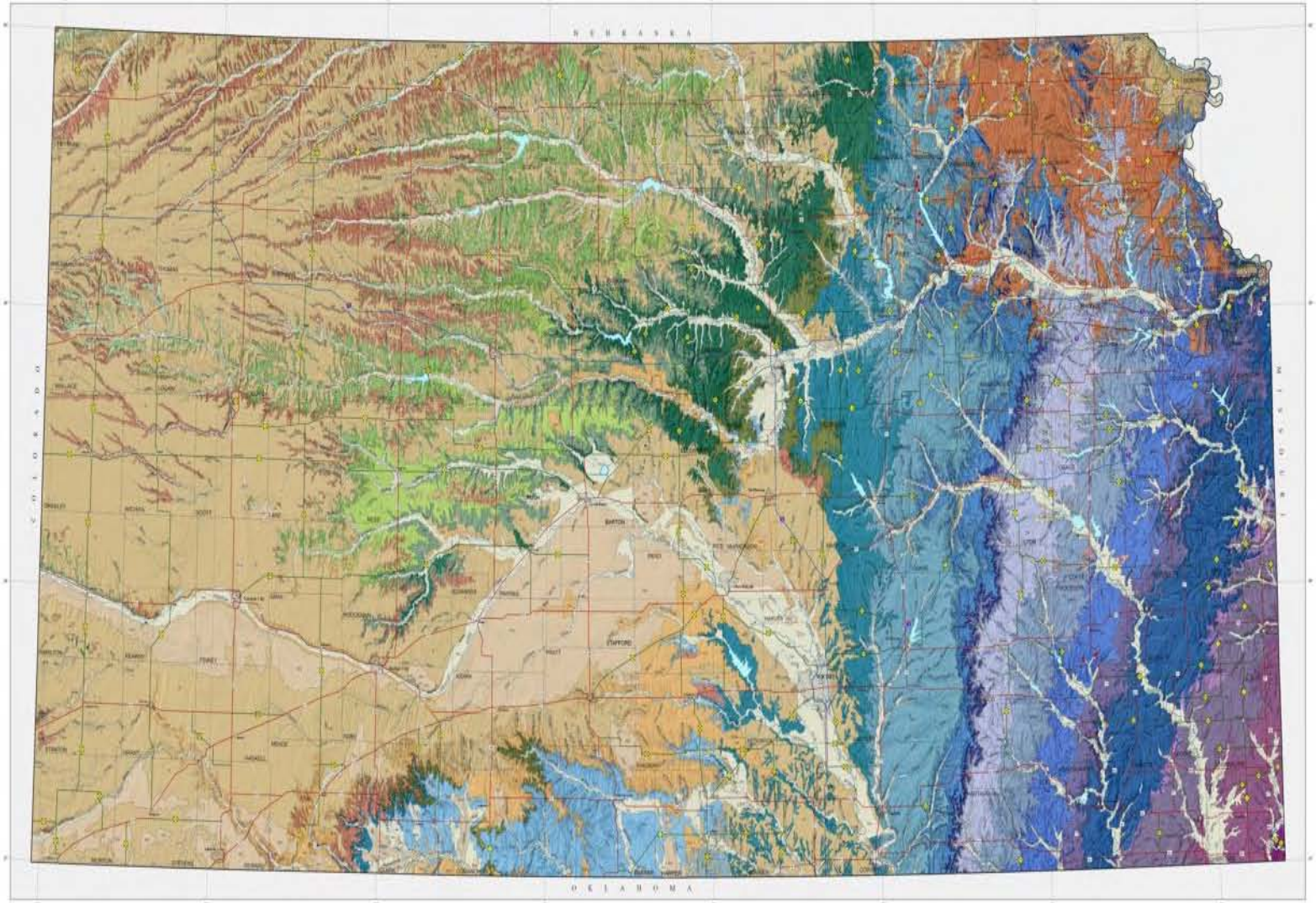
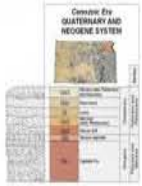
The University of Kansas

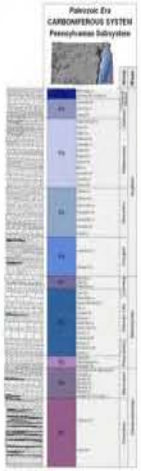
SURFICIAL GEOLOGY OF KANSAS

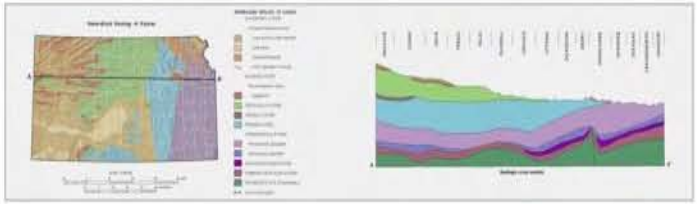
2008

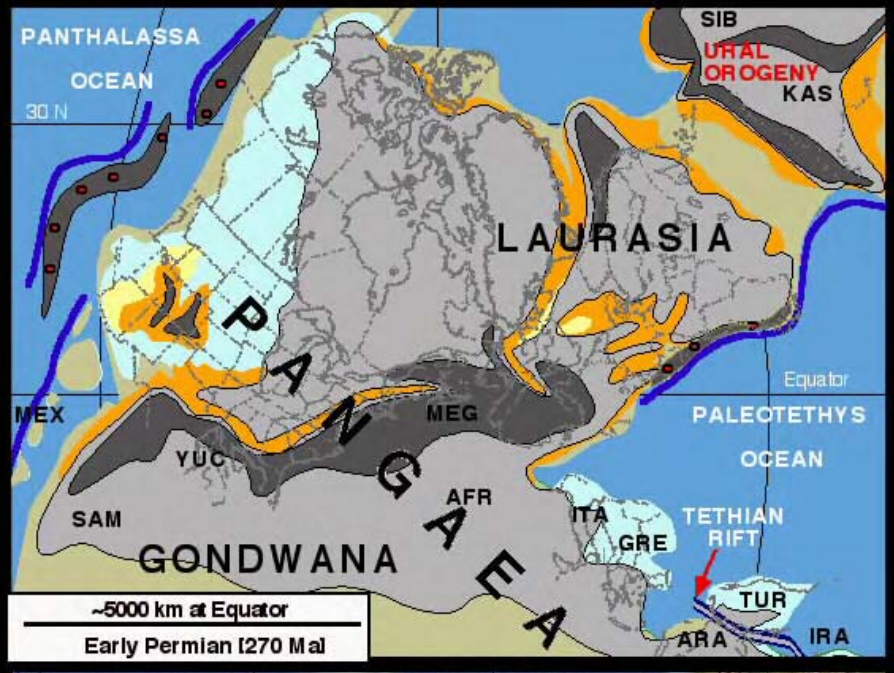
MAP M-118

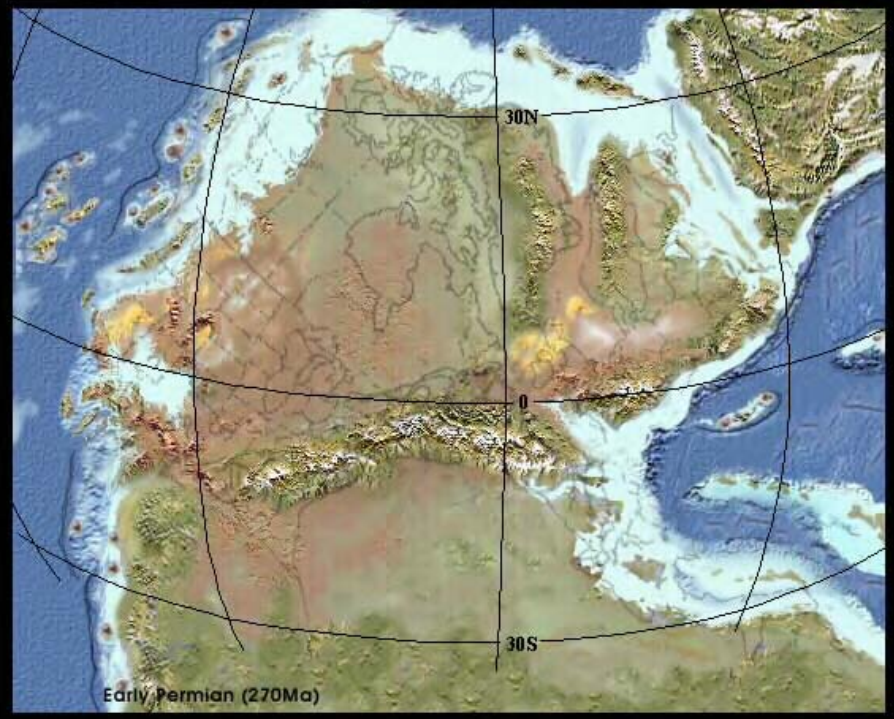








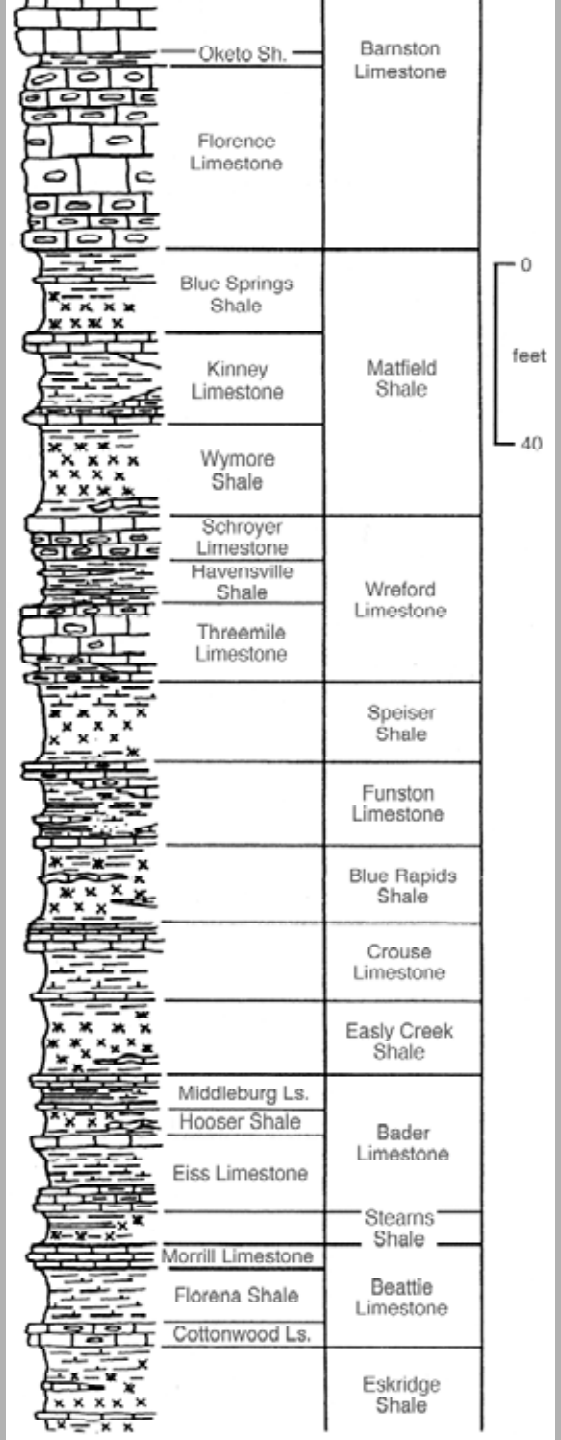

PANTHALASSA
OCEAN
30 N
SIB
URAL
OROGENY
KAS
LAURASIA
PANGAEA
Equator
MEX
MEG
PALEOTETHYS
OCEAN
YUC
AFR
SAM
ITA
TETHIAN
RIFT
GRE
GONDWANA
TUR
~5000 km at Equator
Early Permian (270 Ma)
ARA
IRA


30N
0
30S
Early Permian (270Ma)

Permian System

Wolfcampian Series

Council Grove and Chase Groups



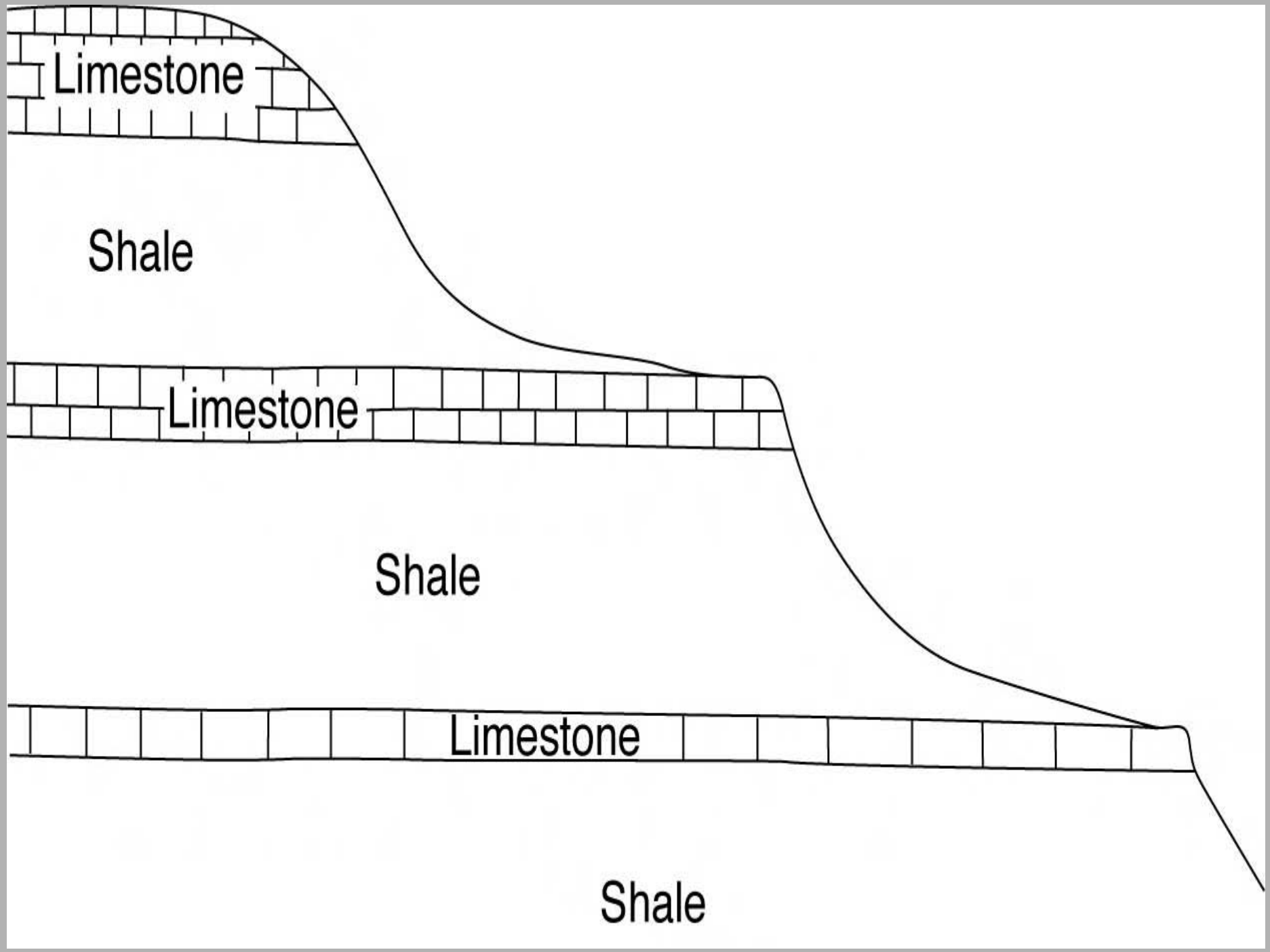
Cottonwood Ls
CP-13

Echinoid spines
CP-113
Schroyer Ls
CM
1

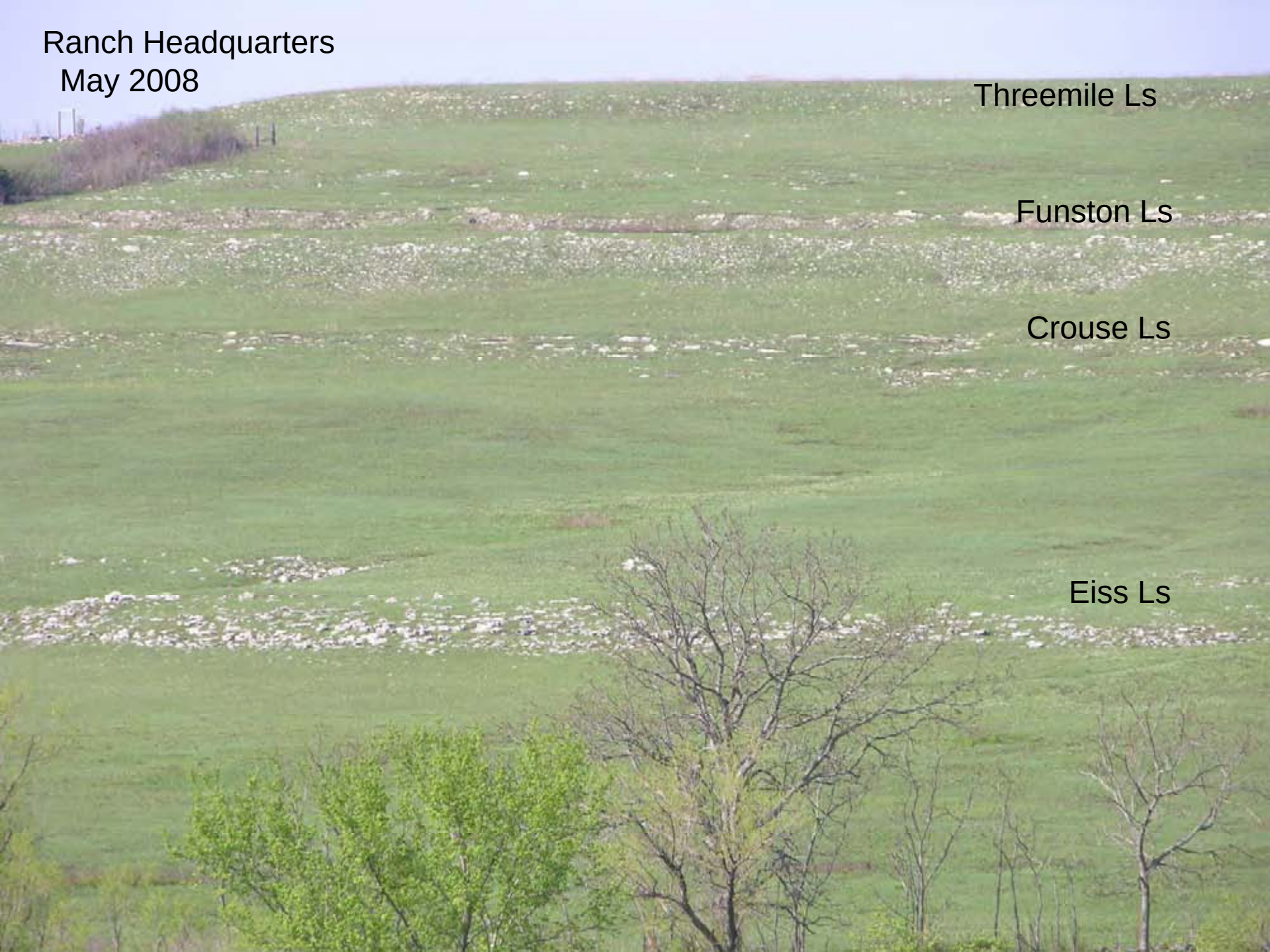
Composita sp.
CP-83
Havensville Sh

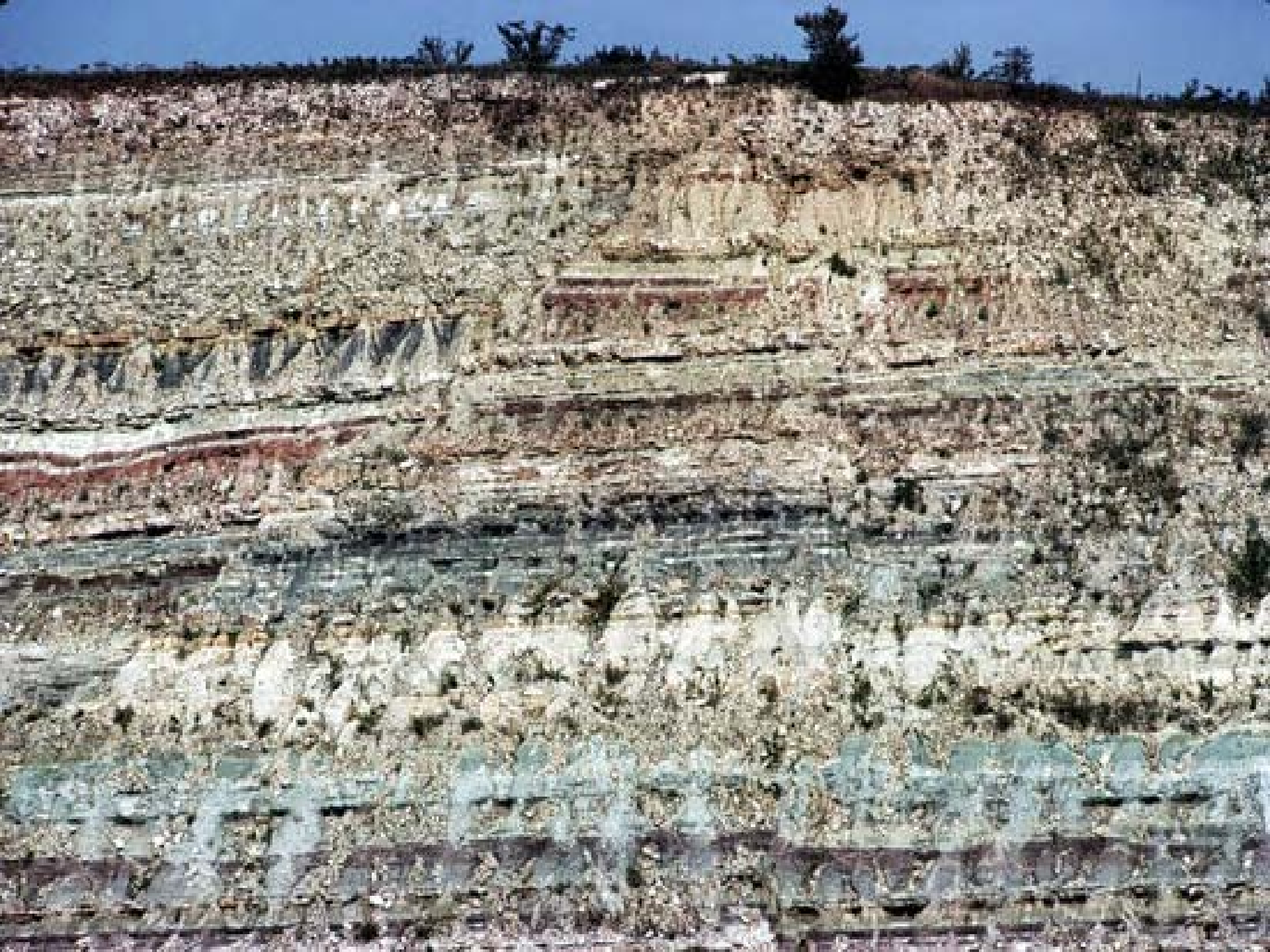
Invertebrate Fossils
CP-171
Florena Sh &
Eiss Ls
MM
CM
www.npagroup.co.uk

Cottonwood Ls
Fusulinids


Limestone
Shale
Limestone
Shale
Limestone
Shale

Big Pasture
April 2001


Ranch Headquarters
May 2008
Threemile Ls
Funston Ls
Crouse Ls
Eiss Ls



Building Stone

Stone Fence and Quarry
Schroyer Ls

The 1867 law abolishing the
open range provided for payment
of 40 cents per rod (16½ ft.)
to landowners to build and
maintain a 4½ ft. stone fence.
Stone was plentiful and our
pioneers built miles of fences.

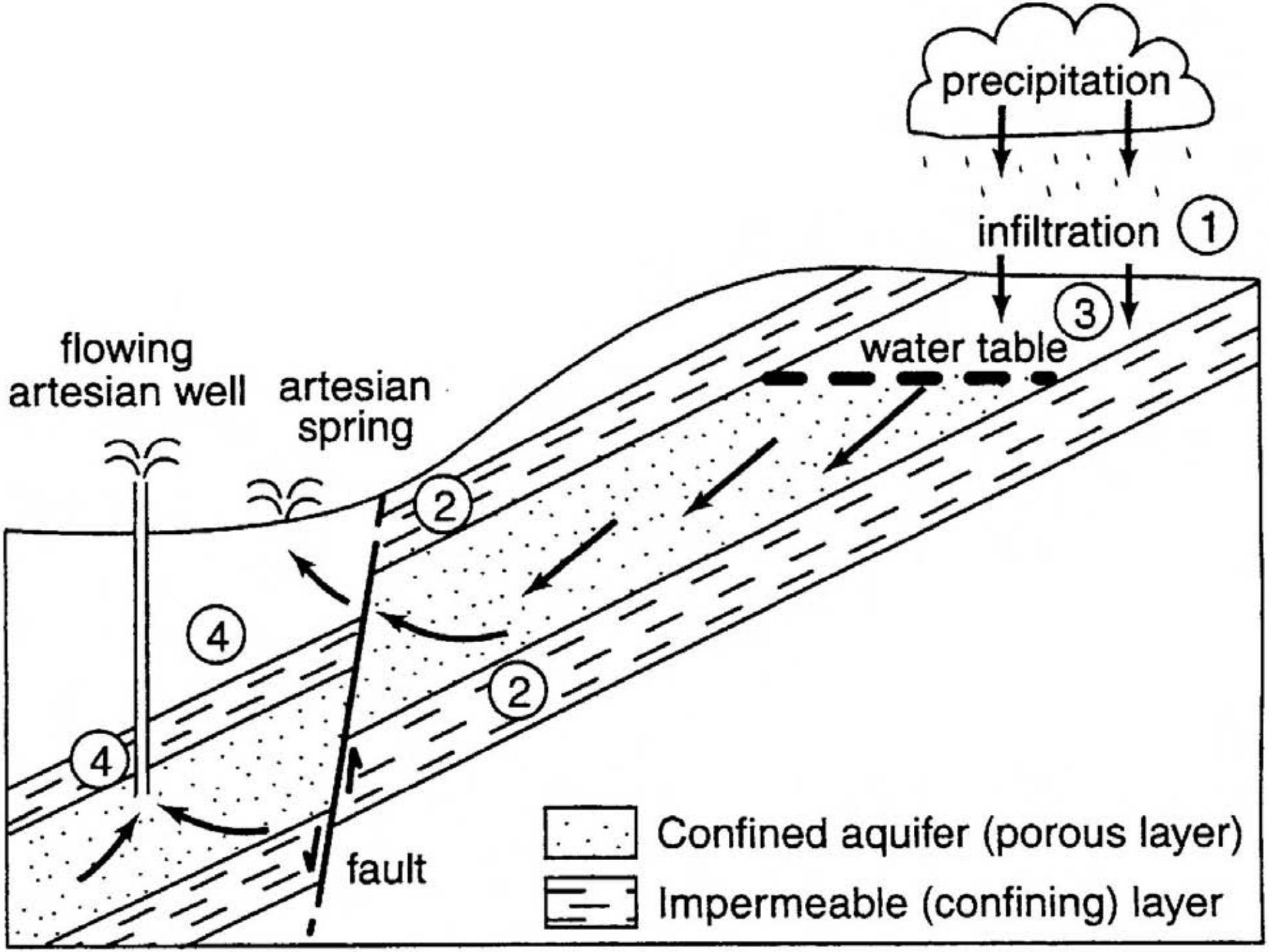
Stone Fence
Big Pasture

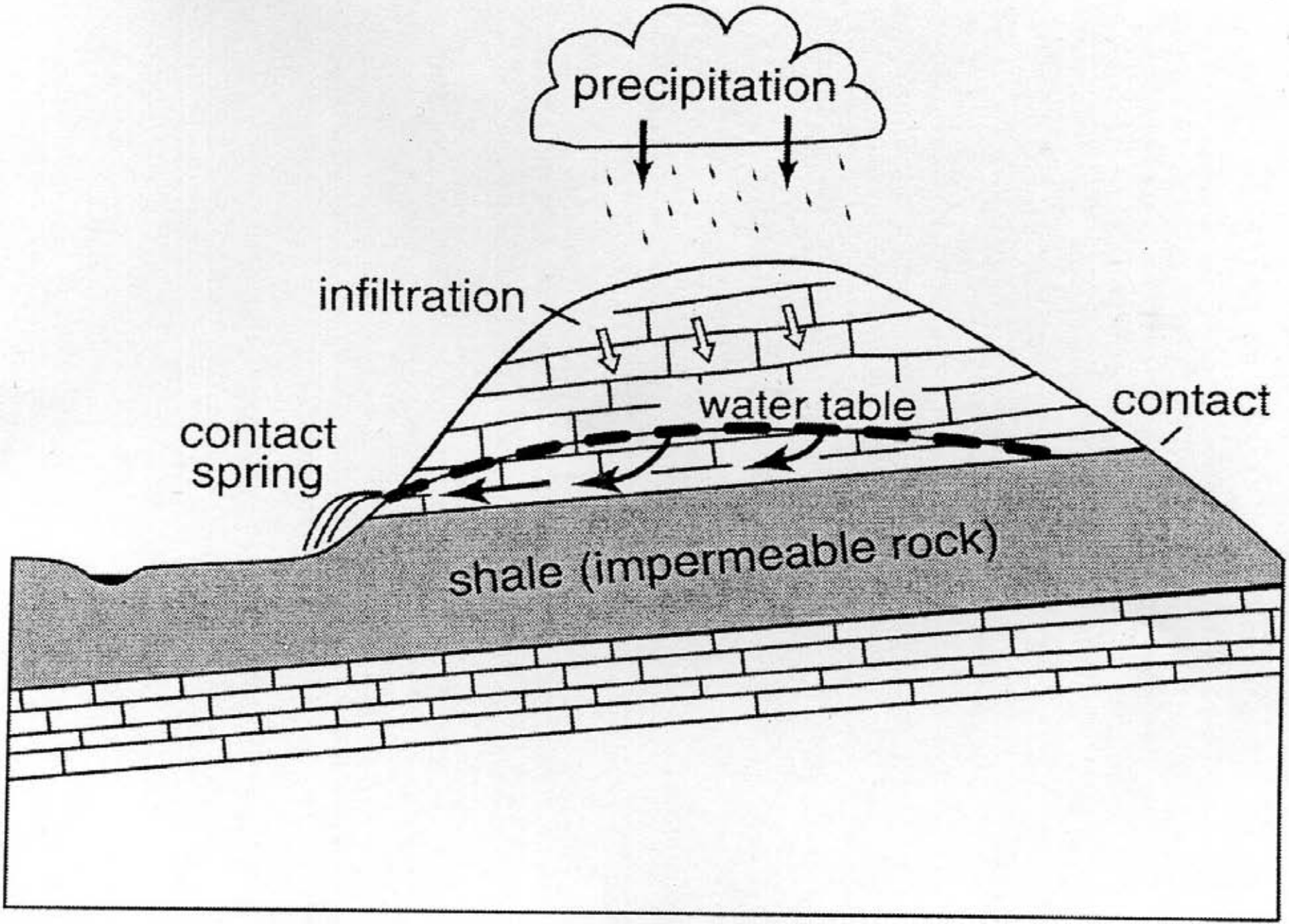
Tallgrass Prairie
National Preserve

KONZA PRAIRIE RESEARCH NATURAL AREA
PRESERVED BY THE NATURE CONSERVANCY
FOR KANSAS STATE UNIVERSITY

Red House Pasture

Florence Ls


precipitation
infiltration
1
3
water table
flowing
artesian well
artesian
spring
2
4
2
4
fault
Confined aquifer (porous layer)
Impermeable (confining) layer


precipitation
infiltration
water table
contact
contact
spring
shale (impermeable rock)

SP 1-18

Konza Series

Silty, contains 1% rocks

Dark, red paleosol

Shale

A1

A2

Bt1

Bt2

Btk1

Btk2

2Bt3

2Bt4

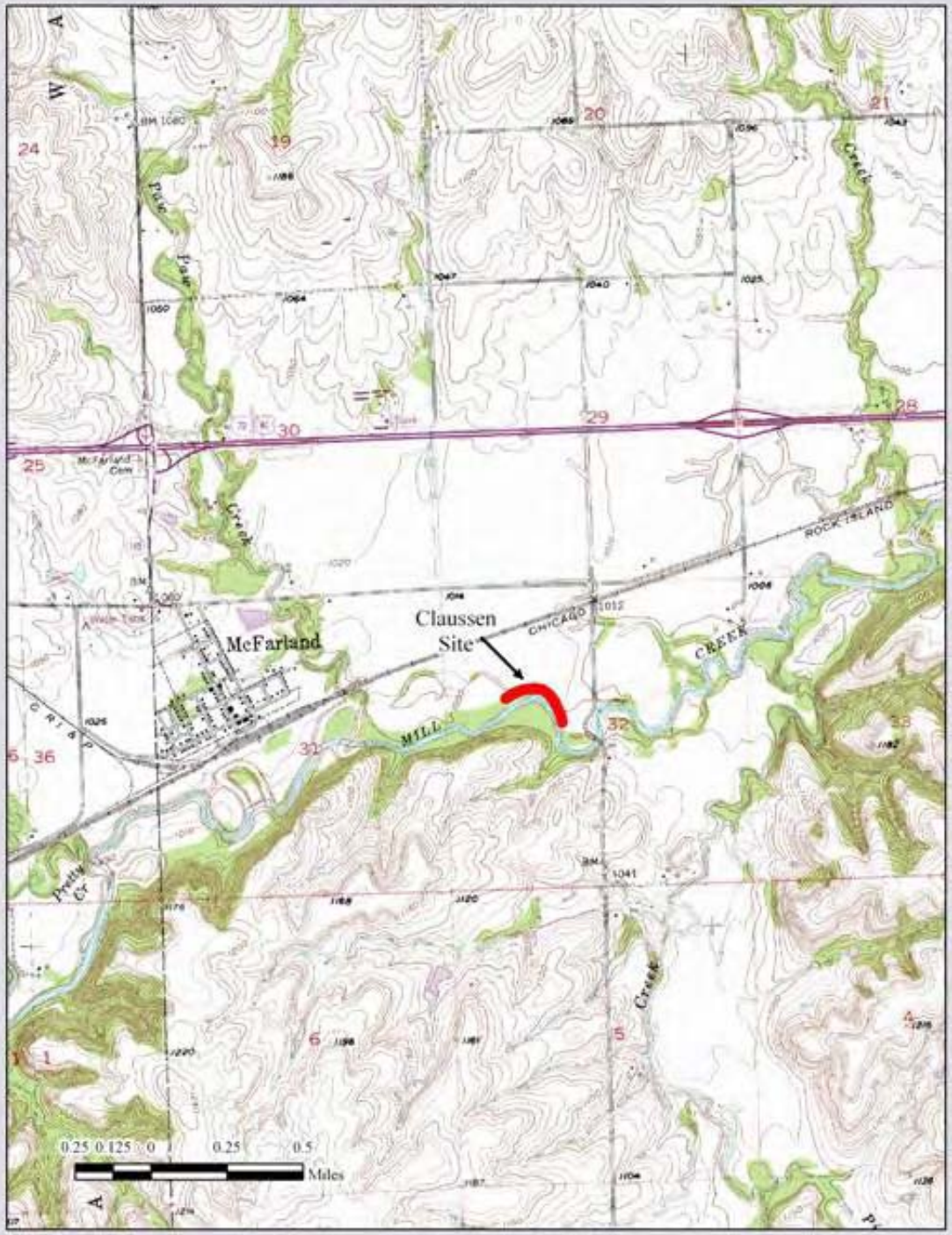
3C

Tuttle Series

Labette Series

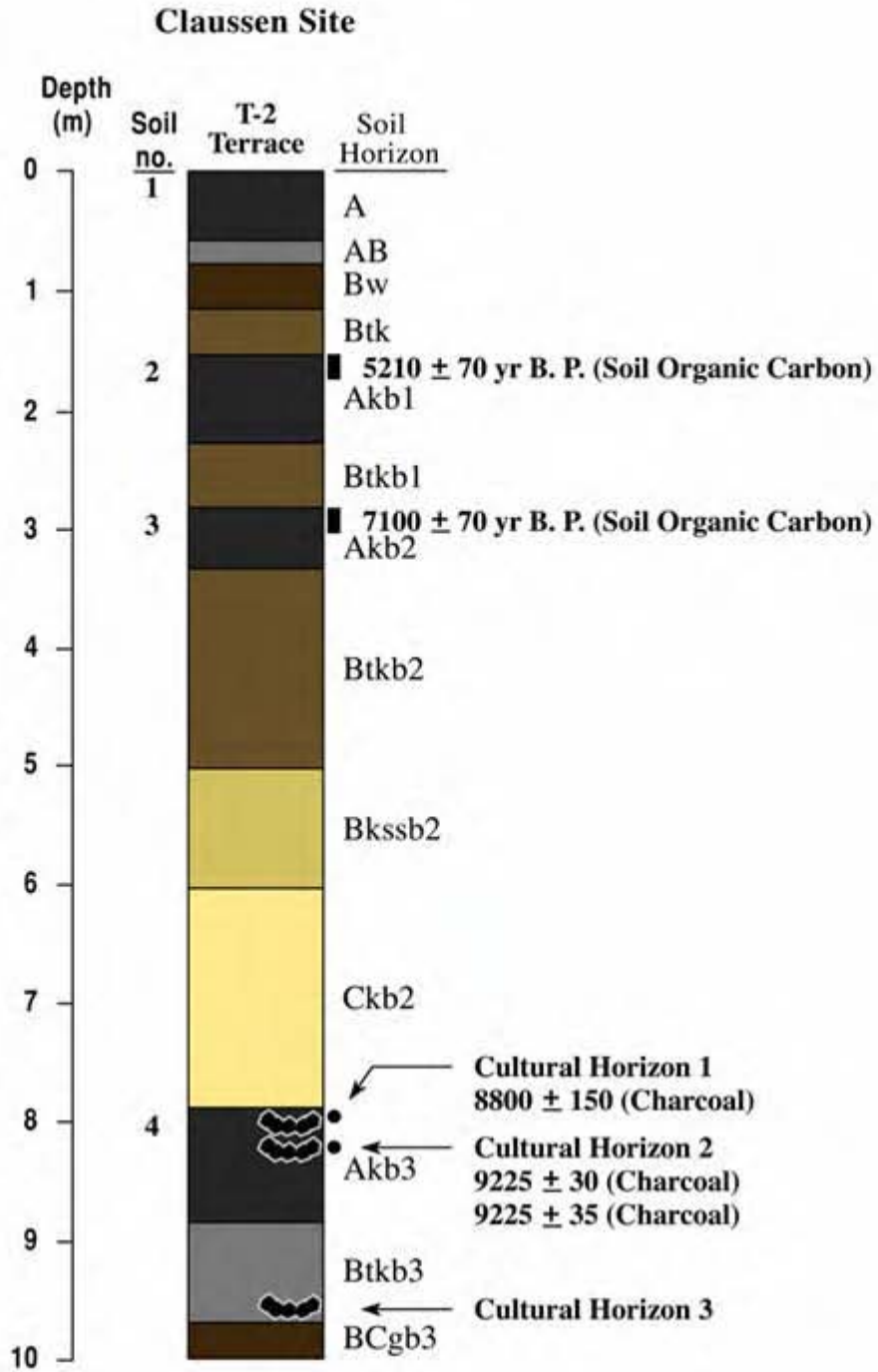
20
40
60
80
100
20
40

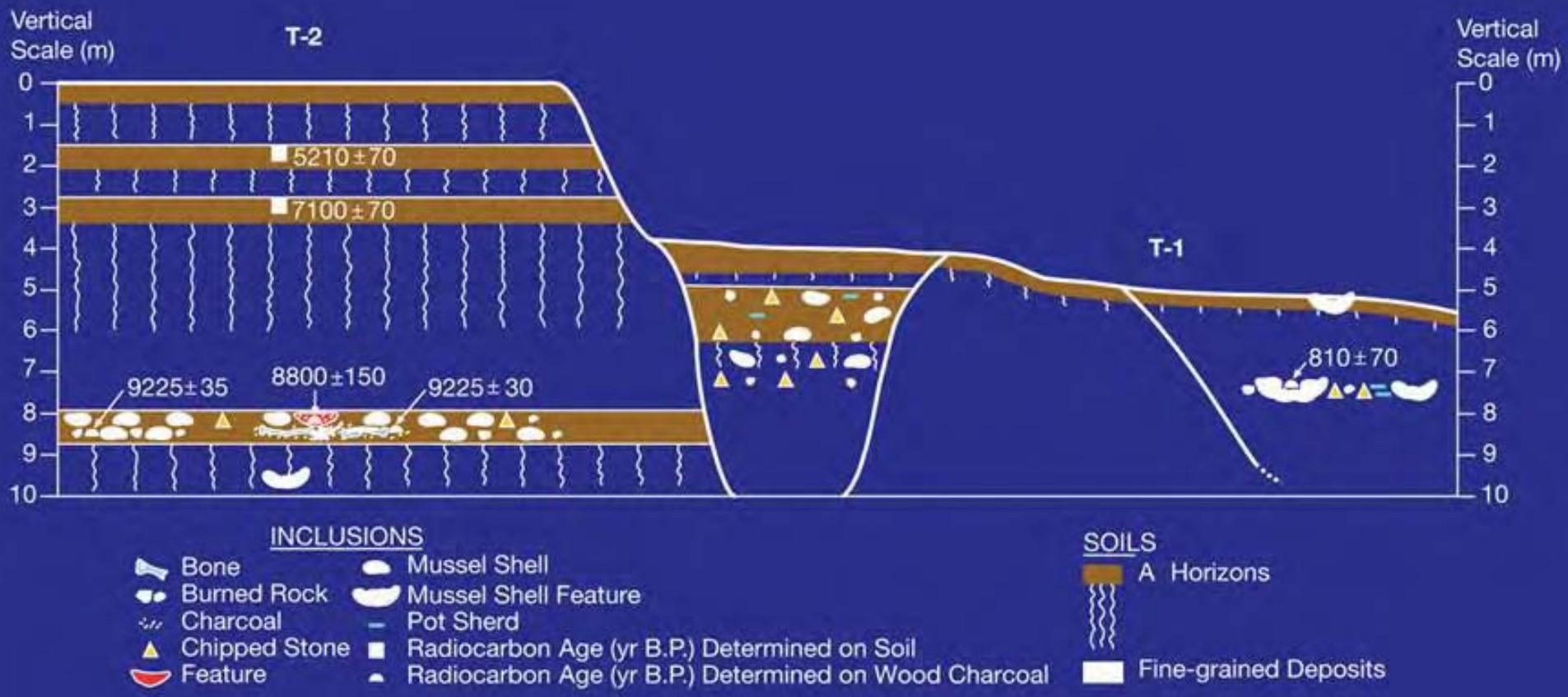
Claussen Site
Kansas River
Neosho River
Arkansas River
Arkansas River
CN
RA
DC
NT
PL
SM
JW
RP
WS
MS
NM
BR
DR
SH
TH
GD
GH
RO
CY
RL
PT
JA
AT
JF
LV
CD
MC
OB
LC
RS
WA
LG
GO
TR
EL
DK
SN
WY
JO
SA
MR
WB
DG
FR
GL
WH
SC
LE
NS
RH
BT
LY
MN
RC
CF
AN
LN
HM
KE
FI
HG
PN
SF
MP
CS
GW
HV
ED
RN
WO
AL
BB
GY
FO
SG
ST
GT
HS
KW
PR
KM
WE
CR
BU
EK
NO
ME
CA
BA
SU
CL
MT
SV
SW
CM
HP
MG
LB
CK
CQ


Claussen
Site
McFarland
MILL
CREEK
CHICAGO
ROCK ISLAND
0.25 0.125 0 0.25 0.5
Miles

Roberts Creek
Member
Gunder Member
Honey Creek
Member

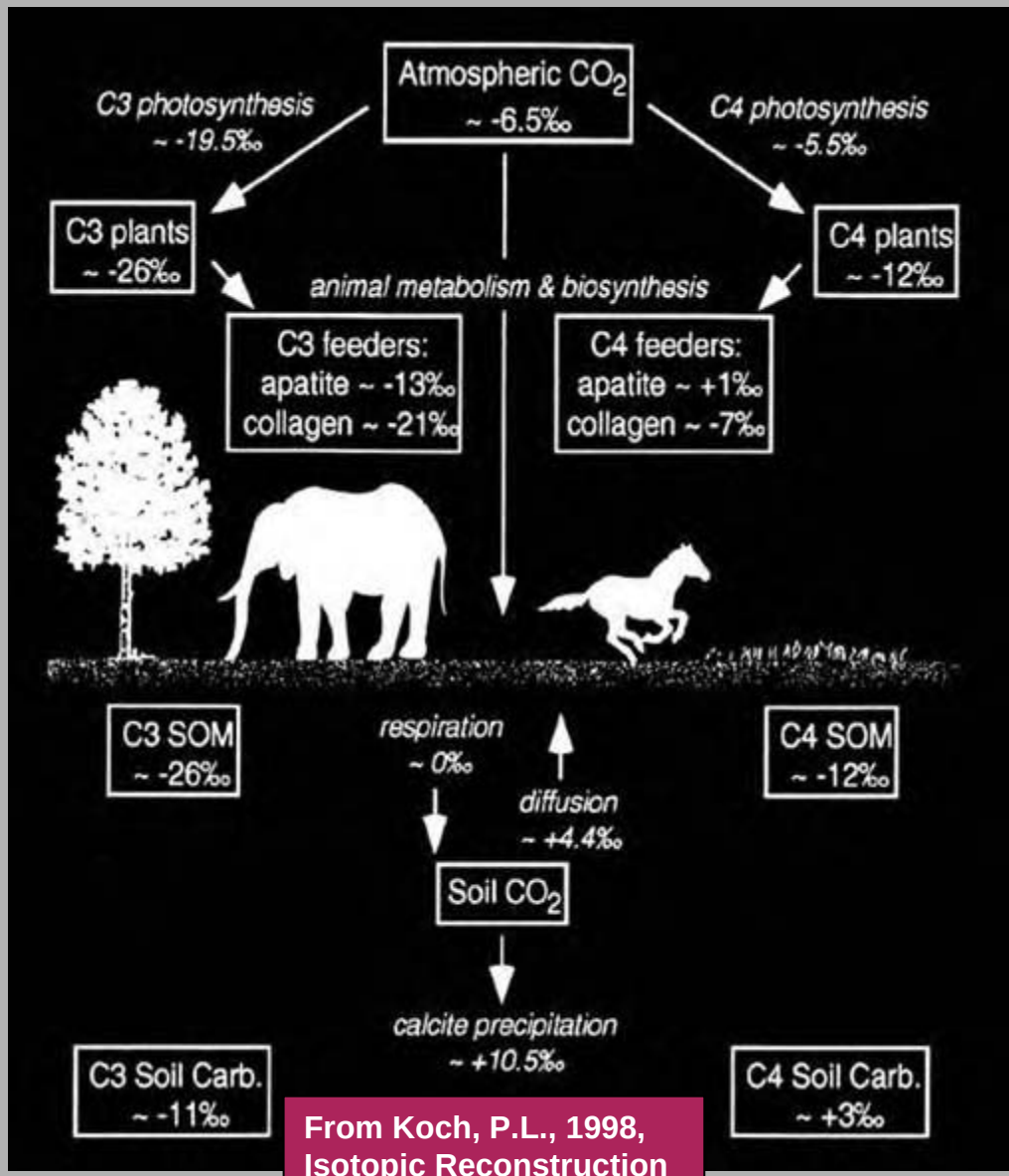
TRUCKING


Claussen Site
Depth (m)
Soil no.
T-2 Terrace
Soil Horizon
0
1
2
3
4
5
6
7
8
9
10
1
2
3
4
A
AB
Bw
Btk
5210 ± 70 yr B. P. (Soil Organic Carbon)
Akb1
Btkb1
7100 ± 70 yr B. P. (Soil Organic Carbon)
Akb2
Btkb2
Bkssb2
Ckb2
Cultural Horizon 1
8800 ± 150 (Charcoal)
Cultural Horizon 2
9225 ± 30 (Charcoal)
9225 ± 35 (Charcoal)
Akb3
Btkb3
Cultural Horizon 3
BCgb3

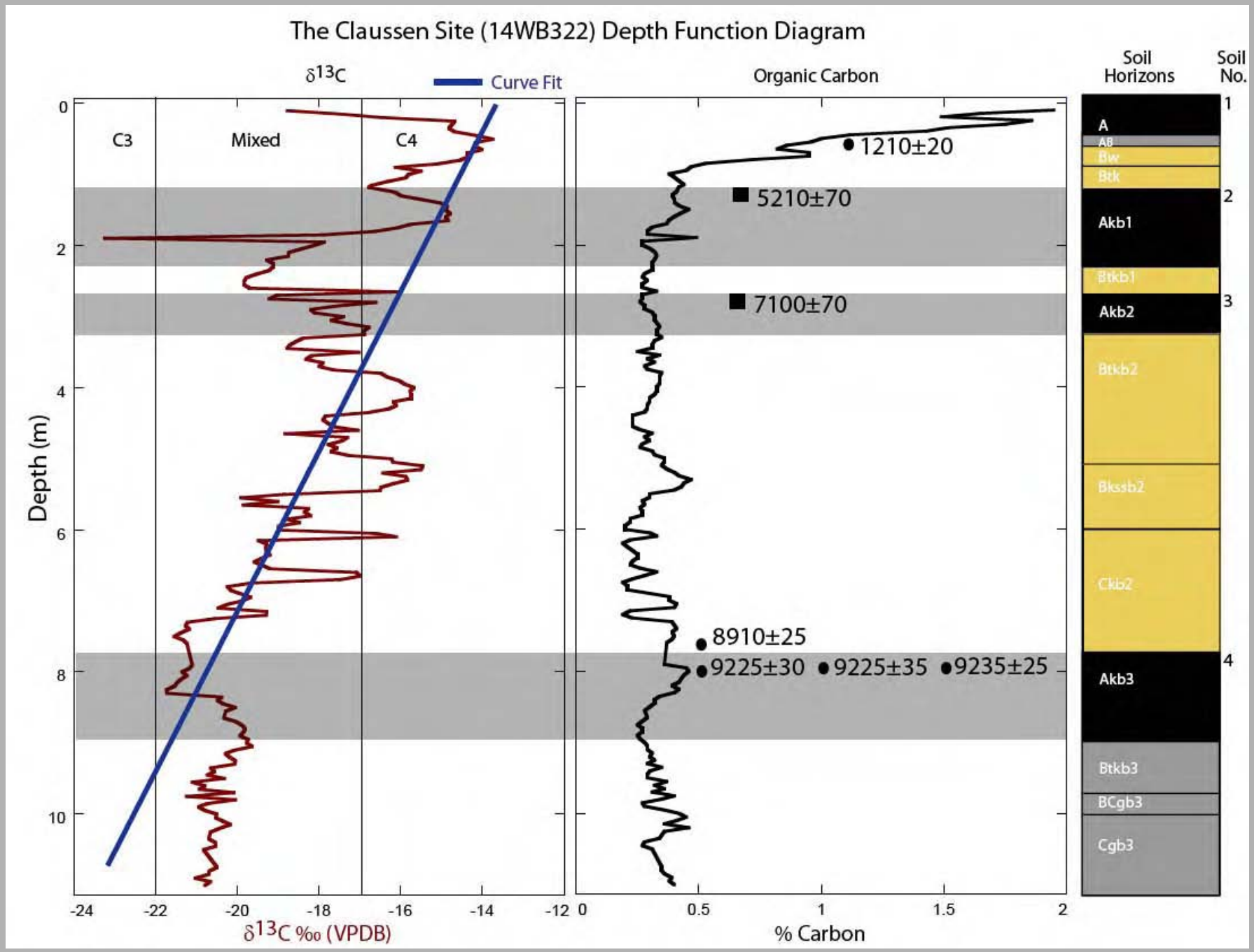

Vertical Scale (m)
T-2
5210±70
7100±70
9225±35
8800±150
9225±30
T-1
810±70
Vertical Scale (m)
0
1
2
3
4
5
6
7
8
9
10
INCLUSIONS
Bone
Burned Rock
Charcoal
Chipped Stone
Feature
Mussel Shell
Mussel Shell Feature
Pot Sherd
Radiocarbon Age (yr B.P.) Determined on Soil
Radiocarbon Age (yr B.P.) Determined on Wood Charcoal
SOILS
A Horizons
Fine-grained Deposits

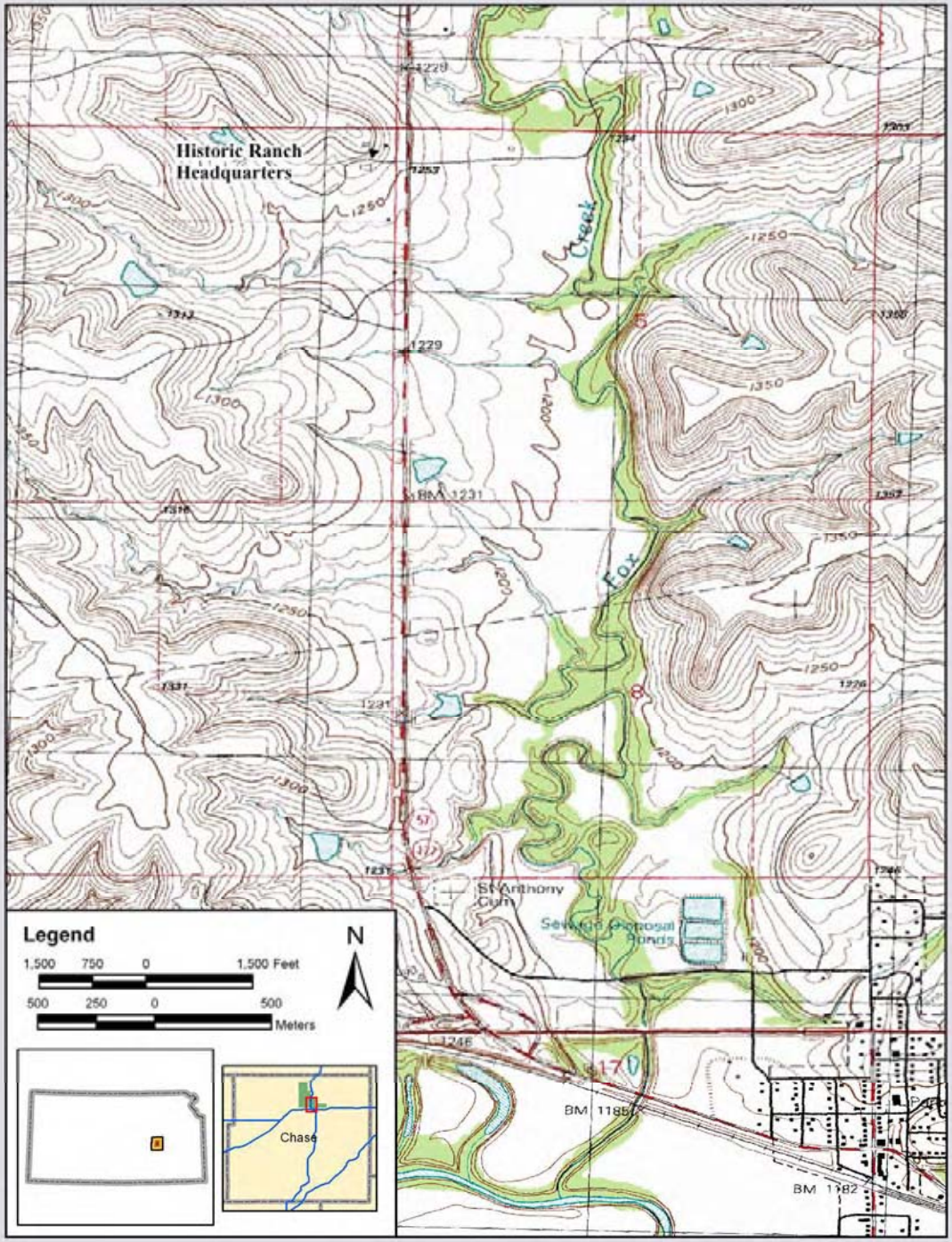
Stable Carbon Isotope Analysis

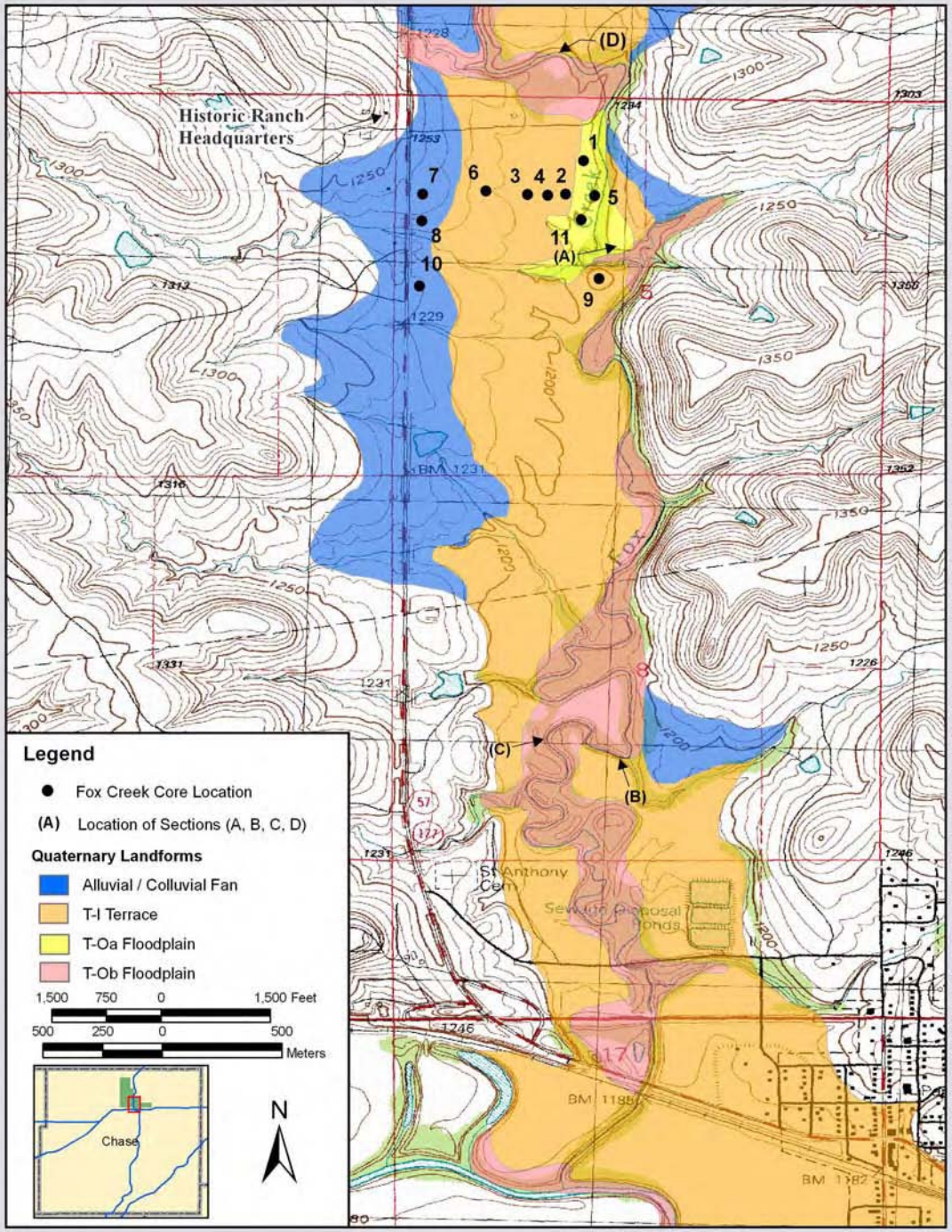
- SOM contains $^{13}C/^{12}C$ isotope ratio that reflect the photosynthetic pathways of C_3 and C_4 plant communities
- The $\delta^{13}C$ value: the difference between the $^{13}C/^{12}C$ ratio and a known standard
  - expressed in ‰
- C_3 values range from -32‰ to -22‰
- C_4 values range from -17‰ to -9‰



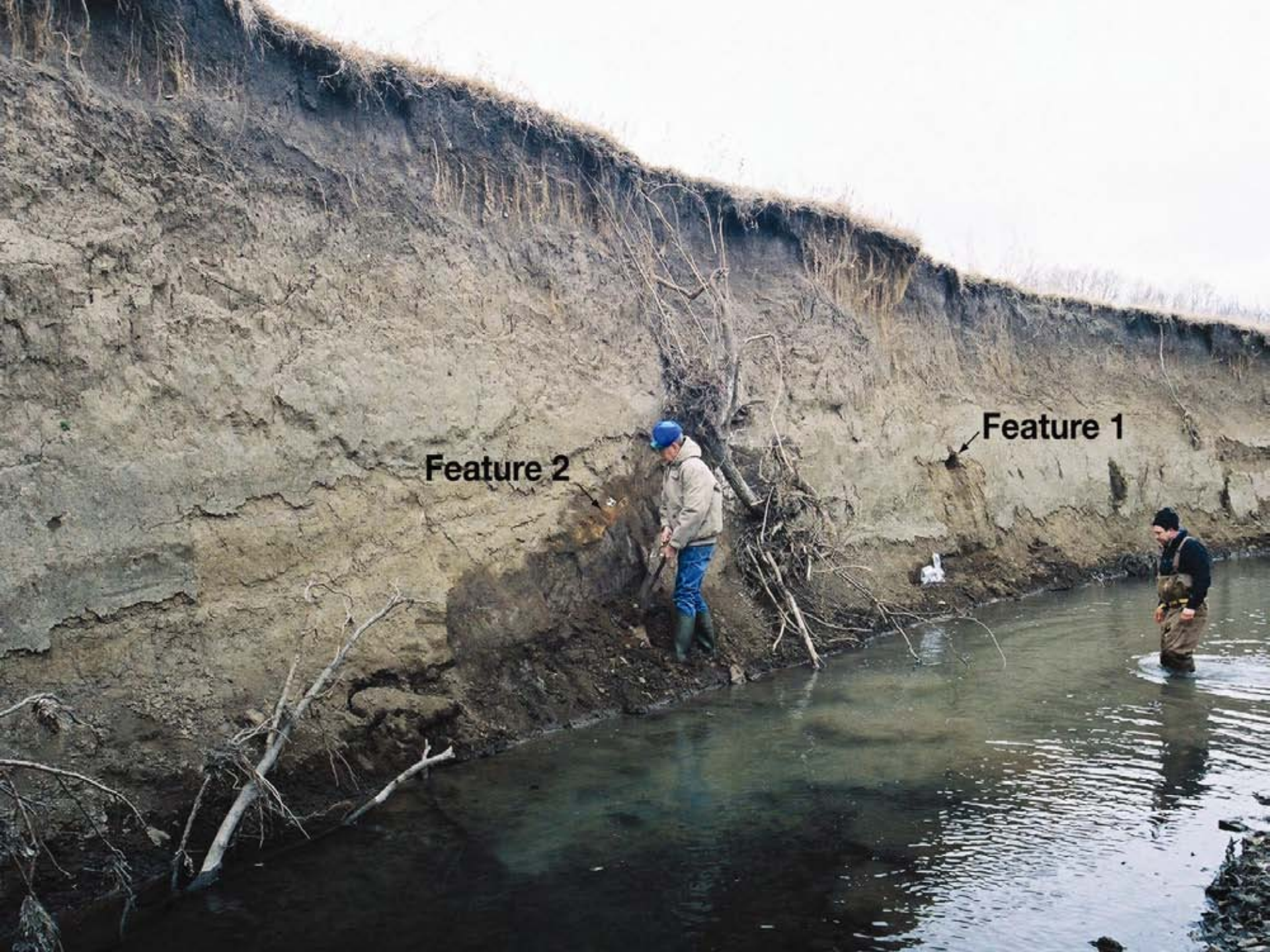
From Koch, P.L., 1998, Isotopic Reconstruction of Past Continental Environments: Ann. Rev. Earth Planet. Sci. 26:573-615.

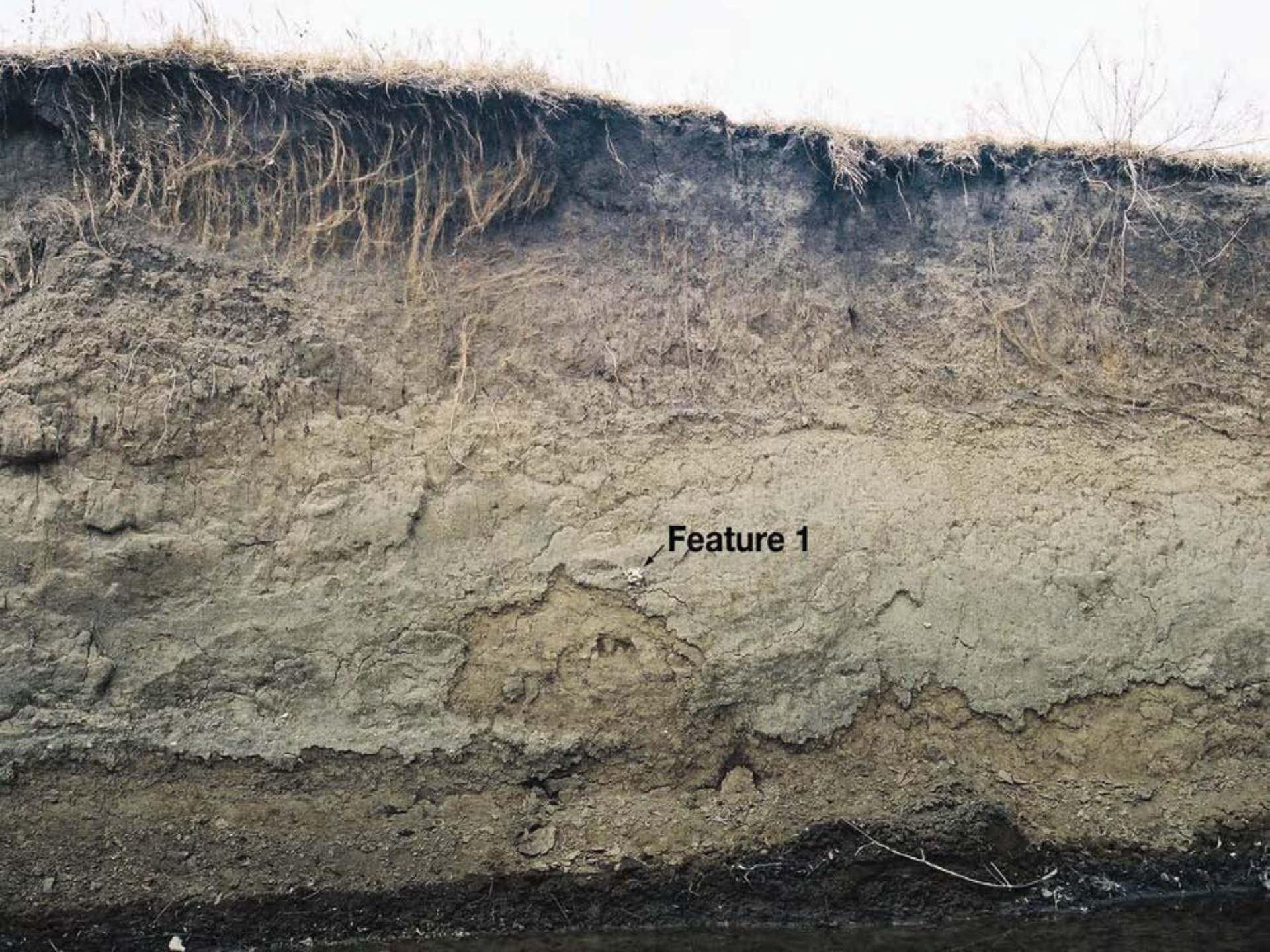

The Claussen Site (14WB322) Depth Function Diagram
δ13C
Curve Fit
Organic Carbon
Soil Horizons
Soil No.
C3
Mixed
C4
Depth (m)
0
2
4
6
8
10
-24
-22
-20
-18
-16
-14
-12
δ13C ‰ (VPDB)
0
0.5
1
1.5
2
% Carbon
1210±20
5210±70
7100±70
8910±25
9225±30
9225±35
9235±25
A
AB
Bw
Btk
Akb1
Btkb1
Akb2
Btkb2
Bkssb2
Ckb2
Akb3
Btkb3
BCgb3
Cgb3
1
2
3
4


Historic Ranch
Headquarters
Fox
Creek
St Anthony
Cem
Sewage Disposal
Ponds
BM 1185
BM 1182
Legend
1,500 750 0 1,500 Feet
500 250 0 500
Meters
N
Chase

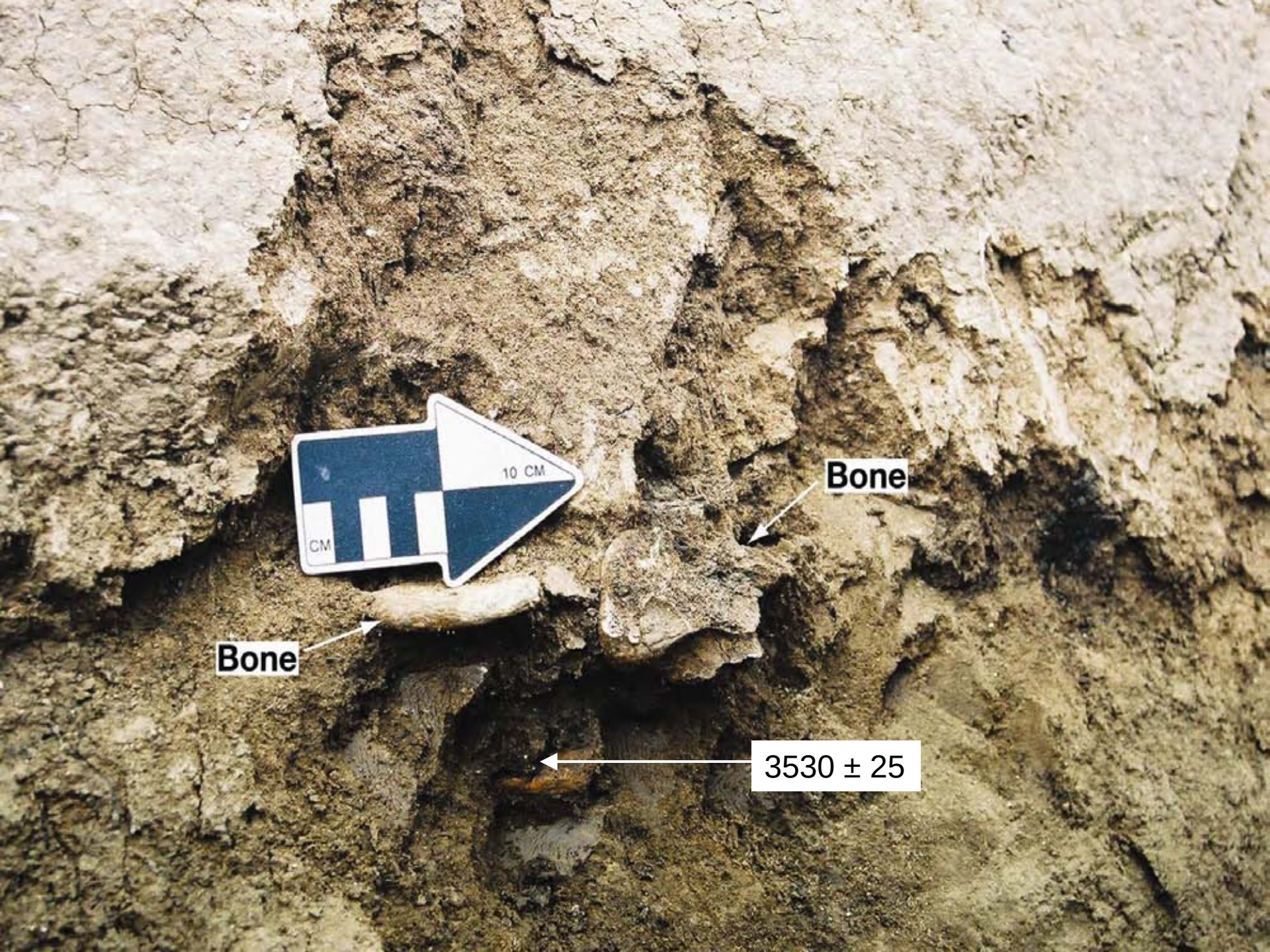

Historic Ranch Headquarters
(D)
(A)
(B)
(C)
1
2
3
4
5
6
7
8
9
10
11
Legend
Fox Creek Core Location
(A) Location of Sections (A, B, C, D)
Quaternary Landforms
Alluvial / Colluvial Fan
T-I Terrace
T-Oa Floodplain
T-Ob Floodplain
1,500 750 0 1,500 Feet
500 250 0 500 Meters
Chase
N
St Anthony Cem
Sewage Disposal Ponds
BM 1231
BM 1185
BM 1182

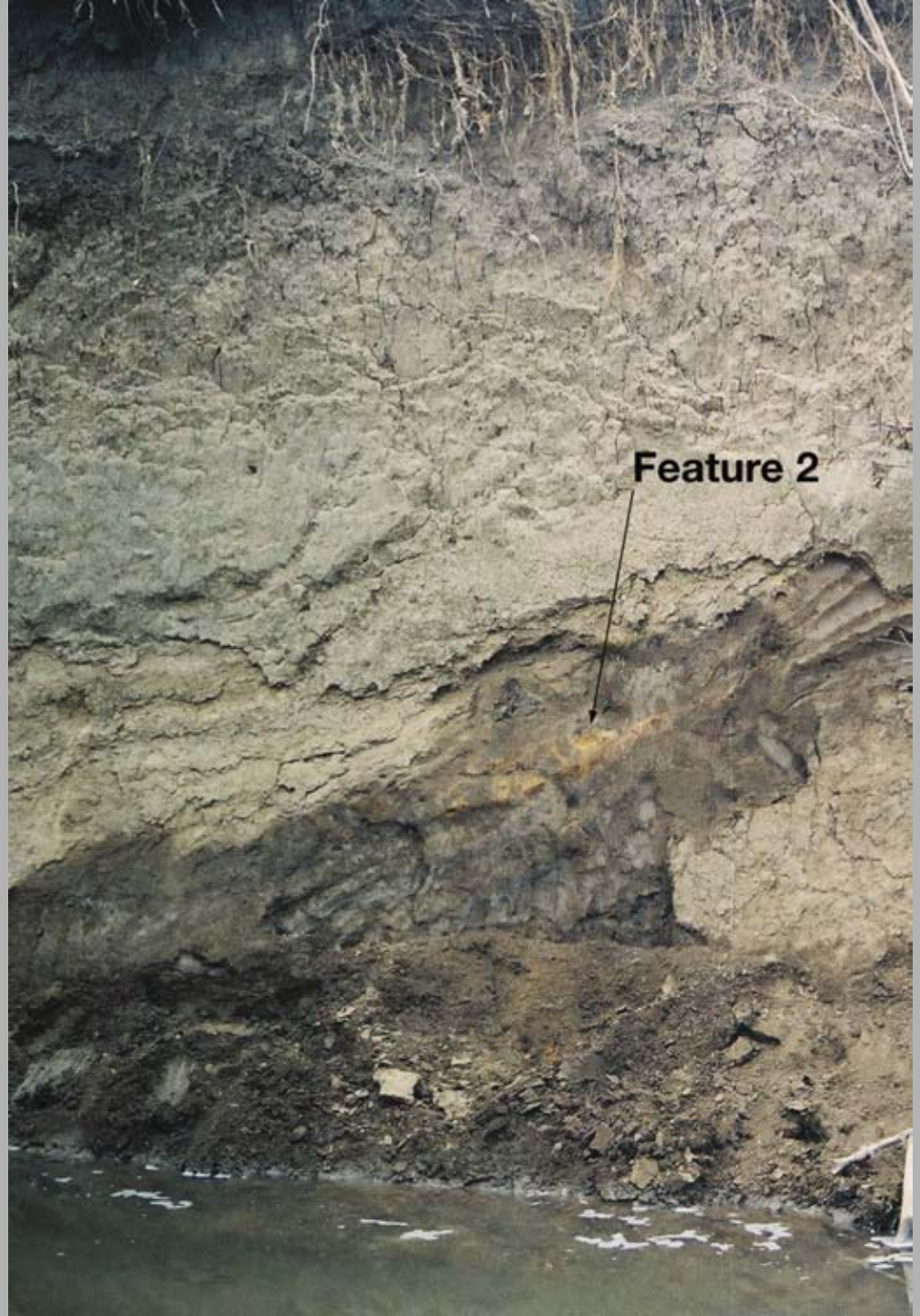
Feature 1

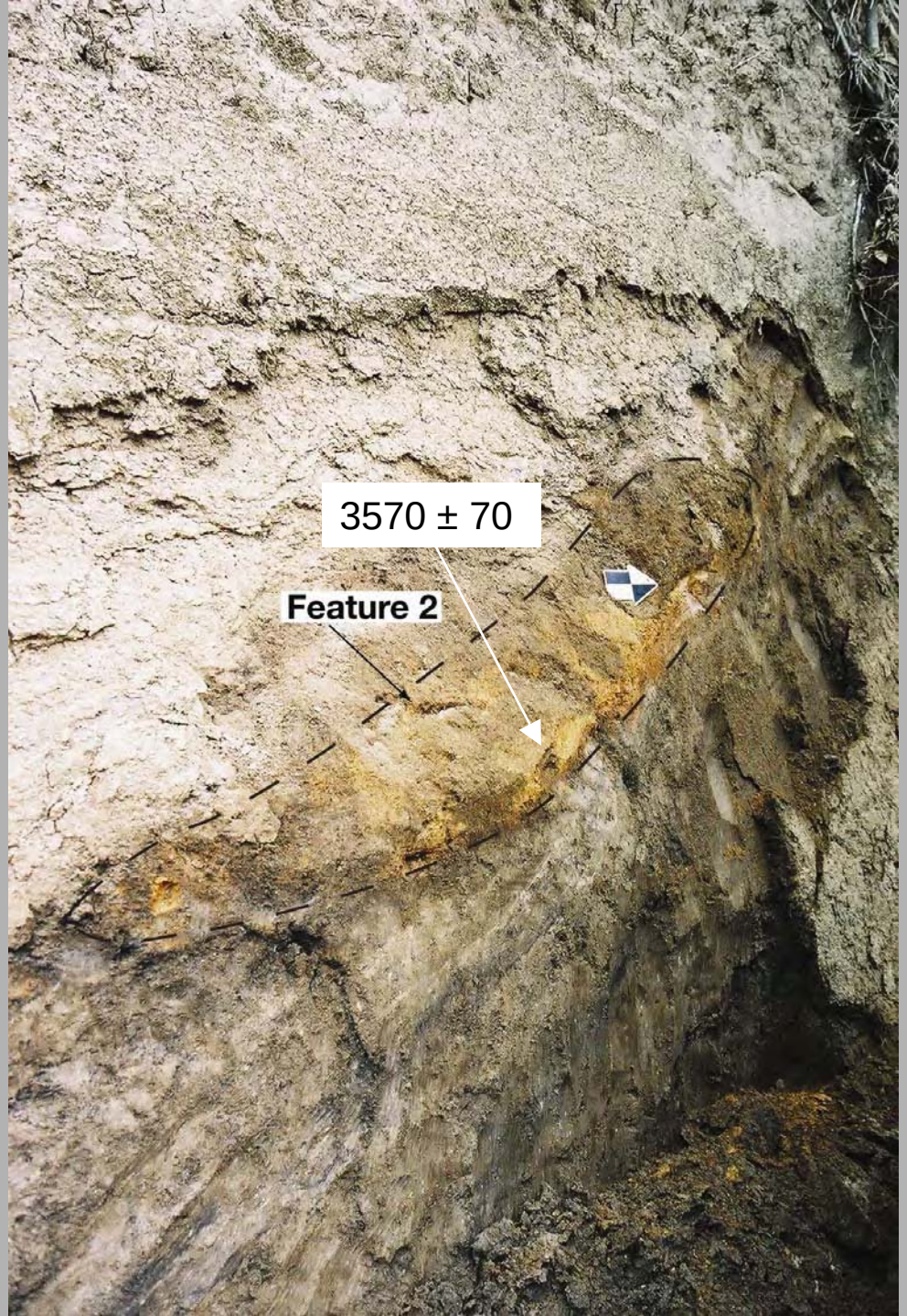

Feature 1
Feature 2


Feature 1

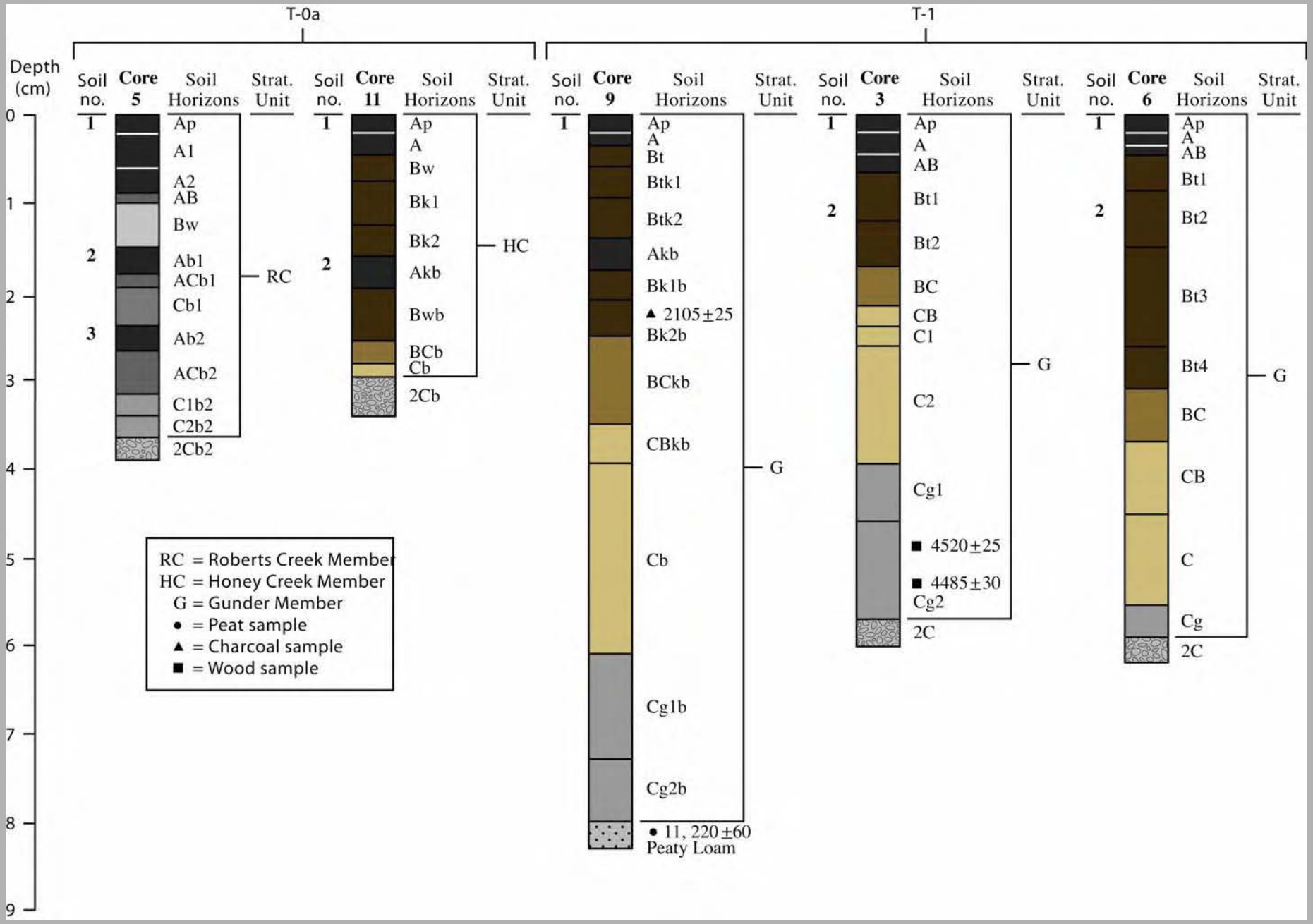
Feature 1

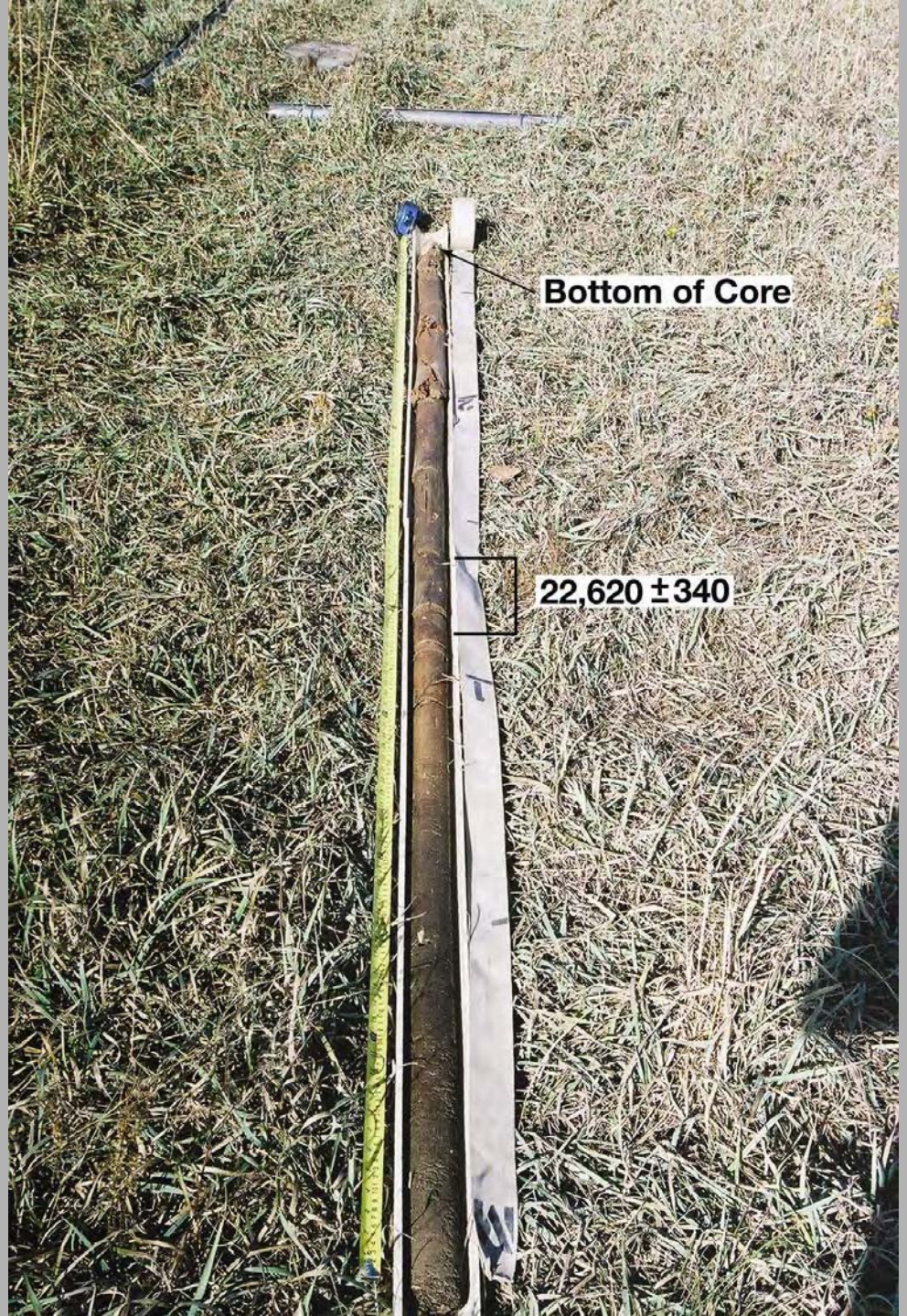

10 CM
CM
Bone
Bone
3530 ± 25


Feature 2

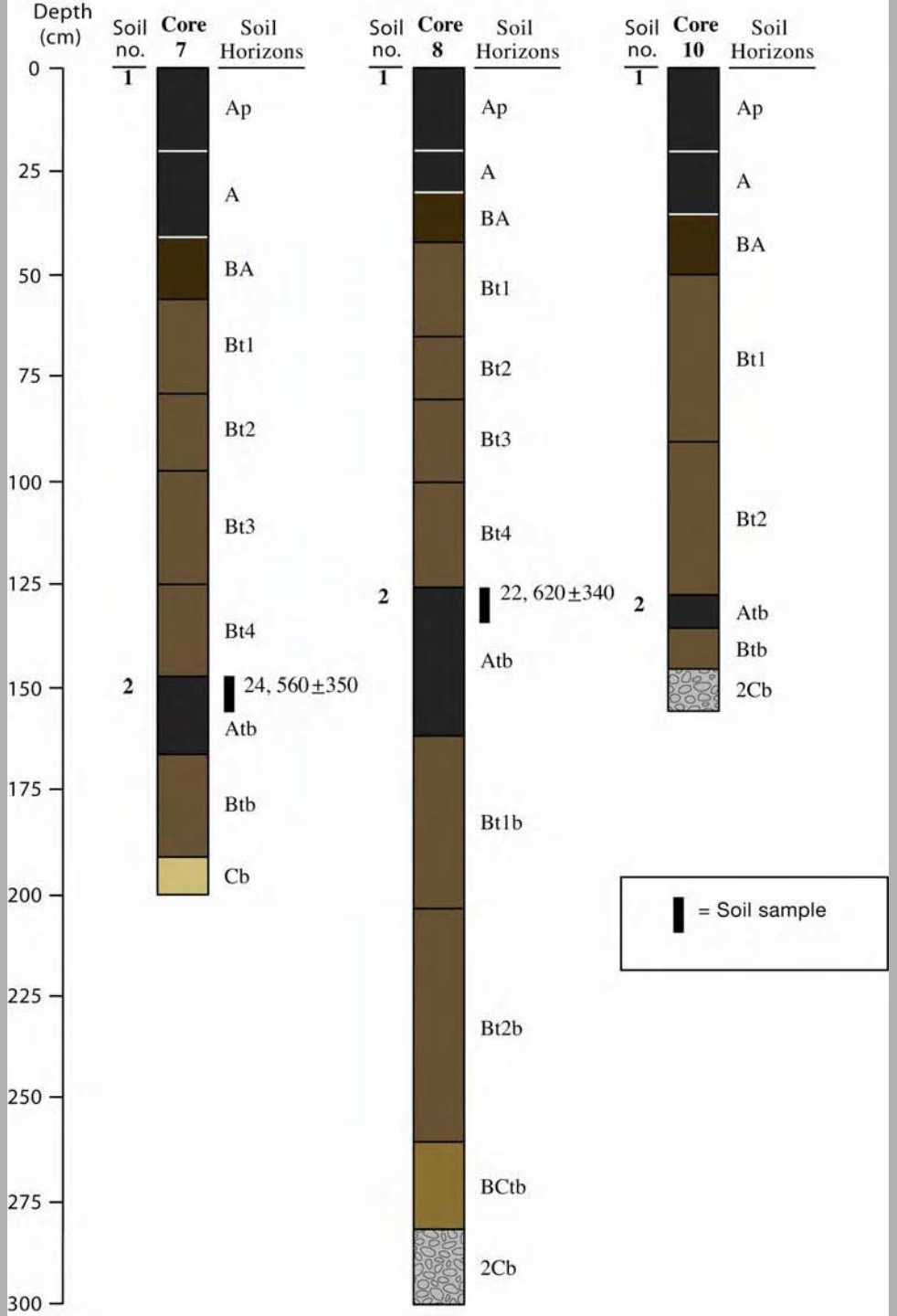

3570 ± 70
Feature 2

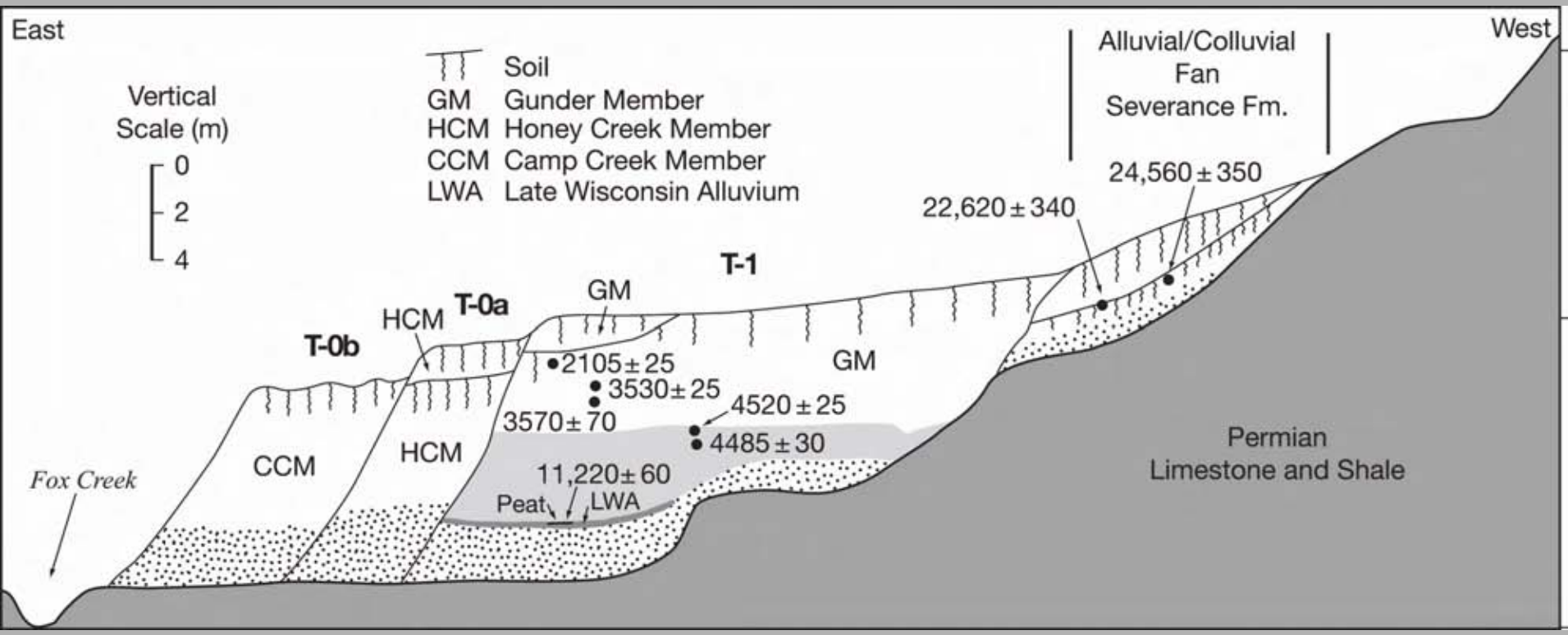
Top of Core
4520 ± 25
4485 ± 30


T-0a
T-1
Depth (cm)
Soil no.
Core 5
Soil Horizons
Strat. Unit
Core 11
Core 9
Core 3
Core 6
Ap
A1
A2
AB
Bw
Ab1
ACb1
Cb1
Ab2
ACb2
C1b2
C2b2
2Cb2
RC
A
Bk1
Bk2
Akb
Bwb
BCb
Cb
2Cb
HC
Bt
Btk1
Btk2
Bk1b
▲ 2105±25
Bk2b
BCkb
CBkb
Cg1b
Cg2b
• 11, 220±60
Peaty Loam
G
Bt1
Bt2
BC
CB
C1
C2
Cg1
■ 4520±25
■ 4485±30
Cg2
2C
Bt3
Bt4
C
Cg
RC = Roberts Creek Member
HC = Honey Creek Member
G = Gunder Member
• = Peat sample
▲ = Charcoal sample
■ = Wood sample


Bottom of Core
22,620 ± 340

Bottom of Core
24,560 ± 350


Depth (cm)
0
25
50
75
100
125
150
175
200
225
250
275
300
Soil no.
Core 7
Soil Horizons
1
Ap
A
BA
Bt1
Bt2
Bt3
Bt4
2
24, 560±350
Atb
Btb
Cb
Soil no.
Core 8
Soil Horizons
1
Ap
A
BA
Bt1
Bt2
Bt3
Bt4
2
22, 620±340
Atb
Bt1b
Bt2b
BCtb
2Cb
Soil no.
Core 10
Soil Horizons
1
Ap
A
BA
Bt1
Bt2
2
Atb
Btb
2Cb
= Soil sample


East
West
Vertical
Scale (m)
0
2
4
Soil
GM Gunder Member
HCM Honey Creek Member
CCM Camp Creek Member
LWA Late Wisconsin Alluvium
Alluvial/Colluvial
Fan
Severance Fm.
24,560 ± 350
22,620 ± 340
T-1
GM
T-0a
HCM
T-0b
2105 ± 25
3530 ± 25
4520 ± 25
3570 ± 70
4485 ± 30
GM
CCM
HCM
11,220 ± 60
Peat
LWA
Fox Creek
Permian
Limestone and Shale

Gas Well
Big Pasture

Wind Energy

Elk River Wind Farm, Butler Co.