Revisiting & Integrating Compositional Ceramic Datasets on the Northern Great Plains

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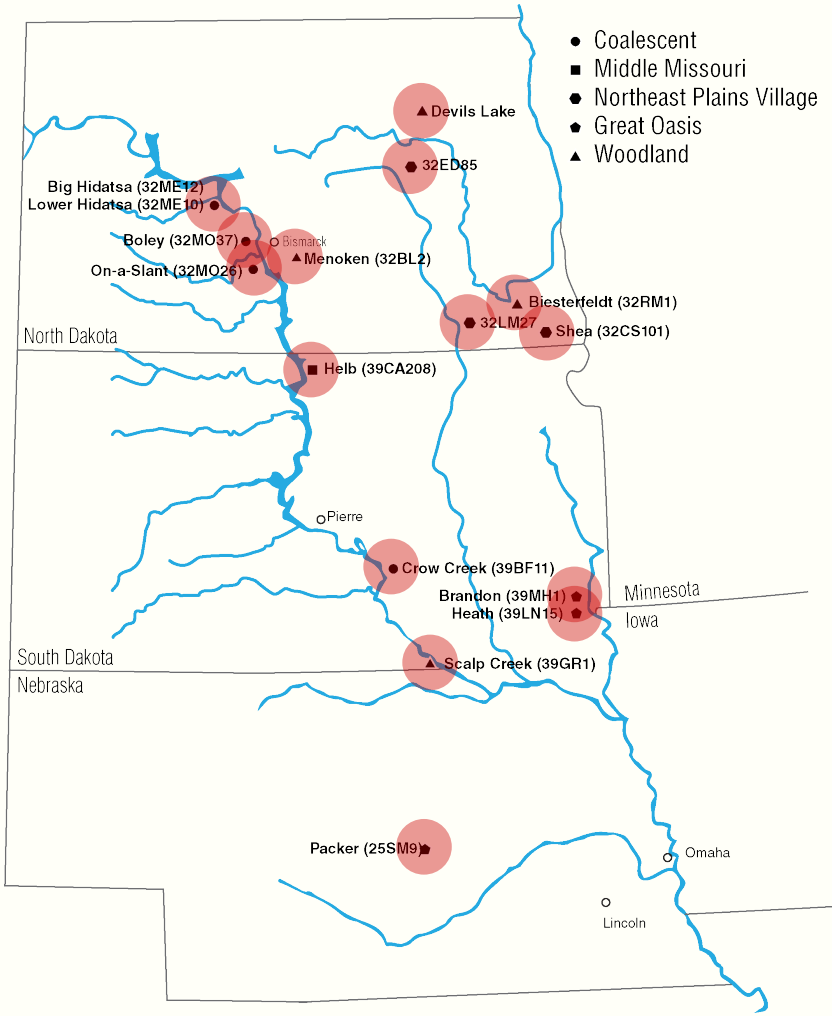
Brief history of studies

Archaeological Pottery

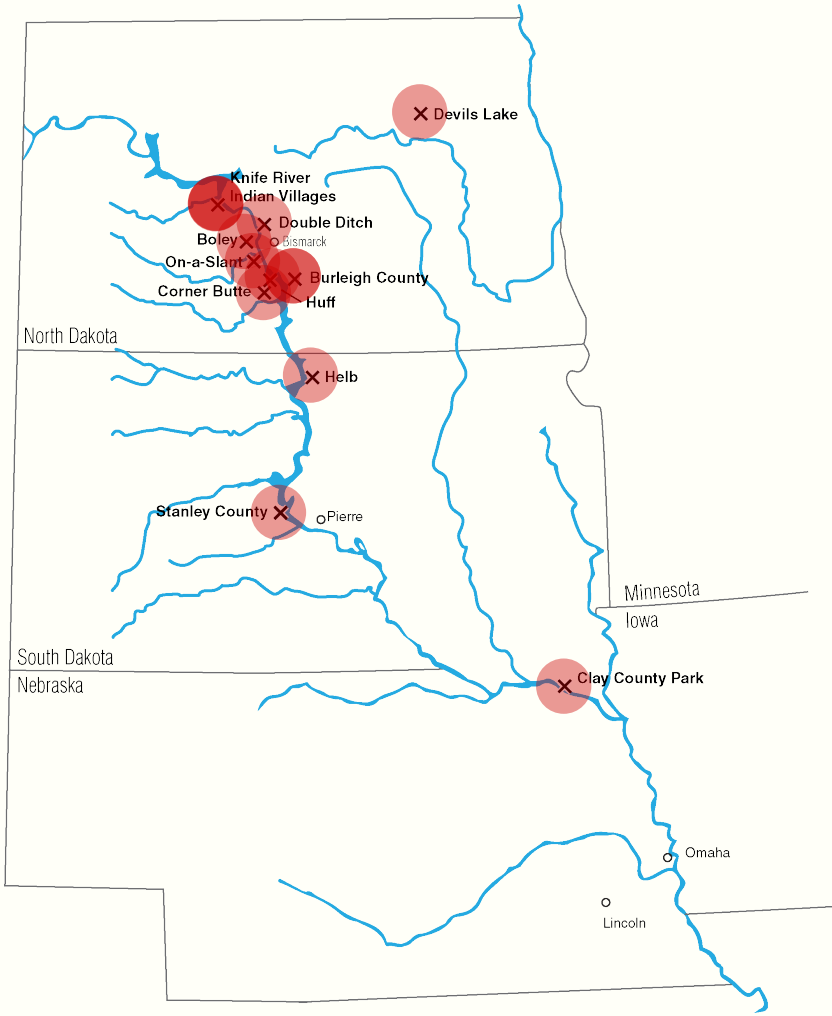
- Dunn and Kay[1]
  - Extended Middle Missouri
  - Riggs Ware
  - n = 29
- Speakman[2,3]
  - Terminal Middle Missouri & Coalescent
  - Knife River & LeBeau Wares
  - n = 230
- Nepstad-Thornberry[4]
  - Late Plains Woodland & Initial Middle Missouri
  - Scalp, Ellis, Great Oasis, Sanford, Stuart, Riggs, and Foreman Wares
  - n = 106
- Hollenback et al. (ongoing)
  - Middle–Late Plains Woodland, Northeast Plains Village
  - n = 45
- Roper, Cobry, and Hoard
  - Central Plains materials



[1] Kay, M. et al. 2000. Helb Site pots: is it Huff or Memorex? *Plains Anthropologist* 45(173): 323–330.
[2] Speakman, R.J. 1997. Neutron activation analysis of northern Plains pottery: chemical distinctions between Mandan and Hidatsa pottery from Slant Village (32MO26) and Boley (32MO37), Morton County, North Dakota. Paper presented at the 65th Plains Conference.
[3] Speakman, R.J. 2000. Change in Mandan and Hidatsa pottery at Slant Village (32MO26). Paper presented at the 65th Annual Meeting of the SAA, Philadelphia.
[4] Speakman, R.J. and M.D. Glascock. 2004. Instrumental Neutron Activation Analysis of Plains Village Pottery from South Dakota and Nebraska. Prepared by the MURR Archaeometry Laboratory. Prepared for C. Nepstad-Thornberry, UC-Boulder.

Geological Clays

- Dunn and Kay[1]
  - Clay-rich sediments from alluvial contexts between KRIV and Clay County, SD (n = 9)
- Speakman[2,3]
  - Clay and clay-rich sediments from alluvial (valley) and residual (upland) contexts between Corner Butte and KRIV (n = 30)
- Mitchell[4]
  - Clay-rich sediments from alluvial contexts from near Double Ditch and Shermer (n = 10)
- Hollenback et al. (ongoing)
  - Clay-rich sediments from alluvial and lacustrine contexts from locations around Devils Lake and near KRIV (n = 11)



[1] Kay, M. et al. 2000. Helb Site pots: is it Huff or Memorex? *Plains Anthropologist* 45(173): 323–330.
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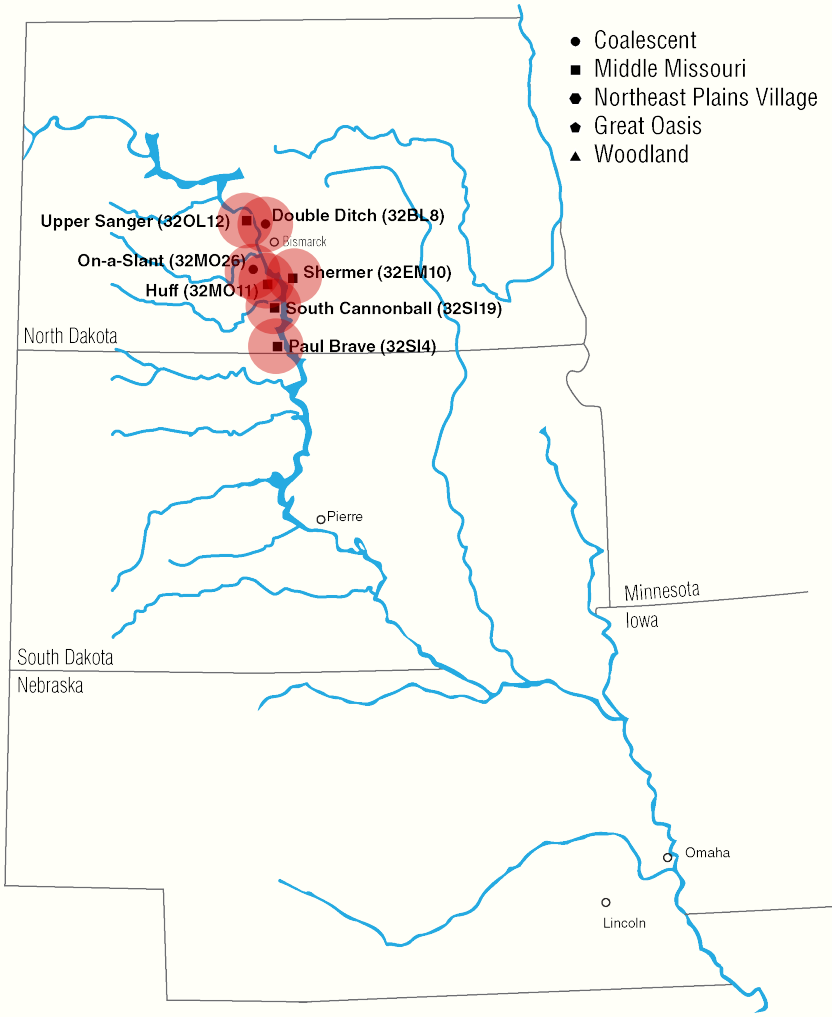
[4] Ferguson, J. R. and M.D. Glascock. 2007. Instrumental Neutron Activation Analysis or [sic] Raw and Archaeological Clay Samples from Central North Dakota. Prepared by the MURR Archaeometry Laboratory. Prepared for M.D. Mitchell, UC-Boulder.

Archaeological Clays

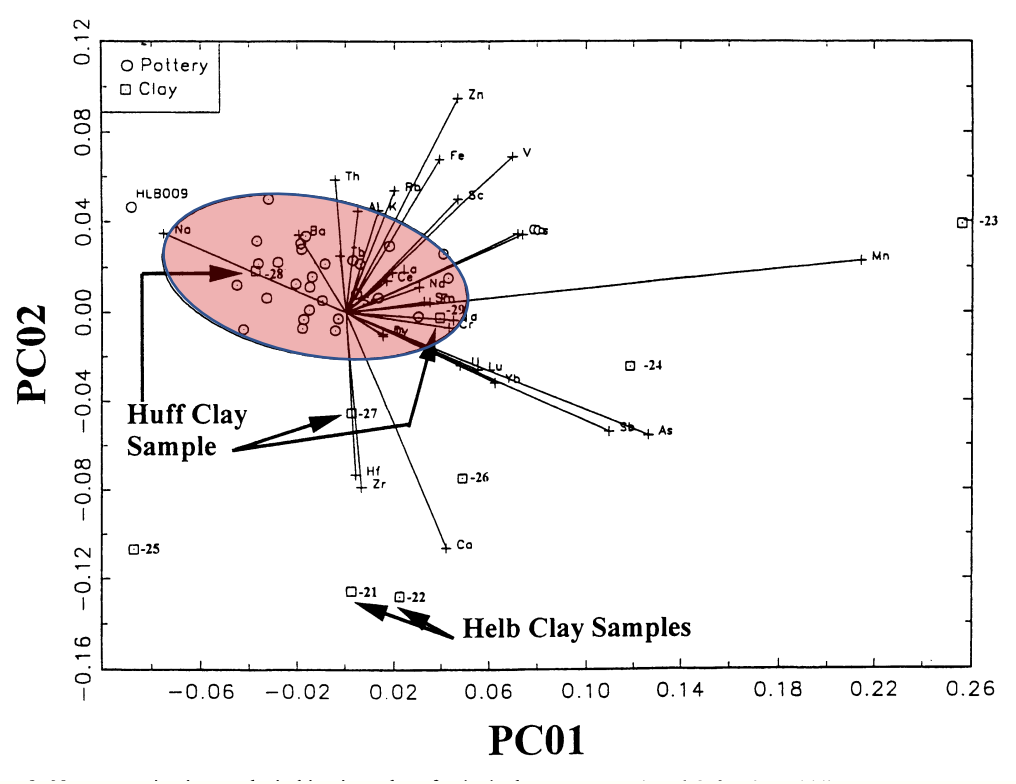
- Mitchell[1]
  - Middle Missouri
    - South Cannonball (n = 2)
    - Paul Brave (n = 1)
    - Shermer (n = 3)
    - Huff (n = 2)
  - Coalescent
    - On-a-Slant (n = 1)
    - Upper Sanger (n = 1)
    - Double Ditch (n = 9)



[1] Ferguson, J. R. and M.D. Glascock. 2007. Instrumental Neutron Activation Analysis or [sic] Raw and Archaeological Clay Samples from Central North Dakota. Prepared by the MURR Archaeometry Laboratory. Prepared for M.D. Mitchell, UC-Boulder.

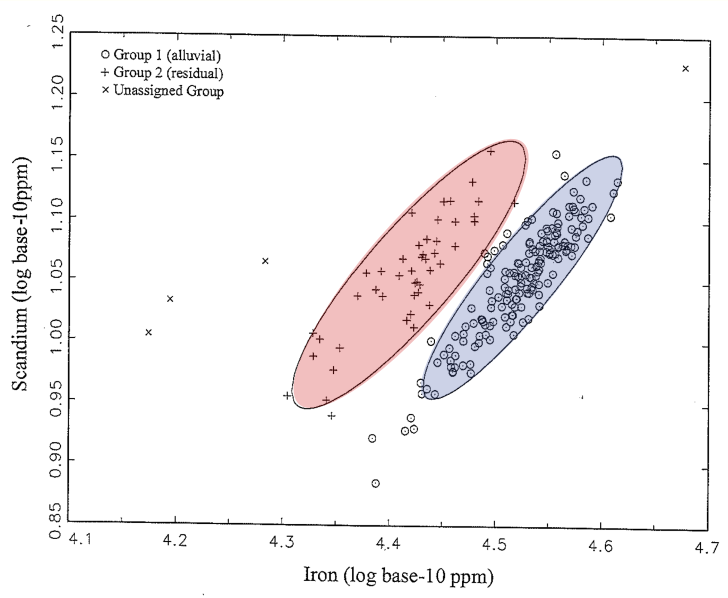
Summary of findings

- Helb
  - A single compositional group
  - Affinities with alluvial clayey sediment from Burleigh County, proximate to Huff
    - But—similarities with clayey sediment from nearby Helb



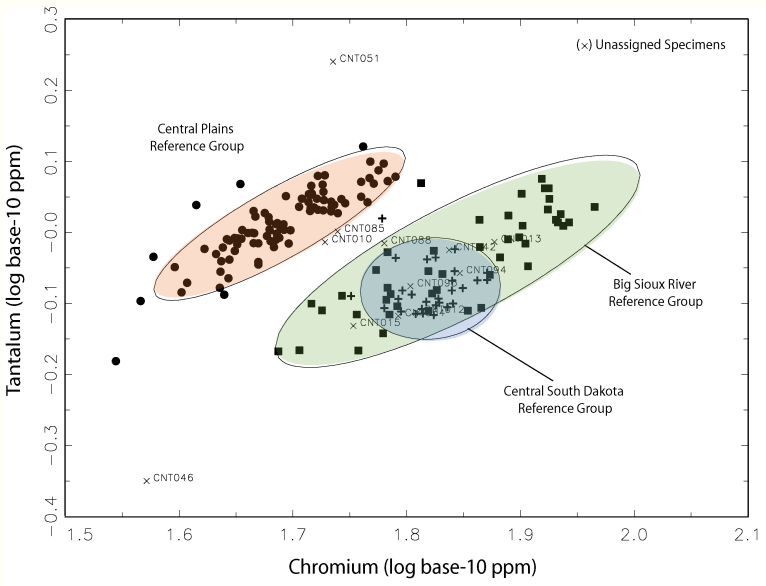
Kay, M. et al. 2000. Helb Site pots: is it Huff or Memorex? *Plains Anthropologist* 45(173): 323–330.

- Central North Dakota
  - Two broad compositional groups
  - Distinguished primarily by differences in transition-metal ratios
  - Each appears to be broadly associated with clays of distinct geological origins
    - Alluvial (M/H-1)
    - Residual (M/H-2)
  - Little correlation with wares, villages, etc.



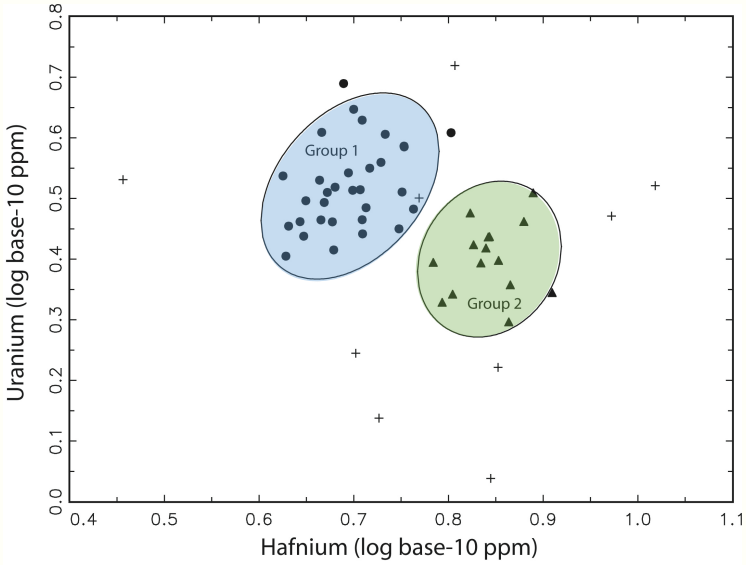
Speakman, R.J. 2000. Change in Mandan and Hidatsa pottery at Slant Village (32MO26). Paper presented at the 2000 Annual Meeting of the Society for American Archaeology, Philadelphia, PA.

- South Dakota
  - Crow Creek & Scalp Creek
  - Big Sioux River
  - Some pieces similar to Central Plains
  - All distinct from central North Dakota materials



Speakman, R.J. and M.D. Glascock. 2004. Instrumental Neutron Activation Analysis of Plains Village Pottery from South Dakota and Nebraska. Prepared by the MURR Archaeometry Laboratory. Prepared for C. Nepstad-Thornberry, UC-Boulder.

- Archaeological clays
  - Two groups defined on the basis of Hf and U
  - No comparison to archaeological pottery
    - Archaeological clays grouped together
    - Geological clays grouped together



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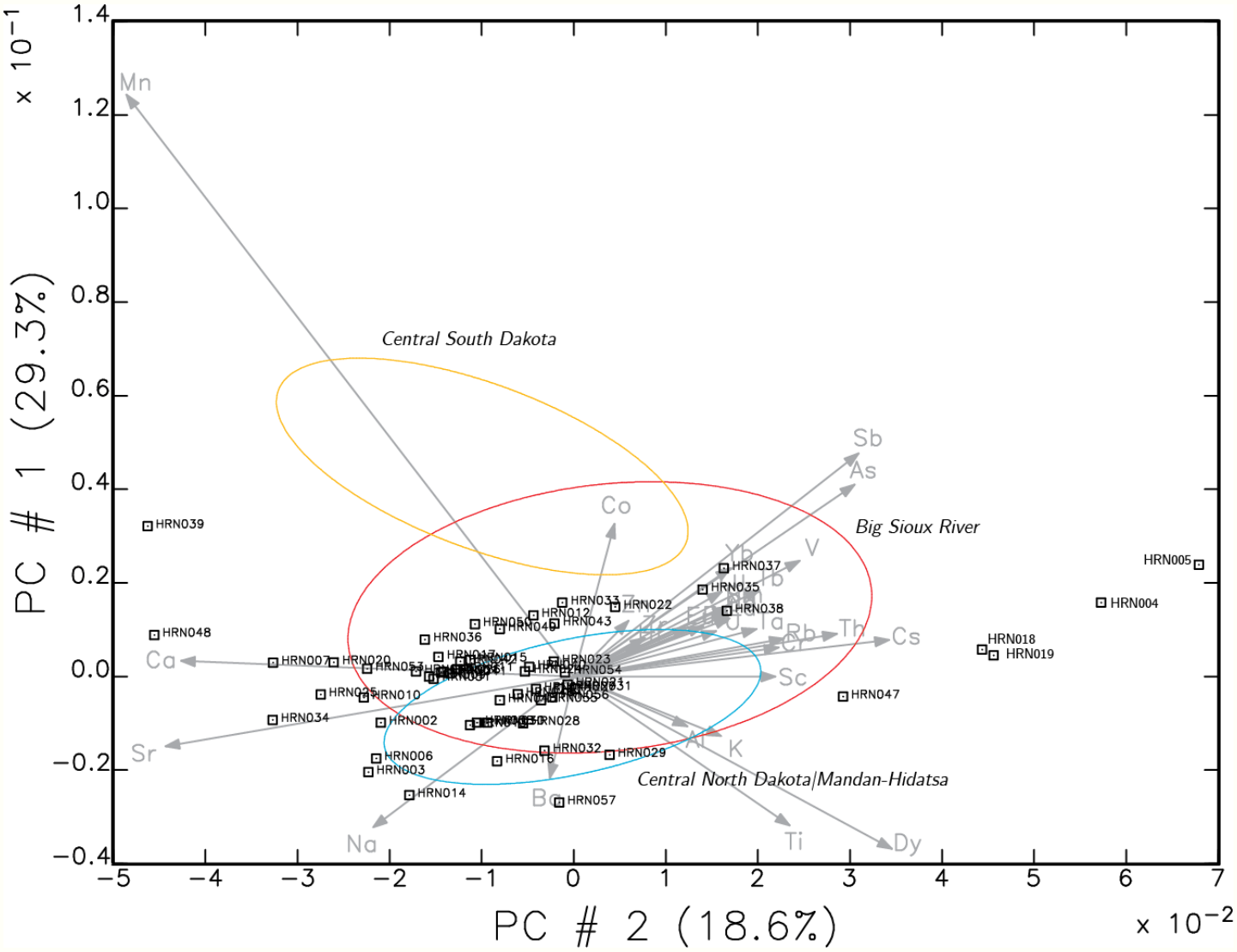
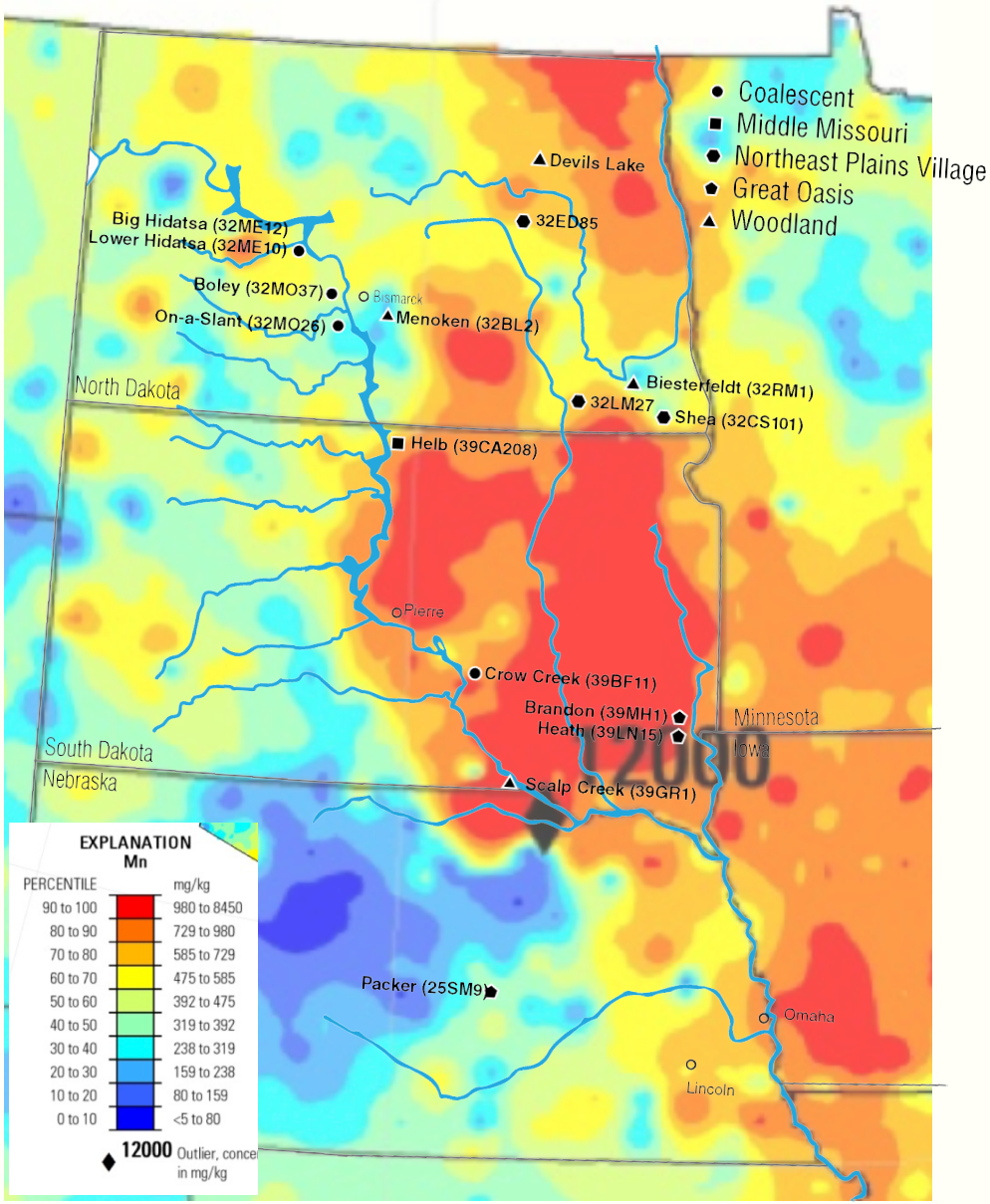
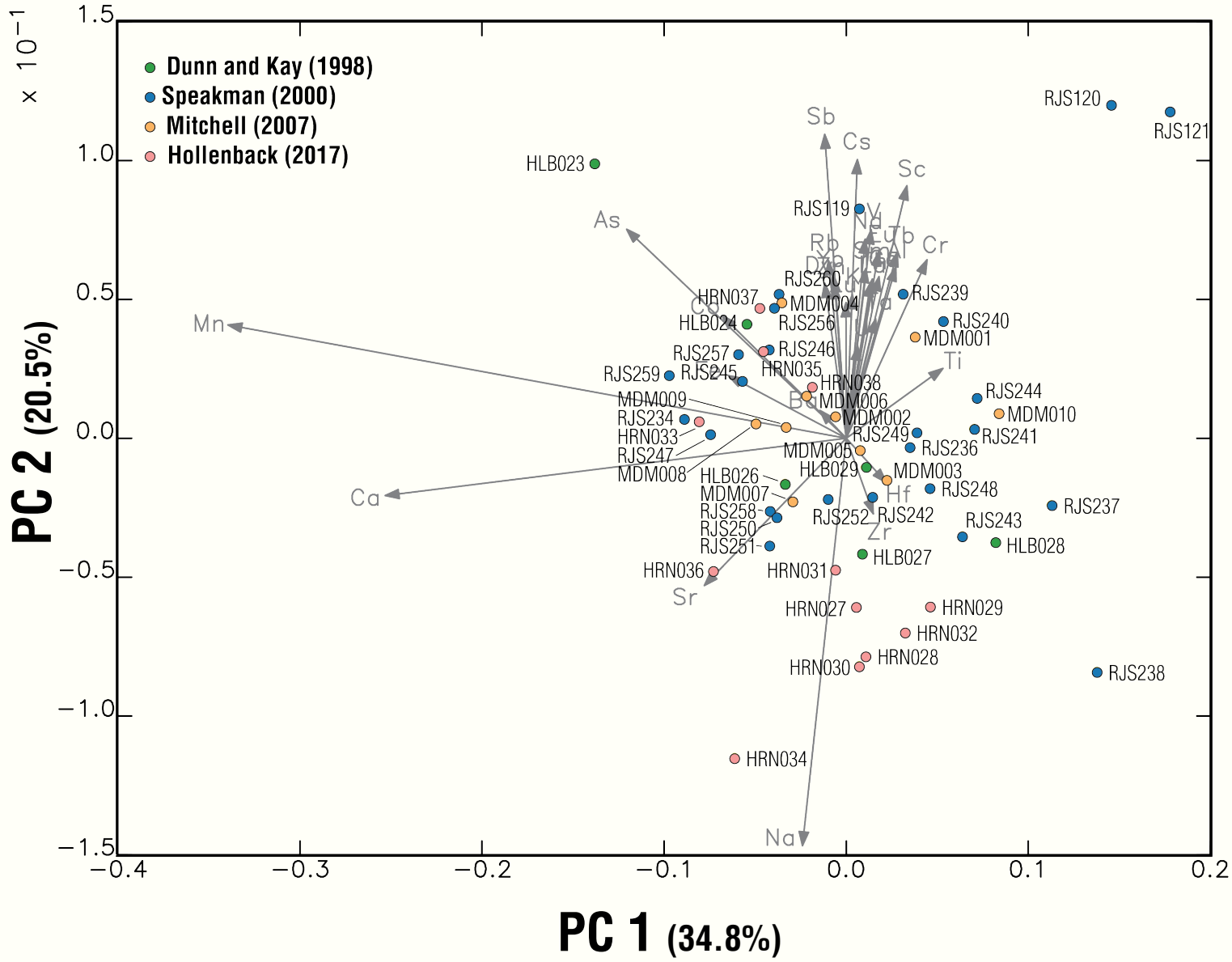
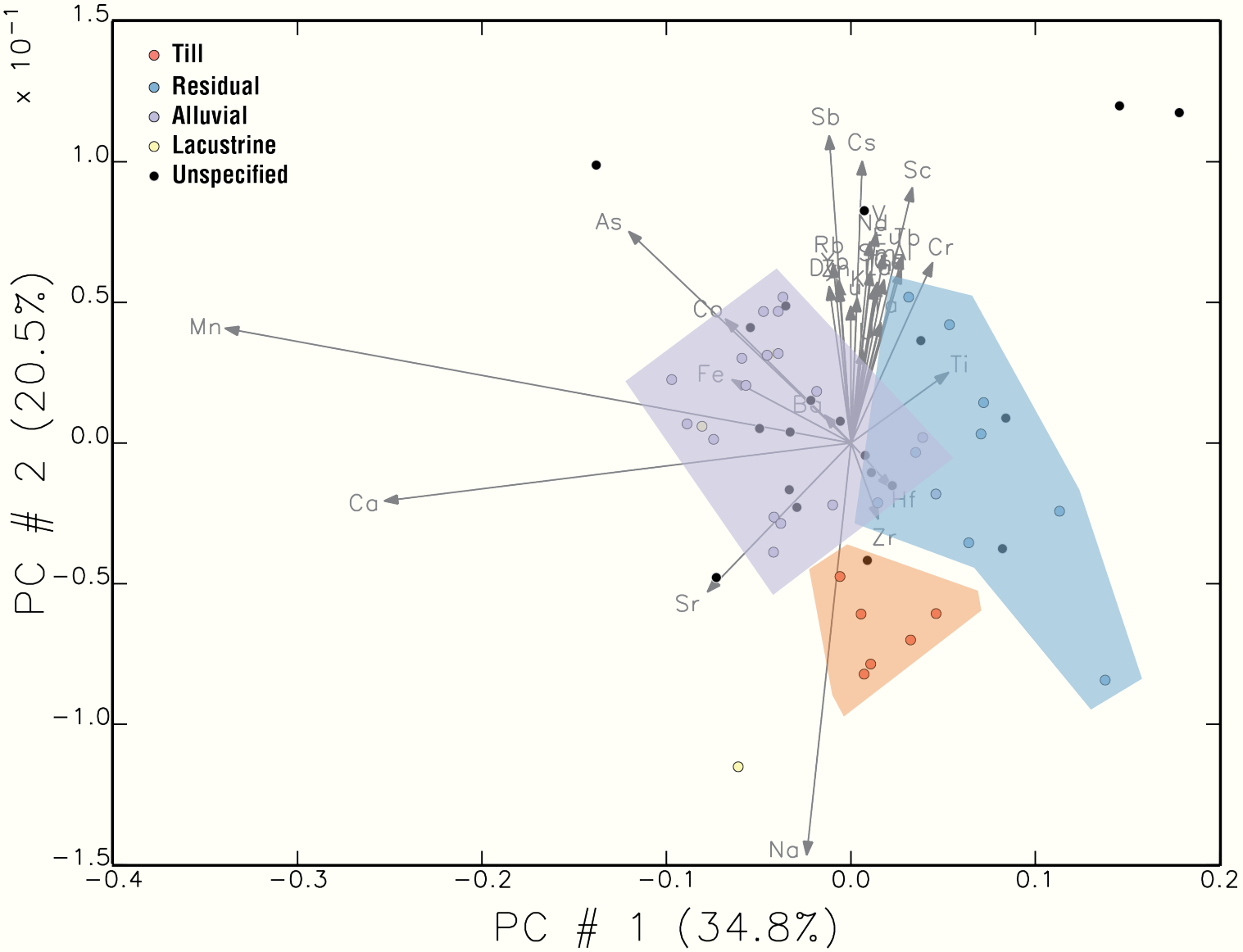
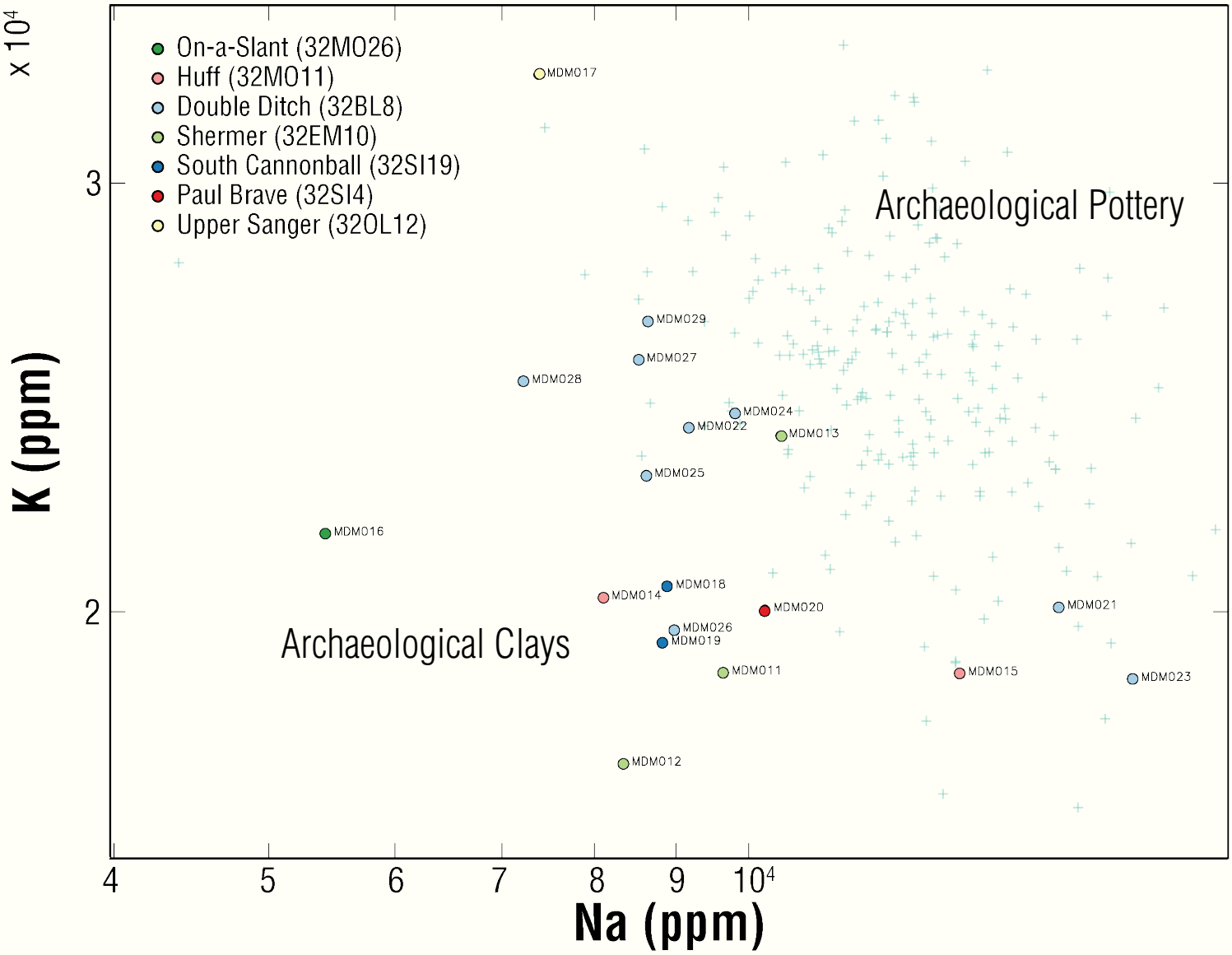

PC # 1 (29.37%)
× 10⁻¹
PC # 2 (18.6%)
× 10⁻²
Central South Dakota
Big Sioux River
Central North Dakota/Mandan-Hidatsa
Mn
Sb
As
Co
V
Cs
Th
Rb
Sc
Ca
Sr
Al
K
Ti
Dy
Na
HRN039
HRN048
HRN005
HRN004
HRN018
HRN019
HRN047
HRN037
HRN035
HRN038
HRN033
HRN022
HRN012
HRN043
HRN036
HRN007
HRN020
HRN025
HRN010
HRN034
HRN002
HRN028
HRN032
HRN029
HRN006
HRN003
HRN016
HRN014
HRN057

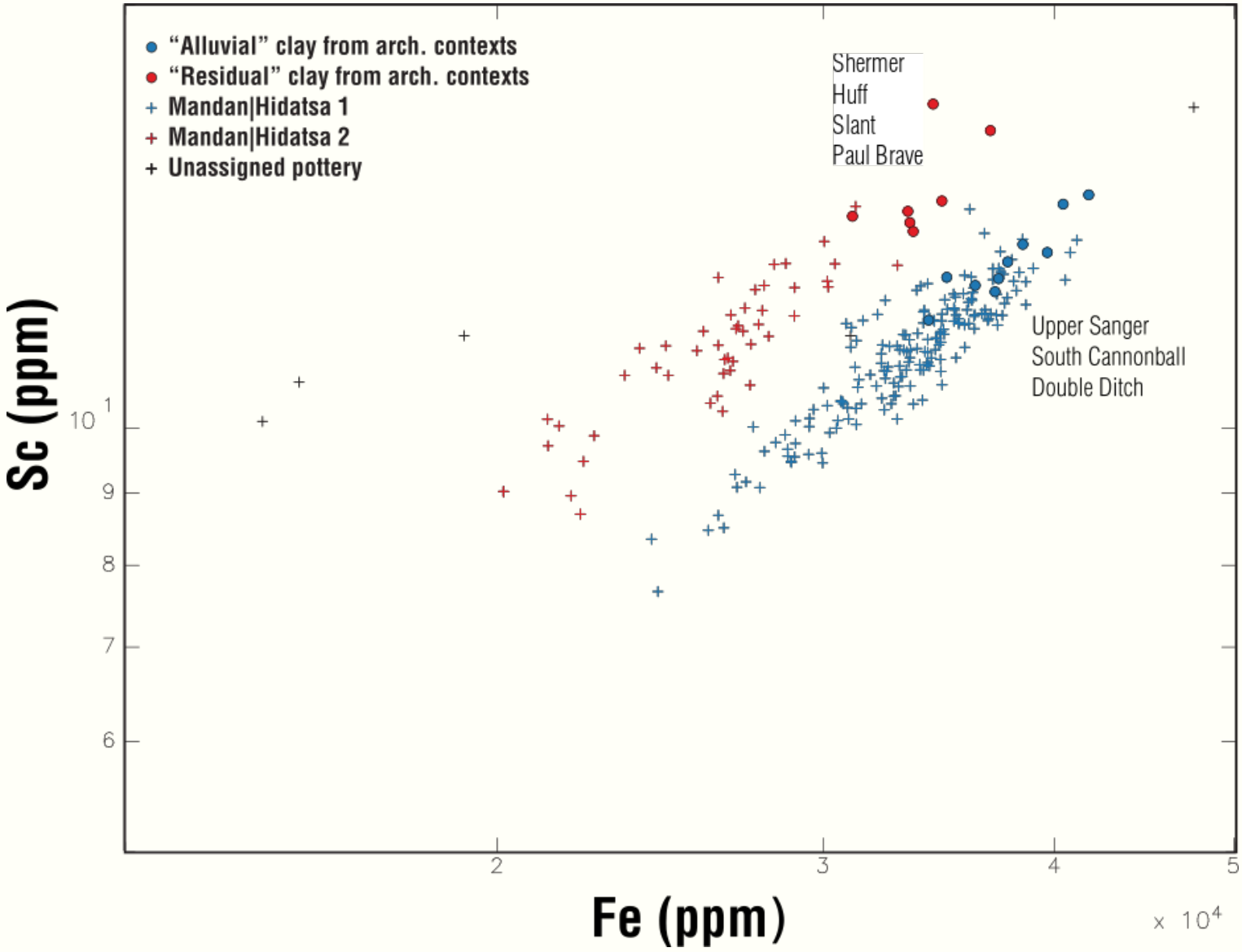


Smith, D.B. et al. 2014. Geochemical and Mineralogical Maps for Soils of the Coterminous United States. USGS OFR2014-1082.


Dunn and Kay (1998)
Speakman (2000)
Mitchell (2007)
Hollenback (2017)
× 10−1
PC 2 (20.5%)
PC 1 (34.8%)
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−0.4
−0.3
−0.2
−0.1
0.0
0.1
0.2
Sb
Cs
Sc
As
Cr
Mn
Ti
Ca
Hf
Zr
Sr
Na
RJS120
RJS121
HLB023
RJS119
RJS260
RJS239
HRN037
MDM004
RJS240
HLB024
RJS256
MDM001
RJS257
RJS246
RJS259
RJS245
HRN035
HRN038
RJS244
MDM009
MDM006
MDM010
RJS234
MDM002
HRN033
RJS249
RJS241
RJS247
MDM005
RJS236
MDM008
HLB029
MDM003
HLB026
RJS248
MDM007
RJS237
RJS258
RJS252
RJS242
RJS243
RJS250
RJS251
HLB028
HLB027
HRN036
HRN031
HRN027
HRN029
HRN032
HRN030
HRN028
RJS238
HRN034


Till
Residual
Alluvial
Lacustrine
Unspecified
x 10⁻¹
PC # 2 (20.5%)
PC # 1 (34.8%)
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−0.4
−0.3
−0.2
−0.1
0.0
0.1
0.2
Sb
Cs
Sc
As
Cr
Mn
Co
Fe
Ba
Ti
Ca
Hf
Zr
Sr
Na


x 10^4
K (ppm)
3
2
On-a-Slant (32MO26)
Huff (32MO11)
Double Ditch (32BL8)
Shermer (32EM10)
South Cannonball (32SI19)
Paul Brave (32SI4)
Upper Sanger (32OL12)
MDM017
MDM029
MDM027
MDM028
MDM024
MDM022
MDM013
MDM025
MDM016
MDM018
MDM014
MDM020
MDM021
MDM026
MDM019
MDM011
MDM015
MDM023
MDM012
Archaeological Pottery
Archaeological Clays
4
5
6
7
8
9
10^4
Na (ppm)


"Alluvial" clay from arch. contexts
"Residual" clay from arch. contexts
Mandan|Hidatsa 1
Mandan|Hidatsa 2
Unassigned pottery
Shermer
Huff
Slant
Paul Brave
Upper Sanger
South Cannonball
Double Ditch
Sc (ppm)
10 1
9
8
7
6
2
3
4
5
Fe (ppm)
x 10^4

Modeling Ceramic Compositions

$$S_i = (P \times T_i) + ([1 - P] \times C_i)$$

Wherein

i is the abundance of a particular element

S is the modeled ceramic

P is the proportion of temper (by mass)

T is the temper

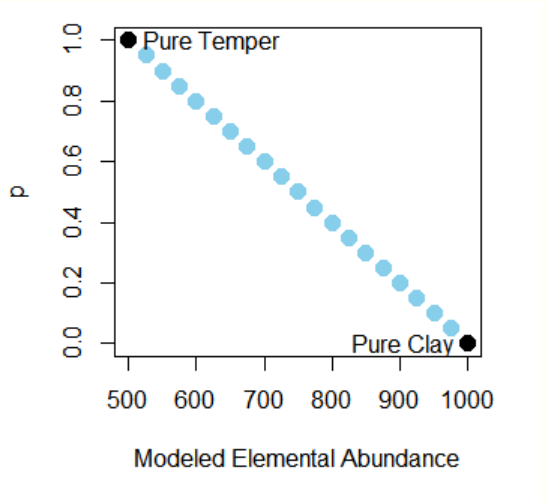
C is the clay

Hector Neff, Ronald L. Bishop, and Edward V. Sayre, "A simulation approach to the problem of tempering in compositional studies of archaeological ceramics," *Journal of Archaeological Science*, 15 (1988), 159–172.

Hector Neff, Ronald L. Bishop, and Edward V. Sayre, "More observations on the problem of tempering in compositional studies of archaeological ceramics," *Journal of Archaeological Science*, 16 (1989), 57–69.

Modeling Ceramic Compositions

$$(.25 \times 500) + (.75 \times 1000) = 875$$

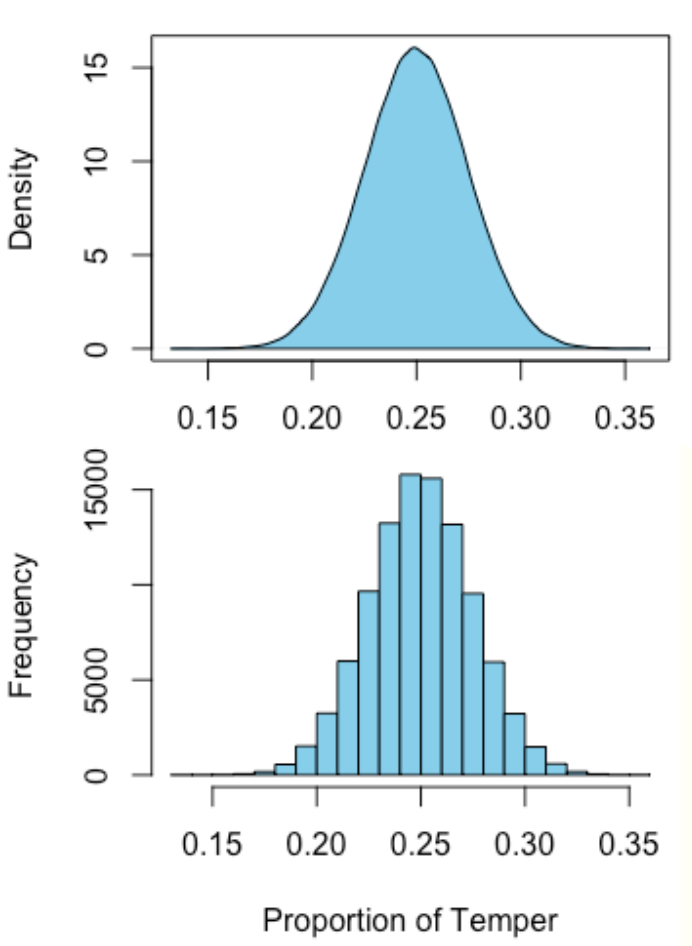


- Temper:clay ratio of 1:3 (25% temper)
- Temper: 500 ppm; Clay: 1000 ppm
  - Results in 875 ppm pottery
- Point estimates between end-members
  - Assumes uniformity in temper:clay ratio
  - Does not consider variation in both components
  - Does not consider analytical uncertainty

Modeling Ceramic Compositions

$$S_i = (P \times T_i) + ([1 - P] \times C_i)$$

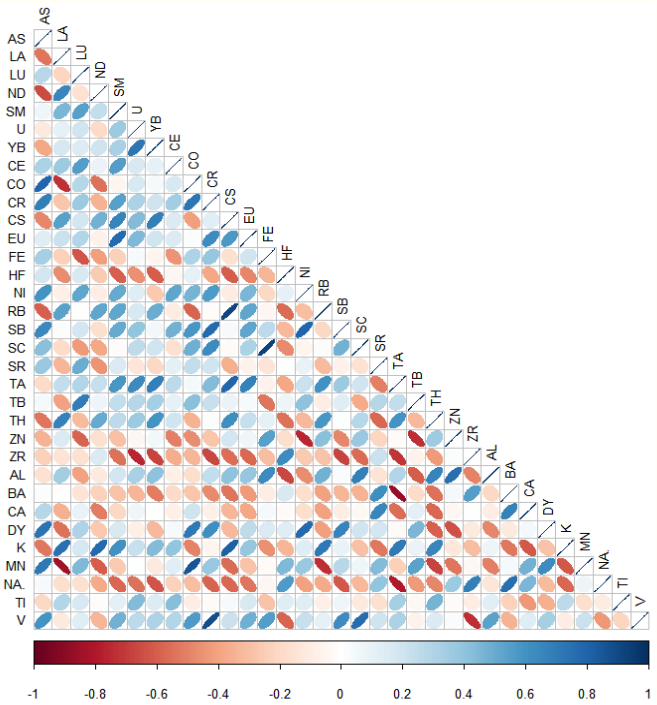
- P is sampled from a truncated normal distribution defined by
  - μ (average amount of temper added)
  - σ (variation in temper:clay consistency)

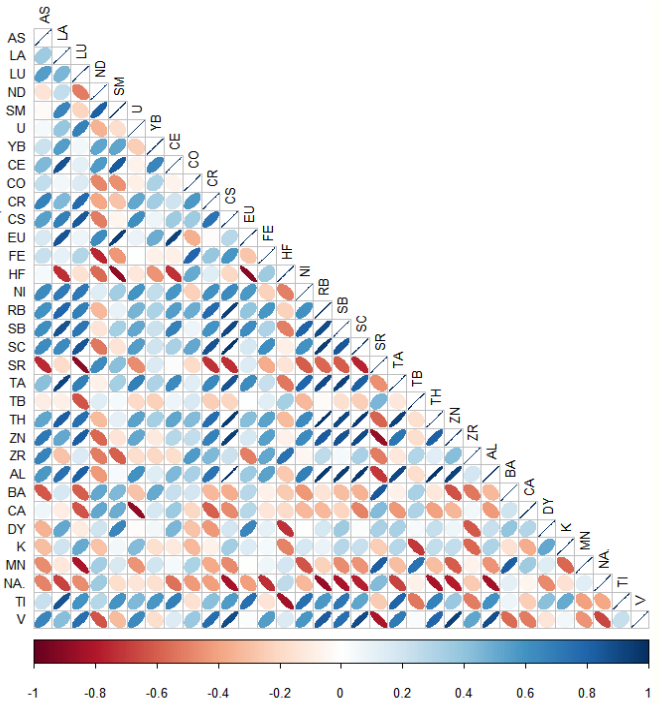


Modeling Ceramic Compositions

$$S_i = (P \times T_i) + ([1 - P] \times C_i)$$

- Means and covariation matrices are determined from analyses of multiple clay and temper specimens
- Multivariate-normal distributions are produced for each component

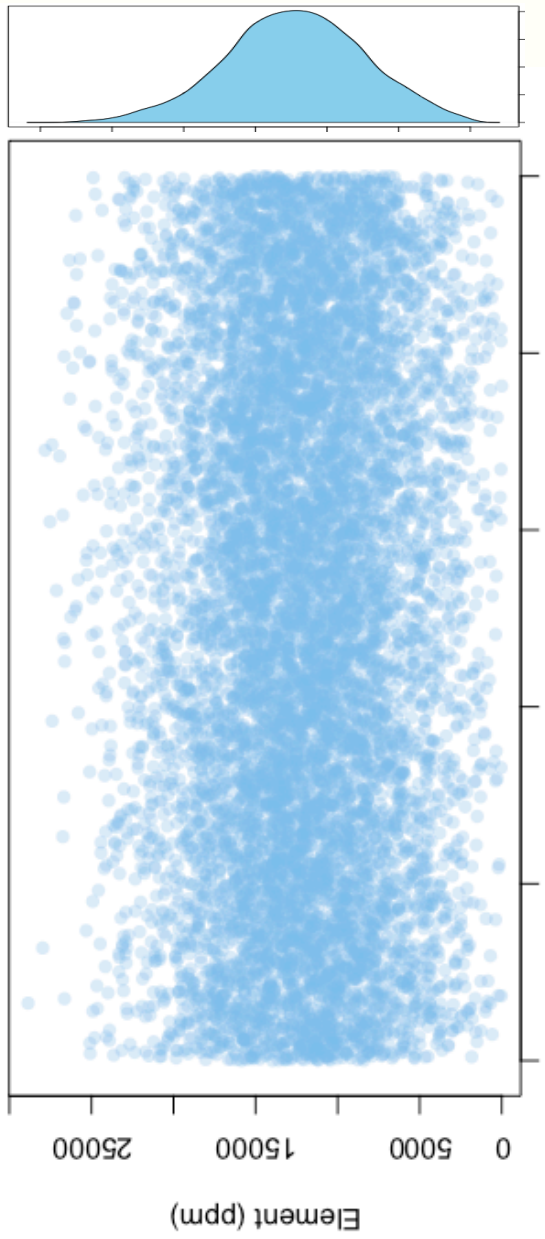




Modeling Ceramic Compositions

$$S_i = (P \times T_i) + ([1 - P] \times C_i)$$

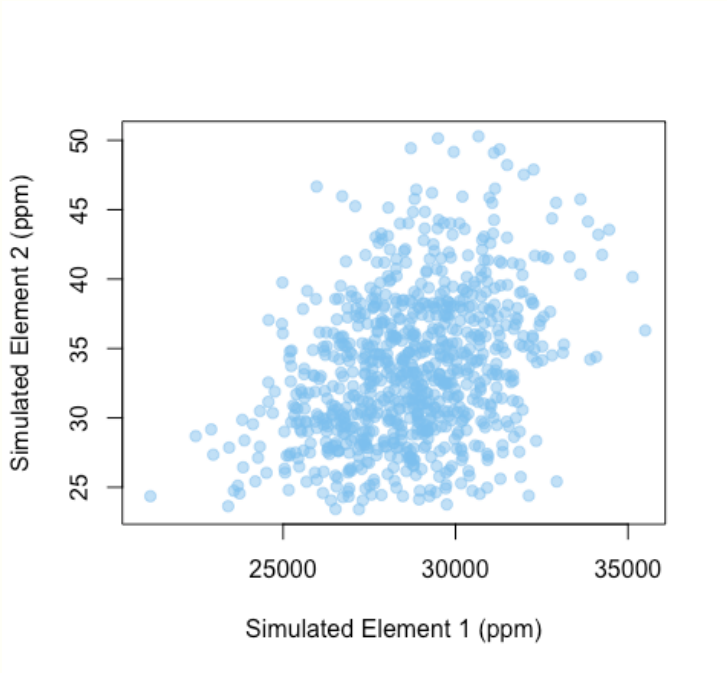
- Simulated tempers and clays within these distributions are generated producing *possible* compositions for each

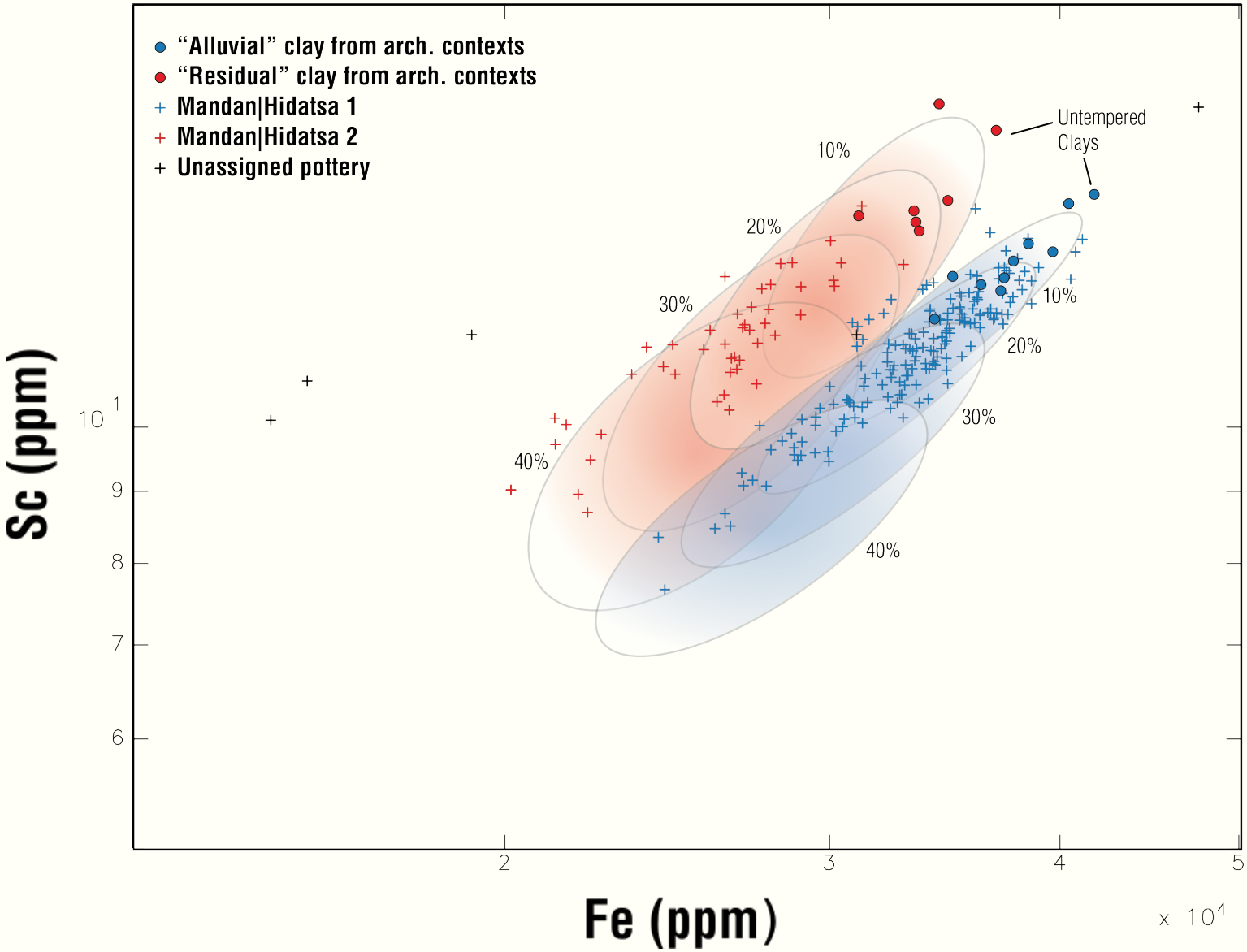


Modeling Ceramic Compositions

$$S_i = (P \times T_i) + ([1 - P] \times C_i)$$

- P, T, C are sampled from the respective distributions to produce *n* possible ceramic compositions




"Alluvial" clay from arch. contexts
"Residual" clay from arch. contexts
Mandan|Hidatsa 1
Mandan|Hidatsa 2
Unassigned pottery
Untempered Clays
10%
20%
30%
40%
10%
20%
30%
40%
Sc (ppm)
10 1
9
8
7
6
2
3
4
5
Fe (ppm)
x 10 4

Recommendations

- Pottery from Middle Missouri Tradition sites to complement extant Coalescent ceramic data
- Clay sampling
  - Archaeological clays
  - Consider and record geological context
  - Workability and textural studies: is it *usable*?
- Temper sampling

Acknowledgments

- All prior data were generated with support through a laboratory-support grant from the NSF
- Whitney Goodwin and Abigail Fisher
- Marvin Kay, Mark Mitchell, Curtis Nepstad-Thornberry, Jeff Speakman
- State Historical Society of North Dakota