

2010 Society for American Archaeology Meeting, St. Louis, MO

Cooking With Limestone: Does it Enhance Maize Nutrition?

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The Nutritional Quality of Maize

(Robles 1988; Carmen 2003)

- Lysine
- Tryptophan
- B Vitamin:
Niacin



Results of Niacin Deficiency:
conditions such as Pellagra

history.nih.gov/exhibits/goldberger/docs/2b.htm

Nixtamalization, or Alkaline Treatment:

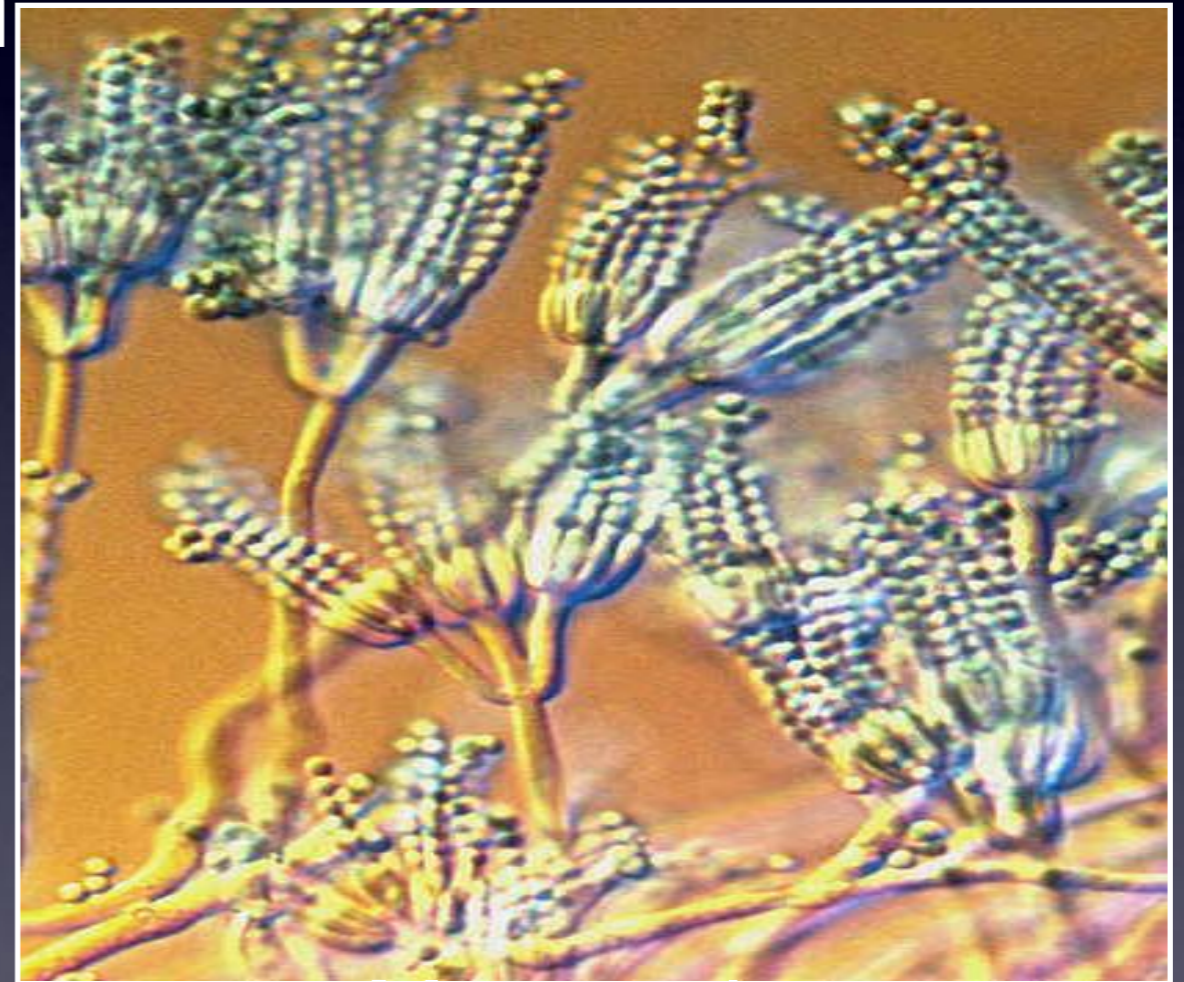
- 1) Maize is boiled (~85 C) in a water/slaked lime solution
- 2) It is then allowed to steep for several hours
- 3) Liquor is drained, and the maize is rinsed
 - a) The pericarp is usually removed
- 4) Maize may be immediately ground into a dough or dried and then ground into a flour

Alkaline Treatment of Maize

Nutritional Benefits

(Gutierrez-Dorado et al. 2008; Katz 1974)

- Increases in calcium content
- Releases niacin and tryptophan
- (Arguably) releases lysine
- Reduces Mycotoxins



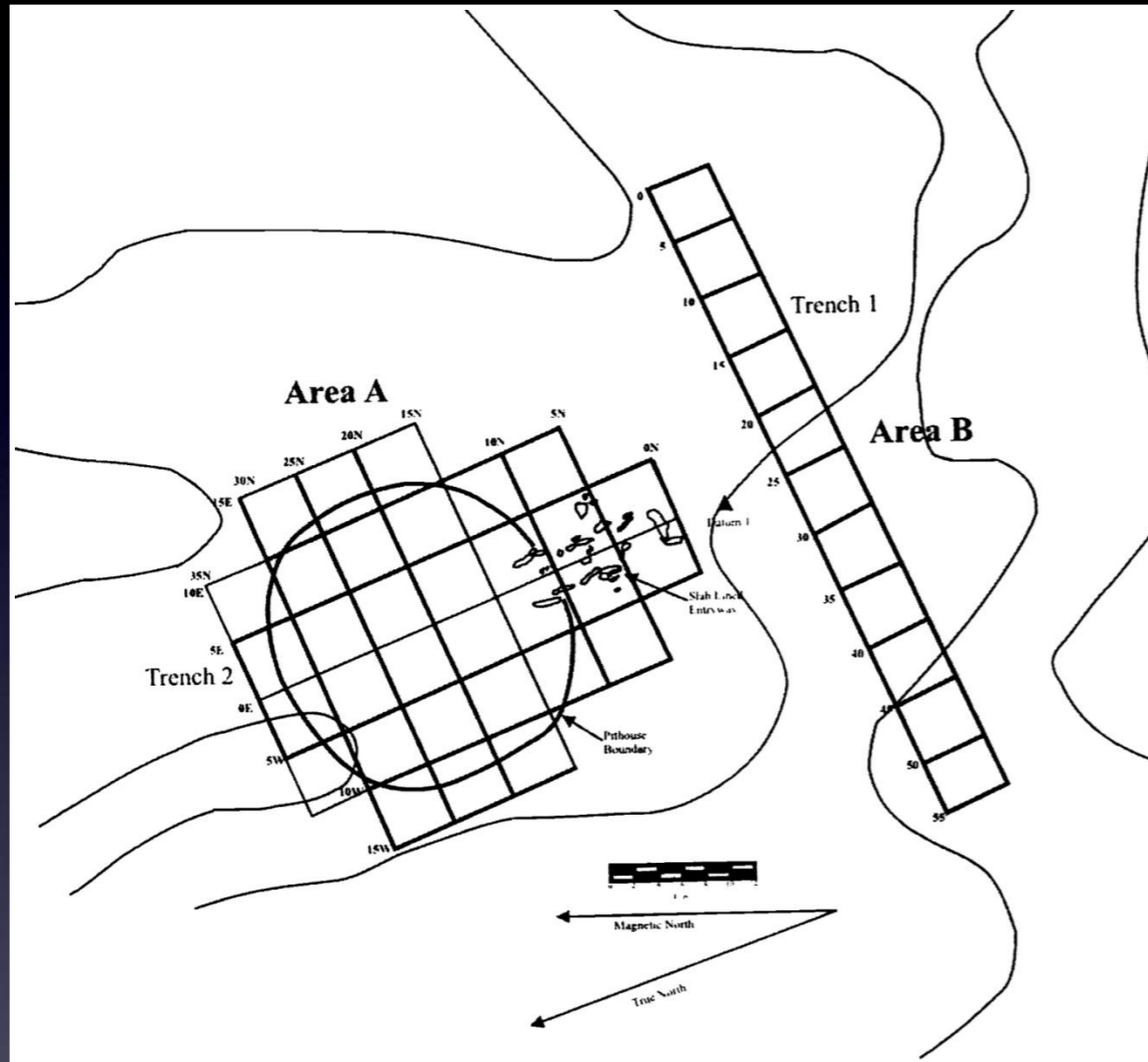
Mycotoxin:

Penicillium

www.uoguelph.ca/~cplant/MISCE/LCNEOUS/april.htm

Cedar Mesa:

Basketmaker II Habitation Sites in Southeast Utah:



- Archaeologists R.G. Matson and William Lipe noted the frequent appearance of limestone on the middens of Cedar Mesa Basketmaker II habitation sites (1988).

- Grand Gulch Phase (AD 200 - 400):

- 1) Pithouses
- 2) Heavy dependence on maize
- 2) Lack of fired pottery
- 4) Limestone surface scatters
- 5) Lack of beans as vegetable protein

- Matson theorized that these Basketmaker II groups may have used limestone boiling to process maize (Matson and Chisholm 1991: 7).

Site 42SA7406:

Veres Site, a Basketmaker II^p Habitation Site in SE Utah

“Area B” is the midden location where limestone was noted (Pollock 2001).

Limestone Basicity

and the Transition from Limestone to Lime

(Hoak et al. 1944)

Limestone Chemical Makeup:

- Calcium Carbonate (92.8 %)
- Magnesium Carbonate (2.07 %)
- Metal Oxides (.74 %)
- Acid-Insoluble (4.2%)

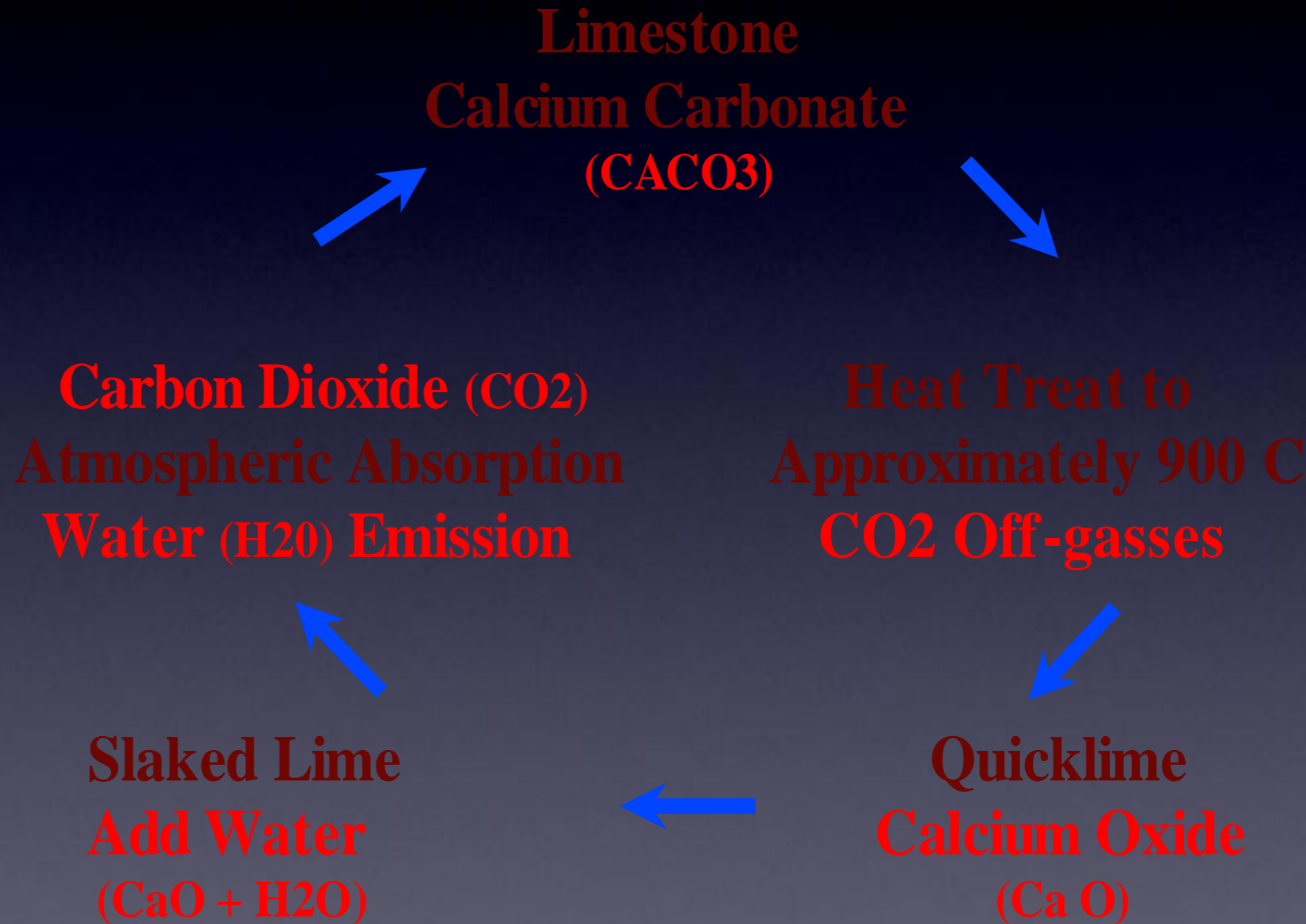


Cedar Mesa Limestone

The Transformation

- To produce lime from limestone, the calcium carbonate in the stone must be subjected to heat to produce carbon dioxide and calcium oxide, or chemical lime.
- When mixed with distilled water to create slaked lime, the general pH range is between 11.4 and 11.6.

Limestone Calcination:



Methods:

- 1) Natural limestone was collected from Cedar Mesa
- 2) Limestone samples dried at 105 C for 24 hours
- 3) Heating for 3 hours (Interval Scale):
 - a) 300 to 900 C
- 4) Samples placed in room-temperature distilled water
 - a) 1:2 limestone to water
- 5) Limestone was steeped and water temperature monitored over
24 hours
- 6) Water samples were collected for pH testing throughout

Results:

Average pH of Distilled Water: 7-7.5

500 C

- a) 30 minute steep = 7.65 pH
- b) 24 hour steep = 9.32 pH



600 C

- a) 30 minute steep = 7.9 pH
- b) 24 hour steep = 9.26 pH

Cedar Mesa Limestone Heated to 700 C

700 C

- a) 30 minute steep = 11.7 pH
- b) 24 hour steep = 12.55 pH



Cedar Mesa Limestone Heated to 800 C

800 C

- a) 30 minute steep = 12.89 pH
- b) 24 hour steep = 12.96 pH

Fire Temperatures

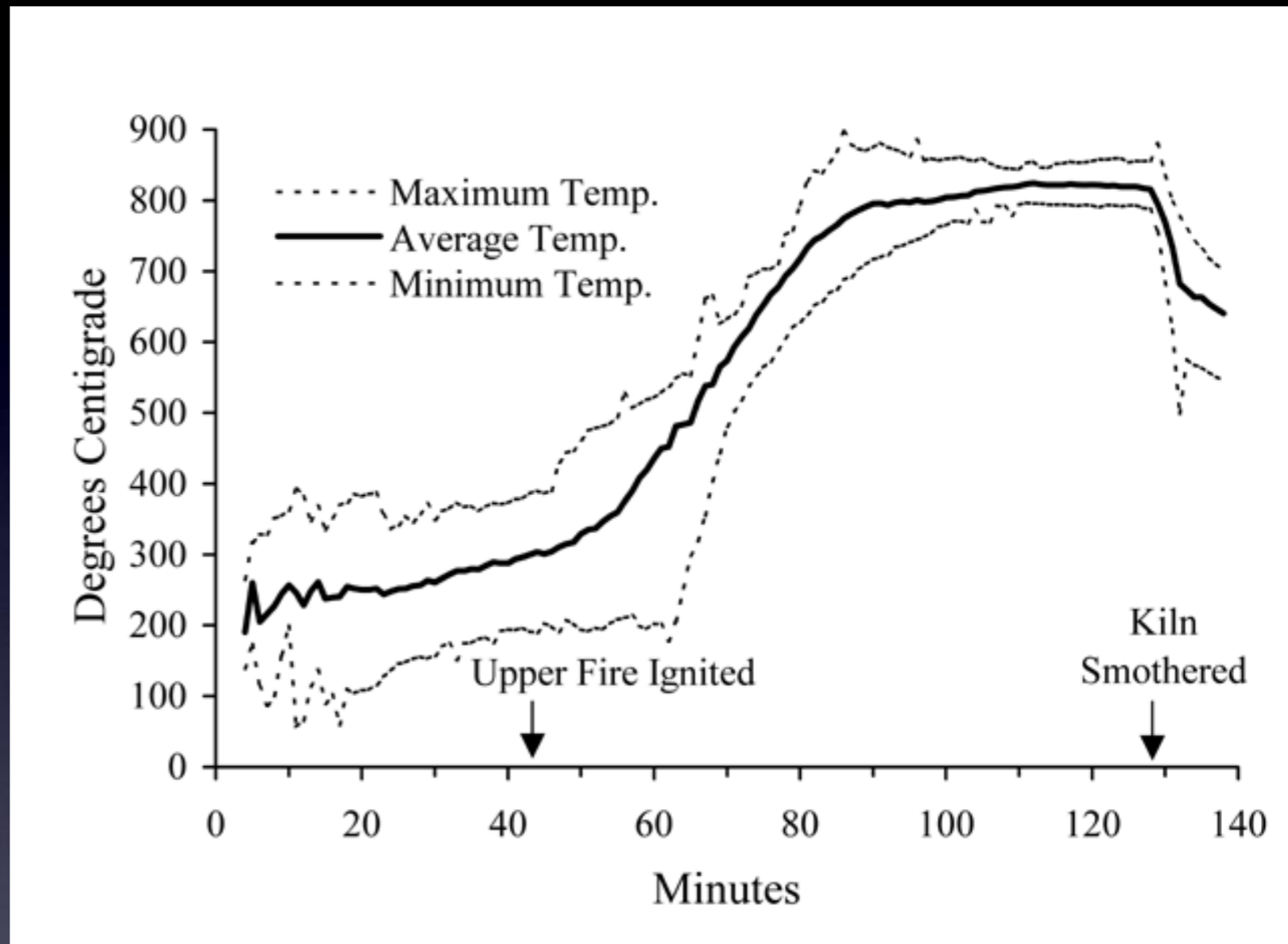
-Cedar Mesa
Woodlands:
Pinyon-Juniper

- Studies of Pueblo
period
kiln firings have found
that 800 C may be
reached:

1) 30-40 minute burns
(Ermigiotti 1997)

2) Approximately 80
minutes (Pierce

2004)



Mesa Verde Replicate Kiln
Temperatures:

Dry Juniper

(Pierce 2004)

<http://www.webdawn.com/epaper/01/01/view/18/30/>

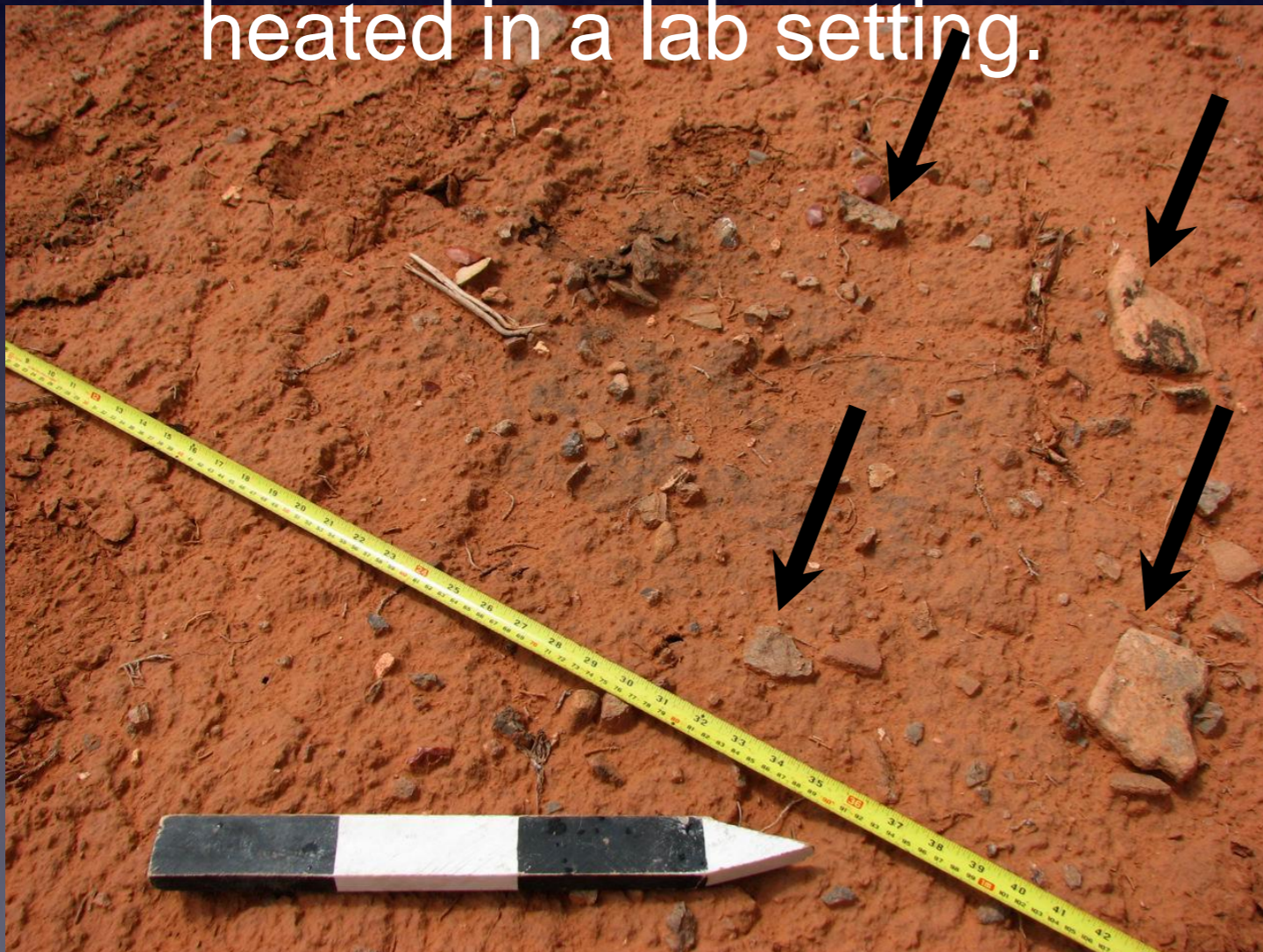
The Next Steps:

- Several traditional varieties of maize will be:
 - 1) Boiled with limestone
 - 2) Rinsed
 - 3) Steeped
 - 4) Dried and ground to flour

- These finished samples will be sent to Paul Scott at
Iowa State University's Department of Agronomy
for nutritional analysis to assess shifts in key essential amino acids:
 - 1) Tryptophan (- Niacin)
 - 2) Lysine

Limestone

- Archaeological limestone samples will be collected from Cedar Mesa Basketmaker II habitation sites for physical analysis and comparison with limestone heated in a lab setting.



Cedar Mesa BM II
Site:
Limestone Scatter
Detail

Conclusion:

- Cedar Mesa limestone was readily available as a source for hot stone cooking.
- Traditional kiln firing studies prove that temperatures needed to produce the chemical changes necessary for maize alkalization were also available to these groups.

Acknowledgements:

Bill Lipe

Tim Kohler

R.G. Matson

Karen Adams

Paul Scott

Melissa Goodman-Elgar

Jane Wallace Dillard

Native Seeds Search

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