# PERMIAN QUARTERLY

Permian Basin Programmatic Agreement Quarterly Newsletter

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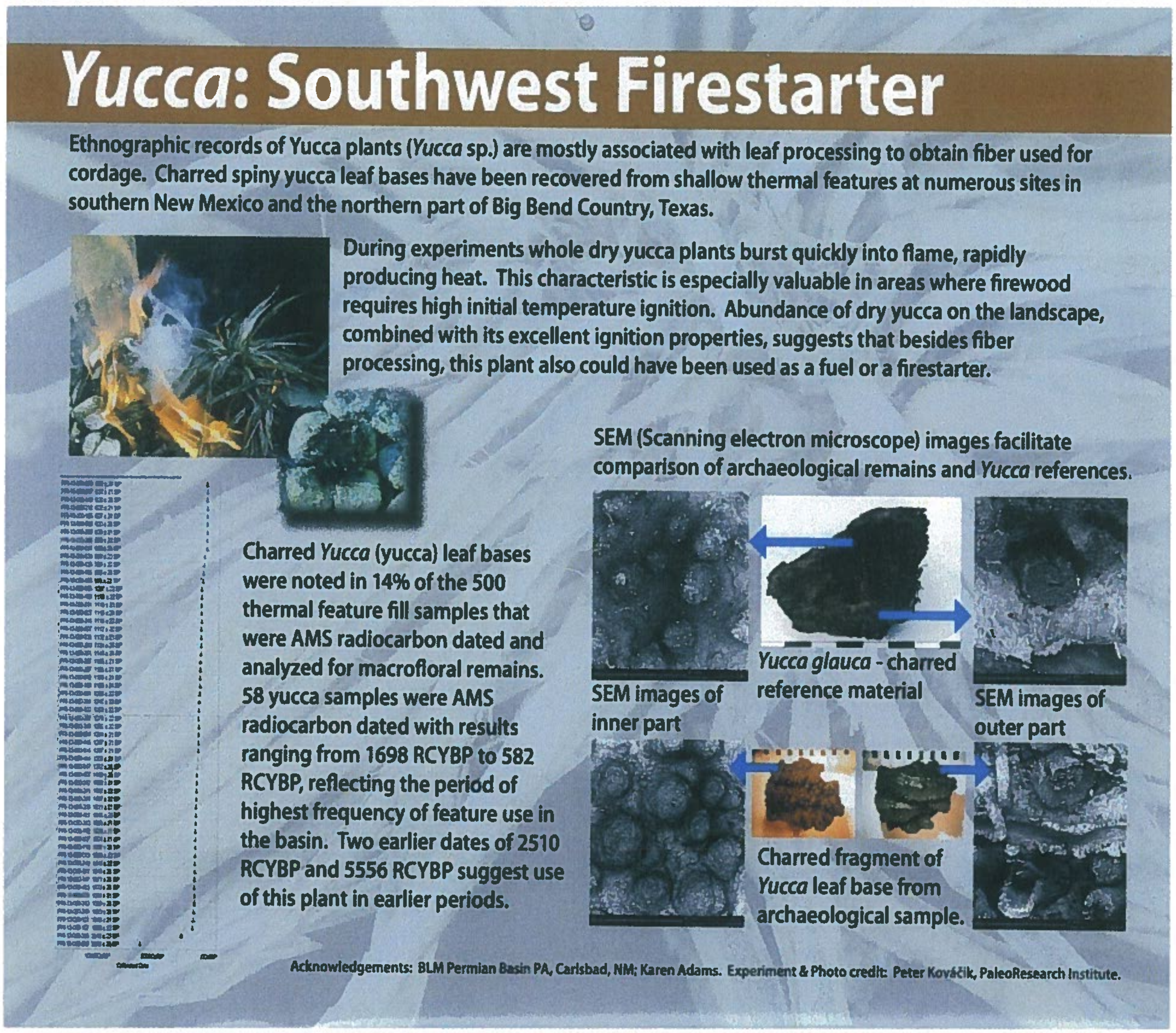
New Mexico




This page is found in the 2014 calendar published by the PaleoResearch Institute of Golden, Colorado. Information about prehistoric use of yucca partly came from a Permian Basin PA research project. Read more about the research project on the inside of this newsletter.

The *Permian Quarterly* is a newsletter for participants in the Permian Basin Programmatic Agreement (PA) and for other interested persons. Its purpose is to provide information in a timely manner about implementation of the PA and to disseminate that information to a wide audience.

## Introduction to the Permian Basin Programmatic Agreement

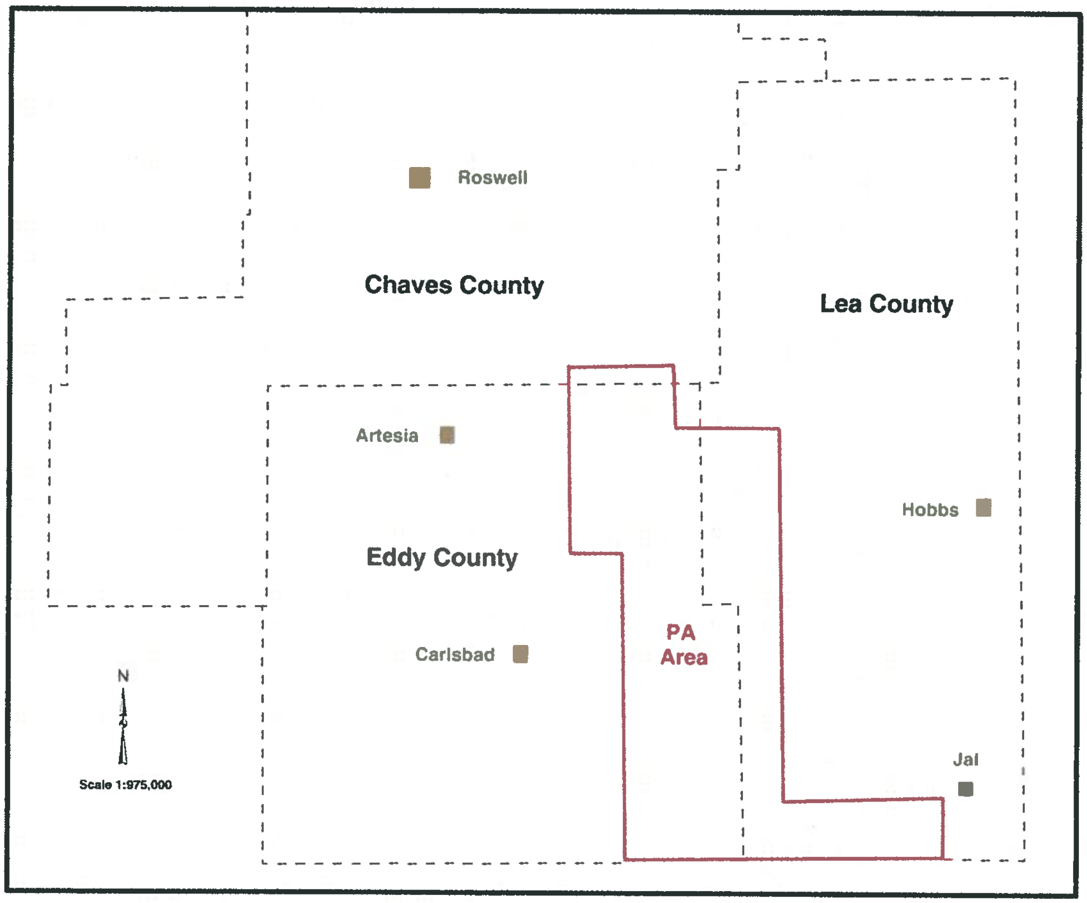



Figure 1. Map showing the Permian Basin PA Area.

The PA is an alternate form of compliance with Section 106 of the National Historic Preservation Act of 1966, as amended, that is offered to the oil and gas industry, potash mining companies, and local governments in southeastern New Mexico for federal projects located on Bureau of Land Management (BLM) land or private property. Formerly called the Permian Basin MOA, it was extended for a period of three years in April 2013 as a Programmatic Agreement. The PA area, noted above in red, is located partially in Chaves, Eddy, and Lea counties and generally coincides with a physiographic region in southeastern New Mexico called the Mescalero Plain. Proponents of projects within the PA area may contribute to a dedicated archeological research fund in lieu of contracting for project specific archeological surveys, provided their proposed projects avoid recorded archeological sites. This dedicated fund is then used to study the archeology and history of southeastern New Mexico.

## Current PA News

### Firms Selected for Research Contracts

Task Orders created through the BLM contracting system have provided the major thrust of research efforts undertaken through the PA; however, the contracting method used, called an Indefinite Delivery Indefinite Quantity (IDIQ) contract, has expired along with the original Memorandum of Agreement that produced the research funds. A new funding mechanism called a Blanket Purchase Agreement (BPA) has been recently approved to fund Permian Basin PA projects. Four firms, Statistical Research Incorporated, SWCA Environmental Consultants, TRC Environmental Corporation, and VersarGMI, have been approved by the BLM National Operations Center to submit bids under the BPA for proposed research projects. These firms have completed different kinds of archeological projects, such as site survey, site evaluation, and the synthesis of previous research in southeastern New Mexico and they are familiar with the archeology of the region.

### Research Update

A major project recently completed is an analysis of the content of soil samples taken from 500 features, primarily hearths, distributed across the PA area (See Figure 2). This project resulted in an inventory of sites dated by the radiocarbon method and the identification of charred plant remains present within the features, as well as the identification of plants represented by microscopic starch and phytoliths.

All but 14 of the radiocarbon samples were obtained within the Permian Basin PA area. The 14 outlying samples were collected primarily to determine the chronological occupation of selected sites, such as the Merchant Site, a 15th Century Formative period village, which figures prominently in the prehistory of the region. The research potential of this data set is multifaceted and it will provide the raw data for numerous research projects extending into the foreseeable future. For example, the previous issue of the *Permian Quarterly* (Vol. 1, No. 3) had an article by Carlsbad Field Office (CFO) archeologist Bruce Boeke that examined the distribution of dates from the features and compared them to a similar, but earlier study. Despite different methods used to order the dates, both studies indicate the majority of the sites recorded in the Permian Basin PA area are from the Formative period (*circa* A.D. 500 to A.D. 1450). Boeke's article also pointed out some limitations in the data. Although an effort was made to collect samples from all parts of the Permian Basin PA area, not all sites recorded had features with carbon present in the soil matrix and thus the localities sampled within the PA area are not evenly represented. The map in Figure 2 below shows some clusters of features and some blank areas, but this does not necessarily reflect the actual use of the land by prehistoric populations. The sampled features are a statistically skewed sample, but this is a common problem in archeological studies, where holes in the data are expected.

The results of the 500 sample analyses were presented in the form of a written report and files that can be used in the Carlsbad Field Office Geographical Information System (GIS). Using GIS enables information from each feature to be displayed with other GIS layers, for example, topography, soil types, or geology to enhance the interpretive potential of the data.

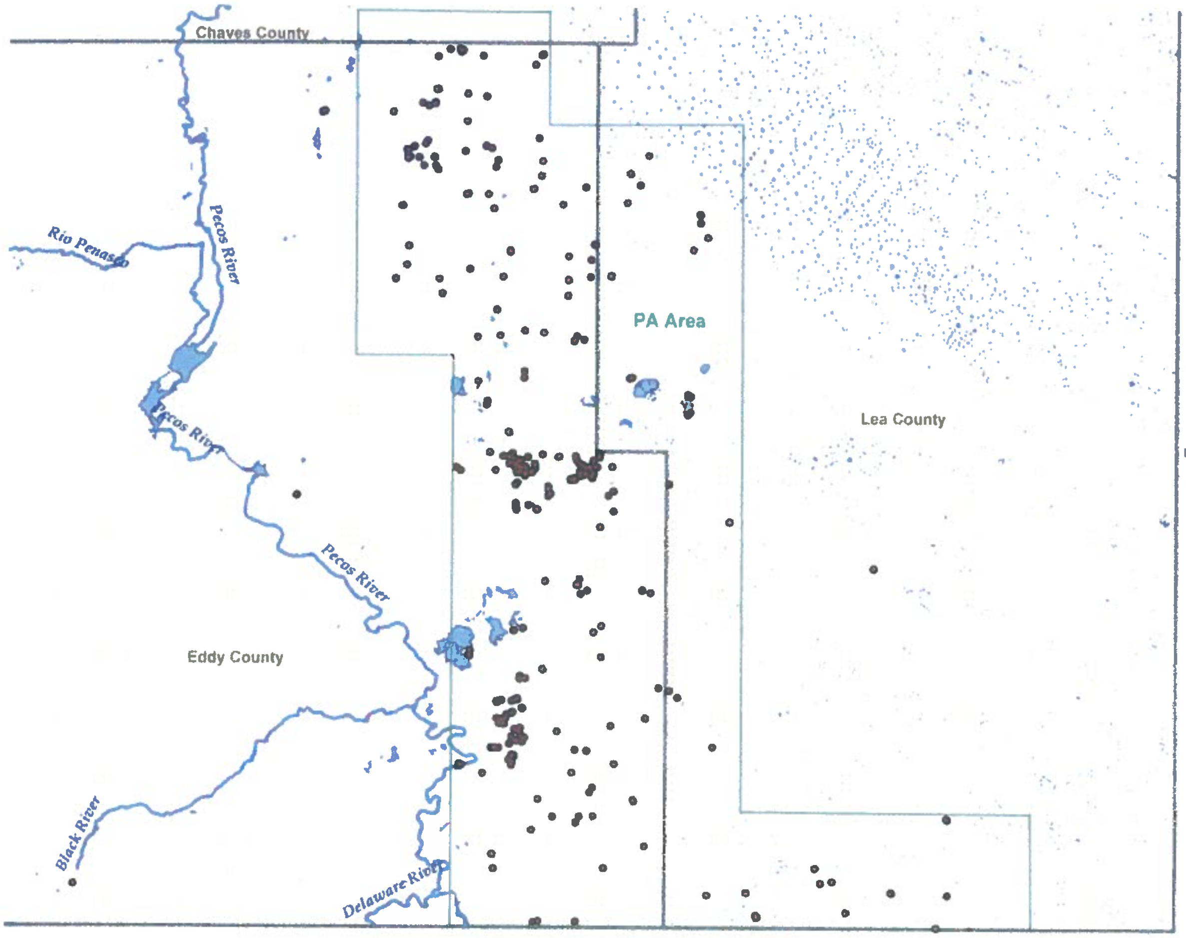



Figure 2. Map showing the distribution of features sampled as indicated by red dots. The PA Area is outlined in green. Blue figures indicate the locations of rivers, lakes, and playas. The presence of numerous playas on the Llano Estacado (upper right) defines the southern terminus of the High Plains in New Mexico.

The report entitled "Macrofloral, Phytolith, and Starch Analyses, and AMS Radiocarbon Dating for the Permian, Basin MOA, New Mexico," by Linda Scott Cummings and Peter Kováčik discusses multiple aspects of the results of the analysis including the use of different species of plants for food, fiber, tools, and medicine as documented in historic and ethnographic publications. The macrofloral (charred plant) and charred wood fragments recovered from the 500 features, as well as the starch and phytolith evidence, were also identified and discussed. A valuable experiment was conducted by dating different plants from the same sample and comparing the resulting dates to determine if one type of plant is preferable for radiocarbon dating. As an example, yucca leaf bases were relatively common in the samples and when dated the results produced younger dates than were obtained for the longer-lived mesquite charcoal. On the other hand yucca and four-winged salt bush samples produced comparable dates. Other plant species as different as cholla cactus and oak, are evaluated for their suitability for radiocarbon dating. The report also includes an archeoclimate model constructed from weather data for Artesia, New Mexico.

As much as the report includes it also occasionally notes absences, such as this quote: *It is interesting to note that very few of the features contained charred seeds in quantities often encountered with features that represent economic activity.* In other words, the features that were sampled represent primarily hearths, but they do not contain much evidence of cooking or parching seeds. This might be due to wind scouring and loss of at least part of the fill of many or most features. The method of gathering samples by relying on exposed charred material on the ground surface resulted in finding more hearths than other kinds of features that might contain evidence, such as stored containers, of the food upon which people relied. There is much to read about in the report, but for this newsletter two topics are further examined: the identification of a fabric sample from site LA 172564, that was mentioned in a previous newsletter, and the evidence for corn (*Zea mays*) in the Permian Basin PA area. The report is in a draft form at present, but it will be available in the future through the Digital Archaeological Record (www.tDAR.org). Readers interested in discovering more details about the project, and finding more fascinating insights into the use of plants, are encouraged to go to the tDAR website. Type in tDAR report number 391881 and download the report at no charge.

## A Note on Radiocarbon Dating and the Format of Dates

Archeological interpretation relies on answering the "5 Ws" of Journalism – who, what, where, when, and why, but unlike the journalist an archeologist cannot ask his or her subjects questions to elicit the answers. "When" is almost always a central question, but oftentimes "when" can only be determined in a general way by comparison, for example, a stone tool found in a stratified (layered) site beneath a tool of metal is presumed to be older. The stone tool is on a surface that was buried by soil accumulated naturally by geological processes before the later metal-tool-using people occupied the same geographical location. This is an example of relative dating and examples similar to this are still used and are useful in interpreting archeological data. In contrast absolute dating pinpoints the use of a site or artifact to a specific time. The most familiar type of absolute dating is provided by tree rings. Archeologists in some parts of the Southwest are fortunate to find preserved construction timbers from sites that can provide tree ring dates. A tree ring calendar has been constructed (and it is still being amended) that includes dates that encompass the occupation of many of the recorded sites found in the region. Matching tree rings from timbers found in a site to the tree ring calendar makes it possible to accurately determine when a site was occupied.

Tree ring dating is unique to a relatively small geographic area. In much of the United States, including southeastern New Mexico, archeologists rely on comparative dating or radiocarbon dating when charred material is available, such as in the 500 sample project. In simplified terms a radiocarbon date measures the decay of the radioisotope Carbon 14 ($^{14}$C) in an organic sample. $^{14}$C is an unstable isotope that decays at a relatively constant rate. During life, organisms such as plants, replenish their lost $^{14}$C. When the plant dies $^{14}$C is no longer added and the decay of $^{14}$C is measured to determine the time of death of the plant. The $^{14}$C date denotes the death of the organism being dated, not necessarily when humans utilized the material being dated. The radiocarbon date is a statistical statement of the probability that the organism being dated died within a specific time period and it is denoted as a sigma date with an error factor.

Dates in this newsletter are expressed using the familiar Gregorian calendar, an international standard for secular use that was developed in the Christian world. Conventionally this calendar uses "A.D." for those years after Christ was born and "B.C." for those years before Christ. (The year 1 B.C. was followed by the year 1 A.D.). Some people today prefer to use the more generic terms C.E. and B.C.E., meaning "Common Era" and "Before the Common Era" instead of A.D. and B.C., respectively. Radiocarbon dates are commonly expressed as "Radiocarbon Years Before Present" or RCYBP. The "Present" in this case is the Gregorian calendar year A.D. 1950, which was chosen as a reference point. Dates in the "Macrofloral, Phytolith, and Starch Analyses, and AMS Radiocarbon Dating for the Permian, Basin MOA, New Mexico," report are expressed as RCYBP, for example, "633 ∀ 25 RCYBP."

## Fabric Sample Proves to be Modern in Origin

The charred remains examined for this project included a small piece of woven fabric from site LA 172564. The tiny scrap was the cause of much speculation, but unfortunately it proved to be modern in origin (See Figure 3). Authors Linda Scott Cummings and Peter Kováčik discuss the sample in their report as follows:

> The fabric was radiocarbon dated to 453 ∀ 21RCYBP, suggesting a very late prehistoric or early historic fabric. However, the fibers in the fabric are very fine and, although burned, appear very regular. Visual identification of the fibers and fabric was not possible due to thorough charring. This combination of fineness (thinness) and smoothness is typical of modern, industrial fabrics. Although also noted in *Linum* fibers, these characteristics are not as typical for plant fibers or animal hair. Often plant fibers exhibit some kind of cracking or irregularity, but due to the burning it was not possible to observe any details for the fibers. In addition, the weave of the S-twist fibers was also very fine. Therefore, *Prosopis* charcoal also was selected to provide a second date for this feature. The date returned on the *Prosopis* charcoal is 69 ∀ 21 RCYBP, suggesting a late Nineteenth or early Twentieth Century use of the feature. If the fibers were synthetic they would be expected to produce an anomalous date. Scanning electron microscopy provides images of the fibers and additional information. The twisted fibers measure approximately 500 microns or 0.5 mm in width (Figure 34 C and D). They are composed of hundreds of individual fibers measuring less than 5 microns each in width. SEM photographs indicate that each of the fibers is very regular, indicating that they are synthetic. Although we do not have an elemental probe on our SEM, it is likely that it would register the presence of carbon since the fibers are so burned.

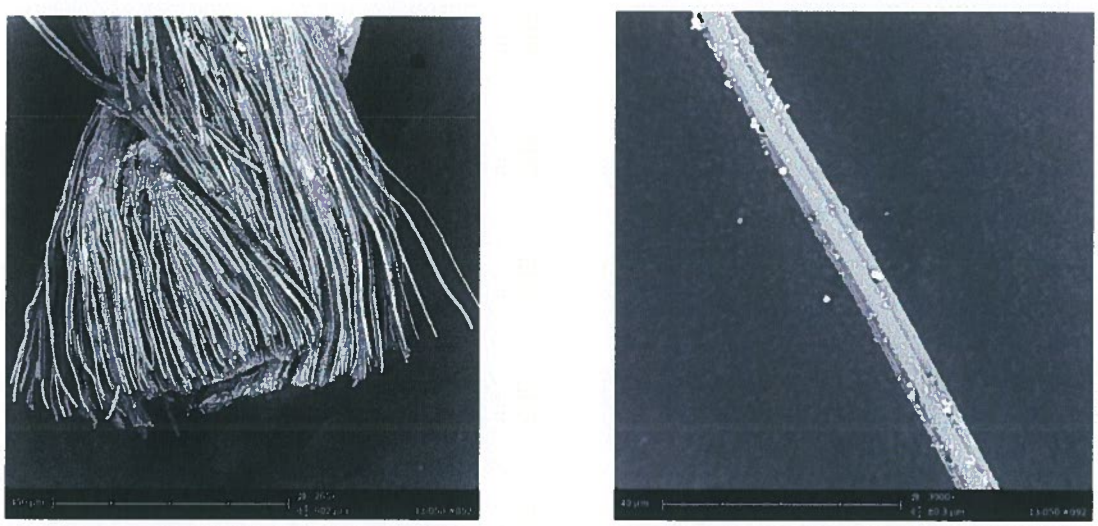


Figure 3. SEM micrographs of the serrated/cut end (left) and an individual fiber (right). Adapted from Scott Cummings and Kováčik 2012: Figure 34.

## The Search for Corn (*Zea mays*) in Southeastern New Mexico

In modern-day America corn is a common and staple food item. It is also a gift from the past, as corn is perhaps the most completely domesticated of all field crops. Its perpetuation for centuries has depended wholly on the care of man and it could not have existed as a wild plant in its present form (Gibson and Benson 2002). First domesticated in central Mexico corn was grown prehistorically in North and South

America, arriving in southern New Mexico at approximately 2000 B.C., although it was not until approximately1,500 years later that corn was fully integrated into an agricultural system. The importance of corn and other domesticated plants to ancient people is evident by the remains of reservoir and canal systems seen on the landscape in arid locales such as Mesa Verde, Colorado and the Salt River valley in Arizona, as well as other parts of the Southwest. Corn became the principal crop and reliance on corn and other domesticated plants is cited as a main impetus in the creation of more permanent villages and sedentary societies. Given this background it is not surprising that many of the research questions posed in the *Southeastern New Mexico Regional Research Design and Cultural Resource Management Strategy*, the guiding document for the Permian Basin PA, relate to corn and agriculture. Specifically these questions are:

- When were cultigens introduced into southeastern New Mexico?
- Was agriculture adopted by some segments of the local population or did Anasazi and/or Jornada farmers expand into the region?
- Was there a single cultural adaptation based partly on agriculture and partly on the exploitation of wild plant and animal resources, or was the region concurrently occupied by populations of farmers and hunter-gatherers?
- Did agricultural groups eventually withdraw from southeastern New Mexico, or did they abandon farming and revert to a hunting and gathering adaptation focused on bison hunting?
- If so, was the transition fostered by the development of Pueblo-Plains trade centered on the exchange of bison meat for cultigens?

Although the geographical region of southeastern New Mexico is larger and encompasses the Permian Basin PA area, it was hoped that the results of the analysis of plant remains in the 500 samples could shed some light on one or more of these questions. The laboratory search for evidence of corn included an examination of the samples for charred remains of the plants, an examination of phytoliths, small silica structures in plant cells that remain in the soil after the plants decay, and starch grains, which are identified according to their shapes, and Fourier Transform Infrared Spectroscopy (FTIR). FTIR measures the frequencies of an infrared beam that are absorbed in a sample (and the strength of the absorptions) producing an inferogram. A computer reads the inferogram and uses the Fourier transformation to decode the intensity information for each frequency and then presents a spectrum that can be interpreted to identify the material being analyzed (Boggus, et.al.2010: Appendix D). Below are sections from the Scott Cummings and Kováčik report that pertain to finding evidence of corn.

> *Zea mays* (maize, corn) has been an important New World cultigen, originating from a wild grass called teosinte. Maize has long been a staple of the Southwest inhabitants, and charred maize is found in almost every cliffhouse in the Southwest (Stevenson 1915:73). Various colors of maize were grown, including white, yellow, blue, red, black, and a combination of these. Innumerable ways of preparing maize exist. Green corn was widely used, and ears were collected from the regular fields. Mature ears were eaten roasted or wrapped in corn husks and boiled. The kernels could be parched, soaked in water with juniper ash, and boiled to make hominy. Dried kernels could be ground into meal, which was used as a staple. Cornmeal was colored with *Atriplex* ashes. Black corn was used as a dye for basketry and textiles and as body paint. Maize could be husked immediately upon harvesting, and the clean husks were saved for smoking and other uses, such as wrapping food. Ears also were allowed to dry on the roof, and ristras of maize could be hung inside from the roof. Whole ears and/or shelled kernels were stored for future use. Corn pollen was widely used in various rituals and ceremonies (Cushing 1920:264-267; Robbins, et al. 1916:83-93; Stevenson 1915:73-76; Vestal 1952:18-19; Whiting 1939:67-70).

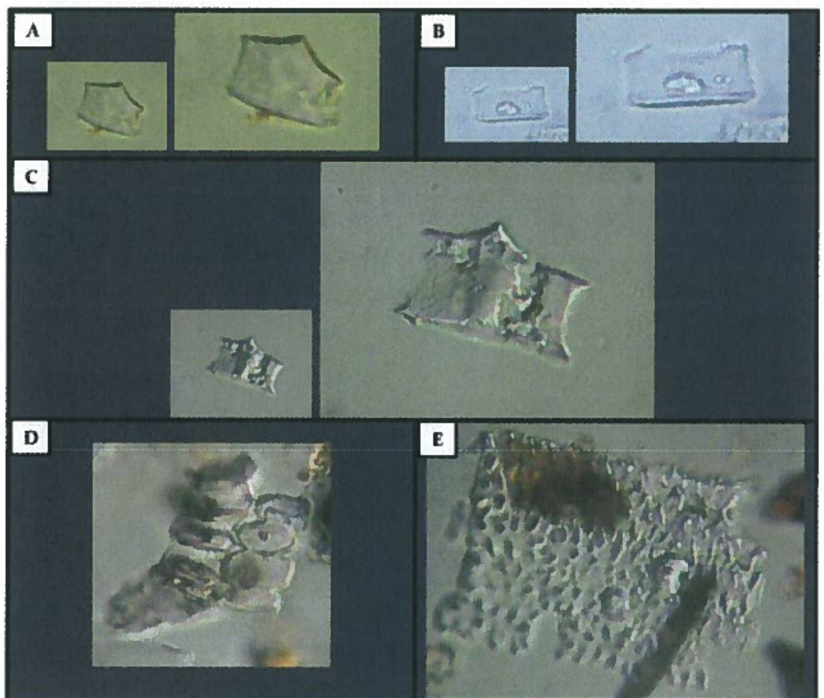
Chapalote popcorn or pinole-popcorn is an ancient type of maize thought to have arrived in the American Southwest more than 4,100 years ago (Nabhan 2008:84). The variety has been deemed among the first land races of maize in Mexico. Producing small ears and tan to coffee-colored kernels, this maize usually has twelve to fourteen rows of kernels some of which are flinty, while others more resemble popcorn. Toasted kernels may be ground into a sweet meal and used to make a variety of foods such as polenta, cornbread, pinole, atole, and tortillas. Writing about chapalote, Nabhan (2012:71) remarked that "Three corn experts associated with Harvard and the Rockefeller Foundation singled it out for further study:
"Chapalote is one of the most distinctive races of maize in Mexico. It is primitive in being not only a popcorn but also a week pod corn. One of the most distinctive characteristics of chapalote is its brown pericarp [kernel] color." (Citation not attributed to Nabhan).
Chapalote has been found to "perform well even during relatively dry years, because it was early maturing, and needed little supplemental irrigation is planted with the first monsoon storms of the summer season" (Nabhan 2012:71). Some of the Chapalote that has been grown now exhibits kernels partially wrapped in paper-like glumes similar to the famous tunicate pod corn that was sacred to tribes in northwest Mexico and the American Southwest. The great Mexican ethnobotanist, Efrain Hernandez-Xolocotzli, believed that Chapalote exhibited traits that indicated cross-pollination with teosinte and he classified this type of maize as a bridge between the wild ancestors of corn and the more recent popcorn's and flint corns, speculating on possible trade routes through western Mexico (Nabhan 2012:71).

Reventador, known locally as "*maiz reventador*, which means, quite literally, "exploder corn" or popcorn, is "small-grained, small-cobbed, flinty and undented" (Anderson 1944:301) with white kernels. It is noted to have been grown in western Mexico in the Colonial period. Similar maize was recovered from archaeological sites including Paso Real and Culiacan, Sinaloa, excavated by Dr. Isabel Kelly. *Maiz chapolote* is reported to look similar to *maiz reventador* except that those ears look even more primitive and exhibit a dark tan pericarp. *Maiz reventador* has a longer growing season than *maiz chapolote*. Anderson further remarks that *maiz reventador* is similar to a maize grown by the Pima and Papago Indians in plant color and in "having narrow cobs, tesselated seeds, well-developed tillers, and prominent husk striations" (1944:307).

In addition to having kernels a similar dark brown to those of teosinte, *chapolote* exhibits "large knobs on every chromosome except No. 10. It would seem as if these western Mexican varieties represent a maximum introgression of teosinte. If so, this must have occurred at some time in the past. While teosinte is not unknown in western Mexico it is now a rarity in the fields where we have studied *maiz reventador*" (Anderson 1944:307). The topic of crosses with *maize reventador* is explored, noting that within the resulting X1 population some of the maize will more closely resemble *maiz reventador*, while others are less similar – a fact that he observed in maize fields in western Mexico (Anderson 1944:307). This same phenomenon is visible within the morphometric data for modern Hopi cobs suggesting that they are the result of crossing. Thus far we have not identified the probable races of maize for this cross.
Evidence for growth of *maiz reventador* farther northward is noted in a "manuscript copy of the 1776 Relación of (San Miguel de) Sahuaripa" where it is located on a map of Sonora. That entry indicates *maiz "rebentador"* has small white grains and that it was used to make a form of *pinole* that was commonly eaten in the area. Generally Reventador was used for popcorn and for *pinole*, although it was not the only maize used to make *pinole.*

Wavy-top phytoliths and other phytoliths interpreted to represent *Zea mays* cobs were observed in ten samples that ranged in age from 2901 RCYBP to 435 RCYBP (Figure 60). In order from earliest to latest the dates in radiocarbon years are: 2901, 2425, 1549, 1340, 1332, 1274, 1185, 1170, 546, and 453. In addition, charred *Zea mays* cupules and kernels also were noted in Sample CN:405, along with a *Zea mays* rondel phytolith group *in-situ* (i.e. in their anatomical position within the plant). A date of 546 ∀ 22 RCYBP was obtained on the maize cupule.

This limited evidence for *Zea mays* as part of the subsistence system for people occupying or passing through this portion of the Permian Basin suggests transport of maize as a packed food rather than indicating local agriculture within the basin. Recovery of phytoliths representing cells typical of the more primitive popcorns were observed in two samples (CN:211 and CN:376) ranging in date from 2081 ∀ 21 RCYBP to 633 ∀ 25 RCYBP, suggesting availability of popcorn-type maize over a long time interval. Popcorn types considered to be primitive on the landscape include Chapalote and Reventador, which are reviewed in the Ethnobotanic Review, above.




(micrographs taken at 600x magnification, unless otherwise noted)

FIGURE 60. MICROGRAPH COMPILATION OF *ZEA MAYS* PHYTOLITHS RECOVERED FROM NEW MEXICO.

A) *Zea mays* wavy top rondel phytolith (side view) - Sample 520 (left image to scale, same image to right enlarged to show detail).

B) *Zea mays* wavy top-type rondel phytolith (side view) - Sample 138 (left image to scale, same image to right enlarged to show detail).

C) *Zea mays* wavy top rondel phytolith (side view) - Sample 111 (left image to scale, same image to right enlarged to show detail). Note the surface dissolution ("pitting") on this phytolith due to taphonomic modification.

D) *Zea mays* rondel phytolith group *in-situ* - Sample 405. These morphotypes are produced in maize cobs.

E) Silicified, thick glume epidermal sheet with bumpy surface ornamentation and rondels in-situ - Sample 211. This heavy silicification of glume material has been observed in teosinte (a likely maize progenitor), specifically in *Zea perennis* reference material at PaleoResearch and reflects the retention of primitive traits.

Figure 4. Scott Cummings and Kováčik 2013: Figure 60 reproduced.

(Editor's Note: The references cited in the excerpt of the Scott Cummings and Kováčik report above are not provided here. Readers interested in the full citations should consult the report.)

A review of other excavation reports was undertaken in order to find additional evidence of corn within the CFO boundaries and more specifically within the Permian Basin PA area. The use of a flotation technique to recover plant remains during excavation has been practiced for more than 30 years in the CFO. Flotation involves putting soil samples containing charred material into agitated water, which then separates the lighter charred pieces from the heavier dirt matrix. After drying the charred remains can be identified. Identifying plants through the examination of pollen, phytoliths, starch, and FTIR are more recent developments.

In total 119 sites have been investigated using one or more of the methods outlined above to identify evidence for plants. From these sites, a total of 682 samples were examined for macrofloral remains, 251 for pollen, starch was identified in 217 samples, and phytoliths in 117. Forty artifacts were examined using FTIR. Corn was identified in 21 of the sites by finding charred cupules in 2 instances, corn pollen in 3 samples, phytoliths in 2, and starch in 13 samples. Signatures for corn were found in 7 artifacts using FTIR. Two additional sites were noted to have charred corn cobs; LA 2000, which was excavated partially in the 1930s and again in 1953, and LA 32228, which was dug into by members of the Lovington Junior Archeological Society in the early 1960s. This review identified a total of 23 sites with evidence for the presence of corn in addition to the 10 found in the 500 samples analysis, for a grand total of 33 sites. Ten of these sites are located outside the PA boundaries, leaving 23 within (See Figure 5).

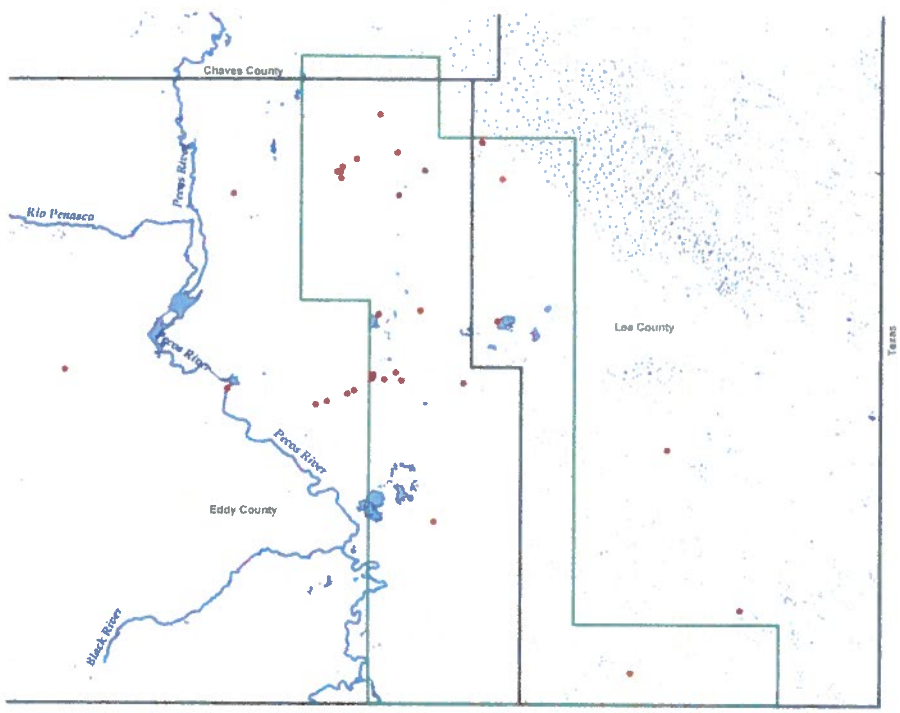



Figure 5. Map showing sites with evidence for corn (*Zea mays*) within the CFO boundaries (site LA 2000 not shown). Permian Basin PA boundary drawn in green. Streams and playas are shown in blue.

It is interesting to note the observation made by archeologist H.P. Mera during his 1930 field work in the Dark Canyon drainage west of Carlsbad. Though he visited 10 cave and rockshelter sites where perishable artifacts, such as fiber sandals and woven baskets, were preserved he said, "Perhaps the most surprising of all was the entire absence of corn in every one of the numerous caves investigated." (Mera 1938:48). The scant remains of corn in CFO archeological sites continue to surprise us today, but the reasons for the lack of corn in these sites remain to be discovered.

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## Reports Added to the Digital Archaeological Record

Two Permian Basin PA reports were recently added to the Digital Archaeological Record (www.tDAR.org). "The Geologic and Archaeological Contexts for Lithic Resource Acquisition in Southeastern New Mexico," edited by Scott H. Kremkau, Kate E. Zeigler, and Bradley J. Vierra (tDAR Reference Number 391880) and *Rocks and Ancient People in Southeastern New Mexico*, by Bradley J. Vierra, Kate E. Zeigler, and John V. Cafiero (tDAR Reference Number 391882). Another report entitled "Dunes and Deflation: Excavations at LA 124525 and LA 161918 at the Intrepid Potash East Mine, Eddy County, New Mexico," by Douglas H. M. Boggess and Andrew Zink (tDAR Reference Number 391880) was also added. These reports are available for downloading at no charge from the Digital Archaeological Record.

## Other Archeology News from the Permian Basin

Archeologists from Marron and Associates investigated prehistoric archeological site LA 71607 in advance of construction of the proposed Double Eagle waterline for the City of Carlsbad. The work, required by the New Mexico State Historic Preservation Officer, consisted of a surface survey, hand dug tests, auger tests, and 20 backhoe trenches spaced at 15 meter intervals within the site. Analysis of the excavations is underway and the results will be reported in a future issue of this newsletter.

### Newsletter Contact Information

Questions or comments about this newsletter or the Permian Basin PA may be directed to Martin Stein, Permian Basin PA Coordinator, BLM Carlsbad Field Office, 620 East Greene Street, Carlsbad, New Mexico 88220. Phone: (575) 234-5967; E-mail address: cstein@blm.gov.