PERMIAN QUARTERLY

Permian Basin Programmatic Agreement Quarterly Newsletter

Volume 4, Number 3, September 2016 - Bureau of Land Management, Carlsbad Field Office
New Mexico

Coppice dunes are common in the vicinity of Bear Grass Draw. These "islands" of sandy soil are anchored by vegetation such as the mesquite pictured here. Extreme erosion has replaced the former grassland with this partially denuded landscape. A significant study has been recently completed that describes the formation of the current landscape of the Mescalero Plain and evaluates its present-day potential for archeological research. Find out more inside this newsletter.

Introduction to the Permian Basin Programmatic Agreement (PA)

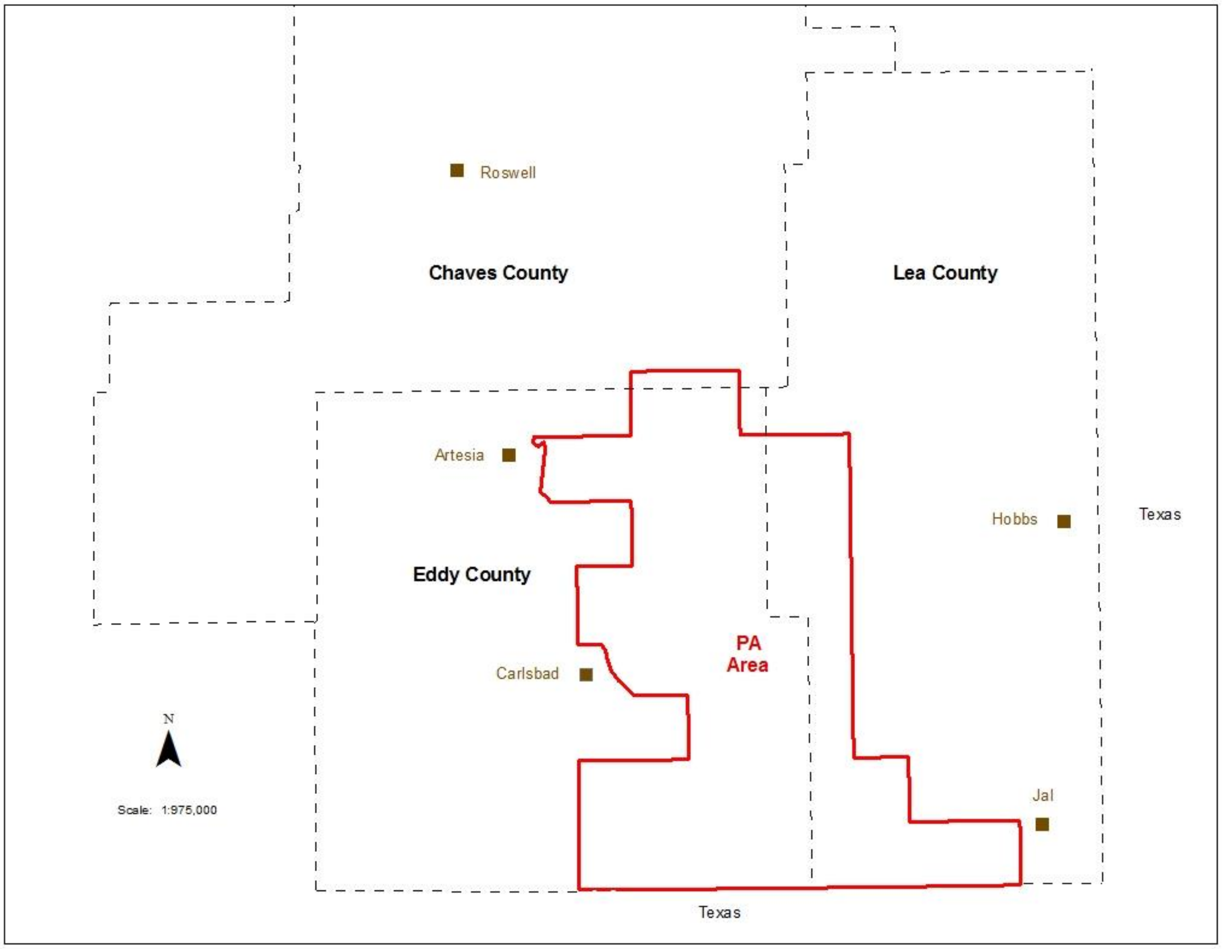

Figure 1. Map showing the Permian Basin PA Area.

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 for other industrial projects located in southeastern New Mexico. The PA can be used for federal projects located on Bureau of Land Management (BLM) land or BLM sponsored projects located on private property. Originally begun as a Memorandum of Agreement (MOA), it was extended for a period of three years in April 2013 as a Programmatic Agreement (PA) and the PA was further extended for a period of 10 years beginning in May 2016. The PA area is located partially in Chaves, Eddy, and Lea counties. 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

Mescalero Plain Geomorphology Report is Completed

The ideal context for discovering archeological remains is to find them just as ancient people left them. The Mug House cliff dwelling in Mesa Verde National Park, Colorado was named because:

> *Of all these houses the one most remarkable for what we found in it was the Mug House, so named because of four or five mugs found tied together with strings through their handles. It appeared as though the people had been frightened away with no opportunity to carry anything with them. All seemed to have been left just where it had been used last. No house in Mesa Verde yielded so much in proportion to size.* (Rohn 1971:1)

Excellent preservation of artifacts and their contexts at the Mug House site was due in part to its general location in the arid Four Corners area of the Southwest, coupled with its specific location within a large cavity in a sandstone canyon wall that sheltered it from the elements.

Sites located within the Mescalero Plain in southeastern New Mexico provide a dramatic contrast to the situation at Mug House. Sandy soils in the Mescalero Plain, an area of approximately 4,100 square miles (10,619 square kilometers), occur on low broad ridges, with intervening valleys and basins, and are exposed to the elements. In particular strong winds produce deflation basins, more commonly called "blowouts," or they shape the sand into elongated crescent-shaped parabolic dunes.

Figure 2 . Blowouts at site LA 76490.

The climate here is also arid, the average rainfall in the Mescalero Plain and at Mesa Verde National Park is the same, but the lack of protection in the open sites, coupled with the abrasive action of the shifting sand, leads to the deterioration and decay of all except the most durable stone and ceramic artifacts. Site locations are commonly marked by the presence of burned caliche nodules from former hearths or baking pits, stone flakes, and occasional stone tool or pottery fragments exposed in the bottoms of blowouts.

Blowouts may be shallow (knee-high or lower) or deep (well above a person's head) depending upon the depth of the sand at a particular location. Walking in a transect that is a more or less straight line, as is commonly done in an archeological survey, requires a person to do much climbing and descending of blowouts, as well as weaving between dune tops covered with thorny plants, such as mesquite. Slogging through the sand one can't help from wondering about this landscape. Was it always this way, a surface pockmarked by blowouts? Potsherds and different styles of projectile points indicate some sites were created by people living here more than a thousand years ago. Did they live within these blowouts and look out upon craters? More important to the archeologist is the question of a site's physical integrity. Are there any sites within the Mescalero Plain that have not been disturbed by erosion? The Mescalero Plain is a major focus of research supported by the PA.

Answers to these questions are partially provided by a recent report entitled, *Quaternary and Archaeological Geology of Southeastern New Mexico*, by Stephen Hall and Ronald Goble. Prepared as Volume II of the *Permian Basin Research Design 2016-2026*, the report summarizes all of the recent geomorphological work in this region and it provides some fascinating insights into the current landscape.

The report's analysis and conclusions rely to a large extent on dating soil samples taken from different locations and depths below the ground surface using the optically stimulated luminescence (OSL) technique developed in 1985. The report describes OSL dating in this way:

> *In our studies in this region, OSL analyses were carried out by Dr. Goble at the University of Nebraska. The dated material in nearly all cases was quartz sand grains in the 0.090 to 0.150 mm size range, or very fine to fine sand. The optical signal in the sand grains is a product of the surrounding natural radiation that is derived from radioactive components of minerals in a sedimentary deposit. Most of the radiation is produced by potassium oxide ($^{40}K_2O$), uranium (U), and thorium (Th). Radioactive decay of these components produces high-energy particles that dislodge electrons within the quartz (or feldspar) mineral grains. The dislodged electrons are trapped in defects in the crystal structure of the grains. With the passage of time, more electrons are dislodged and trapped.*
>
> *In nature, the luminescence signal is zeroed out and lost by a few seconds exposure to light. Eolian sand is well suited for OSL dating because the quartz sand grains are exposed to sunlight and the luminescence signal is reset before being deposited and buried. In other words, the luminescence signal gives us the time of burial of the sand grains in a deposit.*
>
> *In the laboratory, under amber-light conditions, the OSL sample is subjected to light of a specific wavelength (typically blue-green or green). The trapped electrons are energized by the light, causing them to be evicted from their traps and give off energy in the form of short wavelength light as they fall into a lower energy state. The intensity of the light signal given off by a prepared sample is measured. The intensity corresponds to the number of trapped electrons; the greater the luminescence, the greater radiation exposure a sample has had and the older the sample* (Hall and Goble 2016:5).

Aside from dating, the authors examined different aspects of these sedimentary deposits using field and laboratory procedures common to geomorphological studies. They defined the stratigraphy present in the sand deposits, the sedimentation rates of the different deposits, particle sizes and bioturbation (disturbances to deposits caused by plants and animals), and the chemistry of the sand deposits. Coupled with this are observations on what these studies mean for future archeological research and for describing past environments in southeastern New Mexico.

The authors defined six episodes of eolian (wind caused) activity and sand deposition within the Mescalero Plain beginning approximately 90,000 years ago. There are two stratigraphic units within the Pleistocene epoch (2.6 million to 11,700 years ago) and four within the succeeding Holocene epoch that extends to the present day. Five of these deposits are sand sheets of varying thickness, but the sixth is a relatively modern episode of erosion producing parabolic and coppice dunes. These episodes are shown graphically in Figure 3 below that is copied from Hall and Goble 2016:Figure 15.1.

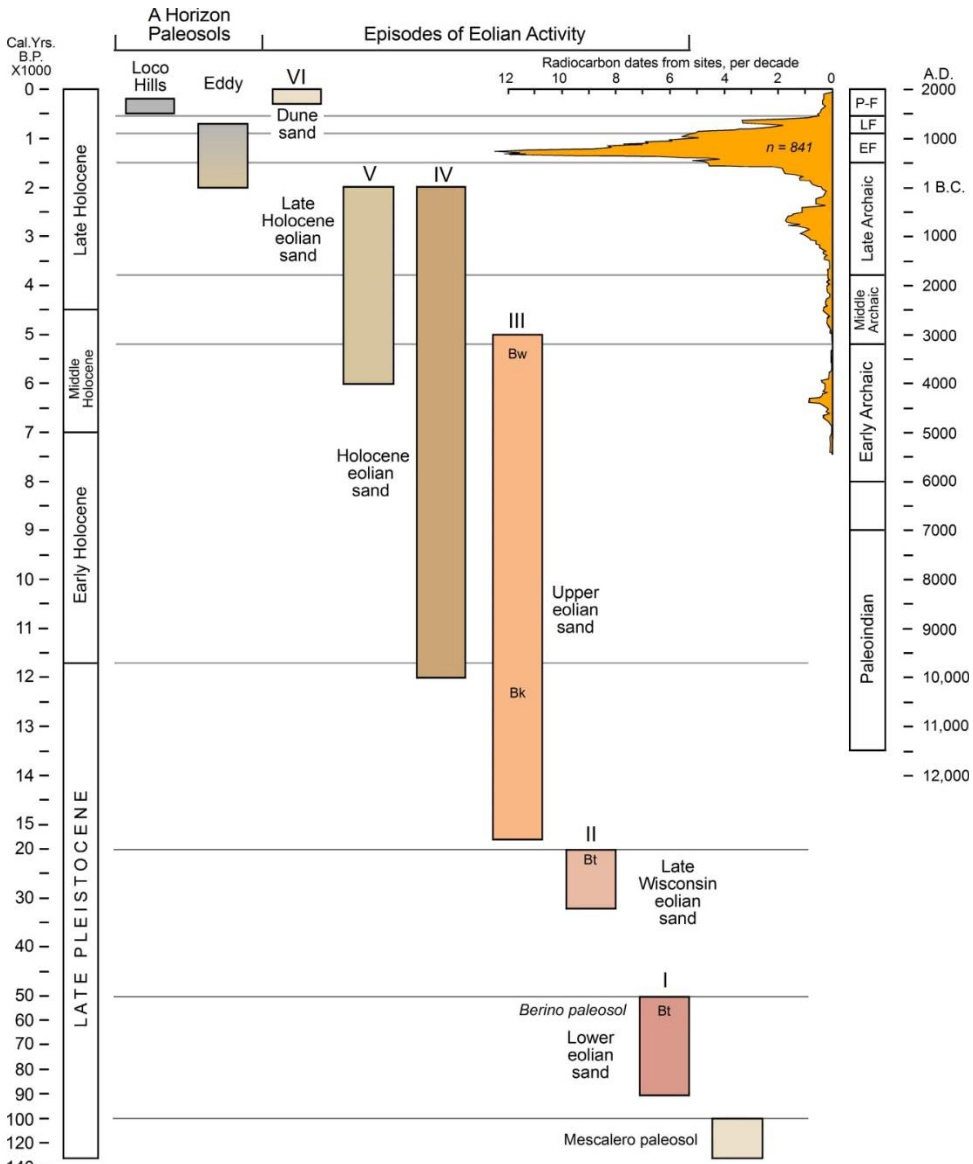

Figure 3. Summary of eolian stratigraphy, paleosols, and age-frequency of radiocarbon dates from archaeological sites, Mescalero Plain. Shown here, the chronology of the eolian sand units, including the dune sand, is based on OSL dating; the chronology of the Eddy paleosol is provided by OSL dating; the age of the Loco Hills paleosol is based on OSL and AMS radiocarbon dating. The archeological periods and the age frequency of 841 radiocarbon dates from archaeological sites in the Mescalero Plain are from Railey (Volume I); P-F, Post-Formative; LF, Late Formative; EF, Early Formative.

The chemical signature of the Mescalero Plain sands indicate they came from multiple sources through time, although, it is postulated that the original source was sand eroded from the Ogallala formation located east of the Mescalero Plain. During the cool and wet climate of the Late Wisconsin glacial stage numerous springs created streams flowing across the Mescalero Plain introducing new sand from erosion of the Ogallala escarpment. These stream beds, ephemeral in dry periods, were major contributors of sand. Reworking and re-deposition of the original sands in later time periods created still other stratigraphic units.

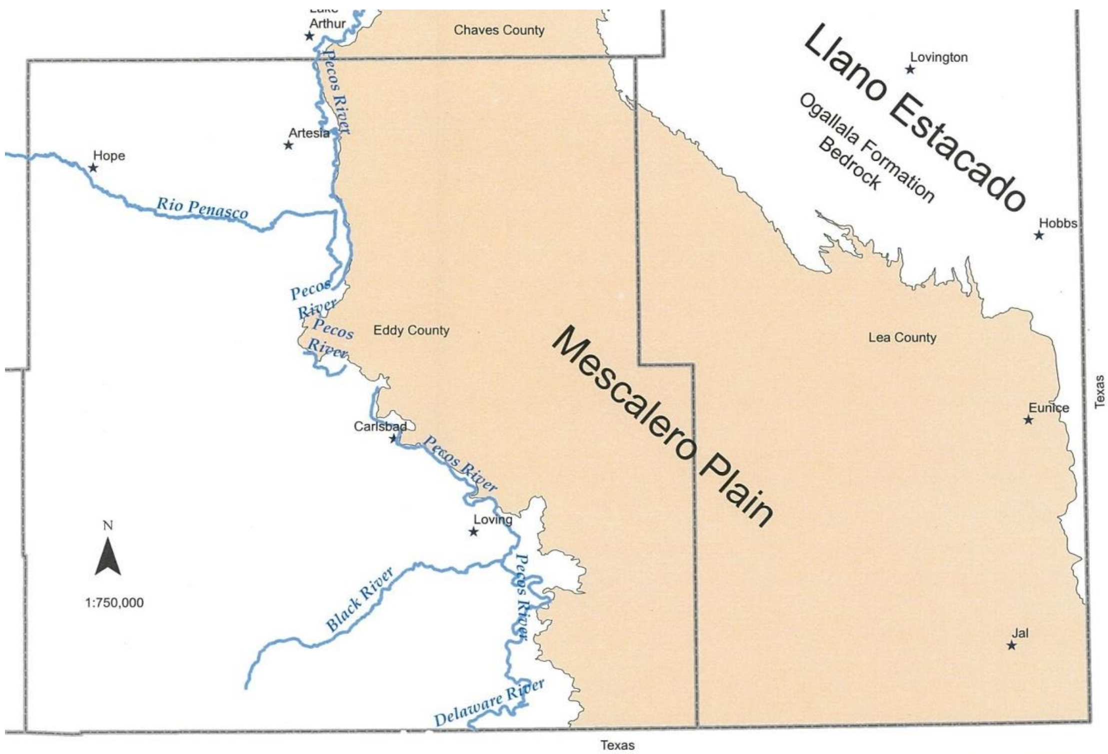

Figure 4. Map showing the relationship of the Mescalero Plain to the Ogallala Formation bedrock source of sand.

These deposits contain four named paleosols, from oldest to youngest they are the Mescalero, Berino, Eddy and Loco Hills paleosols. Paleosols are relict soils, former ground surfaces that are no longer in the process of formation. They are fossils of the past and like fossil bones they can through study provide additional information about their development. Foremost they mark periods of relative stability in the geological record and for the Mescalero Plain they mark periods of more available moisture. As the graph in Figure 3 shows, the Eddy and Loco Hills paleosols were formed during the prehistoric Late Archaic and Formative occupations of the Mescalero Plain. Most of the prehistoric sites in the Mescalero Plain occur in the Eddy paleosol, although it continued to develop into the Historic period. The Eddy Paleosol is dated from A.D. 1 to A.D. 1700.

With sufficient rain grass forms a ground cover that traps sand and dust particles. As long as the vegetation growth continues there will be a gradual accumulation of trapped sand creating a cumulic soil horizon that can envelope archeological features and artifacts. The average rate of sedimentation for the Eddy paleosol is 0.411 mm per year (0.16 inches) and at that slow rate of accumulation it would only be 4 cm (1.57 inches) deep after a 100 year time span. Thus a site and its features would be exposed to natural or man-made disturbance, as well as water and wind erosion prior to its complete burial, with consequently poor preservation of features and artifacts.

Other disturbance to the natural bedding of a deposit (or to a site) can occur, particularly by rodents burrowing into the soil for their homes and by other predatory animals that dig into the ground in search of the smaller burrowing ones. For one example, badgers dig home burrows as deep as three meters (over nine feet), with 10 meter (almost 33 feet) long connecting tunnels. These kinds of disturbances are minimal on the Mescalero Plain, but cicada nymph burrows are extensive.

Figure 5. Dr. Steve Hall examines cicada nymph burrows at an exposure.

The report describes these burrows as follows (Hall and Goble 2016:45):

> *Cicada nymphs live and burrow underground, feeding on juices from rootlets, for periods of 13 or 17 years after which they emerge for four to six weeks as adults. Their burrows are cylindrical and about 10 to 20 mm in diameter. As they dig forward, they push the sediment back into the passage, resulting in crescent-ridged burrow fills.*
>
> *We suspect that eolian sands of all ages on the Mescalero Plain have been infested with cicada nymphs at one time or another. We occasionally see cicada burrow fills where they have a slightly different color from the surrounding sediment, especially at unit boundaries. Also, we have observed cicada burrows in the upper layers of caliche at the contact with eolian sand where cicada nymphs have penetrated the carbonate, forming small cylindrical cavities.*

The most significant disturbance to the sand sheets of the Mescalero Plain began circa A.D. 1700 with a shift to a warmer climatic regime. This period, termed Episode VI in the report, extends into today and is characterized by the deflation of the Pleistocene and Holocene sand sheets and the formation of parabolic and coppice dunes that are now ubiquitous across the landscape. Parabolic and coppice dunes have different shapes and different origins that relate to archeological site preservation and research potential.

Figure 6. Parabolic dune with U-shaped blowout indicating the wind direction from left to right. (Hall and Goble 2016:Figure 3.20)

Parabolic dunes form in sand that is typically greater than one meter deep (over 3 feet), with elliptical blowouts oriented in the direction of the prevailing winds. Over time blowouts expand and they can merge together to form larger, higher dunes with elongated blowouts. The tops of these dunes can extend three to four meters (approximately 10 to 13 feet) above the bottoms of the blowouts. Vegetation on this thick sand is primarily shinnery oak (*Quercus havardii*) and an abundance of shinnery oak is an indication that at least 1 to 2 meters (three to six feet) of sand is present. Archeological sites may be buried within the deep sand.

In contrast, coppice dunes are formed in thinner sand deposits of less than a meter (three feet) in depth and they form mostly around mesquite shrubs. On the Mescalero Plain the predominant shrub is Torrey mesquite (*Prosopis glandulosa torreyana*), but dunes have been formed around honey mesquite, javelina bush, and soapweed yucca also. The report describes the formation of coppice dunes (Hall and Goble 2016:30).

> *Coppice dunes form only in circumstances where mesquite shrubs are present to capture wind-transported sand. Thus, the age of the dunes reflects the timing of the increased abundance and range of mesquite. The dunes follow the mesquite. Prior to the increase in mesquite, wind-blown sand from late nineteenth century rangeland disturbance accumulated as thin layers of cover sand across the ground surface. When mesquite showed up, the sand then accumulated around the shrubs, forming coppice dunes.*
>
> *Most of the coppice dunes in southeastern New Mexico are fairly small, about 0.5 to 1 meter high and 3 to 9 meters in diameter … Dunes may be much larger where small dunes merge with closely growing mesquite, forming one large sand mass. The sand that makes up the dunes is derived from deflation of Pleistocene or Holocene eolian sands that occur at the present-day surface. The texture of the sand in the dunes is generally the same as the underlying sand, indicating that the dunes are formed from local sands in the immediate area of the dunes.*

The OSL dates for the formation of coppice dunes range from A.D. 1745 to A.D. 1931. Sites located in coppice dunes may be damaged, with portions of the site eroded onto the bottoms of blowouts, while other portions are preserved under the dunes. On the other hand they may be totally destroyed with previously eroded portions of the site now buried under coppice dunes. What is preserved through burial in this instance is the already disturbed portion of the site.

In answer to the question posed at the beginning of this article, "Was it always this way, a surface pockmarked by blowouts?" The authors have provided an answer:

> *If we could look back to A.D. 1500, we would see an undulating sand sheet covered by a thick topsoil with a dense grassland and shinnery oak vegetation. Stone features from recent prehistoric sites may protrude above the soil. Earlier sites would be buried in the topsoil or in the underlying sands. Dunes and their blowouts and scoured surfaces would be absent.* (Hall and Goble 2016:117).

This article has focused on the geomorphology of the Mescalero Plain primarily from the viewpoint of archeological site preservation and research potential. The report covers many more topics including the evidence for Late Wisconsin glacial-age features, such as springs and wet meadow deposits; a comparison of the Mescalero Plain sand sheets to those of the Bolson and Strauss sand sheets located further west in southern New Mexico, colluvial hillslope deposits; a discussion of buried-site potential maps; alluvial geology of the Pecos River; and a discussion of the paleoenvironmental history of southeastern New Mexico. There is also, of course, much detailed analysis and factual information to support the conclusions of the report.

References Cited

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Other News from the Permian Basin

NM-128 Archaeological Project Report Now Available
by R.N. Wiseman

From October of 2006 to October of 2007 Bonnie Newman and her team from the Office of Archaeological Studies (OAS), Museum of New Mexico in Santa Fe investigated seven prehistoric and one recent historic sites along the west end of highway NM 128 for the New Mexico Department of Transportation (NMDOT). Subsequent lab work and report writing were completed by R.N. Wiseman of the OAS. The final report, entitled *Prehistoric Camps along Lower Nash Draw* (700+ pages in two volumes), should be available soon as a free download from both the OAS and the NMDOT websites. The report is Archaeology Note 398 in the OAS series and Cultural Resources Technical Report 2015-4 in the NMDOT series.

Figure 7. View of excavations at LA 129214. NM 128 traffic is in the background.

Analyses presented in this report suggest that all prehistoric occupations of the sites were of short duration by small groups of people. Three sites were re-occupied so frequently that anthrosols – man-caused accumulations of dark sediments – were formed. Numerous fire-pits were stratified within these soils. Evidently, men, women, and possibly children were present during many or most of those occupations for purposes of food collection, processing, and consumption. Plants included wild annual and perennial species, with yucca stems probably being one of the main target species. Animal foods were mainly small mammals. Corn residues and pollen were documented on several tools. However, the question still remains as to whether these represent corn grown in the vicinity of the sites or was obtained from farmers living west of the Pecos river. Seasons of site use probably included late spring, early summer, and mid-summer to fall. The nearest known sites that may have been used for overwintering by the NM 128 peoples are at a nearby group of lakes, including Laguna Plata.

One hundred forty-five radiocarbon dates reference dozens of occupations that took place at the sites and indicate that all of the sites were visited on multiple occasions. The majority of occupations occurred between AD 1 and the early to mid-1400s. Five dates attest to a few occupations from the period 4500 to 4200 BC. Three Golondrina projectile points (late Paleoindian) were recovered from two of the sites, but all appear to represent "pick-ups" by later peoples. However, buried possible Paleoindian features at one site were dated by optically stimulated luminescence (OSL) to 8970 BC and 10,600 BC.

Figure 8. View of anthrosol exposed in a backhoe trench at site LA 129214. Anthrosols are dark colored soils derived from human deposited organic matter, for example, charcoal fragments from cooking or baking fires, food remains, decomposed grass from sleeping mats, and other accumulated organic items.

A geomorphology study of the NM 128 project area made substantive additions to Stephen A. Hall's 2002 field guide to the Mescalero Sands country. In addition, Hall studied a protected drainage that had agricultural possibilities, but the results were negative.

Editor's note: Regge Wiseman is Emeritus and a Research Associate with the Office of Archaeological Studies, Museum of New Mexico, in Santa Fe.

New BLM Website is Operational

The Bureau of Land Management has a new website (blm.gov) that is compatible with different kinds of electronic devices, such as computers, phones, or tablets. The website has a variety of information available about BLM programs nation-wide organized by topic and by geographical area. A person can find recreation maps, oil and gas lease sale information, facts about the wild horse and burro program, or opportunities to volunteer. The website also has information about current events, such as the Oklahoma Field Office relocation to the University of Oklahoma. Explore blm.gov for yourself.

Back Issues of the *Permian Quarterly* are Available

Back issues of the *Permian Quarterly* are available at the Bureau of Land Management, New Mexico State Office website at http://www.blm.gov/nm/st/en.html. Use the "Quick Links" section then go to Cultural Resources - Research/Partnerships - Permian Basin Partnership.

Newsletter Contact Information

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