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Park Paleontology

Geologic Resources Division, Paleontology Program

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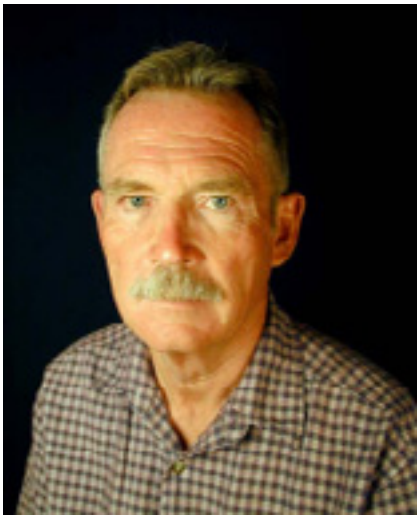
Two New Paleontologists Join the NPS

We welcome two new paleontologists to the National Park Service. Pete Reser has joined the staff at Petrified Forest National Park as a preparator and Mary Carpenter is the new preparator at Hagerman Fossil Beds National Monument.

Pete Reser - I was hooked at the age of seven when my mother took me to the Field Museum in Chicago, where I saw a large block of red sandstone on exhibit containing the skull of something obviously reptilian. But what really captured my attention was the network of chisel marks across the block from which I understood that someone could actually shape and remove stone to reveal what the rocks contained. I was transfixed.

Other than that, I have led a relatively normal life for someone of my generation. I served in Vietnam, experienced "the Sixties", and was a perennial "returning student" at the University of New Mexico. It was here I met the young Spencer Lucas who was an undergraduate in the Anthropology Department. He assembled a nucleus of students who were very interested in Paleontology and we proceeded to research the rich and varied fossil resources of New Mexico.
One of the things that we accomplished happened to be a very large survey, for the BLM, of the fossil resources of the San Juan Basin. This resulted in a large voucher collection in the New Mexico Museum of Natural History and I made it my business to learn fossil preparation techniques to deal with that collection. I have been a preparator, off and on, ever since.

I spent fifteen years as the Chief Preparator at the New Mexico Museum of Natural History and started as the fossil preparator at Petrified Forest National Park in June. The Park's incredible fossil resources have always intrigued me and I have thought that, like an iceberg, we've only seen approximately 10% of what is really there. Accordingly, I am delighted to be part of the team that will work on



Pete Reser

revealing and understanding the other 90%.

Mary C. Carpenter - I was born and raised in central Wisconsin, I received an Associate Degree in Graphic Arts in 1984. I discovered paleontology in the late 1980's on a motorcycle trip to the Hot Springs Mammoth Site in Hot Springs, South Dakota. After several summers as an EarthWatch volunteer at the Mammoth Site, I moved to Flagstaff, Arizona to begin my academic career. While at Northern Arizona University, Flagstaff, Arizona I completed my Bachelor of Arts, with a major in Anthropology and a minor in Geology. I complted by Master of Science in December 2003 through the Quaternary Sciences Program.

My master's thesis involved the identifications of bat, bird, horse, bighorn sheep, and extinct mountain goat bones from Rampart Cave, Grand Canyon National Park. During my 12 years in Flagstaff, I was involved in numerous archeological and paleontological projects, including a stint during the summer of 1998 as a fossil preparator at Hagerman Fossil Beds National Monument. Most recently, I have been involved in ongoing excavations and research at a Pleistocene, and possible late Pliocene, paleontological site in northern Sonora, Mexico with a crew from Northern Arizona University.

My paleontological interests are wide, but I am especially interested in faunal identifications and morphological characters of the bones of artiodactyls, raptors, and vulturids. In my spare time I enjoy exploring, outdoor activities of all kinds, travel, and reading. I am looking forward to the variety of work and professional research potential that HAFO has to offer. Certainly the fossil preparation will be a fun (yes, fun) job and keep me extremely busy.

Mary Carpenter

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Documentation of Paleontology Resources at New River Gorge National River

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The New River Gorge National River is starting the documentation of paleontology resources which may exist in or near the gorge area. This process began in October 2003 and begins with research of the existing literature which has already documented areas that are known to contain fossils. Another aspect of the initial inventory is to research the location of collections which may have exhibits of fossils from this area. This portion of the inventory should be completed by mid summer. Then the second part of the inventory should be planned – actually going out and seeing if rock layers mentioned in the literature search contain fossils. Once verified which rock layers contain fossils and where these rock layers may be found the third step in the inventory process can be planned - protecting the fossils from being lost and preserving a sample of fossils for public education.

It is already known what types of fossils ought to be found in this area. The New River Gorge is comprised of rock layers from the Carboniferous Period (Coal-bearing) - specifically, the late Mississippian and early Pennsylvanian. Rocks from the early Pennsylvanian are dated to about 300 million years before present time. Fossils from this period of time are generally limited to invertebrate (animals without backbones) and plant fossils. Plant fossils at the very earliest part of the Pennsylvanian system include one that is used as a boundary marker between the earlier Mississippian and later Pennsylvanian rock layers – *Neuropteris pocahontas.*

Leaf of the seed fern *Neuropteris pocahontas.*

Seed of of the seed fern, *Neuropteris pocahontas,* also known as *Holcospermum.*

Neuropteris pocahontas is classified as a seed fern. The taxonomy indicates that the leaf pattern terminates into a single leaflet attached to the stem at a single point and that the stem pattern shows a tri-pinnate geometry. The *N. pocahontas* produces a seed – *Holcospermum sp.* and pollen bearing organ – *Aulacotheca sp.* The latest portion of the Mississippian system contains the Hinton Formation, the Princeton Sandstone, and the Bluestone Formation. A short transitional sequence is encountered before starting into the first formation of the Pennsylvanian system – an un-named 'early member' of the Pocahontas formation. *N. pocahontas* is first encountered in this transitional area and occurs throughout the early Pennsylvanian until it became extinct.

What is a Seed Fern?

Seed ferns (Pteridospermales) are an extinct group of gymnosperms distantly related to living pine, spruce and cycads. Although their foliage resembled that of modern ferns, they reproduced by means of seeds. This distinguishes them from true ferns which reproduce by spores. Seed ferns were large, spongy-wooded trees that grew in swampy forests during the Carboniferous. and helped form many of our major coal deposits. Some seed ferns continued into the Mesozoic.
http://taggart.glg.msu.edu/bot335/sfern.htm

New Discoveries of Fossil Vertebrates at Florissant Fossil Beds National Monument

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Last summer I was a paleontology intern at Florissant Fossil Beds National Monument in Colorado, sponsored by the GeoCorps program of the Geological Society of America. Although Florissant is famous for its plant and insect fossils, a few mammal fossils had been discovered over the years. Because I am interested in mammalian paleontology, I revisited the site where a jaw of the early horse *Mesohippus* had been discovered in 1992 (Evanoff and De Toledo 1999). After weeks of crawling the surface and screening sediment, the project yielded 20 teeth and four jaws of mammals, in addition to hundreds of bone fragments. This new material, which has added considerably to the diversity of the known mammalian fauna of the Florissant Formation, forms the core of my master's thesis in Museum and Field Studies at the University of Colorado at Boulder.

In addition to the *Mesohippus*, other prior known mammals include a full skeleton of the mouse opossum *Peratherium* found in lake shales in the 1930s (Gazin 1936), an upper jaw fragment of the artiodactyl (even-toed ungulate) *Merycoidodon*, and a vertebra of a large rhino-like animal called a brontothere (Evanoff and De Toledo 1999). New material I discovered in 2003 includes a large molar tooth of a brontothere, which confirms the the

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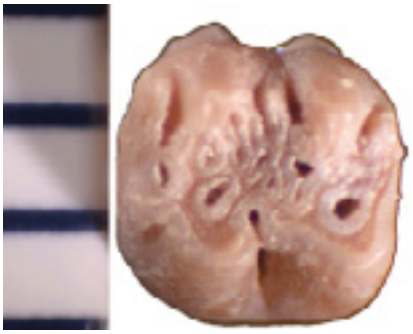
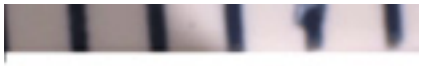


Tooth of *Eutypomys parvus,* an extinct relative of beavers, from Florissant Fossil Beds. Scale is in millimeters.

Lower jaw of *Domninia*, the earliest known shrew, from Florissant Fossils Beds. Scale in millimeters.

presence of the group in the Park. I also recovered lower molars of two different artiodactyls. The smaller artiodactyl tooth has been identified as *Leptomeryx cf L. speciosus*, which was a very tiny hoofed creature. The larger belongs to the family merycoidodontidae, the same as that of *Merycoidodon*. Six lagomorph teeth were found, the first rabbit fossils from the park. Four belong to the genus *Megalagus*, while the others may be from the smaller *Paleolagus*.

The diversity of extinct rodents includes *Ischyromys cf I. douglassi*, and a second large species of *Ischyromys*, as well as two different species of the genus *Pelycomys*, which may not be referable to any known species. *Eutypomys parvus*, known from the latest Eocene of Montana and Saskatchewan, is a member of the family eutypomyidae, which later gave rise to the castoridae, the family of the modern beavers (Korth 1994). The eomyid *Adjidaumo minimus* is also represented. One jaw of the tiny shrew *Domnina cf D. thompsoni* was recovered, in addition to the geolabidid insectivore *Centetodon magnus*. An additional insectivoran jaw was found,



Tooth of a large species of the rodent, *Ischyromys,* from Florissant Fossil Beds. Scale in millimeters.

which has thus far not been identified, and may be a member of the proscalopidae.

This mammalian fauna is consistent with the Chadronian North American Land Mammal Age (NALMA), which agrees with the $^{40}Ar/^{39}Ar$ age of 34.07 ± 0.10 Ma of the Florissant Formation (Evanoff et al. 2001). The Florissant fauna appears to be most similar to the middle Chadronian Pipestone Springs Local Fauna of Montana and also closely resembles the middle Chadronian Calf Creek Local Fauna of Saskatchewan, and fauna of the Chadronian section at Flagstaff Rim, Wyoming. The similarity to these particular faunas stems from a similar age, but also supports an emerging Rocky Mountain region faunal coherence.

It is especially exciting for me to have made these discoveries in a National Monument because the possibility of using the information to inform and inspire the public is so much more immediate. I am confident that further investigation of the Florissant formation will uncover even more mammalian diversity.

Additional Reading

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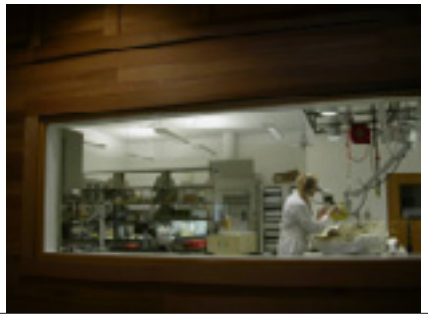

General view of the Thomas Condon Paleontological Center.

New Paleo Center at John DayFossil Beds National Monument nearing Completion

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The Thomas Condon Paleontology Center (TCPC) is a new facility devoted to curation, research, and education. Named for 19th-century Oregon pioneer, minister, and geologist Thomas Condon, the 11,000 square-foot facility houses more than 40,000 paleontological and geological objects that represent over 45 million years of evolutionary history in the John Day region. Consisting of museum collections storage, research areas, a paleontology preparation laboratory, a research library, an audiovisual theater, classroom, multiple temporary exhibits, and a 2,500 square-foot museum exhibition gallery, the new building effectively introduces students and the general public to paleontology research processes and the knowledge gained from study of the John Day region.

The TCPC opened to the public with limited operation in December (2003), and the museum collections move was completed in May 2004. The museum gallery exhibits will be completed in time for a grand opening during the summer of 2005.

Left - View of the new paleontology laboratory at the Thomas Condon Paleontological Center at John Day Fossil Beds

Planned Widening of East Entrance Road Reveals Important Geological Resources

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As most recent visitors to Yellowstone have noticed, the park's road system has been undergoing a lot of reconstruction lately. The Park's aging network of paved roads not only is showing signs of deterioration, but also is proving undersized to the more than 2 million people that visit the Park each year, many driving large vehicles.

In order to improve accessibility to Yellowstone's natural treasures, the Park has begun a 20-year plan to reconstruct and, in places, widen its extensive road system. This road improvement is a delicate operation. Like the old historic road network, the new one is designed to 'lie lightly on the land' and thus to provide access to the Park's beauty without dominating its landscapes. Part of the plan to integrate these road improvements into the Park's educational outreach program is a systematic effort to study the paleontologic and geologic resources that are revealed during the reconstruction process.

Current road improvement efforts are focusing on a six-mile stretch of highway that runs from the East Entrance west to Sylvan Pass. This stretch of road is one of along the road between the East Entrance and Sylvan Pass is anything but ordinary. Research on the geology of the East Entrance road revealed a cross-section through an ancient, now extinct volcano that was centered near Hoyt Peak, about a mile north of Sylvan Pass and was active about 45 million years ago during the Eocene Epoch. I have been working with Yellowstone scientific and administrative personnel to evaluate the geologic and paleontologic resources that will be even better exposed by planned road improvement activities along the East Entrance road. As part of this work, I mapped, studied, photographed, and sampled each natural outcrop and each artificial exposure between the East Entrance and Sylvan Pass. I am currently working with Park personnel to develop plans for a series of interpretive road-side pull-outs designed to highlight various parts of the volcanic system.

The stretch of highway between Sylvan Pass and the East Entrance passes by a series of rocks that together represent a cross-section through the eastern flank of an extinct Eocene volcano. Cropping out at Sylvan Pass are layers of volcanic breccia, a rock type itself composed of angular bits of volcanic rock probably derived mostly from surface talus that formed the steep sides of the volcano. Intruding and cross-cutting the breccia layers are vertically-oriented sheets of andesitic volcanic rock. The vertical sheets, called dikes, formed by injection of molten magma into vertical cracks in the interior of the volcano. Well-formed mineral crystals of hornblende and plagioclase in the andesite suggest the magma cooled slowly underground after being injected into the cracks. Though it can't be demonstrated yet, it is likely that some of these subterranean magmatic injections corresponded with actual eruptions of material from the volcanic vent. Viewed on a geologic map, the andesitic dikes form a radial pattern that converges on the postulated site of the volcanic mouth just north of Sylvan Pass. Moving east from Sylvan Pass, the road cuts through the breccia/dike complex inferred to represent the nominal volcanic center, through a series of east-tilted basalt and andesitic lava flows that are also locally intruded by andesite dikes and that likely represent the eastern flank of the volcano. Further along towards the East Entrance, layers of brown conglomeratic rocks crop out. These sedimentary rocks were deposited by debris flows that slid down the side of the volcano. Although conglomeratic strata associated with the debris apron occurs within the park, the best exposures of this part of the volcano are found outside of the park in the impressive cliffs, canyons, and mountainsides of brown volcaniclastic conglomerate on the road to Cody. Careful study of these debris flow layers reveals that they commonly contain casts of fossil wood from forests that colonized the sides of the Eocene volcano. Due to the poor state of preservation, however, it has not yet been possible to identify the wood further.

Closeup of coarse boulders in an inferred paleo-valley fill on the Sylvan Pass-East Entrance highway. Fossil wood casts are also present in the deposits.

Example of the fossil wood casts preserved in the Tertiary debris flow deposits.

Now that the initial site surveys and pre-reconstruction geologic assessments have been completed, crews are preparing to begin widening the highway between Sylvan Pass and the East Entrance. During the reconstruction process, trained personnel will be present to evaluate and catalog any fossil debris that the road crews recover. This material will be added to the collection I have started and will contribute to the development of the road-side information signs that will be posted along the route. Reconstruction of the East Entrance road is scheduled to be completed in 2006.

Report of the 2004 field collections and mapping of mammoth (*Mammuthus exilis* and *Mammuthus columbi*) remains: Santa Rosa Island, Channel Islands National Park (CHIS), California.

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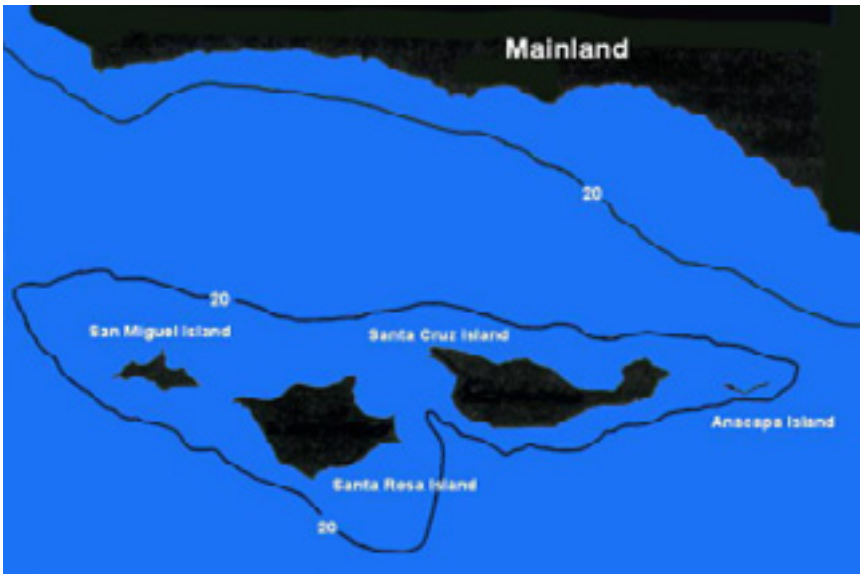

Map showing outline of the megaisland, Santarosae formed by the lowering of sea level by 20 meters during the Pleistocene. Pygmy mammoths have been found on San Miguel, Santa Rosa and Santa Cruz Islands. Modified from map made by Tom Rockwell, 1994.

Field mapping and collection of mammoth remains was conducted from May, 26-June, 2, 2004 by a four person team consisting of Kelly Minas (CHIS), Sam Spauling (CHIS), Don Morris (CHIS-retired), and Larry Agenbroad (Mammoth Site of Hot Springs, SD). The field procedure was the same as employed since the excavation and recovery of the 1994 skeleton of *Mammuthus exilis*; i. e. pedestrian survey with GPS control of fossil discoveries. The 2003 trip was cancelled due to storms, so the 2004 trip had a two-year erosion interval since the prior (2002) field season. A total of 60 localities were documented. As in previous seasons, only specimens of paleontological significance, or those threatened by imminent erosional destruction were collected. Seven localities contained elements of *Mammuthus columbi*, the remainder were *Mammuthus exilis*, maintaining an approximate 1:10 ratio of Me/Mc, as noted in prior field collections. Twenty specimens were collected, transported to the Santa Barbara Museum of Natural History (SBMNH) which is the repository for CHIS. There are currently no personnel at SBMNH experienced in the preparation, preservation, and cataloging of the mammoth remains, so an agreement was made to take the specimens to The Mammoth Site of Hot Springs, South Dakota for those tasks, to be returned to the SBMNH collections, upon completion. A paper was presented on the contemporaneity of mammoths and early human remains (Arlington Springs Woman) on Santa Rosa, at the 6th Channel Islands symposium in Ventura (12/1-3/03). The paper was submitted and accepted for inclusion in the symposium volume and is currently in press. The importance of the paper is the confirmation of accelerator-mass spectrometer (AMS) radiocarbon dates indicative of temporal overlap of early humans and mammoths at 11,030 BP (uncorrected radiocarbon years) on Santa Rosa Island. This coincidence places a strong correlation for human hunting, rather than climate change, or hyperdisease, as the cause of extinction of the island mammoths. No 'smoking spear' kill site has yet been discovered, however. It will take continued field work to locate and document potential kill sites.

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Directed Discovery and the Partnership between the National Parks and the GeoCorps America Program

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In the spring of 2003 I applied to the Geologic Society of America, GeoCorps America Program and received a position as a Geoscientist in the Park at Wupatki National Monument for the summer. My supervisor, Mary Blasing, defined this position as 1/2 geology research and 1/2 interpretive ranger. The interpretive ranger aspects of my position included operation of the fees desk and answering general and interpretive question for on site and off site visitors. Interpretive activities also included creation and execution of formal and informal interpretation on a wide variety of subjects. Roving front country sites and participation in and leading of backcountry hikes rounded out the interpretive aspect of my position.

Paul Whitefield, Chief of Natural Resources at the Flagstaff Area Monuments, defined the research aspects of my position as a paleontological investigation of the trace fossil potential of Wupatki National Monument. Because of the time constraints involved in my position, I narrowed this research to consist of an evaluation of vertebrate trace fossil potential of the lower Wupatki member of the Moenkopi formation. Based on my research of the literature, the trace fossil collection at MNA, and examination of the WUPA P1 trace fossil, I defined my research parameters to include only the lowest units of the Lower Wupatki Member (defined as those units above the Kaibab Formation and a below the Lower Massive Sandstone unit of the Wupatki member). Vertebrate trace fossil in the Wupatki unit form as sand-cast impressions of the tracks and traces rather than from preservation of the impressions themselves. As a result, the trace fossils are found on the underside of massive sandstone ledges. Through my initial field work, I quickly confirmed that the most likely vertebrate trace fossil potential for these units resides in the thin, massively bedded sandstone ledge forming units, which crop-out directly below the Lower Massive Sandstone unit.

This research and investigation at Wupatki National Monument resulted in the discovery on 21 June 2003 of an important early Triassic trackway that included very large *Chirotherium* trace fossils. The largest trace fossils have been tentatively assigned to the trace fossil ichnogenus *Chirotherium* with a possible affiliation to the *C. rex* or *C. moquiensis*. The bases for this assignment resides with the size and shape of the imprints. The largest dimension was measured at

Outcrop of the early Triassic Wupatki Member of the Moenkopi Formation at Wupatki in which the fossil tracks were found.

Tracks of *Chirotherium* from Wupatki National Monument

15cm. This measurement, however, was only for the digit portion of the hind foot (pes) track. Descriptions of *C. rex* and *C. moquiensis* pes tracks from the literature list a length in excess of 30 cm for complete tracks, showing both digit and sole imprints. The digit portion of these described imprints represent a little less than half the overall length of the track. Following this line of reasoning, the entire track length (including both digit and sole imprints) of the trace fossils would exceed 30 cms, thereby placing it within the size range of either *C. rex* or *C. moquiensis.* A distinguishing feature that separates both *C. rex* and *C. moquiensis* from the other species of *Chirotherium*, is the rather blunt and stubby toe impressions. This unique feature of the digits matches the observed imprints of the trackway. Several imprints of *C. rex* in the literature are described as lcaking the fifth digit in the fossil impression. This digit is also absent from the new imprints.

The new locality includes a rather rare occurrence of a trackway, which presents a series of sequential tracks preserved in the stratigraphic record. This trackway runs parallel to the erosional face of the cliff along a stratigraphic unit showing nearly 20 meters of exposed and eroded fossil tracks. Approximately twenty tracks of a large archosauromorph have been observed at the locality, both *in situ* in the exposed strata and in fragments eroded from the strata and lying atop the talus below the exposure. Numerous smaller, unidentified tracks are visible along with the archosauromorph tracks, possibly created by either reptiles or amphibians.

Trackways provide important evidence for scientific study of the geometry of movement of long extinct animals. Trackways also reveal compelling clues to associations and environments for extinct fauna. The newly discovered trackway offers a strong potential for furthering the scientific understanding of this early Triassic fauna. The proximity of the

trackway to the Permian/Triassic border adds another component of interest to these trace fossils. The fossil forming stratagraphic unit occurs only 18 to 20 meters above the Permian boundary, placing the dates on these track firmly in the early Triassic, approximately 137 to 240 million years ago. The Permian/ Triassic border represents an event of unprecedented extinction in the history of the Earth. The trace fossils at the locality provide potential insights into the recovery and evolutionary radiation of fauna after this catastrophic event. My Geocorps America position at Wupatki National Monument provided me with an extraordinary opportunity to extend my experience as a geoscientist beyond the boundaries of the academic environment, participate in the discovery of an important paleontological resource for the park system, and fulfill a life-time interest in natural history and education as an interpretive park ranger. It is my hope that the GeoCorp America program will continue providing this unique partnership between the National Parks and geoscientists for many more generations.

Trackway of *Chirotherium* from Wupatki National Monument.

Answer to Name the Fossil Park: Hancock Mammal Quarry and Clarno Nut Beds, in the Clarno Unit, John Day Fossil Beds, Oregon

Paleontologist at Florissant Fossils Beds Awarded NSF Grant

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The National Science Foundation has awarded a grant to Dr. Deborah Woodcock (Clark University) and Dr. Herbert Meyer (National Park Service, Florissant Fossil Beds) to complete a research and conservation project for the petrified forest site at Sexi, Peru. The project is "The Peruvian Fossil Forest Piedra Chamana: A Record of Continental Conditions during the Middle Eocene." The grant provides funds of $146,000.

The research aspects of the project will involve a combination of field and laboratory studies to reconstruct the environment and climate of a Middle Eocene low-latitude site, using fossil wood (i.e., monocots and dicots) from the northern Peruvian Andes. The scientific premise for the research is that while continental and oceanic proxy records have established the existence of warm climates at high latitudes during the Middle Eocene, conditions at tropical latitudes during this period are not as well documented. It has, in addition, been difficult for climate models to simulate the degree of high-latitude warmth indicated for the Eocene and also the much lesser extent of warming in the lower latitudes. The fossil forest is thereby an important record of tropical conditions during a time of notable warmth worldwide and before the changes of the latter part of the Eocene. The diversity of taxa at the Peru site is ideally suited for paleoclimate reconstructions.

The project also provides assistance for conservation of the site, and it will include establishing a site inventory and monitoring project. The grant will provide the funding for developing a museum in the small community of Sexi, as well as educational and interpretive information for the local school and for visitors. The site currently remains very remote and generally unvisited, although the community is eager to develop ecotourism. The fossil forest was formally designated for protection by the Peruvian government in 1997 under the Cultural Patrimony of the Nation.

This project will facilitate international exchange of ideas and analytical techniques between US and Peruvian scientists, enhance the conservation of important scientific specimens, and provide a unique learning experience for a graduate student. In addition, the project represents a strong and supportive collaboration between the US National Science Foundation, Clark University, the US National Park Service, and the National University San Marcos in Peru that will help the research and conservation efforts progress effectively.

Petrified Wood

Most types of fossil wood that we refer to as "petrified" or turned to stone is formed by a process called permineralization. Fossils that are permineralized when spaces in the wood (or bone) become filled with mineral-rich water. As water rich in minerals passes through the wood, concentrations of the minerals increase and eventually the minerals precipitate out, filling the voids and surrounding the original cell walls and cell membranes. The types of minerals that are deposited depends on the mineral content of the sediments that buried the tree. Some examples of minerals that commonly dissolve and saturate in solution include silica (SiO_2), calcium carbonate($CaCO_3$), and iron ores like pyrite (FeS_2). Each type of mineral a distinctive color and this is what makes fossil wood so colorful.

http://paleo.cortland.edu/tutorial/Taphonomy&Pres/preservation.htm

Fun in the Sun: The 2004 Paleontological Survey of Colorado National Monument

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Colorado National Monument is a paradise for photographers, hikers, and geologists. Sedimentary rocks ranging in age from Late Triassic to Late Cretaceous are exposed within the boundaries of Colorado National Monument (COLM), and they form many picturesque canyons and cliffs, towers and spires. But these rocks are not just scenic – they also hold a wealth of fossil resources.

During the summer of 2004, Margaret Imhof (Museum of Northern Arizona), Zach Walke (recently graduated from Southern Oregon University), and I spent 11 weeks hiking the trails and bushwacking through the backcountry of Colorado National Monument in search of fossils. Our mission was threefold: 1) to assess fossil localities that had previously been located, 2) to survey areas of COLM that had not yet been prospected for fossils, and 3) to compile all this information into one easily accessed database using GIS. The information gathered would then be used to help manage the fossil resources of COLM.

Over the past 30 years, several formal paleontological surveys were conducted at COLM. The first two surveys, by Dr. George L. Callison in 1977 and Dr. George F. Engelmann in 1995, focused exclusively on the Morrison Formation (Late Jurassic). Both of these surveys found many occurrences of dinosaur bone as well as fossils of smaller vertebrates and invertebrates. A third study, by Dr. Rodney D. Scheetz in 2001 and 2002, was based around the trails of COLM and surveyed most rock units in the monument. A preliminary study of the Quaternary fossil resources in COLM was done in 1994 by Dr. Kirk Andersen from the Museum of Northern Arizona, and bones recovered from a fissure exposed by a rockfall were collected in 2000 and identified by Dr. Jim Mead of MNA. In addition to these studies, scientists affiliated with the Museum of Western Colorado have occasionally surveyed various areas and formations in COLM. Several new dinosaur tracksites have been located by Dr. John Foster, Ryan King, and Josh Smith over the past few years.

In our survey, we located 19 new fossil localities and formally reported 57 others that had been known previously. Each of these 76 localities was given a COLM locality number, and at each locality we took GPS coordinates and photographs. In addition, we assessed the condition of each locality with regard to the numbers of fossils seen, weathering rates and stability of the site, and occurring or potential vandalism or theft. All of the data collected is housed at COLM in both print and electronic forms.

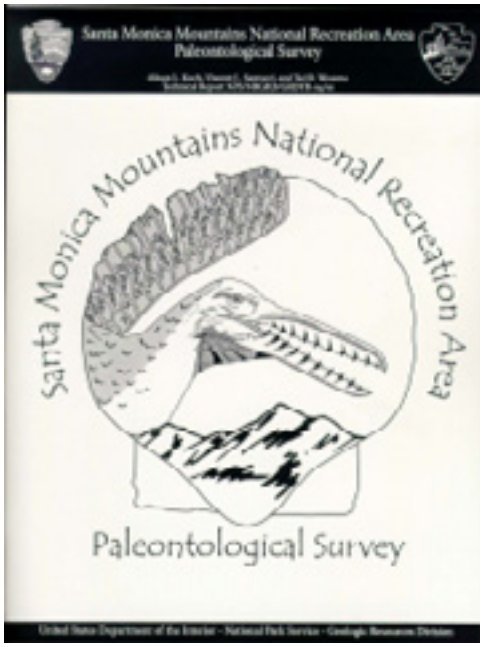
Margaret Imhof and Zach Walke, two GeoCorps volunteers, sitting on the Brushy Basin Member of the Morrison Formation at Colorado National Monument.

As a result of our summer's work, we now know that all sedimentary rock units exposed in COLM contain fossils. The types of fossil localities reported from COLM include trace and body fossils of plants, invertebrates, and vertebrates. The most exciting finds include well-preserved sauropod bones in fallen blocks of the Burro Canyon Fm., a lungfish tooth from the Tidwell Member of the Morrison Formation, the only known vertebrate bone from the Kayenta Fm. of Colorado, and large numbers of dinosaur tracks from the Wingate Fm. We also learned about metoposaur scutes and teeth that had been collected from the Chinle Fm. (Late Triassic) in COLM about 50 years ago. The fossils were donated to the Museum of Western Colorado many years ago, and a search is underway to locate them.

All in all, we had a productive and fun summer. The information we provided will allow resource managers and others at COLM to keep track of their fossil resources in order to preserve and protect them. All of the folks at COLM were great to work with. And we got to spend our summer wandering around Colorado National Monument! For geologists and paleontologists, it doesn't get any better than that!

General overview of the geology of Colorado National Monument. Independence Monument in the center.

Recent Literature on Park Paleontology Resources



The final report of a paleontological survey of Santa Monica Mountains National Recreation Area has just been completed by Alison Koch, Vince Santucci and Ted Weasma. The report provides an overview of the variety of paleontological resources present in the park.

Copies of Santa Monica Mountains National Recreation Area Paleontological Survey, Technical Report NPS/NRGRD/GRDTR-04-01 are available from the: Geologic Resources Division, National Park Service, P.O. Box 25287,Denver, Colorado 80227

Name the Fossil Park

Two of the most famous fossil quarries in North America are subtly visible in this landscape image from a small National Monument.
Answer on page 7.

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Echinoid from the Permian Bird Spring Formation, top of the Providence Mountains, Mojave National Preserve, California. Photograph by Ted R. Weasma