GEOLOGY at SMU

A newsletter for alumni and friends - Fall 2003

Louis Jacobs & colleagues study early mammals

Professor Louis Jacobs looks for any opportunity to satisfy his passion for early mammals. His work extends SMUôs effort in early mammals that are unique to north Texas. The late Bob Slaughter brought S k ì collection (located in the basement of Heroy Hall) as material for teaching, Louis convinced Ph.D. candidate Yoshi Kobayashi to reexamine a mammal named after Bob Slaughter called *Slaughteria eruptens* (Figure 1) as part of a class that he and staff member Dr. Dale Winkler were teaching on new techniques in vertebrate paleontology.

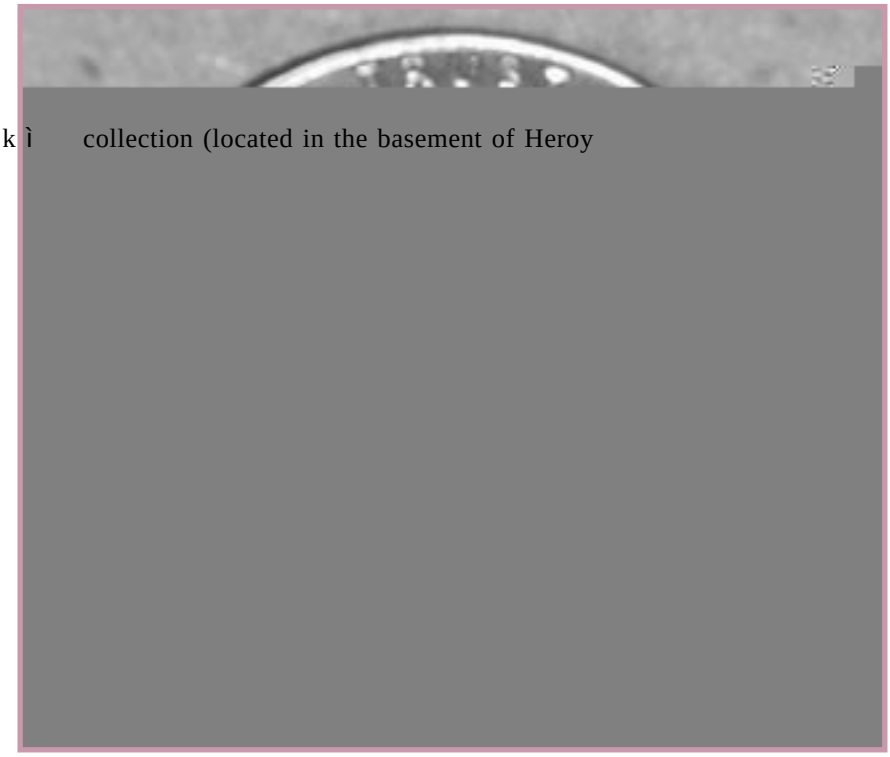

Figure 1: Specimen of a jawbone prepared for ultra high

Remember that mammals ýrst appeared during the age of dinosaurs when being very small was a good survival strategy in a world crowded with giants. However, small vertebrates are not so easy to ýnd so the record is ssm Ρ Ψ < n‰ pa distinctive patterns of tooth replacement. Dif ferent animal groups have distinctive strategies for replacing teeth either because of wear or because of changes brought on by maturing from juvenile to adult states.

Modern placental mammals replace many ñbabyò teeth with adult teeth while modern marsupials only replace one premolar on each side of the jaw; premolars are teeth usually situated towards the front of the jaw and have morphologies consistent with uses other than the grinding function of molars. When Bob Slaughter originally examined *Slaughteria*, he concluded that the fossil jaw contained no replacement teeth and that all of the teeth were of an adult type. Another worker examined the same jaw and concluded that premolar and molar teeth were present; this is critical for determining the signiýcance of replacement teeth for classiýcation purposes. Both workers did not recognize any teeth in the process of eruption; the jaw bone blocked the view of the underlying root structure of the teeth.

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Chairman's Report

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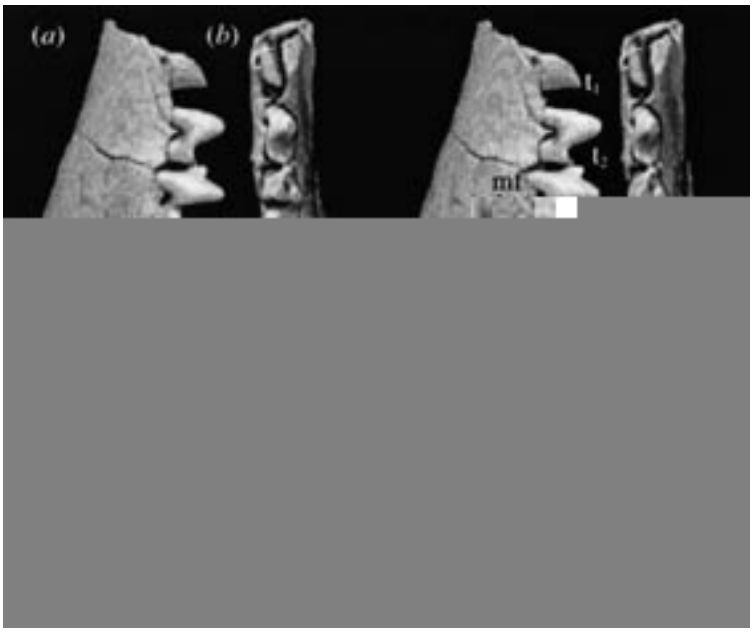
By Robert Gregory



As part of his class project, Yoshi Kobayashi got the machine time that allowed him to take X-ray pictures of the jaw bone in 36 micron intervals using a technique called ultra-high-resolution X-ray computer tomography (CT). They were able to make 3-dimensional stereographic images of the jaw. The X-ray scans enabled the reconstruction of the underlying structure of the teeth without destroying the priceless specimen (Figure 2). Their analysis revealed the existence of a simple permanent premolar in a pre-eruption position. While it doesnôt sound like much, this is a critical piece of evidence when the whole specimen is smaller in size than a single dinosaur tooth. The new technique enabled the SMU group to make a new discovery.

The existence of a replacement tooth in a pre-eruption premolar position indicates a pattern of tooth replacement that could be a precursor to both of the styles now observed in modern placental and marsupial mammals. It suggests that the two ƆmoŞc ԁÈ ԁpMma ` ԁÈ ` who two Ɔm

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For many years years now, either the ñRocks and Mapsò or the ñIntroduction to Field Studiesò classes have made the pilgrimage to the Colorado Plateau. Our alumni tell us that this practice extends back to the early days of the department; publications on Meteor Crater dating back to 1936 are credited to Claude Albritton, Jr.

The current trip consists of a marathon drive followed by stops beginning on the western side of the Rio Grande Rift (the Colorado Plateau is the western rift shoulder) leading to a hike into the Grand Canyon covering outcrops from the Permian Kaibab Limestone to the Cambrian Tapeats Sandstone. The students get to walk through rock formations that span some 250 million years of earth history, perhaps one of the best places to observe ñuniformitarianò geology on the ground, gaps and all. At Plateau Point, they gaze down through the Precambrian rocks of the inner gorge to see the current level of the Colorado River just west of the conþuence with Bright Angel Creek.

On the way to the Grand Canyon, we always make it a point to stop at Meteor Crater, Arizona, to see the worldôs best preserved example of an impact crater, one of the important data points for the new catastrophism. The ýrst rate crater museum is operated by Meteor Crater Enterprises, a company that has roots in the original mining claims that staked out the crater as a potential iron ore mine. Enough drilling and exploration was completed to enable the claim holders to patent the claim and eventually get title to the property. It is currently worth far more as a tourist attraction than it ever was as an iron ore mine.

Sunset Crater, one of the youngest strombolian cinder cones in the continental United States with its spectacular *aa* lava þow, is a good place to camp. SP Crater, with its block lava þow, and Crater 160, an example of an ex . p ȝ plabof Ā o

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in training exercises for remote sensing. These basaltic volcanoes are overshadowed by the presence of the San Francisco Peaks, a giant stratovolcano that in the recent geologic past experienced a Mt. St. Helens-style lateral blast eruption. Later on, during the trip, the students see the silicic pyroclastic deposits of the Superstition Mountains where geologists are still arguing about the locations of the vents for these gigantic eruptions.

In the Little Harquahala Mountains near Salome, Arizona, the group does some geologic mapping by following the contact between several slivers of overturned Paleozoic rocks and underlying Precambrian granitic rocks. The Paleozoic formations correlate with those on the Colorado Plateau and in the Grand Canyon. The Precambrian granodiorite and the fault contact with the metamorphosed Paleozoic rocks are intensely hydrothermally altered. Several gold mines were once active in the area.

On the way back to Dallas, the group travels through metamorphic core complex country via Phoenix and then follows the Salt River to see the economic fruits of the Salt River Project which supplies the water that makes the modern Phoenix metroplex possible. In the Salt River Gorge, the students get reacquainted with the unmetamorphosed Paleozoic section and get their ýrst whiff of petroliferous limestone. Upon returning to the Colorado Plateau, a visit to the Petriýed Forest National Park caps off a visit to the Triassic of the Painted Desert.

As a result of all of these stops, the students get to observe the geologic products of many different agents operating on many different time and spatial scales. They learn about life in the ýeld.

Clockwise from top right: Postdoctoral fellow Neil Tabor points out ancient earth cracks penetrating the Hermit Shale ýlled with sand from the overlying Coconino cross-bedded sandstone. Petriýed logs from Triassic rocks of the Colorado Plateau. Photomosaic of Meteor Crater (1.2 km in diameter) taken from the northeast corner of the rim. The view of the south rim from Plateau Point in the Grand Canyon. View of the Grand Canyon from the south rim.

David D. Blackwell, Hamilton Professor, Ph.D., Harvard. Geothermal studies and their application to plate tectonics, especially of the western United States; energy resource estimates and geothermal exploration.

Robert T. Gregory, Professor, Chair, Ph.D., California Institute of Technology. Stable isotope geology and geochemistry, evolution of earthôs þuid envelope and lithosphere.

Eugene T. Herrin, Shuler-Foscue Professor, Ph.D., Harvard. Theoretical and applied seismology, solid earth properties, computer analysis of geophysical data.

Louis L. Jacobs, Professor, Ph.D., University of Arizona. President of the Institute for the Study of Earth and Man. Vertebrate paleontology, evolution.

Bonnie F. Jacobs, Assistant Professor and Chairman of the Environmental Science Program, Ph.D., University of Arizona. Paleobotany of Tertiary deposits of Africa, application of pollen analysis to Cenozoic geological and environmental problems. bjacobs@smu.edu.

A. Lee McAlester, Professor, Ph.D.,Yale University. Marine ecology-paleoecology, evolutionary theory, Paleozoic geology, petroleum geology.

Jason R. McKenna, Visiting Assistant Professor, Ph.D., Southern Methodist University. Thermal mechanical evolution of subduction zones; thermal modeling of petroleum and geothermal systems.

Brian W. Stump, Albritton Professor, Ph.D., University of California, Berkeley. Seismology, earthquake and explosion source theory, regional wave propagation, seismic and infrasonic instrumentation and data acquisition; mine-related seismicity.

John V. Walther, Matthews Professor, Ph.D., University of California, Berkeley. Experimental and theoretical aqueous geochemistry, þuid-mineral surface interactions, kinetics of dissolution,

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