

Research Title: Taphonomy and Paleoecology of Chasmosaurine Bonebeds, Upper Cretaceous Kaiparowits Formation, Grand Staircase Escalante National Monument, southern Utah

Research Proposal:

My research focuses on identifying factors which govern ceratopsian preservation in the Kaiparowits Formation of Grand Staircase-Escalante National Monument (GSENM), southern Utah. Studies of vertebrate sites in Campanian formations in the northern Western Interior Basin have demonstrated systematic associations between particular vertebrate taxa and taphonomic modes with sedimentological settings and sequence stratigraphic boundaries (Rogers & Kidwell, 2000; Straight & Eberth, 2002). I am investigating whether or not associated ceratopsid sites in the Kaiparowits Formation follow a similar pattern. I am comparing the sedimentologic, stratigraphic, and taphonomic information I've collected from the first two known Kaiparowits Formation ceratopsid bone beds and from other ceratopsian sites within the Kaiparowits with other ceratopsian sites from Alberta, Canada and Montana to determine possible trends and differences in paleoenvironmental factors governing ceratopsian assemblages of North America during the Late Cretaceous.

Field Work and Analysis:

In September, 2010, I travelled with the Utah Museum of Natural History field crew to GSENM to collect information and samples from four ceratopsian localities: a multitaxic bonebed containing two juvenile chasmosaurines (UMNH VP Locality 945) from a fine-grained matrix; a monodominant bonebed containing disarticulated partial remains of three chasmosaurines from a channel lag deposit (UMNH VP Locality 942); and two localities containing associated single skeletons of juvenile ceratopsid dinosaurs from finer-grained sediments. Stratigraphic and sedimentologic information was collected from detailed microstratigraphic sections through the quarries, and from the outcrop at each of the four sites. Thirty-one lithologic samples were collected from the sites, and are currently being prepared and readied for examination under optical microscope and Quantitative Elemental Mineralogy Scanning Electron Microscope (QEMSCAN). The results of the QEMSCAN analysis will allow for detailed quantitative mineral identification, petrologic, and sedimentologic analysis.

Preliminary stratigraphic data from my fieldwork are pointing more toward a fluvial hydraulic skeletal accumulation seen in the Kaiparowits Fm. My current data suggests the depositional environment of locality 945 is interpreted as a crevasse splay, and a mud-dominated floodplain where slight reworking by running water partially disarticulated and deposited the carcasses together prior to burial. This type of depositional environment and preservation is unusual for this study area. Generally, most of the ceratopsid remains that have been recovered from the Kaiparowits Fm. in GSENM are associated or partially articulated single individuals and are commonly associated with channel sandstones, and rapid burial like bonebed 945. The depositional environment of Bonebed 945 is interpreted as a lag deposit from the accumulation of coarse unconsolidated rock and mineral debris in a channel from normal stream processes, at the base of a sandy channel bed in a thin pebbly conglomerate. The skeletons at this site appear to have been transported prior to deposition were breakage, surface abrasion, and loss of smaller elements occurred (Getty et al, 2010). However, similar depositional settings to bonebed 945 were found at two other juvenile chasmosaurine localities in the Kaiparowits Formation, but these sites reflect isolated partial skeletons.

Each site is being or has been mapped for individual element location and orientation, identifying each element and examining it for specific taphonomic information (bone dimension/shape, bone modifications, breakage/ fragmentation, abrasion/rounding, weathering, scouring, surface marks, and bioerosional features). Examining the number of elements preserved, their position, and location within the quarry, in addition to presence or absence of damage associated with bone preservation, will be combined with the sedimentological data to reveal how ceratopsid skeletons accumulated, and how some were preserved as bonebeds. The information gathered from the Kaiparowits Fm. allows me to address the paleoecology of ceratopsid dinosaurs during the late Campanian, and understand the preservational quality of specimens in the Kaiparowits within GSENM.

As of writing, I am in the process of examining preserved skeletal elements for further taxonomic identification where necessary. Skeletal material from UMNH VP Locality 945 has been examined and determined to not be *Kosmoceratops richardsoni*. Additional preparation and analysis is being performed, and it is likely that the two juveniles from this site are assignable to *Utahceratops gettyi*. If so, this could provide an opportunity to examine both juvenile and adult specimens in relation to ontogeny and paleoecology.

Presentation of Results:

Data gathered in September from stratigraphic fieldwork, preparation, and element identification from the second known Kaiparowits chasmosaurine bonebed (UMNH VP Locality 945) were presented at the annual Society of Vertebrate Paleontology Conference as poster discussing the unusual preservation of the bonebed compared to other ceratopsid chasmosaurine sites discovered in the Kaiparowits Fm. The poster focused on the quarry sedimentology, stratigraphy, taphonomy, and specimens preserved. It also highlighted the excellent preservation of a complete left manus and a partial pes from the larger juvenile, and a mostly complete left manus from the second slightly smaller chasmosaurine. These complete limbs provide insight into chasmosaurine osteology by clarifying the phalangeal count for the chasmosaurine manus and pes.

Budget:

Travel to GSENM to collect sedimentological and taphonomic information was estimated to cost \$900, including transportation, meals, and supplies. Supplies purchased included gallon and quart size ziploc bags, hand lens, and fine- and medium-point permanent markers. The dates that were applicable to conducting my fieldwork in GSENM happened to coincide with fieldwork by the Utah Museum of Natural History field crew in the same location in GSENM. As such, I was able to minimize costs for fieldwork. The cost for supplies, transportation and meals for myself and a graduate student assistant ended up being just under \$300. Below is an itemized list of the expenses. I will apply the remainder of the amount to help defray the costs for prepping the collected samples in epoxy plugs, which will be used for analysis under the microscope and QEMSCAN. Total cost for these analyses is expected to be \$600 for preparation of samples in epoxy for 30 samples, and an estimated \$3,000 to \$4,000 for the QEMSCAN analysis with the cost of each sample being based on the point count scan. This amount is higher than predicted, and reflects finer-grained samples being analyzed.

Budget Information:

Itemized Costs (includes tax):

Transportation and meals	\$ 250
Hand lens	\$ 16
Permanent Markers	\$ 16
<u>Ziplock bags</u>	<u>\$ 8</u>
Total Costs	\$ 290

References:

- Getty, M., Loewen, M., Roberts, E., Titus, A. & Sampson, S. Taphonomy of Horned Dinosaurs (Ornithischia: Ceratopsidae) from the Late Campanian Kaiparowits Formation, Grand Staircase—Escalante National Monument, Utah. In (Ryans, M., Chinnery-Allgeier, B, Eberth, D., Ralrick, P. & Dodson, P.) *New Perspectives on Horned Dinosaurs: Royal Tyrrell Museum Ceratopsian Symposium: Life of the Past*. Indiana Univ. Press (2010).
- Straight, W.H. and Eberth, D.A. Testing the Utility of Vertebrate Remains in Recognizing Patterns in Fluvial Deposits: An Example from the Lower Horseshoe Canyon Formation, Alberta. *Palaios* 17, 472-490 (1998).

100 Word Statement for the public:

Name: Deanna Brandau

Institution: University of Utah

Advisor: Randall Irmis

Degree: M.S.

Project Title: The Taphonomy and Paleoecology of Chasmosaurine Bonebeds, Upper Cretaceous Kaiparowits Formation, Grand Staircase-Escalante National Monument of southern Utah

I would like to thank the Dinosaur Institute for providing funding for my masters fieldwork in Grand Staircase-Escalante National Monument, southern Utah. My research focuses on identifying factors that govern the preservation of ceratopsians, horned dinosaurs like *Triceratops*, in the Kaiparowits Formation. I am examining the amount of elements preserved, their position, and location within a quarry, in addition to the presence or absence of modifications (taphonomy) associated with the bones preserved, which can be combined with the sedimentological data (comparing the mineral and organic content) to reveal bone accumulation and paleoecological information.