EARTH SCIENCES

Thursday, 29 April

1:00 pm Provisional Palynological Recognition of the Fern Spike at the Cretaceous Tertiary Boundary, Makoshika State park, Dawson County, Montana
Timothy J Kroeger*, UND, Joseph H Hartman and Wesley D Peck, EERC, Grand Forks 58202

1:20 pm Paleocene Stratigraphy of the Nesson Anticline: Placement of the Bullion Creek-Sentinel Butte Formational Contact, Williams and McKenzie Counties, North Dakota
Joseph H Hartman, Wesley D Peck*, EERC, Grand Forks 58202, and Allen J Kihm, MinSU, Minot 58701

1:40 pm A Diverse Assemblage of Paleocene Nonmarine Mollusks and Mammals from the Sentinel Bute Formation of North Dakota
Joseph H Hartman*, EERC, Grand Forks 58202, Barry Roth, Museum of Paleontology, University of California, Berkeley, 94720 and Allen J Kihm, MinSU, Minot 58701

2:00 pm Evolution of Drainage Networks: Western United States
Eric Clausen*, MinSU, Minot 58701

SOCIAL SCIENCES

Thursday, 29 April

3:00 pm The Influence of Spatial Structure of Geographic Divisions on Migration Rates
Mohammad Hemmasi*, UND, Grand Forks 58202

3:20 pm Spatial and Temporal Consistency in the Determinants of North Dakota's In-migration Rates
Mohammad Hemmasi and Devon Hansen*, UND, Grand Forks 58202

PROVISIONAL PALYNOLOGICAL RECOGNITION OF THE FERN SPIKE AT THE CRETACEOUS-TERTIARY BOUNDARY, MAKOSHIKA STATE PARK, DAWSON COUNTY, MONTANA

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The palynological Cretaceous-Tertiary (K/T) boundary has been located at two sites in Makoshika State Park near Glendive, Montana. At both sites, the stratigraphic level of the boundary approximates the contact between the Hell Creek and Tullock Formations.

Several palynomorph taxa, diagnostic of the Upper Cretaceous, undergo extinction at or below the K/T boundary. None of these taxa are common in the uppermost Cretaceous strata, as their sum does not exceed 3 ± 1% of the identified palynomorph total for samples lying near the K/T boundary. Diagnostic angiosperm taxa include several species of *Aquilapollenites* (*sensu* Tschudy and Leopold [1]), including *A. quadricretaeus*, *A. amplus*, *A. delicatus* var. *collaris*, *A. reductus*, and *A.* n. sp. (2). Other angiosperm taxa suffering extinction include *Liliacidites complexus*, *Tricolpites microreticulatus*, *Proteacidites* spp., *Cranwellia rumseyensis*, *Sindorapollis pilatus*, and *Libopollis jarzenii*. The fungal thallus *Trichopeltinites* sp. and the spores *Foraminisporis undulosus* and *?Concavissimisporites* cf. *?C. variverrucatus* survive the Cretaceous, but undergo severe reduction or extinction within basal Tertiary strata.

One of the sites (M4770) was sampled across the boundary in 5-cm sampling intervals. The basal Tertiary sample from this site bears an anomalous abundance of fern spores, totaling 94 ± 2% of the palynomorphs (excluding megaspores and fungal and algal taxa) (Figure 1). The fern spore assemblage has relatively low diversity and is dominated by *Laevigatosporites* spp. (52 ± 3%) and *Reticuloidosporites dentatus* (29 ± 3%). At least seven other fern spore species are present in addition to algal and fungal spores and fragments of *Azolla* spp. megaspores. All of the fern spore taxa are also present in samples from the underlying Cretaceous rocks. The sum of angiosperm and gymnosperm pollen is 6 ± 2% of the identified grains, an unusually low incidence. The fern spore spike is not coincident with a lithologic change as the two uppermost Cretaceous samples and the fern spike sample occur within a dark brown mudstone containing no obvious lithologic breaks (Figure 1, Unit 3). The "boundary claystone" (3) is apparently not present in the section. An abundance of algal palynomorphs and *Azolla* spp. suggest an aquatic setting for deposition of the mudstone.

In the three Tertiary samples collected within 15 cm above the fern spore spike, palynomorph assemblages begin to regain diversity, although relatively few taxa tend to dominate the assemblages. Dominant taxa in these assemblages include spores of the Sphagnaceae (*Stereisporites* spp.), pollen of the Taxodiaceae-Cupressaceae-Taxaceae complex, and the angiosperm pollen *?Rutihesperipites* sp., *Rhoipites* cf. *R. globosus*, and *Retitricolpites crassus*. Change to these palynomorph assemblages is coincident with a lithologic change from mudstone to coal (Figure 1, Unit 4), and may in part represent an ecologic change to a swamp-forest plant community. Although detailed systematic studies of the palynomorphs have not been completed, no taxa have yet been discovered that were introduced in basal Tertiary strata.

Similar fern spore spikes immediately above the K/T boundary have been reported from nonmarine rocks in the Western Interior (4). The boundary fern spike described here is considered provisional in that these sediment samples have yet to be analyzed for iridium. The iridium anomaly has been used elsewhere to confirm continuous deposition across the K/T boundary. The sharp increase in fern spores has been attributed to the rapid recolonization of the region by ferns following a severe ecological disruption caused by a bolide impact (3). The Makoshika occurrence in easternmost Montana is well within the known distribution of fern spore anomalies delineated by Nichols and Fleming (4), who speculated that the known localities could be the result of a bolide impact near Manson, Iowa.

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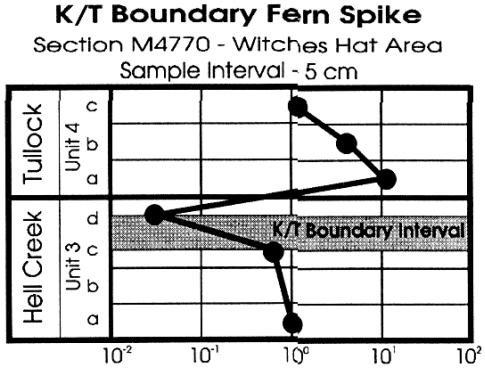

Figure 1. Angiosperm pollen / fern spores

1. Tschudy, B.D. and Leopold, E.B. (1971) Geol Soc Am Spec Paper 127, 113-167. 2. Nichols, D.J. (1993) written comm. 3. Tschudy, R.H., Pillmore, C.L., Orth, C.J., Gilmore, J.S. and Knight, J.D (1984) Science 225, 1030-1032. 4. Nichols, D.J. and Fleming, R.F. (1990) Geol Soc Am Spec Paper 247, 245-455.