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Terrestrial ecosystem destabilization at the K/T boundary in southwestern North Dakota, USA.

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Much of the debate regarding mass extinction events tend to discuss the relationship between such events relative to the moment and timing of internal or external factors (such as volcanism, impact(s), climate, sea-level changes and so on). However, the details of the extinction process itself is still poorly understood, and most of the analysis are based on biodiversity patterns without integrating the biogeographic and environmental context. Another way of approaching the problem would be to propose precise paleoenvironment reconstructions and analyzing their evolution through time, which allows for the understanding of such processes.

The badlands of southwestern North Dakota provides some of the most prolific exposures of the continental Cretaceous/Tertiary (K/T) boundary in the world. The stratigraphical context indicates that the K/T boundary is coincident or lies in close proximity to the contact between the Hell Creek and the Fort Union Formations. In this area, a series of eight stratigraphical sections across a 40 km north-south transect were studied. These sections bracket the formational contact on a 10 m stratigraphical interval. Reconstruction of the depositional environment was undertaken at a centimeter scale by using sedimentological data, as well as palynological, paleobotanical and palaeontological content of the strata, using the K/T boundary as a precise chronological datum of correlation between the sections. Results shows a consistent evolution of pattern across the entire study area :

1) The uppermost 10 to 20 cm of the Hell Creek Formation always corresponds to a sequence of dark rooted mudstone. Pollen content is consistent with a Cretaceous age and displays a diversity of terrestrial taxa.

2) Immediately above, the formation contact lies at the lower part of the first laterally traceable lignite horizon. The K/T boundary indicators (iridium anomaly, shocked quartz, fern spike and boundary claystone) are located at or adjacent to this stratigraphical interval, when preserved.

3) Within or just above the formation contact coal, the relative abundance of palynological taxa indicative of the Cretaceous (K-taxa) drop significantly without significant subsequent recovery.

4) Above the formation contact lignite, lithology systematically the lithology consistently appears as a 1-2 m thick dark mudstone sequence. The palynological record of this interval is dominated by freshwater taxa (Pediastrum sp. and Penetetrapites sp.) indicating general flooding in the study area.

5) Change in the sedimentation style in comparison of the Hell Creek is reflected by the preservation of variegated beds, multiple lignite seams and small scale meandering river systems. The palynological content attest for reworking and erosion.

Conclusions shows that both palaeoenviroments and biodiversity patterns stay consistent throughout the Hell Creek Formation, with the exception of its uppermost part. The vertebrate and plant communities underwent a significant change at this time coincident with the evidence for a impact scenario or catastrophic event of massive scale. Beginning at the very end of the Cretaceous and continuing up into the overlying Fort Union Formation, the area was experiencing the onset of a transgression cycle which contributed to widespread ponding. Following the

impact, modifications in the environment caused by land denudation, changes in sea level and drainage patterns promoted run-off and reworking. The destabilization of terrestrial ecosystems in southwestern North Dakota is coincident with markers of the K/T boundary that supports a catastrophic event taking place over a very short duration.