Sulfur isotope studies of terrestrial K-T boundary sections at Brownie Butte and Berwind Canyon

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Continental K/T sites are generally composed of two layers: a lower kaolinitic layer with spherules believed to represent distal ejecta from the impact, and an overlying smectitic layer which contains evidence of shock metamorphism, iridium, and soot. At the time, the environment consisted of floodplains and backswamps. Carbon concentrations through the boundary are marked by a small decrease followed by a rapid increase into the lowermost Tertiary rocks, with a concurrent sharp decrease in the heavier isotope of carbon by 25 ‰, which recovers to normal Cretaceous values above the boundary layers. Nitrogen isotopes become enriched in the heavier isotope. This is strongly indicative that bacterial methanogenesis was occurring in these sediments. However, it is not clear how anoxic the environment has to be for methanogenesis to occur. The bulk C and N isotope shifts are indicators of anoxia. However the methane produced by the methanogenic bacteria is utilized by methylotrophs, which fix it using a chemosynthetic pathway - but these need a source of electrons to fix methane. If the environment was anoxic, oxygen could not have been the electron source. Here, sulfur is important, as it provides a ready source of electrons, and the increase in sulfur abundance is further evidence that an anoxic environment existed. Sulfur-reducing bacteria could well have played a role in the recovery of fauna and breakdown of dead vegetation after the impact. In our studies of both profiles, Berwind Canyon and Brownie Butte, it is evident that there is a pronounced enrichment in sulfur content and in the lighter isotope of sulfur in the fireball layer above the boundary.