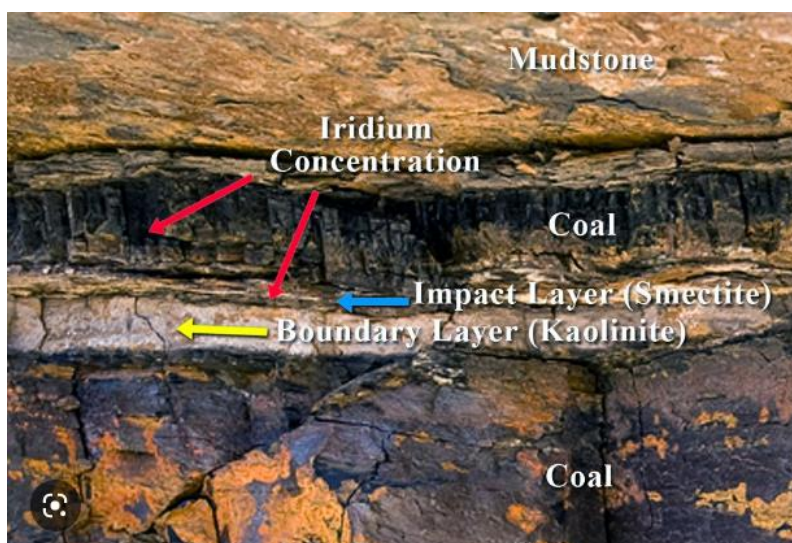


## What is the Mineral Composition of the Cretaceous-Tertiary (K-T) Boundary?

Donald Kasper 4-18-2023

Armed with reflectance infrared spectroscopy and samples of the lower white to pinkish clay layer and upper black layer of the K-T boundary of the Hell Creek Formation of Marmath, North Dakota collected by Geological Specimen Supply, out of the Owens Valley, CA, a number of scans perpendicular and parallel to the layers were carried out. The specimens were collected in 2022 (upper dark layer) and 2023 (lower white to pinkish layer).

First, the literature like the example below states that the white layer is kaolinite and the upper layer is smectite (which would be bentonite) and above that is coal.



K-T boundary image from sciencebuzz.org.

This image produces the illusion the layers are hard and solid when they are actually mud. Here is the image from Geological Specimen Supply in one of their collecting trips.



K-T boundary image where specimens scanned in this paper were collected. From Rudy at Geological Specimen Supply.

Using X-ray spectroscopy typical of these studies it cannot identify a kaolinite from a smectite without special processing, but the infrared fundamental bands and especially water bands in infrared are unambiguous. Here is the spectrum of the identified black coal layer (Fig. 1). Infrared confirms this is dominated by bentonite, obviously with some organic material, that is quite close to the author's jet (anthracite coal) specimen (Fig. 3) that is better seen in well-defined, fine sheet broad faces in the white lower zone (really a misnomer since very thin coal bedding is in this layer).

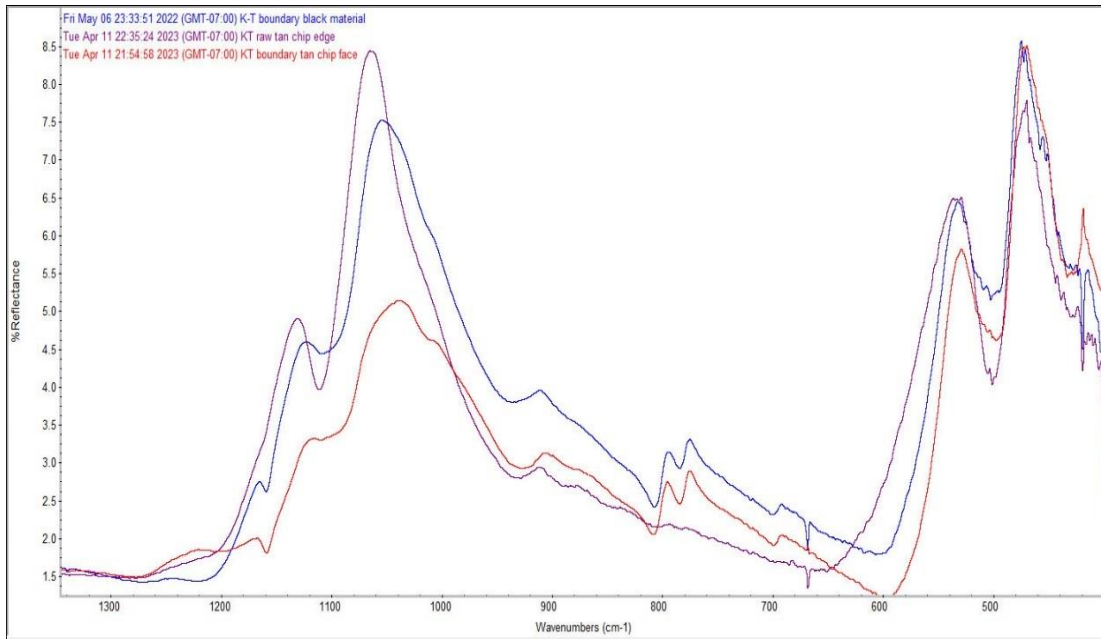


Fig. 1. K-T lower white and upper black layers compared. Upper K-T black coal (blue spectrum), lower K-T tan chip on chip edge (magenta spectrum), cleavage plane face (magenta spectrum). All are bentonite, some scans with quartz.

A comparison of a KT white to tan chip of bentonite it compared to kaolinite and illite to show the differences, (Fig. 2). There are many definitions of illite including fine muscovite, but the author uses the illite spectra in the kaolinite group as indicated here.

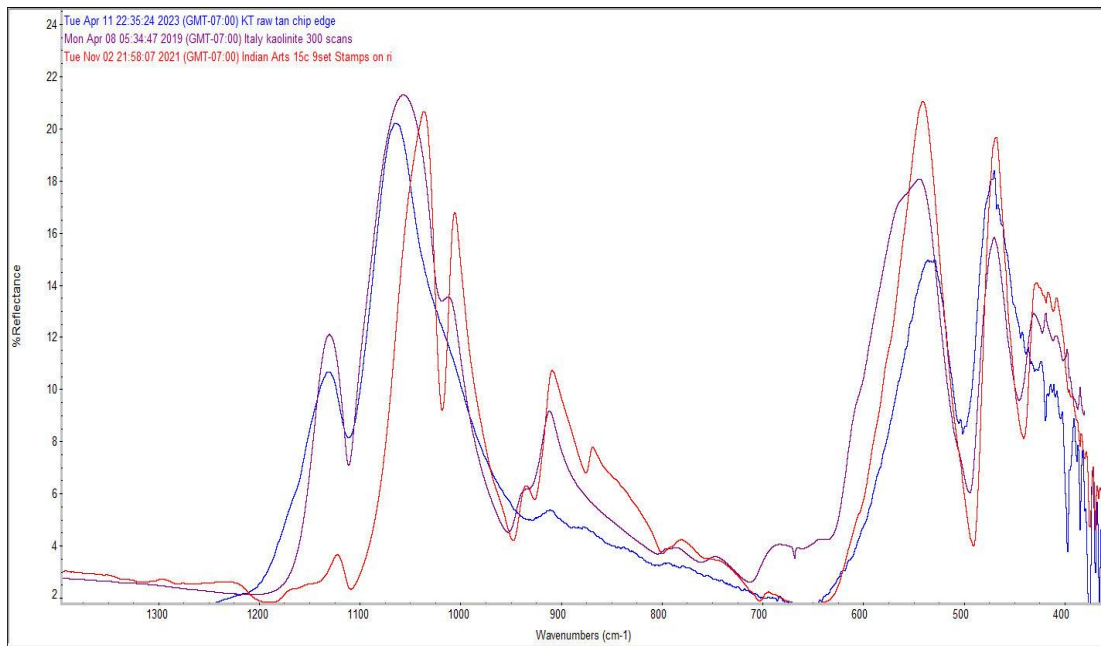


Fig. 2. KT chip of bentonite (blue spectrum), Italy kaolinite showing 900 cm-1 peaks (violet spectrum), stamp with illite, a kaolinite-group mineral (red spectrum). Even though the illite is quite shifted in the 1100-1000 cm-1 region, it has the same 900 cm-1 peaks and one of the two kaolinite water bands (not shown) in the same 4500 cm-1 region.

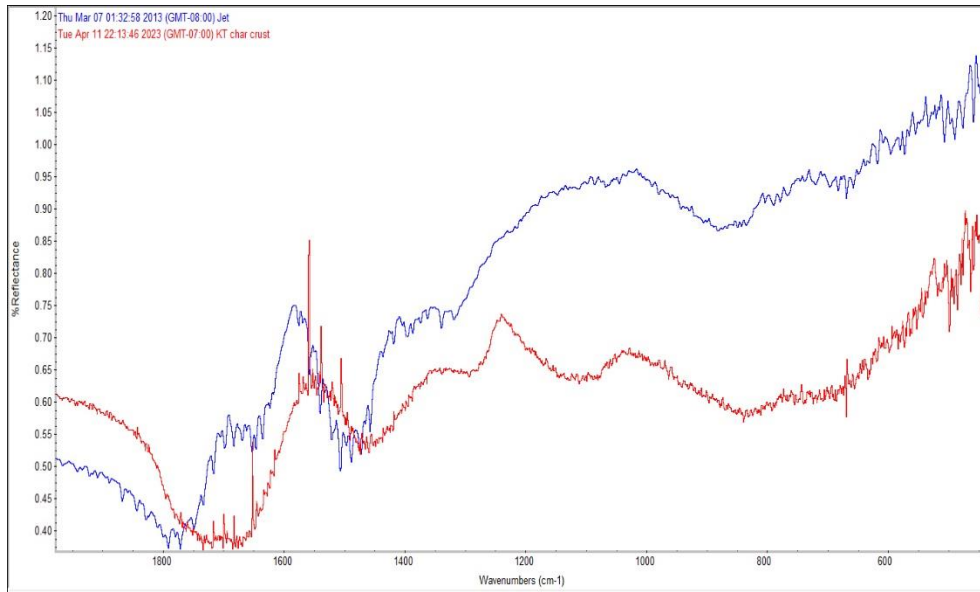


Fig. 3. Comparison of jet (anthracite coal, blue spectrum) to a KT char bedding plane (red spectrum). The two are fairly close. This tiny sheet came from the lower white layer.