



WEIGHING THE EVIDENCE FOR A MASS EXTINCTION PART 2: ON LAND

INTRODUCTION

The iridium-rich clay layer at the boundary between the Cretaceous (K) and Tertiary (T) periods is not only found in rocks that used to be at the bottom of the ocean 66 million years ago. The K-T clay layer is also found in rocks that were part of the land at the time; the fossils in those rock layers reveal what happened to land species during the mass extinction event. In this activity, you will examine the evidence for a mass extinction based on the fossilized plant pollen and fern spores found in rock layers below and above the K-T boundary.

Pollen is produced by both gymnosperms (seed-producing plants, including conifers and cycads) and angiosperms (seed-producing flowering plants, such as magnolias and roses). Ferns, on the other hand, reproduce by spores and have neither seeds nor flowers. By analyzing samples of fossil pollen and spores, scientists have found striking differences in the kinds of plants that were present in the upper Cretaceous and the lower Tertiary periods.

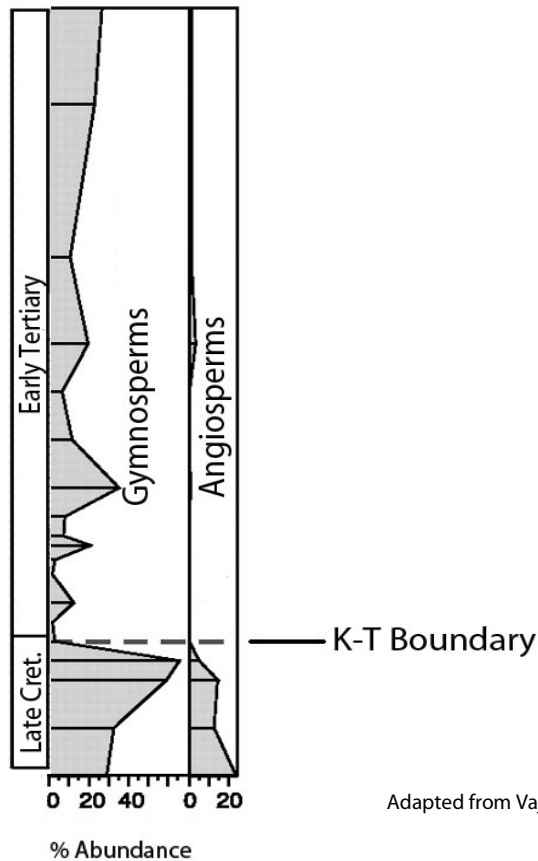
PROCEDURES AND QUESTIONS

Part 1: Analyzing Plant Fossils Found Near the K-T Boundary

The graphs on the next page show the abundance of pollen (Figure 1) and fern spore (Figure 2) fossils isolated above and below the K-T boundary in Moody Creek in New Zealand. Dr. Vivi Vajda and colleagues counted all the pollen and spore fossils found in each sediment layer and calculated and graphed the percent (%) abundance of angiosperms, gymnosperms, and different species of ferns found in the various rock layers.

Part 1: Analyzing Plant Fossils Found Near the K-T Boundary

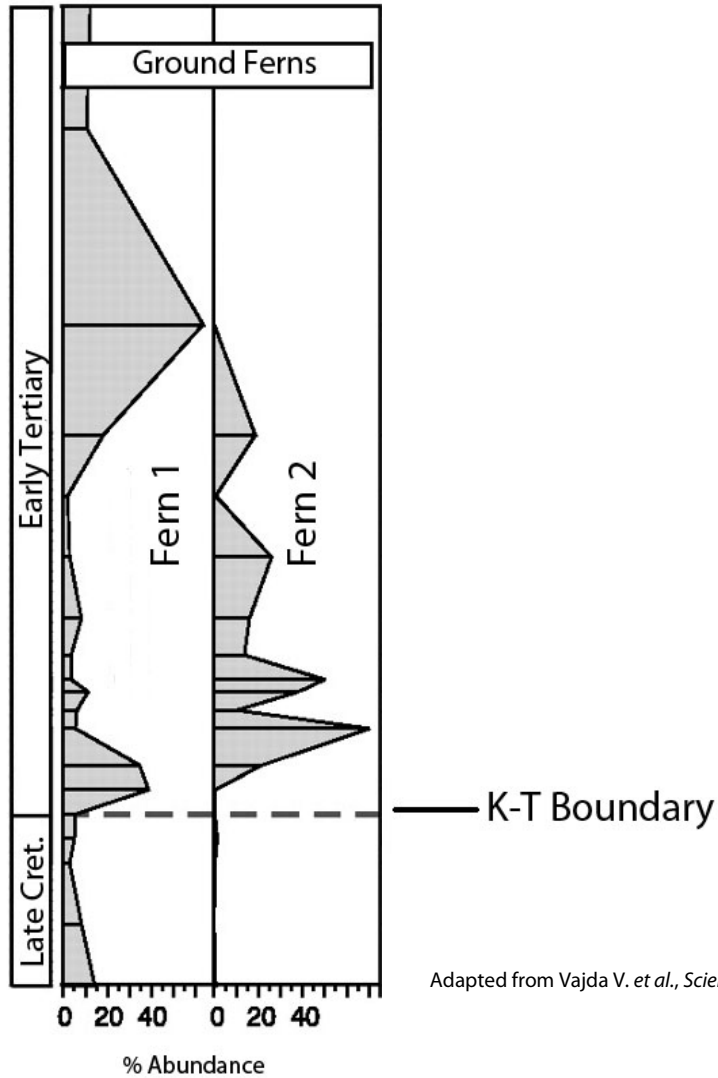
Figure 1. Abundance of Gymnosperm and Angiosperm Pollen Fossils



1. What happens to the abundance of angiosperm and gymnosperm pollen fossils **at** the K-T boundary?

2. What happens to the abundance of angiosperm and gymnosperm pollen fossils **after** the K-T boundary?

Figure 2. Abundance of Two Species of Fern Spore Fossils



Adapted from Vajda V. et al., Science 2001

3. What is the percent composition of fern spore 1 in the sediment of the Cretaceous period? You may write a range.

4. What is the percent composition of fern spore 2 in the sediment of the Cretaceous period?

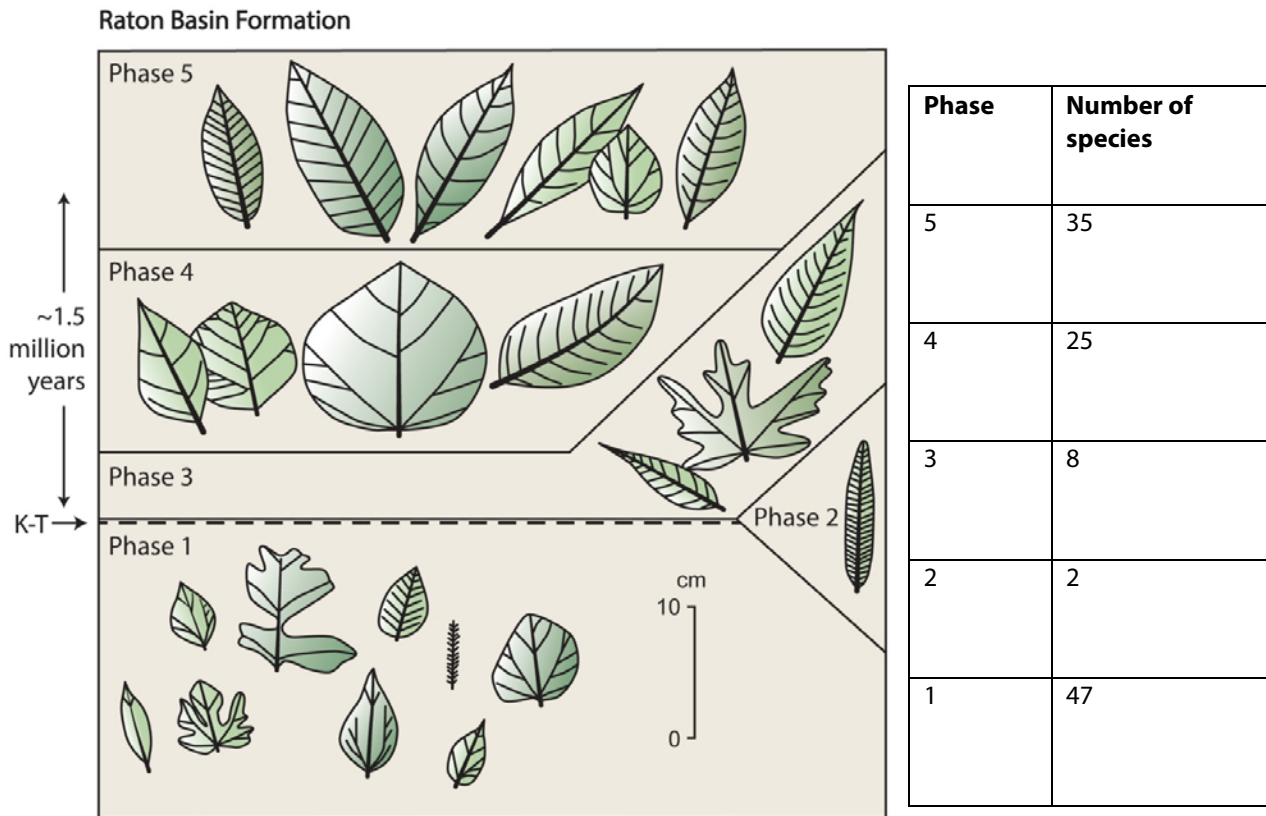
5. Describe what happens to the abundance of fern spore fossils in rock layers right **above** the K-T boundary.

6. Compare the fern spore data to the angiosperm and gymnosperm data.

Part 2: Survival and Recovery

Figure 3 and the accompanying table show the diversity of plants in the late Cretaceous and early Tertiary periods as determined by leaf fossils found in rock layers from the Raton Basin formation of Colorado and New Mexico. The fossils have been grouped in “phases” of changing diversity. The rock layers from the late Cretaceous, labeled Phase 1, show fossils of leaves from palm trees, Laurales (an order of flowering plants related to magnolias), and other plant species that live in tropical climates. The K-T clay layer is shown by the dotted line between Phase 1 and Phase 2. Phase 5 corresponds to about 1.5 million years after the K-T boundary.

Figure 3: Changes in Leaf Diversity from the Cretaceous to the Tertiary Periods



(Adapted from Wolfe, J. A. and Upchurch, G. A. 1987 *Proc. Natl. Acad. Sci. USA* **84**:5096-5100.)



- 7. Which phase has the most leaf diversity?

- 8. Which phase has the least leaf diversity?

- 9. Based on what you learned in Part 1 of this activity, which plant species do you think would be the most prevalent in phase 2, immediately after the K-T event?

- 10. Does leaf diversity increase or decrease between phases 2 and 3? What about in subsequent phases?

- 11. Describe the overall picture of changes in plants throughout the 2-million-year period represented in Figure 3 and in the graphs in Part 1. Be sure to include the following words in your description: extinction, recovery, Cretaceous, millions of years.



12. In the boxes below, draw pictures representing the flora you might have seen right **before** the K-T event and right **after** the K-T event.

Before the K-T event

A large, empty rectangular box with a black border, intended for drawing flora before the K-T event. The text "Before the K-T event" is written in bold black font at the top left of the box.

After the K-T event

A large, empty rectangular box with a black border, intended for drawing flora after the K-T event. The text "After the K-T event" is written in bold black font at the top left of the box.

AUTHORS

Written by Mary Colvard, Cobleskill-Richmondville High School (retired)

Edited by Laura Bonetta, PhD, and Eriko Clements, PhD, HHMI; Susan Dodge, editorial consultant

Reviewed by Vivi Vajda, PhD, Lund University, Sweden

Copyedited by Linda Felaco

FIELD TESTERS

Moira Chadzutko, St. John The Baptist Diocesan High School; Linda Ciota, St John the Baptist Diocesan High School