Honors Seminar 256 — cheat sheet for 11/3/2011 — Andrew Baker

Alvarez et al. (1980)

You should read the whole article. You can skim through the detailed descriptions of the different layers of rock and clay; it is probably not necessary to pore over the figures, although Figure 1 is interesting and the top panel of Figure 3 shows the authors' main result. Key questions:

1. Were the dinosaurs the only group of organisms to become extinct at the end of the Cretaceous period?

2. Why did the authors originally measure the iridium content in the C–T boundary layer? (Hint: it wasn't because they expected it to be unusually high!)

3. When the authors measured a high iridium concentration in the C–T boundary layer, how did they convince themselves this was not simply the result of a tendency for iridium to build up in clay, or a local effect restricted to their particular Italian site?

4. Why did the authors measure the concentration of iridium in present-day seawater? (Can you speculate on why they did this "off the central California coast"? Hint: a likely answer may be found on the first page of the article.)

5. How do the authors argue against the proposition that the iridium enhancement in the boundary layer could have been due to material drawn from the Earth's crust? Are there any weak points to this argument?– and if so, how do the authors deal with them?

6. On page 1102, the authors write that in one scenario for the iridium enhancement, "the positive iridium anomaly should be accompanied by a compensating negative anomaly immediately above, but this is not seen." What's the logic of this argument?

7. What does the lack of plutonium 244 in the boundary layer tell us about the specific origin of the iridium in the boundary layer?

8. What does the ratio of iridium isotopes in the boundary layer tell us about its specific origin?

9. What (qualitatively) are the four strategies the authors use to estimate the size of the asteroid whose impact might have triggered the C–T extinction?

10. On page 1106, the authors write "it would thus appear that the dinosaur and foram–nannoplankton extinctions were not synchronous." Why is this a problem for their hypothesis, and what bold prediction to they go on to make as a result?

11. When this article was published, the Chicxulub crater had not yet been discovered. What explanations do the authors offer for why the crater of the C–T impactor might *never* be discovered?

Key terms:

- **albedo** = fraction of incident light that an astronomical body reflects
- **ammonite** = a type of extinct marine animal whose spiral shells are commonly found as fossils
- **bedding-plane** = boundary between two thicker layers of sedimentary rock
- **belemnite** = a type of extinct marine animal related to squid and octopi
- **beta decay** = atomic process by which a neutron ejects an electron and turns into a proton; if this process occurs inside the nucleus of an atom, the atomic number will increase by one (e.g., $^{15}\mathrm{O} \rightarrow {}^{15}\mathrm{N}$)
- **bivalve** = any mollusk whose shell has two nearly identical pieces (e.g., a clam)
- **bryozoan** = a type of coral-like animal that lives in a colony and produces a calcium carbonate skeleton (some species exist today; others are extinct)
- **chemical yield** = for a chemical reaction, the ratio between the mass of a product that is actually produced per mass in reactants, and the mass of the product that is *theoretically* produced according to the reaction formula
- **chert** = mineral that is found in other sedimentary rock due to geological processing after the sediment was laid down; cherts found in chalk, for example, are referred to as "flints"
- **coccolith** = a single, small plate of calcium carbonate produced by a living organism
- **concretion** = a sedimentary rock formation in which the space between sediment grains has been filled with some sort of mineral cement; often (but not always) round in shape
- **Danian** = the first four million years of the first (Paleocene) epoch immediately after the Cretaceous/Tertiary extinction event
- **diachronous** = adjective describing a sedimentary rock in which different parts have different ages
- **echinoderm** = phylum of marine animals that includes sea urchins and starfish; characterized by fivefold symmetry
- **foraminifera** = category of single-celled organisms that resemble amoebas and generally produce calcium carbonate shells
- **geomagnetic reversal** = a flip in the orientation of the Earth's north and south magnetic poles; a series of such reversals can be traced in the magnetic field that is "frozen into" the new sea-floor material on eiher side of a mid-ocean ridge
- **lamination** = division of sedimentary rock into many thin layers

- **NAA** = neutron activation analysis = technique for identifying the constituents of a mixture of chemical elements
- **nan(n)oplankton** = organisms of all taxonomic classes that float in the ocean and comprise the base of the marine food chain, and whose size is in the range $2 - 20\,\mu$m
- **neutron capture** = mechanism for the production of a heavier atomic nucleus from a lighter one by the addition of a free neutron; this process can occur either slowly inside stars, or rapidly in supernovae
- **pelagic** = adjective describing regions of the ocean that are *not* close to the bottom
- **power law** = a function of the form $y = x^\alpha$ for some value of α; this looks like a straight line when plotted in logarithmic coordinates
- **pyrite** = "fool's gold", a mineral whose composition is FeS_2
- **soft-sediment slumping** = motion of loose material down a slope
- **solar constant** = incident radiation per unit area from the Sun, as measured at the surface of the Earth
- **stratigraphy** = branch of geology focused on the study of rock layers and the process by which they are laid down