LARGE-BODY IMPACT: THE LEAST UNLIKELY CAUSE OF PULSED EXTINCTION

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In the past year, a strong consensus in the geological community has developed in favor of comet or asteroid impact as the ultimate cause of the K-T mass extinction, although many paleontologists remain doubtful. The discovery of tektites and craters with argon-argon ages matching the K-T boundary has finally removed the "smoking gun" problem. It is important, therefore, to evaluate large-body impact as a possible cause of other Phanerozoic extinctions, and to do so as carefully as possible before enthusiasm for the K-T success overwhelms objectivity in this research area.

Approximately 60% of all species extinctions in the Phanerozoic occurred in "pulsed" extinctions, defined as ecologically and geographically pervasive episodes in which the number of species going extinct in a geologically short interval far exceeds any reasonable estimate based on chance coincidence of independent events. In addition to the well-known mass extinctions, pulsed extinctions often mark system, series, and stage boundaries, and probably some zonal boundaries.

To be plausible, any proposed cause of pulsed extinctions must be (1) geographically pervasive (regional or global), (2) effective in diverse habitats, and (3) relatively quick-acting (to inhibit survival of species by migration or adaptation). The stresses causing the extinctions must be sufficiently severe and rare to be beyond the reach of natural selection, so that species do not have prior opportunity to evolve defenses.

These requirements severely limit the possibilities to phenomena that occur on time scales of one million to tens of millions of years, far longer than the tens or hundreds of years available for study by traditional actualistic approaches. In view of the Phanerozoic record, it is not surprising that the earth has not experienced a pulsed extinction in historic times (excluding human influences). This suggests that extinction is one case where the present is a not the key to the past, and a full exploration of the problem will require a substantial re-ordering of thinking.

Furthermore, because pulsed extinctions involve geographically widespread species (as well as restricted taxa), and because extinction of widespread species may be qualitatively different from that of local endemics, the common extrapolation from studies of extinction in local populations is risky.

Of the many phenomena suggested as causes of pulsed extinction, large-body impact is the one that most nearly satisfies the requirements, and is therefore the least unlikely of the candidates. Temporal distribution is especially critical. Currently accepted flux estimates for comet and asteroid impacts are in the appropriate frequency range to explain the extinction record, but testing the hypothesis will depend on better radiometric dating of the 100+ craters and other confirmed impact events.