ACCRETION RATE OF EXTRATERRESTRIAL MATTER: IRIDIUM DEPOSITED OVER THE LAST 70 MILLION YEARS.

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In order to quantify the accretion rate of extraterrestrial matter during the Cenozoic, we have measured Ir concentrations in a continuous series of ~450 samples across most of the length of piston core LL44-GPC3. LL44-GPC3 is a 25–meter–long, large–diameter piston core of abyssal clay from the central North Pacifc (Fig. 1). This core contains a nearly continuous record of sedimentation over the last 70 Ma, as this site migrated from a region near the Equator in the late Cretaceous to its present position north of Hawaii.

We are now in the process of completing our first-cut survey across the core, and all of the conclusions of our earlier study [1], in which we reported the concentrations of Ir, Co, and Sb across 9 meters of this core, (encompassing the time span from ~33 to 67 Ma) remain unchanged. The only strongly enhanced Ir concentrations occur at the KT boundary and outside the KT boundary Ir correlates well with Co, a terrestrial element which is largely present in hydrogenous ferromanganese oxide precipitates from seawater. Concentrations of both elements appear to be inversely correlated with the sedimentation rate. Our estimated accumulation rate of extraterrestrial Ir (~9 ± 3 ng cm^{-2} Ma^{-1}) is consistent with recent estimates of the influx of dust, meteorites, and crater-producing bodies in the mass range 10^{-13} to 10^{18} g. We have failed to find the Ir maxima (>30 times background) predicted by hypothesized periodic comet showers at the KT and Eocene-Oligocene boundaries or in the mid Miocene, and even the KT boundary does not contain as much Ir as predicted by these models. This study severely limits the magnitude of such showers and casts serious doubt on their existence [2].

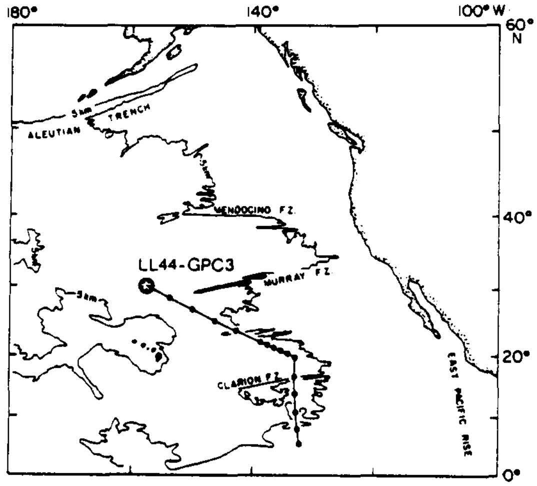

Fig. 1 Present location and backtrack path of LL44-GPC3 relative to the Hawaiian hot spot. Each dot represents 5 Ma.

Although the KT Ir anomaly is unique in magnitude in this core, there are several small bumps in the Ir profile which may reflect smaller accretionary events. However, more detailed work is necessary to demonstrate whether this is the case. The most promising Ir enhancement has been observed in a 30 cm section ~1 m below the KT boundary. Our preliminary data suggest deposition of an excess of ~10 ng Ir cm^{-2} across this interval at a time we estimate to be ~1 Ma before the KT impact event, but we must repeat that there is insufficient evidence at present to prove that this reflects enhanced accretion of extraterrestrial matter. Another interesting feature of the Ir profile is a significant (~2 times) increase in the Ir/Co ratio from the late Paleocene to early Oligocene. Although one possible cause of this increase is a change in the influx of extraterrestrial matter, both the duration and the singularity of this increase in the core argue against its being caused by periodic comet showers.

We are now in the process of preparing a detailed model of the chemical record of sedimentation in this core [4], using a combined database of 39 elements determined by NAA (this study) and XRF (by G.R. Heath) in ~450 samples across the Cenozoic. Using these chemical data it is possible to resolve 8 distinct sediment end-members which have influenced the sedimentation history at this site since the late Cretaceous. These sedimentary components include eolian terrigenous material, hydrothermal precipitates from the East Pacific Rise, Hawaiian volcanics, silicic volcanics, hydrogenous ferromanganese precipitates, biogenic phosphate, biogenic siliceous material, and the extraterrestrial component. Our preliminary working model indicates that the only sedimentary sources which contribute significantly to the Ir budget in this core are the hydrogenous precipitates and extraterrestrial particulates.

REFERENCES:

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