RECENT EVIDENCE ON THE NATURE OF THE LATE PLIOCENE IMPACT EVENT

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The Late Pliocene impact event is recorded in piston cores collected two decades ago by the USNS Eltanin. In our initial study (1) we reported anomalous concentrations of Ir and Au in 2.3 Ma-old sediments in piston core E13-3, and the presence of Ir-rich projectile debris. This core was recovered from seidments at 57°00'S and 89°29'W in the Antarctic Basin in the SE Pacific. In a subsequent study, Kyte and Brownlee (2) described vesicular impact melt debris and unmelted meteoritic material and they reported the discovery of these particles in piston core E13-4 located 120 km SW of the initial discovery. The compositions of the impact melt and unmelted debris indicated that the projectile contained at least 3% metal and that it's silicate components were similar to those in howardites and mesosiderites. They further proposed that the projectile diameter was 100 to 500 m and that an oceanic impact had occurred with no evidence for excavation of seafloor.

We are currently engaged in a series of experiments to further characterize the Late Pliocene event. We have nearly completed detailed chemical analyses of the second locality, E13-4 and are analyzing four additional piston cores for Ir in order to extend our coverage of the event to a radius of 500 km.

The major thrust of our latest analyses has been the characterization of the impact debris and bulk sediment of the horizon in E13-4. We found that Kyte and Brownlee (2) missed the peak concentration of the debris in this section because of an error in the paleomagnetic stratigraphy. The earlier estimate of the impact-derived material was low by a factor of about 100.

To date we have recovered 550 mg of vesicular impact melt from E13-4 with a peak concentration of about 10% particles ranging from 0.5 to 5 mm in size. The present estimate of the particle fluence is 270 mg cm^{-2} (the fluence at E13-3 was 100 mg cm^{-2}). At least 10 unmelted meteoritic particles have also been recovered, increasing the potential for gaining new information about the bulk asteroid. We have analyzed 9 impact melt and 3 unmelted particles by INAA. The impact melt particles are similar in composition to those measured from E13-3; the mean Ir content of this vesicular material is ~200 ng/g. Two of the basaltic particles have very low siderophile contents, but one contains 160 ng/g Ir. We will section this particle to obtain information on the elusive siderophile-rich phase (currently interpreted as metal) in the parent asteroid.

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The peak Ir concentration in E13-4 is found at the interval 1296-1298.6 cm. The base of this horizon occurs at a hiatus in the section where Late Pliocene sediments overly sediments Early Eocene (~55 Ma) in age. Our preliminary estimate of the Ir fluence in the section is 200 ±50 ng cm^{-2} (uncertainties result from broken and missing sections in this old core). This Ir fluence is considerably higher than found in typical Cretaceous-Tertiary boundary sediments (usually <50 ng Ir cm^{-2}). This Ir fluence is also about a factor of 4 greater than expected based on the particle fluence and particle Ir concentration. Kyte and Brownlee (2) noted a similar situation in E13-3 where the particles could account for only 1/3 of the Ir. These data imply that either large amounts of particulate debris have been dissolved by weathering, or that another fraction of the fallout was the major carrier of siderophiles. In the latter case, Ir may have been largely contained in fine-grained matter or in subsequently weathered metal grains.

These data require a new estimate of the projectile diameter. This is accomplished by using assumptions similar to those of Kyte and Brownlee (2): 1) the Ir fluences at sites E13-3 and E13-4 are representative of the amount of fallout, 2) the 200 ng/g Ir concentration of the vesicular impact melt is typical of the bulk projectile, and 3) impact debris is deposited in a gaussian distribution with site E13-4 at the peak concentration. Given these assumptions and an asteroid density of 3.5, the mass of material to a radius of 120 km (to E13-3) is 3×10^{14} g; equivalent to projectile diameter of 560 m. We consider this to be a conservative estimate and expect that characterization of this event in new localities will result in a considerably larger estimate.

(1) Kyte, F.T., Zhou, Z. and Wasson, J.T. (1981) Nature **292**, 417-420.

(2) Kyte, F.T. and Brownlee, D.E. (1985) Geochim. Cosmochim. Acta **49**, 1095-1108.

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