IS THE SOOT LAYER AT THE KT BOUNDARY REALLY GLOBAL? W. S. Wolbach, S. Widicus, S. Moecker, Department of Chemistry, Illinois Wesleyan University, P.O. Box 2900, Bloomington IL 61702-2900, and F. T. Kyte, Institute of Geophysics and Planetary Physics, University of California, Los Angeles CA 90095-1567.

Since 1985, significant quantities of reduced, elemental carbon and soot (submicron spherules of amorphous carbon welded into characteristic clusters and chains) have been found in twelve KT boundary sites [1-3]. Because of the wide geographic distribution of these sites (Denmark, Italy, Spain, Austria, Tunisia, Turkmenistan, New Mexico USA, New Zealand), these data were interpreted to indicate that deposition of soot was a global phenomenon, coincident with the Ir-rich fallout layer. This interpretation was supported by the fact that the highest concentrations of soot were found in samples with the highest concentrations of Ir and other ejecta components. The likely source of the global soot deposit is eolian deposition from extensive (or global) wildfires directly associated with the KT impact event. An estimate of the amount of soot distributed globally from the fires was 2.2 ± 0.7 mg/cm2 [3].

In this paper, we report data that test an important component of this global wildfire hypothesis. At 65 Ma, these twelve sites were all located on continental margins or in epicontinental seaways (most at depths <100 m at the time of deposition). As they were all situated in sedimentary basins where fine-grained detritus from continental margins might be concentrated from non-eolian sources such as rivers and streams, the possibility remains that soot in these sediments is not representative of a global airfall deposit.

To test this, we measured soot in samples from five KT boundary sites which were situated in the central portion of the paleoPacific basin at 65 Ma [4]: LL44-GPC3 (30˚19'N, 157˚49.9'W), ODP Sites 803 (2˚25.98'N, 160˚32.46'E) and 886 (44˚41.38'N, 168˚14.40'W), and DSDP Sites 576 (32˚21,37'N, 164˚16.52'E) and 465 (33˚49.23'N, 178˚55.14'E). Reduced carbon was isolated from sediments using HCl and HCl/HF. Elemental carbon was separated from organic carbon by acidic dichromate oxidation under controlled conditions. The elemental carbon of interest (soot, charcoal) was identified and characterized using SEM imaging and quantified by weighing and particle size analysis [5]. Iridium concentrations were measured in splits of most of these samples.

The KT boundaries from Sites GPC3, 803, 886 and 576 were all from quite oxidized sediments and we considered it possible that soot might not be preserved at these sites. This proved to be correct as no soot or elemental carbon was recovered. Upper limits on soot concentrations ranged from <2 to <18 ppm in these samples. Oxidative destruction of elemental carbon is consistent with an earlier study [6] of charcoal fluxes in marine sediments that were observed to decrease with increased sediment age.

However, at Site 465 the KT boundary is marked by a thin (~3 mm), black, pyrite-rich clay that should contain a record of global soot fallout if such existed in the central North Pacific, some 5000 km from the nearest continental landmass at 65 Ma. Unfortunately, sediments from Site 465 were severely disturbed by rotary drilling of the cores and much of the stratigraphy has been jumbled, but enough information is available to identify specimens of the KT boundary clay [4]. Our

sample of the KT boundary from Site 465 (465A-3-3; 129-131 cm) consisted of fragments of black, pyrite-rich clays, consisting largely of spheroidal material, mixed with tan-colored, pyrite-bearing calcareous ooze. Based on descriptions from an intact piece of the KT boundary described earlier from this core [4] our sample is believed to contain a mixture of boundary clay and lowermost Tertiary sediments. Measured concentrations for Ir (11 ng/g), Au (29 ng/g) and carbonate (~65 %; based on Ca concentration) are consistent with this sample containing ~30% boundary clay material. This would be roughly representative of ~1 cm of stratigraphy including the KT boundary and the lowermost Tertiary.

This KT boundary clay sample contained 3600 ± 400 ppm elemental carbon and 1800 ± 200 ppm soot, at least two orders-of-magnitude higher concentrations than the upper limits measured in any of the oxidized KT boundaries at other sites. An additional seven samples from the same section of core (465A-3-3; 150 cm in length) were analyzed to determine whether soot was abundant in lower Tertiary sediments. Soot was detected in three of these, the highest being 500 ± 70 ppm soot in a tan ooze with 12.5 ng/g Ir; probably from very near the KT boundary. Because of the severe drilling disturbance, we cannot rule out the possibility that these samples might have contained small fragments of the boundary clay. Fragments of black sediment were observed to be distributed over about 2 m of core. Three background samples were taken from each core section above (465A-3-2) and below (465A-3-4). No soot was detected in these, with upper limits ranging from ≤ 1 to ≤4 ppm.

We conclude that the global wildfire hypothesis has passed this test. The only reduced KT boundary sediments known in the Pacific basin contain abundant elemental carbon and soot. A conservative estimate of the carbon flux to this site can be obtained from the KT boundary sample assuming that it is representative of 1 cm of section, that all the carbon fallout is restricted to these sediments, and that the sediment dry density is 1 g/cm3. The calculated elemental carbon flux to Site 465 of 3.6 mg/cm2 is somewhat less that the 11 ± 3 mg/cm-2 average estimated from 12 continental sites, but close to values measured for Agost, Spain, Woodside Creek, New Zealand, and Raton, USA. The calculated flux of soot to Site 465 is 1.8 mg/cm2, well within the average range of 2.2 ± 7 mg/cm2 estimated from other sites. Since the soot is the more fine-grained component of the wildfire smoke, it may be more likely to be globally dispersed and the close agreement of these estimates may be quite significant.

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