AUSTRALASIAN MICROTEKTITES IN THE SOUTH CHINA SEA: IMPLICATIONS REGARDING THE LOCATION AND SIZE OF THE SOURCE CRATER. B. P. Glass, Geology Department, University of Delaware, Newark, DE 19716, USA

Introduction: Australasian microtektites have been found in over 50 sites in the Indian and western equatorial Pacific Oceans; the Philippine, Sulu, and Celebes Seas; and more recently in the South China Sea [1-5]. Glass and Pizzuto [2] used geographic variations in concentrations of microtektites (number >125 µm dia./cm^2) to predict the location of the source crater. The location that explained the geographic distribution the best was 12° N, 106° E. This location was supported by Lee and Wei [5] based on data from two additional cores. Previous estimates of the source crater diameter range from 17 to 114 km [2,5,6].

I report here additional microtektite/impact ejecta data for Core 17957-2 taken in the South China Sea (10° 53.9' N, 115° 18.3' E) during the SONNE-95 cruise [3]. I also report the discovery of abundant Australasian microtektites and associated shock-metamorphosed grains in Ocean Drilling Program (ODP) Hole 1144A, in the northern South China Sea (20° 3.18' N, 117° 25.14' E). ODP Site 1143 (9° 21.72' N, 113° 17.11' E) was also searched for microtektites, but the layer was not found at this site. The new data from Core 17957-2 and Hole 1144A, as well as from other Australasian microtektite-bearing sites, were used to reevaluate the location and size of the source crater.

Core 17957-2: Nearly 3000 microtektites (>125 µm dia.) were recovered from Core 17957-2. About 90% of the microtektites were found between 798 and 818 cm depth (i.e., a 20 cm interval), although scattered microtektites were found over a 2.25 m interval. The peak abundance is at a depth of about 806 cm. Close to 55% of the microtektites are splash forms (spheroids, teardrops, dumbbells, disks), the remainder are fragments. The largest spheroid is ~880 µm in diameter. The largest elongate form is 1.4 mm long and the largest fragment has a maximum length of ~2.1 mm. Many of the fragments are larger than the largest spheroid and exhibit no obvious original outer surface and, thus, may be tektite fragments. Unmelted impact ejecta make up about 20% of the ejecta in the microtektite layer. The most obvious unmelted ejecta are white opaque grains consisting of mixtures of quartz, coesite, and traces of stishovite (and probably lechatelierite). Numerous shocked-rock fragments are also present and X-ray diffraction (XRD) studies indicate that they generally consist of coesite, quartz, stishovite(?), and a clay/mica phase. The maximum length of the largest shocked-rock fragment is ~1 mm. I estimate that the number of microtektites and unmelted ejecta (>125 µm) per cm^2 at this site is 2918 and 814, respectively.

ODP Hole 1144A. The microtektite layer at this site was found in Core 37x, Section 6. More than 90% of the microtektites were found between 61 and 71 cm with the peak abundance at ~68 cm depth (~345.68 m below the sea floor). Scattered microtektites were found over a 1.46 m interval. The total number of recovered microtektites was 18,189. About 75% are fragments, the remainder is splash forms. A small percent of the glass is highly vesicular with a frothy appearance. In addition, a few, dark, translucent to opaque, heterogeneous blebs of normal impact glass were recovered. Unmelted ejecta make up 44% of the total impact ejecta. Roughly 20% (by number) of the unmelted ejecta are white opaque grains, which according to XRD studies, contain various proportions of quartz, coesite, and stishovite (and presumably lechatelierite). One appears to be pure stishovite. Most of the rock fragments are light- to dark-grey, equant, subangular to subrounded, and fined-grained (generally <20 µm). XRD studies indicate that the rock fragments are mixtures of quartz, coesite, and a mica/clay phase. At this site, the estimated number of microtektites (>125 µm)/cm^2 is 9834 and the estimated number of unmelted ejecta grains (>125 µm)/cm^2 is 7327. At the peak abundance level, impact ejecta (including microtektites) make up >90 wt.% of the coarse (>125 µm) fraction. Thus, Hole 1144A has the highest concentration of microtektites (>3 time higher), the highest percent of fragments versus whole microtektites, and the highest ratio of unmelted to melted ejecta of any previously studied Australasian microtektite-bearing site. All of this suggests that this site is closer to the source crater than any other site.

Predicted Source Crater Site and Size: The source area can be predicted by assuming locations of hypothetical source craters and then regressing the concentrations of microtektites at each core site versus the distance from the postulated crater [2]. The location that gives the highest correlation coefficient (r^2 value) indicates the location that explains the geographical variation in microtektite concentrations the best. Using the microtektite concentrations for Core 17957-2 and ODP Hole 1144A given above, as well as data from Glass and Pizzuto [2] and Lee and Wei [5], indicate a source crater location near 15° N and 105° E with an r^2 value of 0.86. This is 3° farther north and 1° farther west than predicted by Glass and Pizzuto [2] and Lee and Wei [5], but it is closer to the location predicted by Schnetzler [7] based on geographical variations in composition of Muong Nong-type Australasian tektites. However, any place in northern Cambodia, central Laos, or eastern Thailand would explain the geographic distribution nearly well. ODP Hole 1144A is the closest microtektite-bearing site to this location (~1430 km away) which is consistent with the observations discussed above that indicate that this site is closer to the source crater than any other Australasian microtektite site.

The size of the source crater can be estimated based on equations that relate the thickness of an ejecta layer to the size of the source crater and distance from the source crater (e.g., [8]). The concentrations of microtektites were first used to estimate the thickness of the layer, prior to bioturbation, at each site (an average microtektite diameter of 200 µm was used in the calculations). The maximum thickness obtained was only ~800 µm. Using these thicknesses in the equations of [8] indicate a source crater diameter of 33 ± 6 km (based on eleven sites with the highest concentrations). If the unmelt ed ejecta at Site 1144A are included in the estimate of the ejecta layer thickness, the estimated size of the source crater increases from 39 to 44 km. Unfortunately, concentrations of unmelted ejecta at most other sites have not been determined, but appear to be too low to make much of a difference. Comparison of microtek tite concentration versus distance from the source crater between the Australasian strewn field and the Ivory Coast and North American strewn fields with source craters of 10.5 km and 85 km in diameter, respectively, suggests that the Australasian source crater is intermediate in size but probably closer to the size of the North American source crater. Thus, a diameter of ~40 km appears to be a reasonable estimate based on present knowledge. This is smaller than most previous size estimates (e.g., [2,5,6]); however, this smaller size is more in line with the apparent lack of any climatological and/or biological effects of the impact responsible for the Australasian strewn field.

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