THERMOLUMINESCENCE AS A TECHNIQUE FOR DETERMINING THE NATURE AND HISTORY OF SMALL PARTICLES.

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Introduction: Thermoluminescence (TL) – and closely related cathodoluminescence (CL) – provides unique information on thermal and radiation history of extraterrestrial samples and the nature and composition of certain key minerals and phases in these materials [1]. The techniques have been particularly useful in addressing the metamorphic history of little-metamorphosed chondrites [2] and surveying the geologically recent history of Antarctic meteorites [3]. For several years we have been considering the value of these techniques in exploring the nature and history of small particles, such as Stardust particles and IDPs, and here summarize results for 50-100 µm fragments of Semarkona matrix and 100-160 µm micrometeorites [4-7].

Semarkona matrix: We analyzed eight fragments, characterized them with SEM and EDX, and measured their natural and induced TL using methods we have frequently described. We detected induced TL signals from all these samples, but the characteristics (TL peak temperature and width) were unlike those of UOCs where the phosphor is feldspar. CL suggests that the major luminescence phase in the Semarkona matrix is forsterite. The present data showed similarities to terrestrial forsterites from igneous and metamorphic locations, but sufficient differences to suggest that they were formed by a different mechanism, perhaps vapor deposition. We suggest that vapor deposited forsterite is an important component of primitive materials.

Micrometeorites: We obtained seven micrometeorites from Cecile Engrand . Three of these objects show measurable induced TL and the shape of the TL curves resembled those of CO and certain CV chondrites, and unlike ordinary chondrites. Four of these objects showed no measurable TL, and in this sense resemble CI and most CM chondrites. These data would suggest that micrometeorites are related to the C chondrite classes, but to date we have not detected any that appear to be ordinary chondrites. Of course, this is in stark contrast to observed meteorite falls where ordinary chondrites dominate and C chondrites are rare.

Concluding remarks: The results suggest that TL and CL can provide information for these small particles similar to that obtained for several decades on macroscopic samples.

References:

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