Cathodoluminescence studies of impact glasses

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Introduction

For the present scanning electron microscope-cathodoluminescence (SEM-CL) study we selected three different impact-derived glasses that are characteristic of the range of sample types among such glasses: Aouelloul impact glass (a glass found directly at an impact crater) [1], a Muong Nong-type indochinite (representing a tektite with some known compositional heterogeneity) [2], and Libyan Desert Glass (a glass of impact origin but without obvious crater association) [3].

Discussion

The cathodoluminescence (CL) images of these glasses show more pronounced contrast and brightness variations than the backscattered-electron (BSE) images. The CL images seem to preserve target rock textures much better than any other electron image, even though the samples appear to be totally glassy (e.g., Muong Nong-type tektite). The Aouelloul sample shows quite clearly a granular structure, which might be related to the texture of the original sandstone. Most spectacular are the CL images of the Libyan Desert glass, which show a distorted original texture, probably indicating high-temperature glass flow, which is not apparent at all in the BSE images. The inverse relationship between BSE and CL brightness might be caused by high concentrations of Al, Li and Na, which can lead to quenching of the CL signal [4].

Conclusions

In conclusion, the maximum temperature – and degree of homogenization – experienced by the three glass types increased from the Aouelloul glass (textural features preserved in BSE and CL images: lowest temperature) to the Libyan Desert Glass (flow textures only in CL images: medium temperature), to the Muong Nong-type tektite (almost featureless in BSE and CL images: highest temperature).

References

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Downcore diagenetic changes in POM: implications for paleoproductivity estimates

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Particulate amino acid (AA) content of a 41.85 m long IMAGES core (MD01-2379) collected from 500 m water depth offshore Northwest Australia was analysed to study particulate organic matter (POM) degradation and preservation through glacial – interglacial changes. Comparison of AA profile of the core with the SPECMAP suggests a core bottom age of about 0.52 Ma, which yields a sedimentation rate of about 8 cm/kyr.

AA concentration is the lowest in the lower half of the core, and the highest just below the topmost layer. The glacial – interglacial change related fluctuations in AA are clearly visible in the upper half of the core, while in the lower half, fluctuations are less prominent, but they are prominent in terms of hexosamine (HA) due to relatively higher stability of HA over AA in the process of diagenesis. Relative mole content of non-protein AA (β-ala and γ-aba), which are degradation products of aspartic acid (Asp) and glutamic acid, respectively, is maximum at about 12 m depth, and not at the core bottom, which is contrary to the observation made in core sediments from Hess Rise. It implies that bioturbation and/or some other process led to maximum degradation of POM before it was buried below the bioturbated layers. In absence of bioturbation, accumulation of non-protein AA would take place resulting in their higher content in deeper layers. Relatively high Asp concentration (19.1 ± 2.0 mol.%) suggests that POM is closely associated with organic matrix inside and around the shells of calcareous plankton, because Asp is a necessary component of the organic template on which shell of calcareous plankton develops. Highly negative correlation between 'Degradation Index' and Asp also support this inference. The depth distribution of AA content can be explained with a logarithmic regression equation ($AA_{(\mu g/g)} = -293.6 \ln depth_{(meter)} + 1328.9$; $R^2 = 0.86$, n = 90). Therefore, paleoproductivity estimates based on the organic carbon content of long cores must take a logarithmic degradation/preservation factor for POM into account.