**AMORPHOUS MATERIALS: PROPERTIES, STRUCTURE, AND DURABILITY**

North American microtektites are more oxidized than tektites†

**GABRIELE GIULI1,a, MARIA RITA CICCONI1, SIGRID GRIET EECCHOUT1,‡, CHRISTIAN KŒBERL3, BILLY P. GLASS2, GIOVANNI PRATESI3, MARIANGELA CESTELLI-GUIDI4,5 and ELEONORA PARIS1**

1School of Science and Technology, Geology Division, University of Camerino, Via Gentile III da Varano, 62032, Italy
2European Synchrotron Radiation Facility (ESRF), 6 rue Jules Horowitz, 38043 Grenoble, France
3Department of Lithospheric Research, University of Vienna, Althanstrasse 14, A-1090 Vienna, Austria; and Natural History Museum, Burgring 7, A-1010 Vienna, Austria
4Department of Geological Sciences, University of Delaware, Newark, Delaware 19716, U.S.A.
5Laboratori Nazionali Frascati, Istituto Nazionale Fisica Nucleare, Via Enrico Fermi, Frascati, Italy

**ABSTRACT**

Iron oxidation states and coordination numbers have been determined by micro-X-ray absorption near edge spectroscopy (XANES) on the cores of a large group of microtektites from the Australasian, Ivory Coast, and North American (NA) tektite strewn field. The North American microtektites used in this study have been collected from five sites at different distances from the source crater; most have SiO2 content between 70 and 80 wt%. Accurate analysis of the pre-edge peak energy position and integrated area allowed determination of Fe3+/Fe2+ ratios on all samples with an estimated error of ±0.05.

Microtektites from the Australasian and Ivory Coast strewn fields show low values of the Fe3+/Fe2+ ratios, in fair agreement with tektites from the same strewn field. In contrast, microtektites from the North American strewn fields show a wide range of Fe3+/Fe2+ ratios from 0.02 to ca. 0.61. Comparison of Fe oxidation state data with chemical composition do not show any relation between Fe3+/Fe2+ ratios and Na, Ca, or K contents, thus suggesting that the high-Fe oxidation states are not the consequence of sea-water alteration.

The difference between the Fe oxidation state of tektites and microtektites from the North American strewn fields suggests that some factors in the formation of the North American microtektites were different than for the North American tektites and for microtektites in the other strewn fields.

Previous Fe oxidation state data on NA tektites strongly suggest that the wide range in Fe oxidation state we found on NA microtektites is not related to lateral heterogeneity of the target rocks. Despite a correlation between microtektite oxidation state and distance from the source crater, we maintain that Fe oxidation state is not related only to the microtektite droplet flight distance. This is in keeping with the fact that no significant variations in the Fe oxidation state have been found in microtektites from the Australasian strewn field, even for Australasian microtektites recovered in Antarctica. The Fe oxidation state in North American microtektites could be explained by interaction of melt droplets with a H2O-rich vapor plumes generated during the impact. These data point out that some difference must exist between the thermal histories of microtektites and tektites from the NA strewn field. Moreover, microtektites from the NA strewn field show also distinctively higher oxidation states than those from Ivory Coast or the Australasian strewn fields.

**Keywords:** Impact glasses, tektites, microtektites, Fe local structure, XANES

**INTRODUCTION**

Microtektites are small (<1 mm) splash-form impact glasses related to tektites, which are found scattered over regions of the Earth’s surface called strewn fields (e.g., Koeberl 1986, 1994). They are associated with three of the four tektite strewn fields so far known: the North American (NA), the Ivory Coast, and the Australasian strewn fields. They are generally found in deep-sea cores (e.g., Glass 1967, 1968, 1972; Cassidy et al. 1969), and their distribution greatly contributed to establish the limits of tektites strewn fields (see Glass 1990; Glass and Pizzuto 1994).

Despite the availability of geochemical studies on microtektites (see Glass et al. 2004 and references therein), few studies exist of the Fe coordination number and oxidation state in such materials (Senftle et al. 1969). As microtektites constitute a large fraction of the mass of glass produced by a tektite-generating impact event, such studies are of great importance for a more complete understanding of the impacts that have occurred in Earth’s history.

† Special Collection: Amorphous Materials: Properties, Structure, and Durability. Special associate editors Daniel Neuville and Grant Henderson. Information about the Amorphous Materials special collection papers can be found on GSW at http://ammin.geoscienceworld.org/site/misc/specialissuelist.xhtml. Additionally the GSW site has a classification tag found on the right-hand side of the article that is a link to all these papers. The MSA website (http://www.minsocam.org/MSA/AmMin/AmMineral.html) has complete information.