NORTH-AMERICAN MICROTEKTITES ARE MORE OXIDISED THAN TEKTITES. G. Giuli[1], M. R. Cicconi[1], S. G. Eeckhout[2], C. Koeberl[3], B. P. Glass[4], G. Pratesi[5], and E. Paris[1]. [1]Geology Division, University of Camerino, Italy; gabriele.giuli@unicam.it. [2]European Synchrotron Radiation Facility (ESRF), Grenoble, France. [3]Dept. of Lithospheric Research, University of Vienna and Natural History Museum, Burgring 7, 1010 Vienna, Austria. [4]Dept. Geology, University of Delaware, Newark, USA. [5]Dip. Scienze della Terra, University of Firenze, Italy

Introduction: Tektites are distal impact ejecta that occur on Earth in four geographically distinct and extended strewn fields. Three of the four strewn fields extend over the ocean and their limits are defined largely by the occurrence of microtektites in deep sea sediments with the same biostratigraphic age as the radiometric ages of the tektites on land. In terms of major and trace element compositions, tektites and microtektites are very similar, even though microtektites show a wider compositional spread. Obviously, tektites and microtektites originated in the same impact event, but their exact modes of formation are not well understood.

Despite the availability of geochemical studies on microtektites, very few studies exist of the Fe coordination number and oxidation state in such materials. As microtektites constitute a large fraction of the mass of the glass produced by a tektite-generating impact event, such studies are of great importance for a more complete understanding of impact-generated glasses and, in particular, to try to reconstruct the oxygen fugacity conditions prevailing during impact melt formation.

Previous data showed a set of microtektites from the North American strewn field to be consistently more oxidized with respect to microtektites from the other strewn fields [1]. This case is unique among tektites and microtektites and, if confirmed, may provide further constrains for a better understanding of microtektites generation processes. In order to confirm previous data, we studied a larger set of microtektites from the same strewn field from other four DSDP cores collected at different distances from the source crater and spanning a wider compositional range. For comparison, also four bediasites and two georgiaites have been studied, as well as a tektite fragment from the DSDP612 site.

Experimental: Iron oxidation states and coordination numbers have been determined by X-ray Absorption Near Edge Spectroscopy (XANES) on a large group of microtektites from the Australasian, Ivory Coast, and North American strewn fields. The XANES data have been collected at the ID26 beamline of the ESRF storage ring (Grenoble, F) using a Si (311) monochromator and with a beam size at the sample of 55 x 120 μm. Most microtektites have been collected from deep-sea cores. In particular, North American microtektites have been collected from five sites at different distances from the source crater, and are representative of a wide compositional range. Accurate analysis of the pre-edge peak energy position and integrated intensity, allowed to determine $Fe^{3+}/(Fe^{2+} + Fe^{3+})$ ratios on all samples with an estimated error of ±0.05 [2].

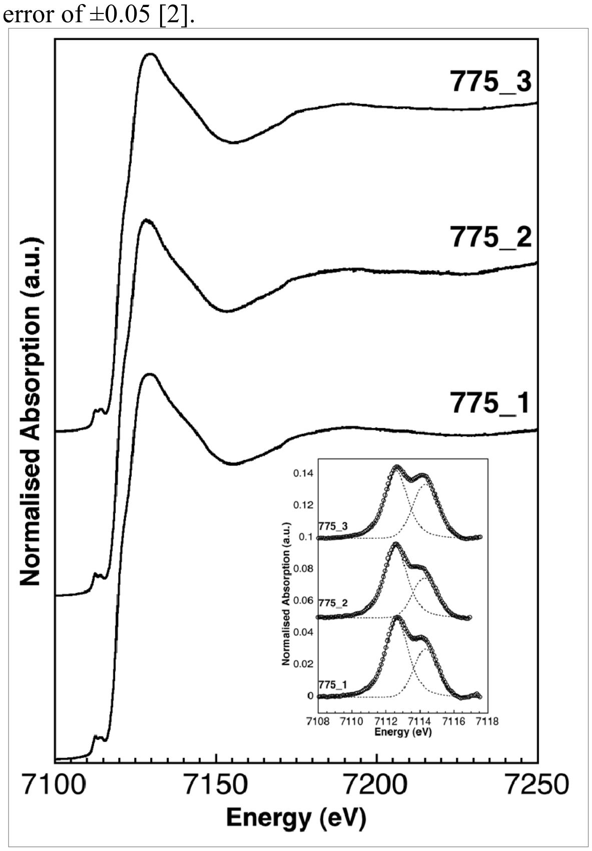

Fig. 1: Fe K-edge XANES spectra of North American microtektites. In the inset is shown the background subtracted pre-edge peaks along with the pseudo-Voigt used to fit their integrated intensity and energy centroid.

Results: Microtektites from the Australasian and Ivory Coast strewn fields show low values of the $Fe^{3+}/(Fe^{2+} + Fe^{3+})$ ratios, in fair agreement with tektites from the same provenance. In contrast, microtektites from the North American strewn fields show a wide range of $Fe^{3+}/(Fe^{2+} + Fe^{3+})$ ratios from 0 to almost 0.75. Comparison of Fe oxidation state data with chemical composition do not show any relation between $Fe^{3+}/(Fe^{2+} + Fe^{3+})$ ratios and Na, Ca, or K contents, thus suggesting that the high Fe oxidation state values 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 factor in the formation of the North American microtektites was different than for the North American tektites and microtektites in the other strewn fields. Interestingly, pre-edge peak data of all North American microtektites seem to lay on different trends all steaming from a single point whose energy and intensity is typical of most tektites studied so far. One possible explanation may involve formation of NA microtektites with Fe oxidation state and coordination number initially similar to that of tektites [3] and Trinity glass [4] (i.e., atomic bomb-produced glass), and subsequent oxidation when still molten. Previous data on NA tektites from different locations and with different chemistry [5] strongly suggest that the difference we found on NA microtektites Fe oxidation states are not related to lateral heterogeneity of the target rock. Despite a correlation between microtektite oxidation state and distance from the source crater, we maintain that Fe oxidation state is not related 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 samples recovered in Antarctica. This further reinforces that Fe oxidation is not related to the travel distance.

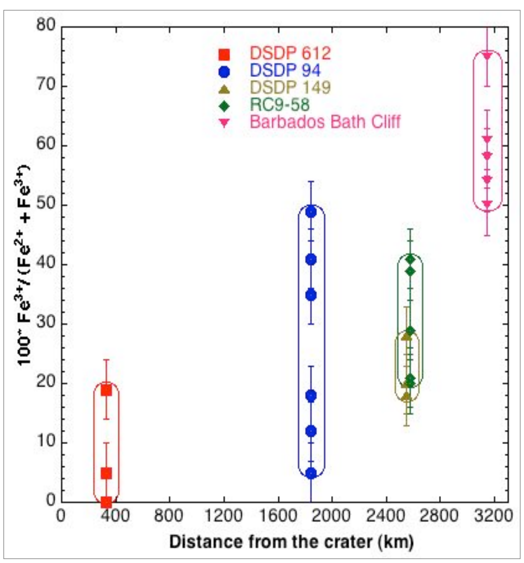

Fig. 2: $Fe^{3+}/(Fe^{2+}+Fe^{3+})$ ratio vs distance of the microtektite collection site from the Chesapeake Bay crater.

Even though the Fe oxidation in North American microtektites could be explained by interaction of melt droplets with a H_2O-rich vapor plume generated during the impact, this interpretation is at odds with current models of microtektite formation. These data, however, indicate that some difference must exist between the thermal histories of microtektites from the NA strewn field and those from Ivory Coast and the Australasian strewn fields.

References:

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