

**NORTH-AMERICAN MICROTEKTITES ARE MORE OXIDIZED COMPARED TO TEKTITES.** Gabriele Giuli<sup>1\*</sup>, Sigrid Griet Eeckhout<sup>2</sup>, Maria Rita Cicconi<sup>1</sup>, Christian Koeberl<sup>3</sup>, Bill P. Glass<sup>4</sup>, Giovanni Pratesi<sup>5</sup>, and Eleonora Paris<sup>1</sup>.  
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**Introduction:** 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 georgiites have been studied, as well as a tektite fragment from the DSDP612 site.

**Experimental:** 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  $\mu\text{m}$ .

XANES spectra have been collected in fluorescence mode over a 270 eV energy interval across the Fe K-edge (7112 eV) with a 0.1 eV energy step and 45 ms counting time. Average of about 20 scans for each sample allowed to obtain very good signal to noise ratios despite the low beam size. The energy reproducibility has been estimated to be 0.05 eV or better.

Background subtracted pre-edge peaks have been fitted with sums of two to three pseudoVoigts components according to the procedure described in [2].

**Results:** XANES spectra of few samples are shown in Fig. 1. The spectra display only few wide features, as is expected for amorphous material. The inset shows the background subtracted pre-edge peaks along with the pseudoVoigt components used for extracting centroid energy and integrated intensity. Clear differences can be detected in the shape of these pre-edge peaks related to the amount of trivalent Fe present. Comparison with pre-edge peak data (integrated intensity and centroid energy) of Fe model compounds

with known oxidation state and coordination number can provide information on Fe oxidation state and coordination environment in the studied glasses.

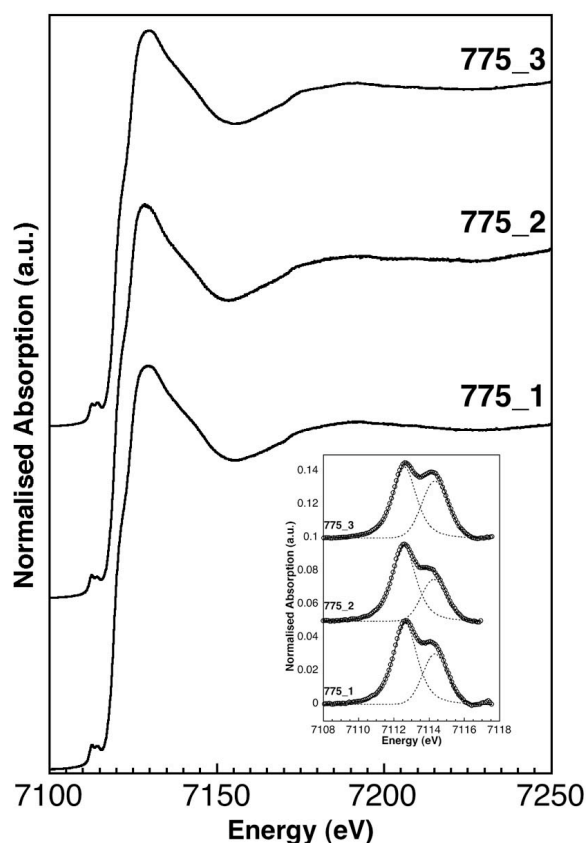


Fig. 1: example of Fe K-edge XANES spectra North American microtektites.

Figure 2 shows the pre-edge peak data of all the samples studied. The origin of the X axis refers to the edge energy of metallic Fe. Shaded ellipses show the fields for Fe model compounds (numbers in square brackets refer to the coordination numbers), whereas the open ellipse encloses values found for a range of tektites from all four known strewn fields.

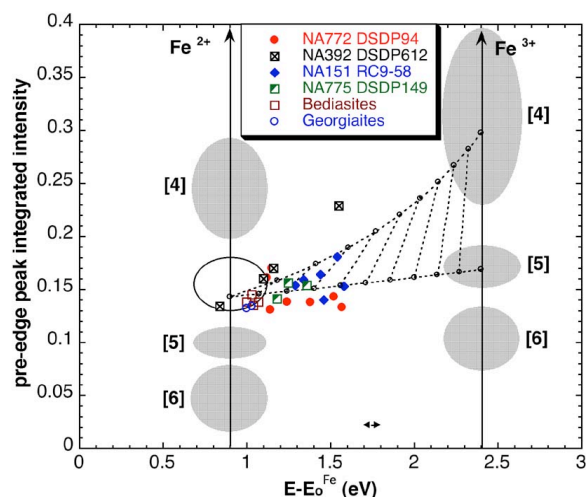


Fig. 2: Pre-edge peak integrated intensity vs. centroid energy. 0 refers to the edge energy of metallic Fe.

Data for the analyzed bediasites and georgiites plot within the open ellipse, as expected. Thus, for these samples, Fe is essentially divalent and in a mixture of [4] and [5] coordinated sites. On the other hand, data for the North-American microtektites plot well outside this range, extending up to 0.6 eV at higher energy with respect to divalent Fe model compounds.

Mixing lines can be calculated between possible end-members in order to quantify  $\text{Fe}^{2+}/(\text{Fe}^{2+}+\text{Fe}^{3+})$  ratios. Most data plot along a trend, falling between two mixing lines joining a point calculated as the mean of a group of the tektites studied so far (consisting of 4- and 5- coordinated  $\text{Fe}^{2+}$ ) to  $^{[4]}\text{Fe}^{3+}$  and  $^{[5]}\text{Fe}^{3+}$ , respectively. Thus, the XANES spectra can be interpreted as a mixture of  $^{[4]}\text{Fe}^{2+}$ ,  $^{[5]}\text{Fe}^{2+}$ ,  $^{[4]}\text{Fe}^{3+}$  and  $^{[5]}\text{Fe}^{3+}$ . There is no evidence for six-fold coordinated Fe; however, its presence in small amounts cannot be excluded from XANES data alone.

$\text{Fe}^{3+}/(\text{Fe}^{2+}+\text{Fe}^{3+})$  ratio of the studied North American microtektites range from 0 to 45 ( $\pm 5$ ) %.

**Discussion:** No obvious correlation has been found between Fe oxidation state and chemical composition of the studied microtektites. In particular, no inverse relationship has been found with Na depletion, which might have been expected in case of oxidation due to sea-water alteration; no any other correlation has been found that would suggest alteration in a marine environment.

Thus, we believe that the oxidation states determined are a signature of the formation process of these microtektites, and not the product of subsequent alteration. Such a wide range in Fe oxidation state is unique within microtektites: microtektites from the Ivory Coast and Australasian strewn fields contain almost purely divalent Fe, as do tektites from the same strewn fields [1, 2].

The marked difference in the  $\text{Fe}^{3+}/(\text{Fe}^{2+}+\text{Fe}^{3+})$  ratio of tektites and microtektites from the North American

strewn field raises the question whether or not microtektites should simply be considered as microscopic analogues of tektites.

Although no clear explanation can be provided, we note a similarity with impact glass spherules from the K/T boundary, which showed a similar trend in pre-edge peak data extending up to 100% trivalent Fe [3,4]. Remarkably, both impacts were of considerable size and occurred in a shallow marine environment. As the variation in Fe oxidation state of K/T impact glass spherules may be explained by oxidation of the impact melt droplets within a  $\text{CO}_2$ - and/or  $\text{H}_2\text{O}$ -rich plume, we suggest that a similar mechanism may have worked in the case of North American microtektites. However, no chemical correlation has been found with Fe oxidation state to support this suggestion so far.

#### References:

- [1] Giuli G. et al. (2007) *Meteoritics and Planetary Sciences*, 42, A56. [2] Giuli G. et al. (2002) *Geochimica et Cosmochimica Acta*, 66, 4347-4353. [3] Giuli G. et al. (2005) *Meteoritics and Planetary Science*, 40, 1575-1580. [4] Giuli G. et al (2008). *Meteoritics and Planetary Science*, 43, (in press).