Oxidation state of transition metals in (micro-)tektites and suevite glass from Bosumtwi crater, Ghana.

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Tektites, microtektites, and suevite glasses are glass products formed by asteroid impacts onto the Earth´s surface. They represent the chemical composition of the uppermost target materials and are known to have formed under reducing conditions. To shed further light on the redox conditions prevailing during the formation of the various impact melts, we have studied the valence states of the four transition metals Fe, Ti, Cr, and Mn, using X-ray Absorption (XANES) and Electron energy Loss Near-Edge Structures (ELNES) techniques. ELNES had to be employed for Fe valence state determination due to the small volume of suevite glass and mikrotektite. XANES permitted to detect the other transition metals occurring only in traces in tektites.

Fe *K* XANES of tektites show a small pre-edge peak followed by a kink in the edge onset. The latter is indicative for pure Fe^{2+} in octahedral coordination. Fe L_{32} ELNES of microtektites and suevite glass indicate however detectable amounts of Fe^{3+}. Microtektites contain generally less than 20 %, suevite glasses up to 40 % Fe^{3+}. Cr *K* and Mn *K* XANES of tektites display also spectral features consistent with mixed 2+/3+ valence states of these transition metals. The Cr *K* pre-edge region indicates a small amount of Cr^{2+} in octahedral coordination, while the Mn *K* spectra are largely compatible with Mn^{2+} in octahedral coordination. The overall shape of Ti *K* XANES of tektites and the energy position of a pre-peak are in very good agreement with data for silicate glass with Ti^{4+} in five-fold coordination [1].

Our results indicate that tektites are the most reduced melt product of impacts, followed by microtektites and suevite glasses. In agreement with conclusions derived from trace element concentrations [2], the highly reduced state of tektites is compatible with very high formation temperatures (> 2000°C), while microtektites and suevite glasses may have formed at lower temperatures and/or have been cooled slower.

[1] Farges *et al*. (1996) *GCA* **60**(**16**), 3039-3053 [2] Deutsch *et al*. (2015) *MinMag, this volume*