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From molten to frozen : Multivalent element behavior during the cooling of silicate melts

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Silicate glasses, whether of industrial or volcanic nature are all made by cooling a high temperature melt to room temperature in a short amount of time. However, oxidoreduction reactions can occur during this quenching process, making the link between high and room temperature redox states complex. Understanding those reactions allow both to better control of the redox state of final glass, but also to retrieve the melting conditions from easy to perform room temperature measurements. The latter being of particular interest in volcanology where redox measurements of lava bombs are used to model the conditions within the magmatic chamber.
The present study uses *in situ* X-Ray Absorption Near Edge Structure (XANES) Spectroscopy to understand the oxidoreduction processes involved both at high temperature and during the quenching of simplified silicate glasses bearing iron and/or cerium. The results obtained are then compared to room temperature measurements performed using XANES spectroscopy, Raman spectroscopy and optical absorption spectroscopy.
Our finding demonstrates that, in simplified systems where only one multivalent element is present, the high temperature redox state is frozen during quenching. However, this is no longer true when a second multivalent element is introduced in the melt as both elements interact during quenching due to a charge transfer process. This leads to room temperature measurements being harder to link to the melting conditions.

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