Kinetics and mechanisms of Iron redox reactions in silicate glasses and melts: A XANES study

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Silicate liquids are materials of prime importance in the glass and metallurgical industry as well as in the earth sciences where these melts have controlled heat and mass transfer at all scales throughout the whole geological history. Understanding of their physical properties thus is an important goal. In this respect, iron oxides raise special difficulties. Specifically, they affect melt properties in a complex way because iron occurs as Fe^{2+} and Fe^{3+} ions, whose abundances markedly depend on intensive thermodynamic variables.

Because XANES spectroscopy allows to determine redox state and to derive structural information about iron, our goal was to follow the evolution of redox state through XANES experiments. The set of iron bearing sample investigated at the threshold K of iron includes alkali borosilicate and aluminosilicate glasses. Redox equilibria were examined as a function of both time and temperature just above T_g and at superliquidus temperature. We observed a shift of the pre-edge position and of the main resonance as a function of time and temperature. We present here some XANES experiments at high temperature up to 2100K on the Fe K-edge, in liquids and glass. From these XANES spectra, redox kinetics can be obtained and discussed as a function of temperature and chemical composition.

LA-MC-ICPMS and multi-ion counting system applied to U-Pb dating of complex zircons from quaternary volcanites: Geochemical implications

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An alternative method to SHRIMP has been developed: MC-ICPMS associated to a multi-ion counting (MIC) system and coupled with a 213 nm UV laser [1]. It allows high sensitivity and precision to date zircons even younger than 1 Ma. This new method was certified by using a young zircon standard (61.308B) and by dating several reference zircons using both SHRIMP and LA-MC-ICPMS. The ^{230}Th disequilibrium is taken into account to correct the apparent $^{206}Pb^*/^{238}U$ ages.

We studied the Queureuilh trachytic ash and pumice flow of the Mont-Dore Massif (French Massif Central) which was previously dated at 0.571 ± 0.060 Ma by $^{40}Ar/^{39}Ar$ method [2]. It yielded numerous zircon grains clear and euhedral. Two populations could be identified. One consists in colorless grains and the second is represented by pinkish-red grains. Grains from the two populations were analyzed by SHRIMP and LA-MC-ICPMS. Three age populations were identified that show a relationship with the color of the grains. Colorless grains gave the youngest age at 0.640 ± 0.017 Ma and the colored grains gave rise to two distinct older ages. The majority of the colored grains were dated at 0.994 ± 0.016 Ma while some grains gave an older age of 2.36 ± 0.04 Ma.

These new geochronological data allow the complex history of a magma to be detailed within a narrow period of time into several stages involving assimilation-contamination, residence time of the magma in more than a single magma chamber and then the emplacement of the lava flow. Furthermore, the behavior of Zr as an incompatible element matching Henry's law can be questioned in such conditions as Zr was mainly trapped as a stoechiometric element in zircons from various origins. In addition, the ability of LA-MC-ICPMS to date zircons from quaternary volcanites is now demonstrated.

[1] Cocherie & Robert (2008, in press) *Gondwana Research*.
[2] Duffell (1999) *DEA*, 56 p.