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Local structure of Ca in natural glasses and tektite

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Introduction

In nature, several kinds of glasses are formed by various geological actives. Tektites and impact glasses are produced by impact event; volcanic actives formed volcanic glass; and plate boundary active produced fault rocks. These natural glasses experienced different extreme environments, which should lead changing of local structure. Titanium, iron, and aluminum local structures are studied on natural glasses and tektites (ex. Wang et al., 2011). Only calcium aluminosilicate glasses were investigated. Few Ca K-edge XANES structure on natural glasses and tektites have been reported although this technique probes information on Ca environment.

Experimental

The specimens of tektites are from different strewn fields, they are tektite (hainanite, indochinite, philippinite, australite, bediasite and moldavite), impact glass (impactite, suevite, and kofelsite), volcanic glass (perlite, obsidian, pitch stone, rhyolitic glass, Kilauea volcanic glasses), and fault rock (pseudotachylite). In order to analysis the local structure of calcium in natural glasses, we used the XAFS methods. The XAFS measurement of calcium local structure was preformed with a Si (111) double crystal monochromator at the beam line BL-7C of the Photon Factory. Spectra near calcium K-edge were collected in transmission and fluorescence mode at the room temperature. Details of analysis were given in reference [1].

Results and Discussion

Fig.1A shows XANES spectra of impact glasses. XANES spectra of two impact glass- impactite and köfelsite composed of pre-edge at 4039.132eV with intensity of 8.5%, a shoulder at 4045.17 with intensity of 67.5% and 67.8%, and white line at 4049.208eV. The pre-edge of impact glasses is lower than tektites, this may cause of high distortion around Ca atom in tektites. The shoulder of tektite is a bit higher and broader than impact glasses. In addition, a slight difference in the trend of post-edge details became apparent in the calcium K-edge XANES spectra of impact glasses, with a possible splitting a contribution. In Fig.2B, pre-edge and shoulder in natural glass possess more lower intensities than tektites and impact glass, and around 4.0-8.0%, 60.1-68.0%.

The difference in the post-edge features in impact glasses and natural glasses suggests a modification in calcium environment, being possible that calcium ions partially substitute for other ions in eight-coordinated site. Glass relaxation of impact glasses and volcanic glasses trends to lower than tektites. Different relaxation processes are caused by the environment when impact glasses are formed. Temperature and annealing time are most important condition for relaxation.

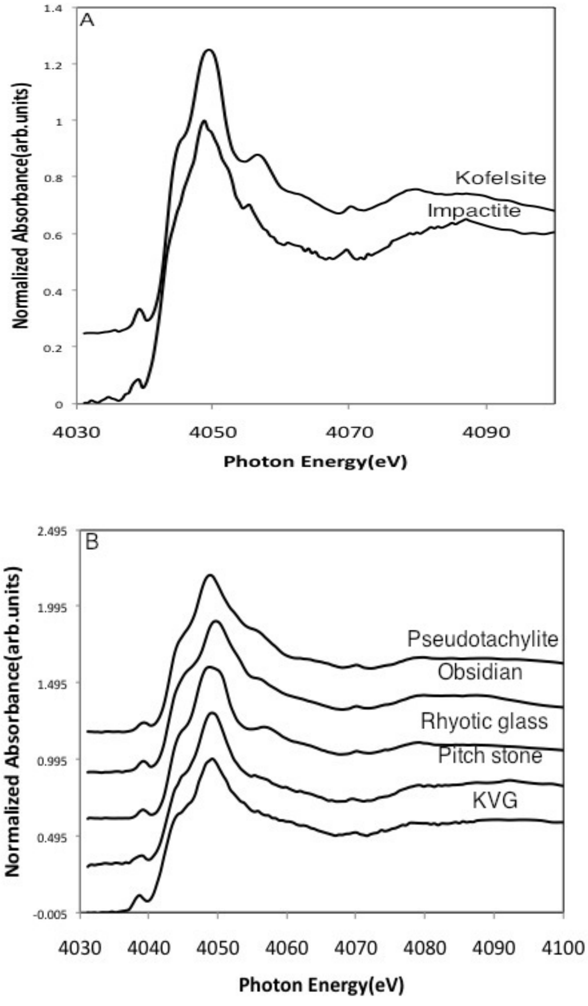

Fig.1. XANE spectra near Ca K-edge for impact glasses and natural glasses

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[1] Wang et al. J. Synchrotron Rad. (2011). 18, 885–890