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AMORPHOUS MATERIALS: PROPERTIES, STRUCTURE, AND DURABILITY

The effect of the [Na/(Na+K)] ratio on Fe speciation in phonolitic glasses†

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Abstract

Natural iron-bearing sodic phonolitic melts represent an extreme compositional range of the effect of the [Na/(Na+K)] ratio on the geochemical behavior of Fe in volcanic systems. Yet phonolitic melts have not been well investigated. The glasses studied here have been synthesized from liquids equilibrated over a range of oxygen fugacity conditions [$\log_{10}(f_{O_2})$ from –0.68 to –11] to elucidate the role of the alkali ratio in influencing the local environment around both divalent and trivalent Fe. In this study, the Fe *K*-edge XAS spectra (XANES and EXAFS) have been employed, to constrain the Fe structural role (oxidation state, coordination number, bond distances) in phonolitic glasses as a function of synthesis temperature (*T*), [Na/(Na+K)] ratio (= 0.0, 0.25, 0.5, 0.75, 1.0) and redox state. We verify that at constant oxygen fugacity, the [Na/(Na+K)] ratio has a strong effect on the $Fe^{3+}/(Fe^{2+}+Fe^{3+})$ ratio. The results obtained are parameterized and discussed in terms of the contrasting effects of *T*, f_{O_2}, and alkali ratio.

Keywords: Alkalis, iron, oxidation state, phonolitic glasses, XAS