Glass-SO₂ reactions occurring at high temperatures have received increasing attention in the past years (e.g., Renggli and King 2018; Casas et al. 2019; Renggli et al. 2019), based on both natural and experimental observations. Laboratory studies carried out at high temperatures (>200 °C) demonstrate that volcanic glass in the presence of SO₂ reacts to form surficial sulfate-bearing minerals (e.g., Ayris et al. 2013; Delmelle et al. 2018), mostly calcium sulfate salts (CaSO₄). Thus, high temperature glass-SO₂ interaction acts as a sink for the magmatic S released during explosive volcanic activity, potentially impacting the S budget of large explosive eruptions. Here, we present the results of new experiments aimed at assessing the influence of the glass Ca content on SO₂ uptake in the temperature range of 600-800 °C. We exposed haplogranitic glasses to SO₂ for diverse time exposures (5-30 minutes). Rhyolitic composition was chosen due to the ubiquity of Si-rich magmas in large explosive eruptions (Cioni et al. 2000).

The experimental glasses were synthesized with an initial HPG8 composition (see Holtz et al. 1992), doped with 1 and 2 wt.% CaO. Furthermore, the role of Fe was tested by doping the glasses with 0, 0.1, 1, 1.5, 2 and 2.5 wt.% FeO and equilibrating them at 1500 °C. Leachates of post-treated glasses were analyzed by ion chromatography in order to determine SO₂-uptake and the nature of the sulfate-bearing minerals formed by solid-gas reactions. The bulk redox state of iron (Fe³⁺/Fe_total), was obtained by the K₂Cr₂O₇ potentiometric titration method. Our results show a strong correlation between the amount of Ca in the glasses and the formation of CaSO₄ surficial deposits (i.e. SO₂ uptake), i.e. the HPG8 + 2 wt.% CaO treated samples produced up to 40 % more CaSO₄ than the samples containing 1 wt.% CaO. Higher Fe content in the glass also enhanced formation of CaSO₄. In contrast, the absence of Fe oxide resulted in preferential formation of Na₂SO₄ and K₂SO₄, when compared to the Fe-bearing specimens. Our experiments confirm that high temperature SO₂ uptake by glass is strongly dependent on the Ca content and temperature, with the optimal reaction temperatures being ≥600 °C. Increasing the amount of FeO in the glasses seems to enhance SO₂ uptake, although this effect appears to be different for Ca than for Na or K, pointing out a more complex influence of redox dynamics on cation diffusion.