Abstract

X-ray absorption near edge structure (XANES) spectroscopic analysis of olivine-hosted melt inclusions (MI) in tephra erupted from the Kīlauea summit between 2008 and 2014 indicates that copper (Cu) is exclusively complexed in the melt as mixtures of Cu(I)-sulfide and Cu(I)-oxide species. In MI with sulfur (S) abundances > 1000 ppm CuS species dominate, whereas in MI with S < 500 ppm CuO species dominate. However, this observation is made on MI without visible vapor bubbles or sulfide precipitates. Crystallization on vapor bubble walls, as well as post-entrapment crystallization, can sequester a substantial amount of volatiles away from the remaining melt in the inclusion. This is important to characterize given that these components may not be readily recognized in sectioned and polished MI that have been prepared for XANES analysis, given the loss of three-dimensional geometry in preparing samples. To investigate the effects of crystallization on Cu complexing within MI, we collected Cu XANES data on 12 naturally glassy Kīlauea MI that contained a vapor bubble and/or a few visible daughter crystals; the MI were not extensively crystallized. Preliminary results show that, for MI from the 2008 phase of the eruption in which we previously found CuS speciation in all MI with no bubbles/crystals, the speciation changed to CuO-dominated in MI with bubbles/crystals. For MI from the 2009-2014 phase of the eruption, in which we originally found mostly CuO speciation, this remained the same. In samples from both phases, crystals nearest to bubbles were found to resemble chalcopyrite. Preliminary results suggest that S sequestration through vapor bubble wall/daughter crystallization results in a lowering of the MI S abundance, which initiates or maintains CuO complexing. Future work will include EMPA analysis to determine MI S and major elements abundances, as well as crystal compositions, which will further elucidate the role of S sequestration on Cu-complexing in basaltic melts.