INTRODUCTION

Data on water solubility and speciation of water in silica melts are needed to determine the incorporation mechanisms of water in more complex, multicomponent aluminosilicate melts. Although numerous studies have focused on water incorporation mechanisms in aluminosilicate melts of feldspar stoichiometry, very few data are available for the join silica-albite. For albite melts, the NMR results of Kohn et al. (1989) suggested that hydroxyl groups are not bonded to Si. Sykes and Kubicki (1993) suggested that only minor Si-(OH) bonds exist in albite. Although the interpretations of Kohn et al. (1989) and Sykes and Kubicki (1993) are still under debate, significant differences are likely between the incorporation mechanisms of water in albite melts, where Na is involved in the dissolution process, and in silica melts, where water species can only be bonded to Si (e.g., Kohn et al. 1989; Pichavant et al. 1992). Because the incorporation mechanisms of water in pure silica glasses and melts are not fully understood, it is unclear whether models developed for feldspar melts apply to more silica-rich compositions (e.g., rhyolitic melts).

Experimental data for the SiO\textsubscript{2}-H\textsubscript{2}O system constrain the H\textsubscript{2}O-saturated and H\textsubscript{2}O-undersaturated quartz solidus and the solubility of SiO\textsubscript{2} in the fluid phase coexisting with melt or crystals (Ostrovskiy et al. 1959; Kennedy et al. 1962; Stewart 1967; Boettcher 1984). Water solubility data are only available for the pressure (P) and temperature (T) conditions of the SiO\textsubscript{2}- and vapor-saturated solidus (Kennedy et al. 1962). Thus, there are no data for hyperliquidus conditions that permit determination of the individual effects of P and T on water solubility. In this study, the solubility of water has been determined for silica melts at 100–600 MPa, 1200–1350 °C, and at each temperature (T) was found to increase with pressure (P). At P ≤ 250 MPa, the effect of T on water solubility in silica melts is small and within analytical precision (±0.15 wt% H\textsubscript{2}O). A positive correlation with T was observed at 400 MPa. Increasing solubility of water with increasing T was observed when large amounts of water are dissolved in silica and quartzofeldspathic melts (i.e., when molecular water is the dominant species in the glasses at room temperature), as already observed for feldspar melts. Change in water solubility (expressed in mol%) with decreasing SiO\textsubscript{2} content of the melt is nonlinear along the silica-albite join. In the compositional range Ab\textsubscript{100} to Ab\textsubscript{25} (100 to 25 mol% albite, respectively, compositions calculated on an eight-oxygen basis), the solubility of water at 200 MPa decreases only slightly with decreasing Ab content (~0.1 ± 0.01 mol% H\textsubscript{2}O per mol% albite). However, at Ab contents less than 25 mol%, water solubility decreases sharply with increasing Qz content. Similar behavior was observed at 500 MPa. These results suggest that two different incorporation mechanisms of water in quartzofeldspathic melts must be considered: one corresponding to an NaAlSi\textsubscript{3}O\textsubscript{8}-H\textsubscript{2}O mechanism, the other to an SiO\textsubscript{2}-H\textsubscript{2}O mechanism.

EXPERIMENTAL METHODS AND ANALYTICAL TECHNIQUES

Apparatus and procedures

All experiments to determine the solubility of water in silica melts (Table 1) were conducted at Orléans (CRSCM-CNRS). Experiments with Ab and Qz-Ab compositions were performed...