

Water and Cl in Lunar Basalts: Solubility and Degassing of OH-Cl in Basaltic Magma. Yang Liu and Lawrence A. Taylor, Planetary Geosciences Institute, Department of Earth and Planetary Sciences, University of Tennessee, Knoxville, TN 37996 (yangl@utk.edu).

Introduction: Recent studies of water in the Moon have produced conflicting implications. Analysis of Apollo samples have shown that volcanic glass beads retained up to 46 ppm OH [1]. Based on diffusive-loss models, these values have been interpreted to indicate the initial OH in the melts that formed the beads of up to 745 ppm [1]. Analyses of lunar apatite grains observed significant amounts of OH, up to 7000 ppm H₂O [2-4]. These recent findings imply that *the interior of the Moon contains more water than previously thought*. However, Cl-isotope compositions of lunar rocks, breccias, and apatite show large positive values, much larger than the range of variation observed in terrestrial rocks, martian meteorites, and chondrites [5]. On the basis of these observation, Sharp et al. [5] suggested that the degassing phase is metal chlorides and *molar H:Cl ratios in lunar rocks are much less than 1*. Sharp et al. [5] further inferred that the interior of the Moon is bone-dry.

Because different lunar rocks were used in the apatite studies[2-5], these opposing views of the hydrous-status of the interior of the Moon could be explained by highly heterogeneous distribution of water in the Moon. However, an underlying question about volatiles in lunar basalts is the solubility and degassing behaviors of H₂O and Cl at reduced conditions of the Moon (~IW-1, [6-7]). Here, we present synthesis of literature data on this subject for terrestrial basalts.

Literature data of H₂O-Cl in basalts: To date, all experiments were conducted for terrestrial composition with >1.9 wt% Na₂O+K₂O under oxidized conditions [8-13]. All experiments were conducted at oxidized conditions (NNO to NNO+2). In H₂O-rich system, silicate melt equilibrates with vapor rich in water (Fig. 1). With increasing Cl contents, a hydro-saline (brine) equilibrates with the silicate melt. The transition occurs at molar H:Cl ratio of ~5.

Degassing of H₂O-Cl fluids: Experimental data of H₂O-Cl fluids in terrestrial basalts show that the degassing of HCl occurs at low P, when Cl reaches saturation and after extensive degassing of H₂O [9-14]. Figure 2 shows that the calculated HCl/NaCl ratio increases with decreasing P and H₂O, modeled by Shinohara [15].

Summary: The literature data on terrestrial basalts suggest that H₂O facilitate the degassing of Cl in vapor or in aqueous fluids. However, no experiments have been conducted for lunar basalt with <0.5 wt% Na₂O + K₂O, and under reduced conditions, prohibiting an

accurate prediction of the degassing behaviors of H₂O-Cl in lunar samples. Presence of other volatiles (H₂, CO, CO₂, and S) need also be considered as they may also complicate the degassing behaviors of H₂O-Cl [13-15].

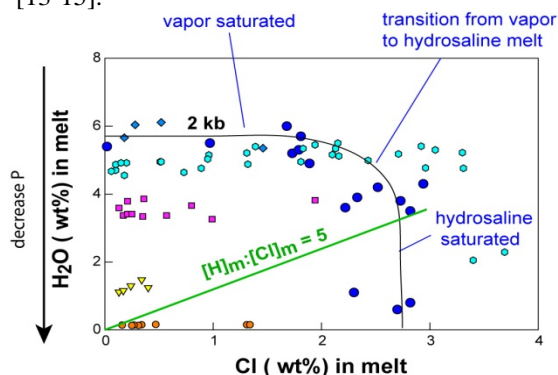


Fig. 1. Solubility of H₂O-Cl fluid in basalt. Data are from [10-12]. The black curve is from [10].

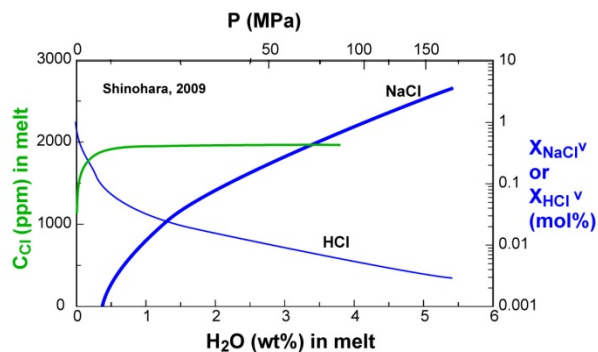


Fig. 2. Variation of Cl in vapor and melt under decompression conditions [14]. The vapor is rich in NaCl at higher P and in HCl at lower P.

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