Supplementary Information

Electron Microprobe vs. Scanning Electron Microscope Analysis

The Ar solubility results presented in this paper correspond to the Ar contents dissolved in the densified liquid phases at high pressures. The reported Ar contents represent an average of 20 points in the areas with no bubbles or microcrystalline phases that would distort the chemical analysis of argon. The chemical compositions of the run products were analyzed by an electron microprobe with an accelerating voltage of 15 kV and a beam current of 20 nA, as well as by a Scanning Electron Microscope which is equipped with an Oxford Instruments Isis 300 energy-dispersive analytical system (the accelerating voltage used was 20 kV, with a beam current of 6 nA). Fe, Ni and Co metals, orthoclase, jadeite, wollastonite, periclase and corundum were employed as standards for both instruments. For Ar analyses, the standard used was an anorthite glass from our work containing 1.5 wt% Ar. The good agreement of the analysis between both apparatus is shown in Fig. S1.

Fig. S1. Comparison of the Chemical compositions as analyzed by Scanning Electron Microscopy (JEOL JSM-840A), and by electron microprobe (JEOL JXA-8800R with 4 wavelength-dispersive spectrometers at Oxford University) with an accelerating voltage of 15 kV and a beam current of 20 nA.
Quenched glasses from HP-HT and Argon contents

The argon contents presented in this paper correspond to the Ar contents dissolved in the densified liquid phases at high pressures. We have checked by Raman spectroscopy the amorphous state of the run products as can be shown in Fig. S2 for anorthite melt.

Fig. S2. Raman spectra of anorthite melt quenched from high-pressure and high-temperature experiments, showing the amorphous state of the quenched samples in the whole range of pressures studied.

A factor which can influence the Ar solubility in a LHDAC is the loss of Ar from the heated sample during the quench. Firstly, Ar was present in all our samples and no significant variation of the Ar contents has been observed within the same sample. Analyses repeated more than 10 times on the same area showed no difference of the Ar content (Fig. S3). Furthermore, we checked the Ar content of several quenched samples polished to different depths, especially those with high and low Ar contents for the same starting material. The Ar contents remained constant up to 20 microns from the raw surface, showing the reliability of the Ar analyses and the homogenous mixing of argon with the silicate melts, ruling out any exsolution during sample quench (Fig. S4). A further argument against the Ar loss during the quench of the samples is that in the interval of the pressures investigated, the diffusion coefficients for most elements in the liquid are in the range of $10^{-11} - 10^{-9}$ m$^2$/s between 1800 and 2800 K (Reid et al., 2001). By taking $10^{-10}$ m$^2$/s as an average of the Ar diffusion coefficient, the characteristic diffusion length in a 10-minute experiment is about 500 µm which is much larger than the run product dimension. In addition, the thermal diffusivity in a LHDAC (about $10^6$ to $10^7$ m$^2$/s) is much higher than the Ar diffusion, leading to a typical diffusion length of Ar of much less than 1 µm after the quench of the samples (the quenching time is estimated to be $10^{-3}$ s) (Chamorro-Perez et al. 1998).
Fig. S3. Argon analysis on the same area for three samples showing different argon contents.

Fig. S4. Ar contents versus the depth in microns for two quenched sanidine melts from 10.5 and 17.2 GPa.
Disproportionation of C1-maj composition

A striking feature observed during our experiments is the apparent disproportionation of the C1-maj melt at all pressures into two distinct chemical compositions (cf. Table 1), whereas the sanidine and anorthite glass compositions observed on quench from HP-HT showed no change from the starting composition. The regions of distinct composition were found from EMP averages on a micron scale and not clearly distinct at any single boundary (Figs S5a-S5b).

**Fig. S5a.** Analyses profiles as enumerated in Fig. 1 and described in the text. Note the good correlation between the Mg, Si and Ar contents for C1-rem and C1-ol compositions.
Fig. S5b. Analyses profiles as enumerated in Fig. 1.
Argon solubilities into pure C1-maj and mixed with an FeNi alloy

Both sets of experiments starting with C1-maj alone, and mixed with metallic FeNi alloy, showed similar Ar contents in the silicate melt fractions. The presence of a FeNi alloy, therefore, does not affect the solubility of Ar in C1-rem melt at high pressures, and is likely due to the low partition coefficient of Ar between metal and silicate liquids at high pressure, measured between $10^{-3}$ and $10^{-4}$ for pressures between 6 and 10 GPa (Matsuda et al., 1993).

![Graph](image)

**Fig. S6.** Comparison of Ar contents as a function of pressure for C1-chondrite model composition and a mix of C1-Chondrite and FeNi alloy. The black square are the data of White *et al.* (1989) for a basalt close to our starting composition.

**Literature**


