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He/Ne solubility in ultramafic melts and its implication for magma ocean degassing

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The $^{3}He/^{22}Ne$ ratio is an important indicator of degassing processes on Earth; however, its mantle value variability is not well constrained. The $^{3}He/^{22}Ne$ of the upper mantle ranges from 5 to 10 whereas the $^{3}He/^{22}Ne$ of the Galapagos and Iceland plumes, which are representative of the primitive mantle, is around 2 [e.g., 1]. Establishing the solubility of He on ultramafic melts can forward the models investigating degassing processes at the early stages of Earth formation, during the magma ocean phase, and help resolving the "helium paradox" [e.g., 2, 3]. Using the He/Ne solubility ratio for mafic and ultramafic glasses (SiO_2 as low as 37.5 wt% and MgO as high as 18.0 wt%) we obtained from high temperature experiments [4, this study], we attempt to tackle these questions by testing non-equilibrium degassing models during the magma ocean stage. We assume that He and Ne were already present in Earth's parent bodies via solar wind implantation [5, 6], since ingassing from the primitive atmosphere into the magma ocean is difficult to consider for ultramafic melts in a slow accretion scenario [4].

[1] Péron et al. (2018), *G³ 19(4)*; [2] Moreira & Sarda (2000), *EPSL 176(3-4)*; [3] Tucker & Mukhopadhyay (2014), *EPSL 363*; [4] Cardoso et al. (2025), *GPL 35*; [5] Moreira & Charnoz (2016) *EPSL 433*; [6] Péron et al. (2017), *GPL 3(2)*.