

**LETTERS**

**Aluminum substitution in MgSiO<sub>3</sub> perovskite: Investigation of multiple mechanisms by <sup>27</sup>Al NMR**

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**ABSTRACT**

In the Earth's mantle, the mechanism(s) of solid solution of Al in MgSiO<sub>3</sub> perovskite strongly impacts its thermodynamic and transport properties. We present <sup>27</sup>Al NMR data for perovskite samples of nominal composition Mg(Si<sub>0.9</sub>Al<sub>0.1</sub>)O<sub>2.95</sub>, to test a mechanism by which Al<sup>3+</sup> substitutes at the octahedral Si<sup>4+</sup> sites, leaving a corresponding number of O-site vacancies. We find evidence for this process in a significantly greater peak area for Al at B (Si) sites vs. A (Mg) sites in the structure, and the possible identification of a small concentration of five-coordinated Al adjacent to such vacancies. However, substitution of Al<sup>3+</sup> at the A sites remains significant. As in perovskite-type technological ceramics, O-atom vacancies may play an important role in enhancing ion mobility and the dissolution of water.