

CHEMISTRY AND MINERALOGY OF EARTH'S MANTLE

**A possible new Al-bearing hydrous Mg-silicate (23 Å phase) in the deep upper mantle†**

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**ABSTRACT**

A new Al-bearing hydrous Mg-silicate that we named as 23 Å phase was synthesized at 10 GPa and 1000 °C, while also coexisting with diaspore and pyrope in the following system: phase A [Mg<sub>7</sub>Si<sub>2</sub>O<sub>8</sub>(OH)<sub>6</sub>] + Al<sub>2</sub>O<sub>3</sub> + H<sub>2</sub>O. The chemical composition of this new 23 Å phase is Mg<sub>11</sub>Al<sub>2</sub>Si<sub>4</sub>O<sub>16</sub>(OH)<sub>12</sub>, and it contains about 12.1 wt% water. Powder X-ray diffraction and electron diffraction patterns show that this new 23 Å phase has a hexagonal structure, with  $a = 5.1972(2)$ ,  $c = 22.991(4)$  Å, and  $V = 537.8(2)$  Å<sup>3</sup>, and the possible space group is  $P\bar{6}c2$ ,  $P6_3cm$ , or  $P6_3/mcm$ . The calculated density is 2.761 g/cm<sup>3</sup> accordingly, which was determined by assuming that the formula unit per cell ( $Z$ ) is 1. This crystal structure is quite unique among mantle minerals in having an extraordinarily long  $c$  axis. Several experiments revealed that its stability region is very similar to that of phase A. We further confirmed that this new 23 Å phase was stable in the chlorite composition at 10 GPa and 1000 °C. The present results indicate that this new 23 Å hydrous phase will form in an Al-bearing subducting slab, and transport water together with Al into the deep upper mantle or even into the upper part of the transition zone.

**Keywords:** New hydrous Mg-silicate, 23 Å phase, phase A, chlorite, subduction zone, upper mantle