American Mineralogist, Volume 100, pages 2330–2335, 2015

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 [$Mg_7Si_2O_8(OH)_6$] + Al_2O_3 + H_2O. The chemical composition of this new 23 Å phase is $Mg_{11}Al_2Si_4O_{16}(OH)_{12}$, 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^3, and the possible space group is $P\bar{6}c2$, $P6_3cm$, or $P6_3/mcm$. The calculated density is 2.761 g/cm^3 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