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# An experimental study of the pressure-temperature stability of MgMgAl-pumpellyite in the system $MgO$-$Al_2O_3$-$SiO_2$-$H_2O$

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## Abstract

The stability field of MgMgAl-pumpellyite, $Mg_5Al_5Si_6O_{21}(OH)_7$, was determined in the system $MgO$-$Al_2O_3$-$SiO_2$-$H_2O$ in reversal experiments at pressures between 34 and 100 kbar and temperatures in the range of 597 to 1050 °C. Brackets were obtained on five breakdown reactions (in order of increasing pressure):

$$8\underset{\text{MgMgAl-pumpellyite}}{Mg_5Al_5Si_6O_{21}(OH)_7} = 19\underset{\text{chloritoid}}{MgAl_2SiO_5(OH)_2} + \underset{\text{kyanite}}{Al_2SiO_5} + 7\underset{\text{talc}}{Mg_3Si_4O_{10}(OH)_2} + 2H_2O \quad (1)$$

$$12\underset{\text{MgMgAl-pumpellyite}}{Mg_5Al_5Si_6O_{21}(OH)_7} = 19\underset{\text{pyrope}}{Mg_3Al_2Si_3O_{12}} + 11\underset{\text{kyanite}}{Al_2SiO_5} + \underset{\text{talc}}{Mg_3Si_4O_{10}(OH)_2} + 41H_2OO \quad (2)$$

$$6\underset{\text{MgMgAl-pumpellyite}}{Mg_5Al_5Si_6O_{21}(OH)_7} = 10\underset{\text{pyrope}}{Mg_3Al_2Si_3O_{12}} + 5\underset{\text{kyanite}}{Al_2SiO_5} + \underset{\text{coesite}}{SiO_2} + 21H_2OO \quad (3)$$

$$6\underset{\text{MgMgAl-pumpellyite}}{Mg_5Al_5Si_6O_{21}(OH)_7} = 10\underset{\text{pyrope}}{Mg_3Al_2Si_3O_{12}} + 5\underset{\text{topaz-OH}}{Al_2SiO_4(OH)_2} + \underset{\text{coesite}}{SiO_2} + 16H_2OO \quad (4)$$

$$6\underset{\text{MgMgAl-pumpellyite}}{Mg_5Al_5Si_6O_{21}(OH)_7} = 10\underset{\text{pyrope}}{Mg_3Al_2Si_3O_{12}} + 5\underset{\text{topaz-OH}}{Al_2SiO_4(OH)_2} + \underset{\text{stishovite}}{SiO_2} + 16H_2OO \quad (5)$$

This phase becomes stable only at pressures of more than 34 kbar and temperatures up to 820 °C. Thus, MgMgAl-pumpellyite may be an $H_2O$-containing phase at depths greater than 100 km in the coldest parts of subduction zones.