Reversed determination of the dehydration of glaucophane in the system Na_2O-MgO-Al_2O_3-SiO_2-H_2O and the effects of NaCl and CO_2

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Arc magmas are thought to be generated by partial melting of the mantle wedge above the subduction slab, which is triggered by dehydration of subducting oceanic crust [1]. Among the dehydration reactions, those occurring at the depths of the blueschist-to-eclogite transition are the most important [2]. The sodium amphibole glaucophane ($Na_2Mg_3Al_2Si_8O_{22}(OH)_2$) is characteristic of blueschists. Determining the upper-temperature stability of end-member glaucophane helps constrain the transition between blueschist and eclogite.

A reversed determination of the dehydration reaction 2 glaucophane = 4 jadeite + 3 enstatite + 2 quartz + 2 H_2O was done in the system Na_2O-MgO-Al_2O_3-SiO_2-H_2O over the pressure-temperature (P-T) range of 2.5-3.3 GPa and 760-900 °C for durations of 24 hours. Besides natural quartz, the other three starting minerals were synthesized using a ½ inch diameter piston-cylinder press, while reversed experiments were done using a 1000-ton Walker-type multi-anvil press in 18/11 mm MgO octahedra. Reaction direction was determined by Rietveld (GSAS) refinements of the powder XRD patterns. The reaction was bracketed at 840 °C at 2.5 GPa and at 820 °C at 2.9 GPa in the presence of water. Besides pure water, 5 m NaCl-H_2O and 5 m CO_2-H_2O fluids were also used in additional runs to check the effects of NaCl and CO_2, respectively, on the dehydration reaction. The NaCl-H_2O fluid shifts the reaction boundary at 2.5 GPa from 840 °C to a lower T (800 °C); however, the CO_2-H_2O fluid shifts the boundary to a higher T (860 °C). This is attributed to the variance of capabilities of NaCl and CO_2 in inhibiting the solubility of quartz in water and in changing the activity of water at such P-T conditions. These changes can shift the depth of dehydration by 6 km for an average low dT/dP geothermal gradient of 275°C/GPa. The shift in the boundary could be considerably larger for shallower dT/dP slab-top geothermal gradients [3].

[1] Pawley & Holloway (1993) *Science*. **260**, 664–7. [2] Peacock (1993) *Geol. Soc. Am. Bull.* **105**, 684–694. [3] Syracuse et al. (2010) *Phys. Earth Planet. Inter.* **183**, 73-90.