# Pargasite stability in the upper mantle at $H_2O$-undersaturated conditions

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Pargasitic amphibole is the most commonly occurring hydrous mineral in mantle xenoliths. While it has been shown that higher alkali contents stabilize pargasite to higher P and T, the effect of water on amphibole stability is not so straightforward. At $H_2O$ saturated conditions, alkali elements partition strongly into aqueous fluid and become less available for crystallization of amphibole. As a result, amphibole seemingly becomes stable at higher P and T when less $H_2O$ is added to the starting material. This observation inspired the hypothesis that pargasite may be an ubiquitous phase in the upper mantle, which contains only a few hundred ppm of $H_2O$. However, previous studies determined pargasite stability at $H_2O$-saturated conditions, where solid phases coexist with an aqueous fluid during experiments. Since such environments are not representative of the nearly dry upper mantle, the purpose of this study is to investigate pargasite stability at $H_2O$-undersaturated conditions.

Because of the high specific surface area of powders, adsorption of atmospheric $H_2O$ on fine grained starting materials makes attaining defined $H_2O$ activities by adding small amounts of water to the sample difficult or impossible. Instead, reduced water activities may be precisely controlled by diluting the water with another inert component. Under such conditions, solid phases are expected to coexist with a low water activity fluid throughout the experiment. As molecular nitrogen is mostly insoluble in upper mantle minerals, we used it in a series of piston cylinder experiments to buffer water activity of the fluid to a desired low value.

Our experiments demonstrate that pargasite is not stable in equilibrium with fluids diluted to $X_{H2O}$=0.1, while the amphibole stability field can extend to 4 GPa and above 1100 °C at high and intermediate water activities ($X_{H2O}$=1 to 0.5). This suggests that the ambient upper mantle is expected to have an anhydrous assemblage while areas affected by metasomatic fluids may be more abundant in pargasite than previously thought.