# Crystal uptake into superheated aphyric arc melts: insights from two-pyroxene pseudo-decompression paths, plagioclase hygrometry, and measurement of hydrogen in olivines from mafic volcanics rocks of the southwest Japan arc

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Minerals of mafic rocks from the southwest Japan arc have been studied to deduce P-T-$X_{H2O}$ conditions and their variations in mafic arc magmas. Two-pyroxene thermobarometry of magmas from several volcanoes yields constant temperatures and variable pressures. MELTS fractional crystallization modelling is employed to show that such "pseudo-decompression paths" (PDPs) are artefacts that derive from uptake of pyroxene antecrysts formed at a range of crustal levels by isobaric cooling of previously intruded mafic melts. It is shown that PDPs can be used to constrain oxygen fugacities and initial water contents of the intruded magmas. These constraints, and plagioclase hygrometry, indicate that initial melt $H_2O$ contents change along the SW Japan arc, consistent with variations in the fraction of water available in the melting region. Direct determination of hydrogen in olivine by SIMS yields consistently low olivine $H_2O$ contents of 11 ± 8 ppm (2 sigma), with little if any along-arc variations. MELTS modeling indicates that crystallization of calcic plagioclase and olivine dominantly occurs during upper crustal differentiation of mafic melts. The combined data indicate that aphyric melts released from the mantle wedge taking up most if not all crystals from prevously intruded plutonic rocks during rapid magma ascent to the surface.