Evidence for a greater abundance of H_2O-saturated melts at arcs

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Traditionally two independent approaches are used to estimate the pre-eruptive dissolved H_2O content in magmas: (1) directly measured H_2O contents in melt inclusions trapped in erupted phenocrysts [e.g. 1,2], and (2) geochemical proxies involving plagioclase equilibria [e.g. 3—5]. In general, both techniques are well calibrated at H_2O-undersatured and shallow (<3 kbar) H_2O-satruated conditions. However these techniques are *unable* to detect H_2O contents >7—8 wt%, due to the fact that plagioclase is unstable in melts that contain >7 wt% H_2O, and the open system behavior and/or lack of preservation of high pressure melt inclusions. The lack of a tool to acurately estimate dissolved H_2O content above 7—8 wt% has led to a biased sample set of pre-eruptive H_2O contents, and the interpretation that such H_2O-rich melts [e.g. 6,7] are rare and a volumetrically minor component [8]. Recent studies on plutonic rocks, and bulk crustal compositions suggest that high-pressure, high-H_2O fractionation is a *dominant* process at arcs [e.g. 9,10], putting this at odds with the canonical interpretation based on melt inclusions, that arc volcanics contain 2—6 wt% H_2O [8].

The use of amphibole chemistry as a proxy for H_2O content was proposed by [11 and 12], and is calibrated for recording dissolved H_2O contents in excess of 10 wt%. Here we present a survey of published data from plutonic and volcanic rocks that shows magma processing in the lower to middle crust often involves dissolved H_2O contents >12 wt%. Amphibole's lack of a stability field at low pressure and the positive correlation between pressure and H_2O solubility are likely major contributing factors to the underestimation of the global significance of H_2O-rich primitive melts that are processed through volcanic arc systems.

[1] Wallace (2005) *JVGR* ***140***, 217-240 [2] Ruscitto *et al* (2012) *G^3 13*, Q03025 [3] Sisson & Grove (1993) *CMP* ***113***, 167-184 [4] Lange *et al* (2009) *Am Min* ***94***, 494-506 [5] Hamada *et al* (2013) *EPSL* ***365***, 253-262 [6] Grove *et al* (2005) *CMP* ***148***, 542-565 [7] Moore & Carmichael (1998) *CMP* ***130***, 304-319 [8] Plank *et al* (2013) *EPSL* ***364***, 168-179 [9] Dessimoz *et al* (2012) *CMP* ***163***, 567-589 [10] Jagoutz *et al* (2011) *EPSL* ***303***, 25-36 [11] Krawczynski *et al* (2012) CMP [12] Ridolfi & Renzulli (2012) *CMP* ***163***, 877-895