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H2O concentration in primary arc magmas estimated by experimental petrological studies and analyses of melt inclusions

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The slab-derived fluids and/or hydrous slab melts released from a subducted slab hydrate the mantle wedge, lower its melting temperature and induce generation of hydrous arc magmas. Experimental petrological studies have clarified that the H_2O shift pressure and temperature conditions of magma generation at subduction zones (Tatsumi *et al.*, 1983 JGR), and thus it is critical to estimate H_2O concentration in primary arc magmas. We will give an overview on selected attempts to estimate H_2O concentration in primary arc magmas by experimental petrological studies and analyses of melt inclusions in recent 30 years. Melting experiments of hydrous primary arc magmas by Pichavant *et al.* (2002 GCA) demonstrated that only primary magmas with low H_2O ($<$ 2 wt.%) can erupt without modification of their primary composition by crystallization differentiation due to comparable dP/dT between olivine liquidus and basalt adiabat. These constraints do not exclude presence of hidden H_2O-rich primary magmas. Indeed, the H_2O concentration in primary magma estimated from the analyses of primitive melt inclusions suggest wide variation (e.g., 2 wt. % at Kamchatka arc and 4 wt. % at Central American arc). H_2O-rich primary magmas may ascend and erupt after differentiation and/or supply volatiles to magmas at shallower level and cause so-called ”excess degassing”.

The H_2O concentration in primary magmas can be variable not only among different arcs and/or volcanoes, but also in a single arc volcano: both H_2O-rich and H_2O-poor primary magmas can coexist. This idea has been proposed by many petrologists to explain coexistence of tholeiitic series rocks and calc-alkaline series rocks in a single arc volcano since Kuno (1950). Further studies on variation of H_2O concentration in primary magmas, in combination with geochemical studies and numerical studies, will constrain genetic conditions of such dual primary arc magmas.

Keywords: H2O concentration in primary arc magma, Experimental petrology, Melt inclusion, Island arc magmatism, Subduction zone