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ABSTRACTS

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Possible existence of deep super-hydrous arc magmas: implications from high-Mg amphibole

The importance of quantifying the amount of H2O dissolved in magmas is obvious. However, pre-eruptive dissolved H2O in magmas is difficult to estimate due to nearly complete degassing of magmas during ascent, eruption, and cooling. Currently, magmatic H2O content estimations are based mostly on two methods: 1) measurements of water dissolved in melt inclusions; 2) plagioclase chemistry 'hygrometers' that are thermodyanmically derived models which use composition and/or phase stability as a function of dissolved water content. There is compelling evidence that these methods are only applicable to magmas in the upper-most part of the Earth's crust. Thus, the tools, which are commonly used for magmatic pre-eruptive H2O estimations are not able to provide information about deep/primitive arc magmas, which may contain much larger amounts of water than normally recognized.

In many ways amphibole may be complementary to plagioclase in its potential use as a hygrometer-type phase. In water-bearing magmas plagioclase crystallization gets suppressed, but amphibole crystallization does not. This leads to amphibole being an early crystallizing phase in deep-crustal hydrous systems, and in particular it crystallizes before plagioclase, and under certain circumstances, coeval with olivine. Primitive amphiboles crystallizing with or possibly even before olivine is a rare but globally ubiquitous assemblege, and has a lot to reveal about just how hydrous are subduction zone magmas when they leave the mantle. The primitive setting for amphibole discussed here is very different from the more typical use of amphibole as a baramoter in evolved acidic rocks. 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 H2O contents >12 wt%. We also outline how petrologic investigations of primitive igneous amphibole could be carried out to highlight the importance and ubiquity of amphibole as an early crystallizing phase. Amphibole's lack of a stability field at low pressure and the positive correlation between pressure and H2O solubility are likely major contributing factors to the underestimation of the global significance of H2O-rich primitive melts that are processed through volcanic arc systems. Ongoing and future experiments will help to better interpret the global array of primitive amphibole samples.