

THE LINK BETWEEN MAGMATIC WATER CONTENT AND GEOPHYSICALLY DETERMINED MAGMA STORAGE DEPTH

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Magma storage depths help shape our understanding of volcanic hazards, crustal structure, and continent formation. However, controls on the depth of magma stagnation are poorly understood. Some have argued for the importance of intrinsic (e.g., buoyancy, viscosity) controls [a], while others have emphasized the importance of extrinsic (e.g., crustal structure) controls [b]. We investigate the role of magmatic water content, a key intrinsic variable that drives changes in magma physicochemical properties. We target 22 arc volcanoes worldwide, focusing on mafic-intermediate systems. Reservoir depths, mostly based on geodetic or seismic observations, are compiled from the literature. Magmatic water contents are based on the maximum water content measured in large melt inclusion suites, which include new data for the Aleutians and previously published data. Storage depths (~2-15 km depth) correlate positively with maximum melt inclusion water contents (~2-7 wt.%), and, for select volcanoes with constraints on degassing style (open vs. closed), we find a strong agreement between storage depth and the depth at which water begins to degas. There are two possible explanations for these correlations: (1) magmatic water content controls magma stalling or (2) melt inclusion water re-equilibrates at the storage depth. If (2) were the dominant control, then melt inclusion water contents would not correlate with non-volatile trace elements (e.g., Nb/Ce and Ba/La), and yet they often do for the volcanoes studied here (our work in the Aleutians, [c], [d], [e]). Such systematics support (1), where intrinsically wetter magmas degas and crystallize deeper than dry magmas, resulting in deeper storage prior to eruption, and they demonstrate the global importance of intrinsic controls on the depth of reservoir formation.

[a] Zellmer et al. (2016). *AmMin*. [b] Chaussard & Amelung (2014). *G³*. [c] Sadofsky et al. (2008). *CMP*. [d] Plank et al. (2013). *EPSL*. [e] Walowski et al. (2016). *EPSL*.