

Water in clinopyroxene from the 2021 Geldingadalir eruption of the Fagradalsfjall Fires, SW-Iceland – a mineralogical perspective

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The magmatic water content is an important factor controlling the activity within a volcanic system, as key physical properties are significantly influenced by the presence of water (e.g., density, viscosity, melting temperature). The pre-eruptive magmatic water content can be recalculated by using phenocrystals of nominally anhydrous minerals, which can incorporate water in the form of hydroxyl (OH), associated to structural defects. By performing H₂-treatments of individual, crystallographically oriented clinopyroxene crystals, the water lost during magmatic processes can be reconstructed and quantified by infrared spectroscopy. By applying this method to clinopyroxene phenocrystals from lava samples collected in April 2021 from the Geldingadalir eruption, SW-Iceland, we obtained pre-eruptive water contents of 0.69 ± 0.07 to 0.86 ± 0.09 wt. % H₂O. These values are higher than those expected for the source of mid-ocean ridge basalts (MORB: 0.3 – 0.5 wt. % on average) and reveal a significant plume (OIB) contribution. Another consequential implication of such water concentrations is that the ascending magmas attained water saturation only at very shallow levels within the plumbing system. This can account for the episodic, shallow, vapor exsolution causing the observed pulsing behavior of the lava pond and within the upper conduits.