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Timescales of Volcanic Processes

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Our understanding of volcanic eruptions is fundamentally reliant on the timing of magmatic events: recharge, repose, unrest, ascent and supply rate are all dependent on chronologies. There has been a recent surge in our ability to deduce magmatic events at ever shorter timescales, largely through diffusion chronometry. Fe-Mg diffusion in olivine has been used to track ascent from the Moho and magma mixing events that occur over years to days. These timescales are comparable to seismic and geodetic unrest prior to eruption, and so allow a new understanding of the magmatic drivers (or not) of such unrest. H_2O diffusion in olivine and along melt embayments records the final ascent and cooling of magmas in minutes. Such work has shown how magma decompression rate scales to explosivity, more than a magma's initial H_2O content. An on-going challenge is the development of longer geochemical time-series, over the lifecycle of a volcano (~100s ka) and its transitions in eruptive style. Claude Allegre was a pioneer in using U-series isotopes to quantify volcanic chronologies over timescales of 100-10 ka. Allegre and Condomines developed the equiline and ^{230}Th evolution diagrams not only to date volcanic systems (often for the first time, using mineral separates), but also to model isotope evolution as a means to quantify magma residence times, magma supply rates and magmatic drivers of caldera formation. These processes are still poorly understood, and future work would benefit from fresh insights into volcano lifecycles afforded by intensive U-series studies, as trail-blazed by Allegre.