

Excess degassing of volcanoes

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Volcanoes emit larger amounts of volcanic gases than can be dissolved in the volumes of erupted magma, that is called as "Excess degassing". The excess degassing occurred during a variety of volcanic processes, not only by eruptions but also by non-eruptive degassing. The amount of volatiles discharged by explosive eruptions is often an order of magnitude larger than those dissolved in the erupted magma and the excess degassing is attributed to magmas that accumulate bubbles before eruption. Volcanic gas emission is a common activity of volcanoes during non-eruptive period. A long-term large-scale degassing, called persistent degassing, is a typical activity of active volcanoes and causes majority of volatile emission from volcanoes. The global annual volatile emission rate by the persistent degassing is about an order of magnitude larger than that by the global volcanic gas emission rate by eruptions. The large excess degassing by persistent degassing is a degassing of a large magma chamber.

Excess degassing and their models reveal magma-gas differentiation processes in a magma conduit-chamber system, which control degassing and eruption styles. Degree of excess degassing during Plinian eruptions is larger than those by smaller eruptions, suggesting that the eruption triggering is controlled by the content of accumulated bubbles, although the quantified examples are still limited. Strombolian, Vulcanian and lava dome eruptions are commonly associated with persistent degassing which requires a much larger volume of magmas than the eruptions, implying that the eruptions are rather minor magmatic process than the continuous degassing.

Magmatic volatiles are supplied to the crust as dissolved volatiles in magmas, and the excess degassing also reveals the magma-gas differentiation process in the crust. Based on geological studies, an intrusive/extrusive magma volume ratio was estimated as 10 for subduction zone volcanoes, but is smaller than that inferred from the excess degassing budget. The disagreement can be attributed to a magma-gas differentiation process in the crust, such as foundering of ultramafic rocks to upper mantle after volatile discharges to the upper crust.

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