Edifice collapse processes and the volcano-magmatic response to collapse

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Recent advances in geophysical imaging and direct sampling have led to an improved understanding of large-scale flank-collapse processes at island volcanoes. On ocean islands, such as the Canaries and Hawaii, such events are among the largest mass movements known on Earth. They rapidly transport large volumes of sediment to ocean basins, are capable of generating substantial (even ocean-basin scale) tsunamis, and, via magma system unloading, may be directly associated with volcanic eruptions or exert an influence on the subsequent evolution of volcanoes. Such processes are not limited to ocean islands, but occur in island arcs and can affect any composite volcanic edifice. They are therefore of fundamental importance in understanding volcanic systems, both in terms of hazard generation and in long-term changes in the style and frequency of volcanic activity at individual centres.

Here, we report on recent work that demonstrates the complexity of collapse dynamics around island volcanoes. Collapses frequently occur in multiple discrete phases, and their volume can be significantly increased by the incorporation of seafloor sediment. Both processes are significant for a correct interpretation of tsunami hazard associated with such events. We also summarise recent results on interpreting the diversity of landslide parameters at different volcanoes, in an effort to draw general observations on collapse processers. We go on to show that the magma system may respond in different ways following collapse, with variations in bulk composition, crystallinity and eruption frequency. All of these responses are, however, potentially consistent with the process of magma system unloading, though dependent on local variation in the storage system.