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El Hierro's floating stones as messengers of crust-magma interaction at depth

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During the early stages of the submarine eruption that started on October 10 2011 south of El Hierro, Canary Islands, Spain, peculiar eruption products were found floating on the sea surface. These centimetre- to decimetre-sized "bombs" have been termed "restingolites" after the nearby village La Restinga and consist of a basaltic rind and a white to light grey core that resembles pumice in texture. According to Troll et al. (2011; see also Troll et al. EGU 2012 Abstracts), this material consists of a glassy matrix hosting extensive vesicle networks, which results in extremely low densities allowing these rocks to float on sea water. Mineralogical and geochemical analyses reveal that the "restingolites" originate from the sedimentary rocks (sand-, silt-, and mudstones) that form layer 1 of the oceanic crust beneath El Hierro. During the onset and early stages of the eruption, magma ponded at the base of this sedimentary sequence, breaking its way through the sedimentary rocks to the ocean floor. The textures of the "restingolites" reveal that crust-magma interaction during fragmentation and transport of the xenoliths involved rapid partial melting and volatile exsolution.

Xenoliths strikingly similar to those from El Hierro are known from eruptions on other Canary Islands (e.g. La Palma, Gran Canaria, and Lanzarote). In fact, they resemble in texture xenoliths of various protoliths from volcanic areas worldwide (e.g. Krakatao, Indonesia, Cerro Quemado, Guatemala, Laacher See, Germany). This indicates that the process of partial melting and volatile exsolution, which the "restingolites" bear witness of, is probably occurring frequently during shallow crustal magma emplacement. Thermomechanical numerical models of the effect of the density decrease associated with the formation of vesicle networks in partially molten xenoliths show that xenoliths of crustal rocks initially sink in a magma chamber, but may start to float to the chamber roof once they start to heat up and vesiculate.

The "floating stones" from El Hierro thus represent the products of crust-magma interaction beneath the Canary Islands, but is probably relevant in most volcanic areas and tectonic settings. In addition, xenolith devolatilisation has important general implications for the mechanics of crustal recycling, magma emplacement into the upper crust and volatile release from active volcanic systems.

References: Troll, V. R., Klügel, A., Longpré, M.-A., Burchardt, S., Deegan, F. M., Carracedo, J. C., Wiesmaier, S., Kueppers, U., Dahren, B., Blythe, L. S., Hansteen, T., Freda, C., Budd, D., Jolis, E. M., Jonsson, E., Meade, F., Berg, S., Mancini, L., Polacci, M., 2011. Solid Earth Discussions 3, 975-999, doi: 10.5194/sed-3-975-2011