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Constraining magmatic processes and timescales with ^{238}U-series disequilibria leading to the 2021 eruption at La Palma, Canary Islands.

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Timeseries of recent eruptions magma composition reveal different magmatic processes and corresponding timescales. Lavas and tephra representing the 2021 magma suite of the Cumbre Vieja eruption, La Palma, were analysed for radioactive disequilibria in the ^{238}U chain. The activity ratios (^{230}Th/^{232}Th) and (^{238}U/^{232}Th) of the magma are respectively 1.11–1.09 and 0.884–0.847, and thus hardly distinguishable, indicating a common parental magma. In contrast, large excesses are observed for ^{226}Ra over ^{230}Th, as observed from (^{226}Ra/^{230}Th) = 1.78–1.68, suggesting an efficient fractionation mechanism of Ra from Th. Tephra from the first day of the eruption has ^{210}Pb and ^{226}Ra in equilibrium whereas later emitted products display ^{210}Pb deficit relative to ^{226}Ra with (^{226}Ra/^{210}Pb) = 1.14–1.13. The difference between early and later products cannot be explained by different magma sources. Magma degassing led to ^{210}Po activity close to nought in the lavas at the time of eruption.

The results obtained so far are consistent with an instantaneous radium addition to the magma causing radium excess over thorium and lead. The first erupted magma probably represents left-over magma from a previous eruption, yielding time for ^{210}Pb ingrowth to attain radioactive equilibrium with its parent nuclide, the ^{226}Ra. From the later erupted magma the possible addition of radium can be calculated to have occurred less than 50 years ago. Since the excess of radium is likely to have affected both the old and the young magmas, addition of radium is most likely linked to the magma formation process beneath Cumbre Vieja volcano. The nature of that process will be discussed, and different hypotheses will be considered such as the simple effect of fusion or possible addition of a carbon-rich agent provoking mantle melting.