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Magmatic timescales after assessment of fractional crystallization on ^{210}Pb-^{226}Ra disequilibria

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Timescales of processes such as magma transport to surface, magma chamber residence time and rate of magma differentiation can be accessed through U-series disequilibria. For solid-liquid fractionation, the shortest timescales are best addressed with the ^{210}Pb-^{226}Ra disequilibria. However, the existence of an ideal gas, ^{222}Rn, between ^{226}Ra and ^{210}Pb in the ^{238}U-decay chain, complicates direct assessment of magma differentiation time utilizing these nuclides. Therefore, the effects of magma differentiation processes on ^{210}Pb-^{226}Ra disequilibria must first be understood. Here, we show that primitive lavas erupted during the 1963-67 Surtsey eruption experienced fractional crystallization, gas transfer and magma mixing on timescales shorter than 10 years. This short duration of magmatic processes is derived from ^{210}Pb-^{226}Ra disequilibria in samples collected in the sixties and the seventies. Moreover, emplacement of Surtseyan basalt beneath the Heimaey island and a decade of fractional crystallization produced hawaiite and mugearite erupted in 1973 in the Vesmannaeyjar archipelago. Constant 210Pb deficit of 20% in the 1973 products and the most evolved basalts erupted in 1963 at Surtla island on the same eruptive fissure as Surtsey, show that fractional crystallization of basalts producing intermediate magmas has no effect on the (^{210}Pb/^{226}Ra).