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Rapid translithospheric ascent rates for Lamprophyres from zircon dissolution speedometry

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Assessing how fast different types of magmas ascend from below the lithosphere to the surface has been difficult to quantify. We use dissolution modelling of mantle zircons formed contemporaneously with lamprophyre melt production in the sublithospheric mantle that were brought to the near surface by lamprophyre magmas, to calculate translithospheric ascent rates. The basis for these calculations is that (ultra)mafic lamprophyres do not reach SiO_2-contents sufficient for zircon saturation, and even though Zr concentrations can reach several hundred ppm zircon will not crystallize from these unfractionated melts. Nevertheless, some (ultra)mafic lamprophyres contain zircon xenocrysts formed in the mantle. The crystallization of these xenocrystic zircons can intriguingly happen in the mantle and they may subsequently be incorporated into highly zircon undersaturated melts that ascend to the upper crust, as shown here. To survive dissolution in the highly zircon undersaturated magmas, the ascent emplacement and quenching must be very rapid. Through a range of methods, we highlight how xenocrystic mantle zircons in lamprophyres, were rapidly extracted from >90 km depth and carried to the upper crust. We provide a quantitative magma ascent speedometer applicable to zircon undersaturated rocks and a tool for accurately dating deep mantle partial melting events recorded by lamprophyre generation.