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Constraining fault-reactivation timing using lower-intercept U–Pb ages of fluid-altered zircons

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Constraining reactivation ages of long-lived intraplate faults is challenging because repeated deformation commonly overprints primary mineral records and syn-tectonic phases rarely yield directly datable minerals. Here we propose an approach that infers the timing of fault-related fluid ingress from zircon U–Pb systematics in fault-zone materials. Hydrothermal fluids circulating within fault cores may introduce non-radiogenic (common) Pb into zircons when pre-existing radiation damage (partly metamict domains) and microcracks provide pathways for fluid–mineral interaction. We analyzed zircons from relatively unaltered host rocks and high-strain fault-core samples collected along the Yangsan Fault and other major structures in South Korea. BSE and CL imaging show that host-rock zircons typically preserve magmatic oscillatory zoning and yield concordant U–Pb ages, whereas fault-core zircons exhibit widespread microfracturing and alteration-related microinclusions associated with discordant isotopic data. We interpret these discordant arrays using lower-intercept ages to estimate the timing of hydrothermal pulses linked to fault movement, thereby bracketing multiple reactivation episodes from the Late Cretaceous to the Late Quaternary.