Dating fault activity around the globe by *in-situ* chronology of fault-related precipitates

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Reconstructions of long-term fault activity are essential for understanding both the mechanisms controlling fault behaviour and accurate earthquake hazard assessments. Our research presents a novel method for constraining long-term records of fault activity based on *in situ* U-Pb dating of fault-related precipitates (opal and calcite). Fault-related precipitates, such as breccia cement, fault-coating, and vein-fillings, are forming in the fault zone during deformation event and direct *in-situ* dating of these precipitates provide valuable information on the timing and mechanisms of faulting events.

We present results from three major active strike-slip fault systems in the world, the Eastern California Shear Zone (ECSZ), The Dead Sea Transform (DST), and the Northern Anatolian Fault Zone (NAFZ). Temporal constraints on activity of faults from this study provide new insights into fault initiation, interaction, propagation-localization, reactivation, and longevity. For the ECSZ we show that faults initiated as early as 10 million years ago and that fault-interactions play a major role in the distribution of deformation within the ECSZ and between the ECSZ and the San Andreas Fault systems. The origin and evolution of the DST are re-evaluated based on our new *in-situ* U-Pb dating and strain analyses of mechanically twinned calcites. Results indicate that strike-slip faulting initiated within a 10 km wide deformation zone in southern Israel at ~20 Ma. Older ages from the southern DST relative to the northern DST suggest northward propagation of this classic strike-slip zone. Finally, for the NAFZ, our results confirmed previous studies that showed early activation of the NAFZ as a normal fault in an extensional regime (Eocene age ~ 41 Ma) and further suggests that reactivation of the NAFZ in the current E-W shearing regime occurred about 6 million years ago.