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Dating young frictional melts of the Alpine Fault (New Zealand) by laser ablation 40Ar/39Ar step heating analysis

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Laser ablation 40Ar/39Ar step heating analysis of pseudotachylyte veins from a single locality along the exhumed central portion of the active Alpine Fault of New Zealand yield total gas age values between 1-19 Ma. The total gas ages show an exponential decrease with increasing proportion of melt matrix and K content. The young values ($<$1.2 Ma) correspond to high K2O ($>$3%), matrix-rich samples and the older ($>$8 Ma) correspond to low K2O ($<$1%), matrix-poor lithologies. These relationships indicate that incomplete degassing and mixtures of radiogenic argon sources characterize these samples, controlled by the degree of melting related to lithological differences and fractionation between clasts and matrix components. These well defined trends imply that these veins are genetically related and formed during coeval episodes of seismogenic melting, conflicting with a spread in formation ages. The true age of melt generation can be extrapolated from the flat portion of the exponential curve, indicating a young episode of crystallization and cooling between 0.9 and 1.2 Ma. Assuming an average exhumation rate up to 9 mm/year for this period of uplift and erosion, the generation of these melts can be placed at 8-11 km depth. This Quaternary slip episode is suggested to have occurred along a relatively anhydrous segment of the Alpine Fault, lying between the infiltration of downward meteoric and upflowing metamorphic crustal fluids. Reliable dating of friction melt events can be made by pre-selecting reservoir veins high in potassic and matrix content.