DATING PREHISTORIC EARTHQUAKES AND THEIR FRICTIONAL MELTS ALONG THE ALPINE FAULT, NEW ZEALAND

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Previous attempts at dating large paleo-earthquake slip events by radiometric analysis of their friction melts have been of mixed success. Frictionally fused rocks (pseudotachylytes) are particularly difficult to date because of the partial nature of "flash" melting which can lead to incomplete resetting of radiometric dating systems, the intense brittle deformation accompanying melting, and the extremely fine-grained nature of neocrystalline material. In this contribution we present a detailed high-resolution transmission electron microscopy and 40Ar/39Ar isotope study of a pseudotachylyte vein from the Alpine Fault, New Zealand. By combining these techniques across this layered vein sample, the complex nature of frictional melting and crystallization is revealed. Two successive, but rapid, injections of frictionally-generated melt are recognized. The initial injection was proximally derived and contains a higher proportion of lithoclasts and a Si-rich glass. This was quickly followed by a second generation of a more distally derived viscous melt, which intruded into the weaker central portion of the vein. Based on our textural and isotopic constants, only the youngest distally derived melt has preserved conditions suitable for dating the event. This layer of the pseudotachylyte is not contaminated by metamorphic biotite derived from the wall-rock schist and was not affected by the excess argon that characterizes the schist. 40Ar/39Ar total gas ages from the vein center give a ca. 1.1 Ma date for melting which, based on current exhumation rates, represents a prehistoric earthquake that occurred at a crustal of depth ca. 11 km.