



Consequences of frictional melting and catastrophic dilation along caldera superfaults: Glencoe, Scotland

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The Glencoe Caldera records complex piecemeal caldera collapse along superfaults with slip rates in sufficient to induce frictional melting. The deeply dissected volcano exposes outer fault segments with cm-scale bands of pseudotachylyte in contact with breccias, cataclasites and magmatic fault intrusions along the fault plane. Processes of frictional melting, cataclasis and intrusion were closely associated and the various materials show evidence for fluid-state mixing. At shallow depths, where the caldera faults dip outwards, rapid subsidence of the caldera footwall led to catastrophic dilation and the formation of free surfaces at low pressures. Decompressed hydrothermal systems were explosively excavated to form irregular voids behind the original fault surfaces. In such dilatant sections of the fault, frictional melts and then magma intrusions were fragmented and explosively transformed to froths or sprays that coated newly-formed void walls. We suggest that these processes are likely to have formed the lithic breccias with hydrothermally altered and thermally spalled clasts - common in caldera-related ignimbrites.

Mineralogy and clast-size distribution analysis indicate that some pseudotachylytes formed virtually in-situ, from the (Dalradian) metamorphic basement psammites and quartzites, while others were apparently sourced at considerable depths. Lithic clasts and xenoliths within the fault intrusions and pseudotachylytes imply a granitic source, probably the Rannoch Moor pluton, which in turn suggests transport of frictional melt for at least several hundreds of metres up the caldera fault, conceivably as fluidized froth. Modelling and reproduction of pseudotachylyte using laboratory friction experiments are intended to investigate the conditions that generated these rocks, and to explore their mobility as melts and fragmented products, shedding light on the processes of friction in volcanic environments.