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Pre-Caldera Uplift Recorded in Volcano-Tectonics, Breccias, and Ignimbrites of the Southern Mountains Zone, Isle of Rum, Scotland

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The first of six stages in Smith and Bailey's classic 1968 model for the evolution of resurgent caldera volcanoes is pre-caldera tumescence due to magma chamber intrusion. At young calderas, however, pyroclastic and sedimentary infill usually obscures evidence for such pre-caldera uplift. Furthermore, recent surveys of ancient and deeply eroded calderas in Western USA and Britain have concluded that evidence for tumescence prior to formation of these calderas is limited or absent. Some doubt therefore exists in the caldera literature as to whether pre-caldera tumescence actually occurs. However, complex volcano-tectonic movements in subsequent stages of caldera evolution may hinder recognition of evidence for pre-collapse uplift. Moreover, many ancient calderas formed in areas of complicated pre-, syn-, and post-caldera regional structure and tectonics.

The Isle of Rum, Scotland, hosts a deeply-eroded Palaeogene igneous centre that is surrounded by relatively undeformed Pre-Cambrian to Jurassic country rocks. Around the igneous centre is a complicated Main Ring Fault system, preserved within which are two marginal complexes - the Northern Marginal Zone (NMZ) and the Southern Mountains Zone (SMZ). We have reinvestigated the characteristics and relationships of the rocks in the more extensive and deeply dissected SMZ. We present new evidence that demonstrates the almost identical natures and relative ages of lithologies in the SMZ and the NMZ. This evidence supports and refines a previously postulated

volcano-tectonic model for Rum of structural uplift from magma intrusion, followed by caldera formation.

The lowermost Pre-Cambrian stratigraphic units are only exposed inside the ring-fault system, and in both zones have been uplifted relative to their regional disposition by up to 1.5km. In places, these lower units are in reverse-faulted contact with upper Pre-Cambrian units that lie outside the ring fault system. The uplifted units inside the ring fault system are also generally tilted outward away from the igneous centre, and display numerous tight folds, the axes of which trend concentrically to the ring fault system. In the SMZ, evidence of subsequent volcano-tectonic subsidence is also preserved along the Main Ring Fault system, as splinters of uppermost Jurassic units lie inside uplifted lowermost Pre-Cambrian units. A $>$200 m thick, undeformed succession of Palaeogene sedimentary 'mesobreccias', sandstones and ignimbrites lies unconformably upon the uplifted, outward-tilted, and locally folded country rocks. In most exposures, mesobreccia clasts are from lower parts of the Pre-Cambrian stratigraphy. We therefore conclude that the Rum marginal complexes indeed represent a rarely preserved window into the lowermost levels of a caldera system whose floor and infill record clear evidence for a phase of pre-collapse uplift.