

THE CHRONOLOGY AND KINEMATICS OF LATE PALAEOZOIC DEFORMATION IN THE NW CONTACT METAMORPHIC AUREOLE OF THE LAND'S END GRANITE



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A structural investigation of coastal exposures between Cape Cornwall and Pendeen Watch, in the NW contact metamorphic aureole of the Land's End Granite, has confirmed a similar deformation chronology as in a reference section around Porthleven. D1 deformation is represented by an ubiquitous bedding-parallel S1 cleavage although F1 folds have not been recognised. D2 deformation is more localised and characterised by open F2 folds that verge WSW to NW and are associated with an ENE to SE dipping S2 crenulation cleavage. These structures are commonly obscured by later deformation and contact metamorphism and have not been described previously. A set of steeply inclined NNW-SSE trending, and subordinate set of moderately SE dipping, post-D2 metamorphic quartz veins formed coevally during an episode of strike-slip deformation prior to, or during, the early stages of D3 deformation. D3 deformation is widespread and represented by F3 folds and a WNW to NW dipping S3 crenulation cleavage; it has been recorded previously as D2 deformation. Two orders of F3 folds are developed; first order folds have a wavelength of up to 50 m, verge ESE, and result in vertical or steeply inclined bedding and S1 cleavage on their short limbs. Second order folds usually have a wavelength of 1 m or less and usually verge ESE, unless on the short limb of first order folds, where they verge WNW. Previously published data, indicating a dominant NW to WNW vergence of F3 folds on the northern flank of the Land's End Granite are incorrect. D3 structures are consistent with formation during the extensional reactivation of large-scale thrust faults. Granite emplacement post-dates all three episodes of ductile deformation but granites and their host rocks are deformed by a late brittle expression of D3 deformation. The Land's End pluton has been accommodated, at the current exposure level, primarily by roof uplift that has resulted in the tilting of D3 and earlier structures to the NW by 40-50°; this may have been accompanied by differential vertical axis rotations of the host rock. The last significant Palaeozoic deformation episode formed F4 folds and S4 cleavage and was a consequence of Mid- to Late Permian ENE-WSW shortening.

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INTRODUCTION

Late Palaeozoic deformation of the Devonian and Carboniferous successions in SW England reflects three principal regional tectonic episodes (e.g. Dearman, 1971; Sanderson, 1973; Leveridge and Hartley, 2006). It is widely accepted that D1 and D2 deformation occurred during Variscan (late Devonian to late Carboniferous) plate convergence and collision whereas D3 deformation relates to a different tectonic regime established prior to, or during, granite emplacement (Turner, 1968; Rattey and Sanderson, 1984; Alexander and Shail, 1995, 1996; Leveridge and Hartley, 2006).

The Land's End Granite and its host rocks provide a suitable location to test the chronology of host rock deformation relative to granite emplacement due to the excellent coastal exposures of these units and their contacts. Relatively little has been published on the chronology and kinematics of deformation within the granite aureole. In part, this may reflect the challenges posed by a locally intense contact metamorphic overprint. The deformation chronology indicated within the aureole on the British Geological Survey Penzance sheet (BGS, 1984), and described in the accompanying memoir (Goode and Taylor, 1988), differs from that proposed in adjacent areas of the Gramscatho Basin (e.g. Smith, 1965, 1966; Rattey and Sanderson,

1984; Alexander and Shail, 1995, 1996). Whilst these latter authors are in broad agreement on the regional deformation chronology outside the aureole, they have differing interpretations of the cause of D3 episode. Rattey and Sanderson (1984) proposed that D3 structures largely developed as a response to vertical shortening brought about by granite emplacement, whilst Alexander and Shail (1995, 1996) proposed a largely pre-emplacement origin during the extensional reactivation of Variscan thrusts.

The purpose of this contribution is to demonstrate that: (i) the regional deformation chronology established by the majority of previous workers outside the Land's End Granite aureole can also be recognized within the NW segment of the aureole. (ii) Ductile D3 deformation within the aureole pre-dates granite emplacement and is kinematically equivalent to D3 deformation outside the aureole. (iii) The accommodation of the Land's End Granite at the present exposure level was achieved largely by post-D3 uplift and tilting of the host rocks. The study is based upon the comparative structural geology of the contact metamorphic aureole on the NW margins of the Land's End Granite and the section around Porthleven on the south coast (Figure 1).