



## Arc-continent collision: orogeny and continental growth

J. F. DEWEY<sup>1\*</sup>, M. A. MANGE<sup>1</sup> AND P. D. RYAN<sup>2</sup>

<sup>1</sup>*Department of Geology, UC Davis, Davis, CA 95616, USA.*

<sup>2</sup>*Department of Geology, University, College, Galway, Ireland.*

*\*e-mail: dewey@geology.ucdavis.edu*

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The mid-Ordovician Grampian Orogen of western Irish Caledonides, the Miocene Bismarck Orogen of New Guinea, and the early Cretaceous Nevadan Orogen of the Sierra Nevada probably developed by the collision of a supra-subduction zone (SSZ) ophiolite/oceanic arc(s) with a continental margin followed by a flip in subduction polarity, leading to the addition of oceanic arc complexes to the edges of continents and, hence, continental growth. In each, imminent collision is heralded by a switch from mafic to silicic magmatism, fore-arc/successor basins preserve a clastic records of collisional events and unroofing of the obducted SSZ ophiolite and underlying metamorphic complexes, ancient zircons from subducted crust appear in the post-collisional arc, and the crust was returned to normal thickness, mainly by extension, not erosion. The preservation of low-grade rocks in these collisional zones may have been the result of four factors. First, subduction systems commonly show a general subsidence of the over-riding lithosphere resulting from the colder negative buoyancy of the subducting slab(s). Second, the

subducting, thinned and stretched, continental margins probably contain substantial amounts of rift-related mafic igneous rocks, which if converted to eclogite during continental thickening it would contribute to depression of the orogen and reduce erosion. Third, the 12 km-thick obducted arc/supra-subduction-zone ophiolite/arc nappes had an average density of about 3200 kg m<sup>-3</sup>, beneath which the evolving orogens were depressed below sea level. Fourth, the Grampian orogen in western Ireland, and probably the Bismarck and Nevadan Orogens, enjoyed a period of late-orogenic extensional denudation, when only very recently-generated staurolite-bearing garnet amphibolites were drawn up beneath an extensional detachment(s) to contribute a statistically significant pulse of detritus, as the ophiolite/arc hanging wall was drawn down. Subduction flip led to extensional collapse and, probably, delamination/detachment of the eclogitised Laurentian root, which would have generated uplift of the Grampian core from which the high-level obducted sheet was withdrawn.