The evolution of the Clew Bay Fault Zone (Baie Verte-Brompton Line) and associated zones in western Ireland

J.F. Dewey[1] and P.D. Ryan[2]
[1]*University of Oxford Parks Road, Oxford OX1 3PR, United Kingdom*
[2]*University College Galway, Galway, Ireland*

The provocative and geographically inept title of the paper is to allow and emphasize some comparisons between Lower Paleozoic structures, lineaments, ophiolitic "suture zones", arcs and sinistral transpressional systems in Newfoundland and Ireland, especially to contribute to the debate about the relative importance and roles of Ordovician versus Siluro-Devonian deformation in the structural evolution of the international northwestern zones of the Maritime Appalachians and British Caledonides.

The Deer Park and Westport complexes crop out in the Clew Bay region, western Ireland and form, we believe, the suture zone between an Ordovician island arc to the south and the Laurentian continental margin. The Deer Park Complex comprises an ophiolitic mélange with knockers of dolerite, sheeted dykes, dolerite-mylonites, static gabbros, ultramafic cumulates, mantle harzburgites, serpentinite breccias and amphibolite-ultramylonites set in a serpentinite or talc-carbonate matrix. This lithological assemblage is characteristic of an ophiolitic backstop thrust located in the hanging wall of a subduction zone nucleated at a transform fault like the Coastal Complex of the Bay of Islands Complex. The Westport Complex contains three components: (1) highly sheared Lower Ordovician muds, silts, sands, dolomites, cherts and microconglomerates of low metamorphic grade; (2) quartz ribbon mylonitic metasediments; and (3) meta-basic volcanites and brecciated serpentinites locally containing crossite. Geographic proximity, structural style and stacking are consistent with a common origin in a subduction-accretion prism

formed against the Deer Park backstop. These complexes are preserved at the site of Llanvirn collision of an arc with the Laurentian Foreland and represent an eastward continuation of the Baie Verte-Brompton Line in Newfoundland. To the south, the South Mayo Trough, a broad synclinorium containing a 10-km sequence of Early Ordovician turbidites passing up into shallow water sandstones is interpreted as a forearc basin with an ophiolitic basement that formed a backstop to an accretionary prism on the northern edge of the north-facing arc. The South-Mayo Trough was fed principally by arc and ophiolite-derived clastics during the Arenig with an increasing metamorphic component during the Llanvirn. Prior to the late Llandovery, sinistral transcurrent faulting transposed the Connemara Dalradian terrane to its present position on the "outboard" oceanward side of the South Mayo Trough. The Late Ordovician transpressional "docking" of Connemara provided the southerly source for high-grade metamorphic clasts in the Deeryveeny Formation.

Regional sinistral transpression generated much of the structure of a broad zone between South Achill/Southeastern Ox Mountains and north Connemara that includes the Clew Bay Zone during the late Silurian. Subhorizontal stretching is dominant in clockwise transecting cleavage sequences with shortening from 25% to 75% and K values from about 0.1 to 1.0; therefore, the bulk transpressional displacement direction was over about 70° from the normal to the boundaries of the deforming zone, and all structures are strongly non-coaxial. Transpression was partitioned strongly in space and time in different parts of the broad zone. In the north, penetrative sinistral shearing is superimposed on earlier dextral transpressive structures and fabrics in South Achill and the Southeastern Ox mountains. The Ox Mountains granodiorite/tonalite Complex was emplaced "lit par lit" in a sinistral pull-apart while the Ladies Brae Fault Zone developed as a "compressional jog thrust". The Clew Bay Zone developed distributed sinistral shear principally in Ordovician serpentinites as the Louisburgh Basin opened as a lozenge-shaped pull-apart with a major shear zone (Emlagh Pt. Zone) along its southern margin. To the south, the South Mayo Trough shows a multiple-clockwise-transecting cleavage sequence related to transpressional shortening and progressive flexure that induced cleavage "refraction" and increasingly steep bedding/cleavage intersection. Early fuchsite (after chromite) shear zones are controlled stratigraphically and are deformed by a clockwise-transecting second cleavage with rare minor S-folds. During flexural steepening, cleavage continued to form in pelites while early formed cleavages in psammites opened vertically to generate quartz vein arrays. Bulk vertical stretching was followed by vertical shortening with gravitationally-controlled flow to the south and north from a transpressional high through the Sheeffry Mountains. Late sinistral shear allowed the intrusion of the Corvock "granite" into a rhomb-shaped sinistral pull-apart. Bedding plane slickensides are partitioned into vertical flexural slip and horizontal sinistral lineations. Partitioning between pure sinistral strike-slip and transpression occurs at all scales from the map to the outcrop. Rotations, as demonstrated by palaeomagnetic data, show the expected anticlockwise with vorticity, but also clockwise, which may be related to motion along sinuous strike-slip faults and/or orientation of passive marker blocks with respect to the instantaneous transpressional displacement direction.

A principal conclusion is that late Silurian structures overprint and, locally, mask Ordovician structures, but that the Clew Bay Fault Zone and the Baie Verte-Brompton Line represent an arc-continental margin collision zone along the line of north-facing early Ordovician subduction zone, from which northwestward ophiolite obduction occurred.