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Sinistral shear during Acadian deformation in north-central Newfoundland, based on transecting cleavage

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Recent observations of cleavage transection in the Caledonides of Britain suggest a genetic relationship between the clockwise transection by cleavage of fold axes to sinistral transpression—on the assumption that buckling precedes the development of solution cleavage (Stringer & Treagus 1980, 1981, Treagus & Treagus 1981, Soper & Hutton 1984, Murphy 1985, Soper 1986, Soper *et al.* in press). The transection angle (T) is commonly 10° or less, in a clockwise sense for sinistral shear.

We report a similar pattern of cleavage transection of fold axes in the Notre Dame Bay area of north-central Newfoundland (Fig. 1), where the post-Caradoc turbidite system of the Point Leamington Formation (Helwig 1967, Pickering 1987a) shows moderate strains, a low metamorphic grade and a well-developed penetrative solution (slaty) cleavage (Fig. 2). Using the unpublished data of Pickering, and data from research in progress by Blewett, lower-hemispherical equal-area projections of poles to bedding and poles to cleavage are plotted (Fig. 2).

Figure 2 shows a mean first penetrative slaty-cleavage trend transecting the regional strike of folded bedding with a 7° clockwise sense. This pattern also has been confirmed by our field observations. A literature survey of data from Horne (1968, cf. fig. 23), and Karlstrom *et al.* (1982, cf. fig. 5), shows a similar pattern of clockwise cleavage transection on New World Island (north-central Newfoundland) with a 9 and 7° clockwise transection, respectively.

The available data suggest that Acadian sinistral shear was important not only in Britain but also in Newfoundland during the closure and final destruction of the Iapetus Ocean. These observations support the view that Acadian (Siluro-Devonian) sinistral displacements occurred throughout long segments of the Appalachian–Caledonian continental margin on the northwestern side of the Iapetus Ocean (Webb 1969, Soper & Hutton 1984, Bluck 1985, Keppie 1985, Anderson & Oliver 1986, Pickering 1987a, Elders 1987, Pickering *et al.* in press, Soper *et al.* in press).

Webb (1969) and Kusky *et al.* (1987) have described dextral faults in the Appalachians of North America, and Stringer (1975) has documented early dextral transpression (anticlockwise cleavage transection to folded bedding) in NE Maine. Kusky *et al.* (1987) showed the NE- to NNE-trending Northern Arm–Reach Fault system in Newfoundland as being dextral. However, this dextral movement is probably latest Devonian to Carboniferous and it clearly cuts the Acadian transected folds, a point accepted by Kusky *et al.* (1987). Preliminary field observations by us suggest that a number of the major fault zones in north-central Newfoundland record a dextral last-displacement, whereas within structural blocks between such faults the earliest recorded major shear appears sinistral. We therefore believe that the major Northern Appalachian dextral shearing occurred from the latest Devonian or earliest Carboniferous (Viséan) onwards, associated with a change from sinistral to dextral shearing as plate motions dramatically altered (e.g. Haszeldine 1984). The data of Stringer (1975) may be explained by oblique collision between Eastern Avalonia and Laurentia from latest Ordovician times onwards, thereby causing major sinistral shear to the north and east of Western Newfoundland, whereas

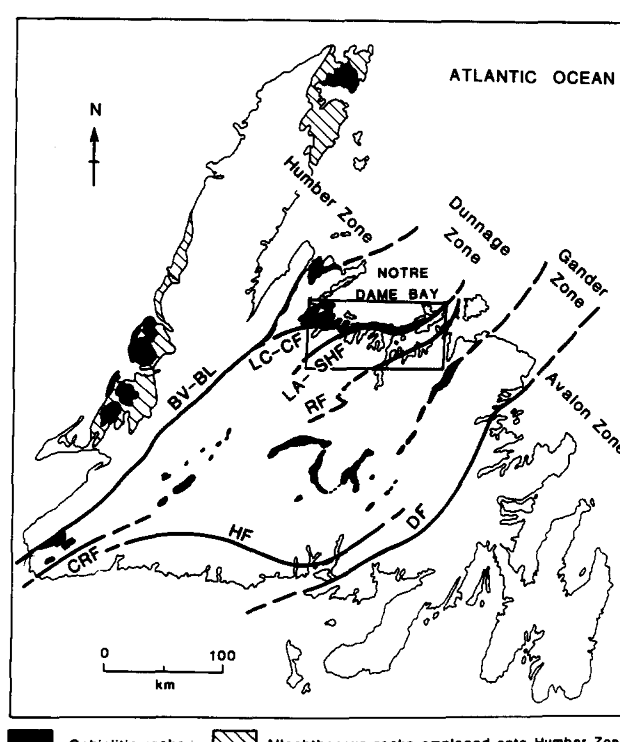

Fig. 1. Location of the Notre Dame Bay study area (boxed) in north-central Newfoundland. Abbreviations: BV–BL Baie Verte–Brompton Line; CRF Cape Ray Fault; LC–CF Lobster Cove–Chansport Fault; LA–SHF Luke's Arm–Sops Head Fault; RF Reach Fault; HF Hermitage Flexure; DF Dover Fault.

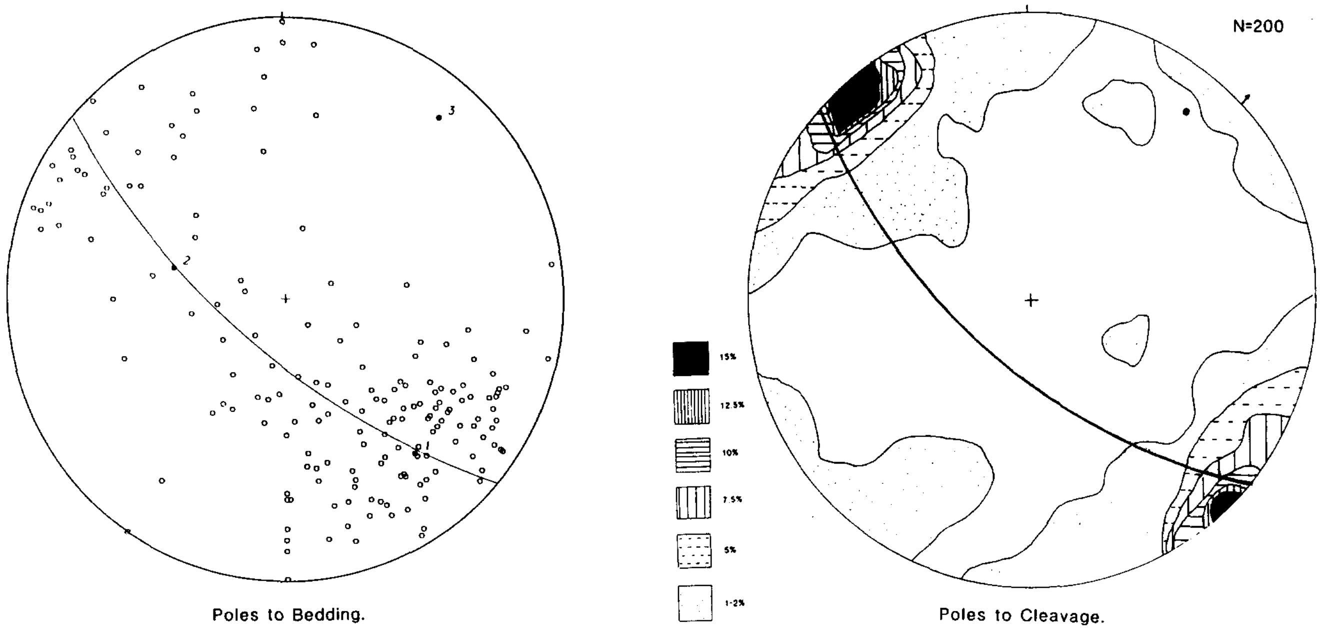

Fig. 2. The best-fit girdle from poles to bedding (left) is plotted on to poles to cleavage (right), and shows a 7° clockwise transection. Lower-hemisphere equal-area projection.

because of the irregular shape of the Laurentian margin together with the direction of the proposed plate vector, the eastern region of the Quebec Re-entrant may have been subject to limited dextral shear (Pickering 1987b, Pickering *et al.* in press).

If faults and shear zones are developing in a zone of transpression, a complex array of synthetic, antithetic, and 'X' shears may develop with other major structures. Rotation of structures with time may give erroneous palaeostress patterns, so the interpretation of regional shear senses interpreted from a single fault (e.g. Kusky *et al.* 1987) must be treated with caution. Our preliminary data, based on a geographically large area covering Newfoundland and Britain suggest that while dextral shear may have been locally significant, the dominant early deformation over wide areas was that of sinistral shear.

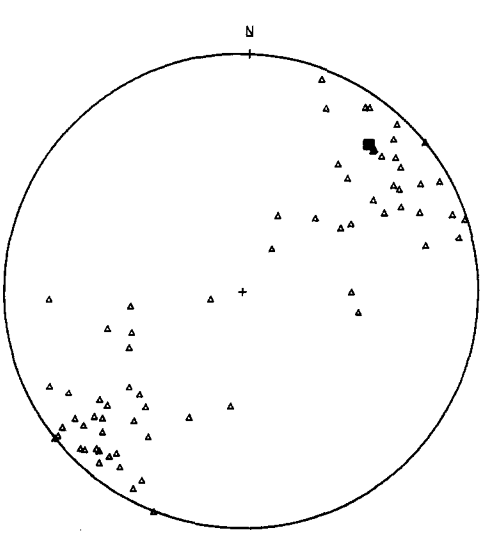

Fig. 3. Bedding–cleavage intersections (triangles) with fold axis (square), from Fig. 2. Lower-hemisphere equal-area projection.

In summary, work in the British Caledonides suggests major sinistral transcurrent motions between Laurentia and the colliding terranes, a pattern also observed throughout north-central Newfoundland. This deformation represents an Acadian transpressive regime similar to that noted by Soper (1986) and other researchers in the British Caledonides. We ascribe the sinistral shear to the progressive collision of Eastern, then Western, Avalonia against the Laurentian margin from the Early Silurian to the Middle Devonian (Emsian).

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