CORRESPONDENCE

The westward continuation of the Leannan Fault of Donegal and its bearing on the Great Glen Fault system

SIR – A Combination of land-based geological evidence from Co. Mayo, aeromagnetic trends and the results of marine shallow seismic investigation in Donegal Bay suggest that a major fault dislocation and splay of the Great Glen Fault, the Leannan Fault of Co. Donegal, passes directly southwest across Donegal Bay to the northwestern approaches of Killala Bay. From there it can be extrapolated beneath the cover of Carboniferous rocks W and NW of Crossmolina into the line of the exposed Corraun Fault of Co. Mayo. This continuous fault feature almost certainly passes into the western continuation of the Great Glen Fault to the W of Ireland in the vicinity of the northern termination of the Porcupine Seabight and can be regarded as the southeast-most wrench-fault splay of the Great Glen Fault system in NW Ireland.

The definition of the fault system in NW Ireland is necessary, when considering the offshore geological framework, as the faults that define the Great Glen system occur both on and offshore. As these faults control the position of potential petroleum-bearing sedimentary basins offshore, their geological history is of particular interest. The precise overall geometry of the Great Glen fault system and its separation from other fault systems associated with the Highland Boundary Fault and the Southern Uplands Fault in Ireland should allow for a better understanding of the structural controls of sedimentation in this as yet imprecisely known offshore area.

1. Geophysical evidence for the extension of the Leannan line

1.a. Marine

In 1974 a cruise of the R.R.V. *John Murray* in part involved geophysical (shallow seismic) investigations of the Irish continental shelf W of Donegal. Two poor-quality lines passed over the critical area (Fig. 1) of sea floor where the Leannan extension should pass. The main rock unit is characterized by only a few internal,

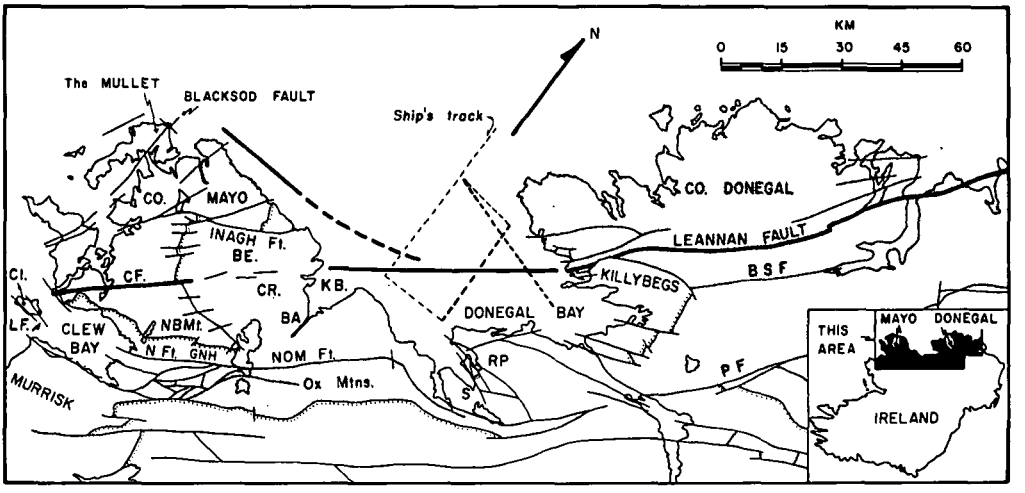

Figure 1. Generalized geological and location map. Main structural lines only are shown and no reference to consequent sedimentation or basin development is intended. Stippled areas are metamorphic and Lower Palaeozoic rocks; Upper Palaeozoic rocks are unpatterned. Heavy line indicates Leannan–Corraun Fault and major splay. Dashed line shows ship's track; heavy dashed ship's track shows lines of usable seismic quality. K.B., Killala Bay; CF., Corraun Fault; Cr., Crossmolina; CI, Clare Island; LF, Leck Fault; GNH, Glen Nephin, Glen Hest; NFT, Newport Fault; NOMFT, North Ox Mountains Fault; BE, Bellacorrick; BA, Ballina; BSF, Belshade Fault; RP, Rosses Point; PF, Pettigoe Fault; S. Sligo; NBMT, Nephin Beg Mountains.

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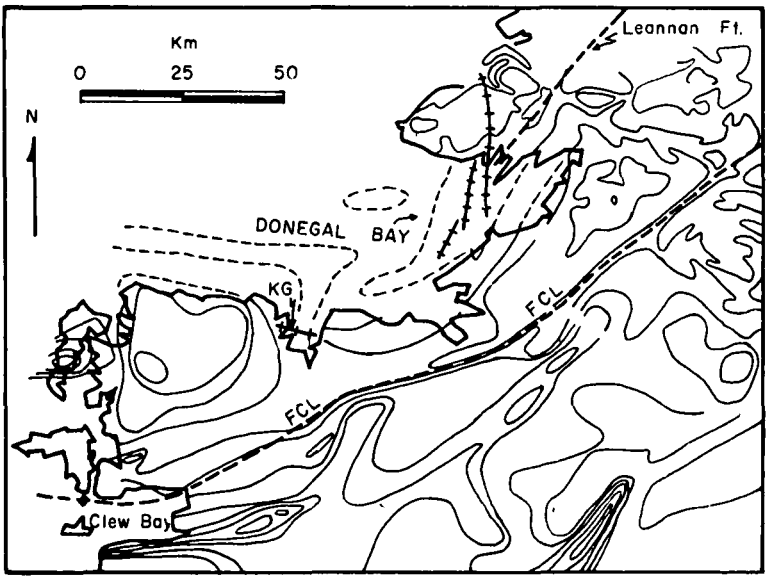

Figure 2. Generalized magnetic map of the Donegal Bay region. Mainland part modified after Max & Riddihough (1975, fig. 1) from predominantly vertical field data. Marine airborne magnetics represent total field data. Cross-hatched lines indicate trend of secondary field component. Compare with Figure 1 for Geological elements. KG, Killala Gabbro; FCL, Fair Head–Clew Bay line.

gently dipping reflectors and the rocks are probably massive limestones with a few shale or sandstone beds; its upper surface takes the form of a smooth rock platform overlain by a veneer of laminated superficial sediments of late glacial or holocene age. The otherwise flat-lying platform of the bedrock reflector deepens and for a period is lost from the records on each of the seismic lines and it is probable that this reflects erosion of a fault course along a single feature. Although the depth of this subsuperficial depression is unknown due to poor penetration, the width is of the order of 1 km. If this hidden feature represent a fault course, it would define a line of structural weakness in Carboniferous rocks which is aligned with the southern end of the Leannan Fault. No other features or major breaks were seen on the record to the E where the bed rock reflector is well defined.

1.b. Magnetic

Contouring of magnetic data in Donegal Bay shows a primary southwesterly trend generally related to geological structure, with minor secondary northerly trends in N Donegal Bay and an ESE trend along the W side of Killala Bay (Fig. 2). These minor secondary trends are probably related to Tertiary intrusives. If this secondary component were to be 'removed', it is likely that greater emphasis would fall along the geologically older SW trend, which in Donegal Bay might assume a slightly more northwesterly position.

2. Discussion

There is a regional trend in the magnetic contours along the N and E portion of Donegal Bay that is probably related to the course of the Leannan Fault. This trend is not as well defined as the virtually continuous linear associated with the north Ox Mountains/Fair Head–Clew Bay Line (Max & Riddihough, 1975) but it is consistent with the weaker magnetic character across the Leannan Fault in Donegal and also of the Corraun Fault (Crow, Max & Sutton, 1971) to the SW. The Leannan Fault is less well defined magnetically than the Great Glen Fault in which it appears to root (Dobson & Evans, 1974) and it is probably a less important geological feature. No magnetic trend passes from the Leannan Fault towards the north Ox Mountains Fault (Long & Max, 1977) and there are no large faults in the Carboniferous on a connecting line. It is therefore unlikely that there is any significant connection between the Leannan Fault and the North Ox Mountains Fault in the underlying basement rocks.

Two fault courses are possible to the NE along the North Ox Mountains Fault and both involve a divergence from the main magnetic linear that can be traced to Scotland via the Fair Head–Clew Bay line. These courses are along the far eastern side of Donegal Bay and towards the Belshade Fault (Fig. 1) along a more northerly line (Pitcher & Berger, 1972, fig. 17–1), or following the North Ox Mountains Fault to pass into the Pettigoe Fault. In either case both these lines are S of, and subparallel to, the Leannan Fault in Donegal.

The magnetic contours (Fig. 2) are roughly parallel with the N Co. Mayo coastline, at least to the approaches of Killala Bay. Bailey, Buckley & Kielmass (1975), from marine magnetic work, have suggested either a fault bounded sedimentary trough or a weaker magnetic character for the pre-Upper Palaeozoic basement within the sea area N of Co. Mayo. Their first alternative is verified by the shallow seismic records that show well bed-differentiated sediments. Such records would normally be used to suggest a much younger age than Carboniferous for the rocks in the basin as they superficially resemble seismic records from proved marine Mesozoics. However, the presence of an important Mesozoic basin in the area is only one possibility. An alternative solution is that these records indicate the presence of shale–limestone–sandstone sequence similar to those seen in the Carboniferous W of Killala Bay unconformably overlying metamorphic rocks on the immediately adjacent mainland (George, 1958; MacDermot & Sevastopulo, 1972). In addition, records of a comparable nature may also be noted from the Upper Carboniferous rocks from the Firth of Forth (Floyd, Mould & Dobson, 1976).

The fault bounding the southern margin of the basin is probably a simple normal fault, but its eastern extension could follow either of two courses. Bailey *et al.* (1975) extended the basin margin fault directly eastwards towards the E–W fault systems of the Rosses Point area N of Sligo. The other alternative (Fig. 1) involves the E–W fault N of Co. Mayo rooting in the Leannan Fault. As such, the E–W wrench faults in the metamorphics, such as is seen at the N tip of the Mullet peninsula (Fig. 1), could then be referred to as third order wrench splays of the Great Glen–Leannan Fault system. In addition, the rapidly diminishing linear magnetic anomaly associated with Bailey's marginal basin fault to the E might be best explained by a connection between this E–W fault off the N Mayo coast and the Leannan Fault.

Although there are many wrench dislocations in Scotland that may be related to the Great Glen Fault system (Pitcher & Berger, 1972, fig. 17–4), the Leannan Fault can be regarded as a major splay in Ireland, connecting via the Loch Gruinart Fault (Dobson, Evans & Whittington, 1975). The Great Glen Fault, as a major structural element, probably continues to the W of Ireland through the Slyne Trough and across the head of the Porcupine Seabight (Riddihough & Max, 1976). Almost certainly the Leannan splay rejoins the main Great Glen Fault to the SW in the vicinity of the southern end of the Slyne Trough and northern termination of the Porcupine Seabight W of Co. Mayo (Bailey, Jackson & Bennell, 1977) and thus the area between the Great Glen Fault and the Loch Gruinart–Leannan–Corraun Fault could be regarded as a discrete structural element during the time of faulting. These two major dislocations can be considered as a 'paired' fault system with the Leannan–Corraun line forming the southern splay of the Great Glen Fault wrench system in Ireland. The fault history within this segment of the crust, then, should have a consistent relationship to Mesozoic and younger sedimentation.

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