

Cenozoic pull-apart basins in the British Isles

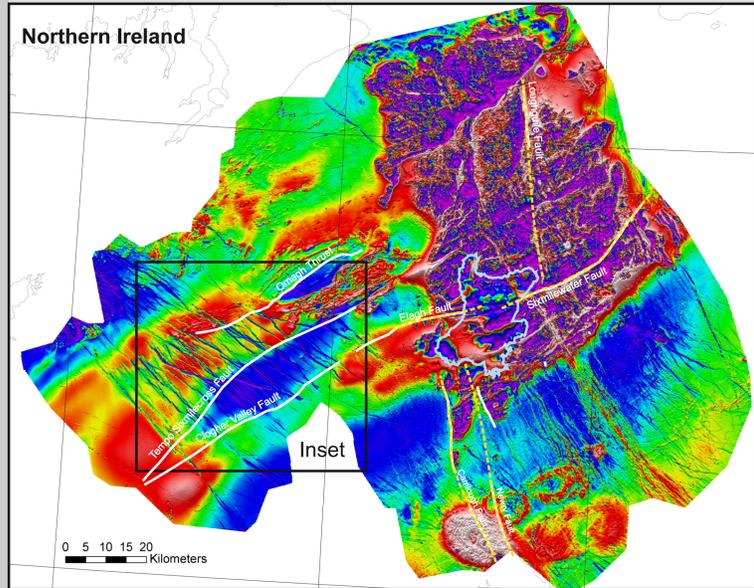
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Pull-apart basins filled with early Cenozoic sediments suggest that a strike-slip regime was widely developed in the British Isles during the Palaeogene.

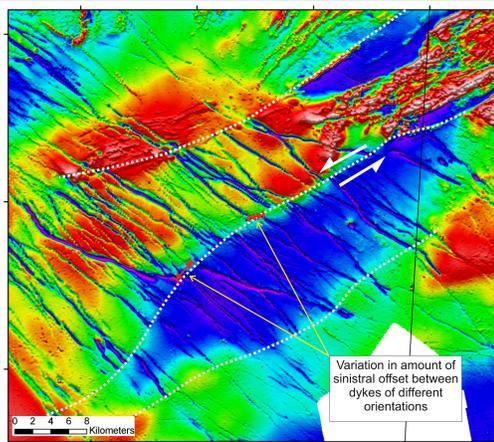
Here, new evidence of strike-slip tectonism from Northern Ireland and the southern North Sea is used to support and extend a tectonic model previously proposed to explain pull-apart basin formation in Cardigan Bay.

Reduced to pole magnetic anomaly map of Northern Ireland.

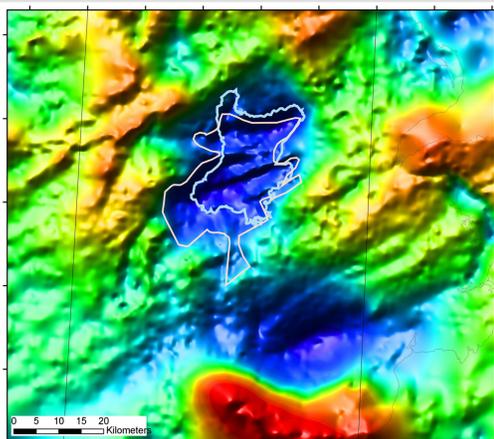


The Lough Neagh pull-apart basin was formed by mid Paleocene dextral transtension acting upon right-stepping NNW-trending faults (Quinn 2006). South of the lough, the Newry and Camlough faults each have a mapped dextral displacement of 2km and may represent a continuation of the Codling Fault zone northwards from the Irish Sea. Potential field data suggest that the NE-trending Sixmilewater and Elagh faults are dextrally offset beneath the lough itself.

Inset

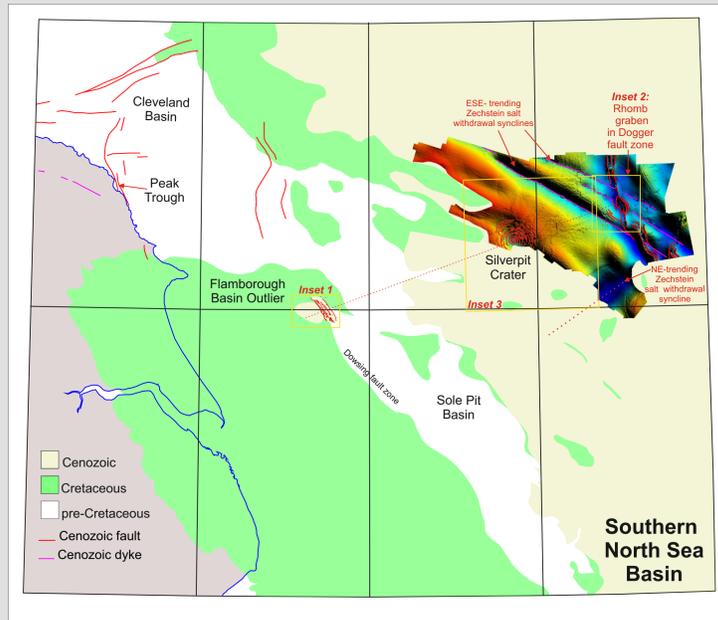


High resolution aeromagnetic data provide the strongest evidence of strike-slip movement in Northern Ireland. Linear negative magnetic anomalies related to Palaeogene dykes show clear sinistral offsets of up to 2.5km along reactivated, NE-trending, Caledonian and Variscan faults. Differences in the amount of offset indicate that at least some of the sinistral movement was synmagmatic.



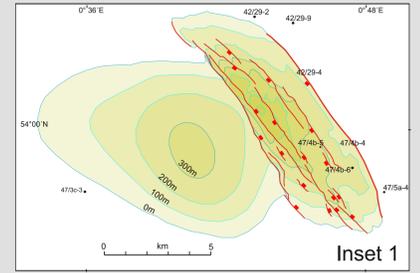
Residual Bouguer gravity anomaly map showing a negative gravity anomaly partly associated with Cenozoic sediments in the Lough Neagh Basin.

Potential field data courtesy of the Geological Survey of Northern Ireland.

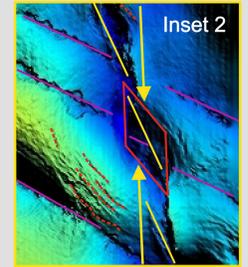


Simplified geological map of the southern North Sea, incorporating a coloured filled isochron map of the top Upper Cretaceous surface.

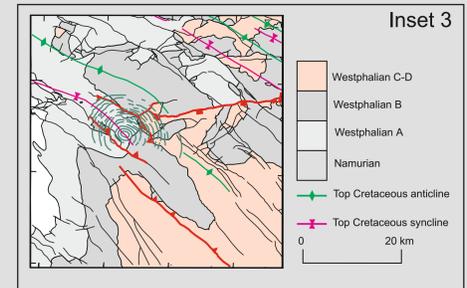
Some small Cenozoic basins in the southern North Sea resemble pull-apart structures. The Peak Trough is a transtensional graben, which probably has at least a component of Cenozoic dextral movement (Milsom and Rawson 1989). 3D seismic reflection data reveal that the Flamborough Basin (Stewart and Bailey 1996) and part of the Dogger fault zone have the characteristic shape of rhomb graben. The Silverpit Crater is a putative impact structure (Stewart and Allen 2002). An alternative origin involving Zechstein salt withdrawal and dextral transtension was proposed by Smith (2004, 2005).



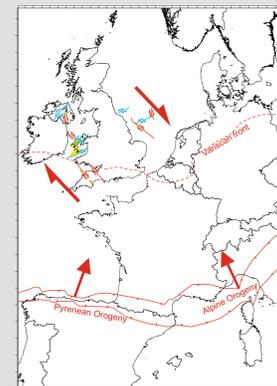
Flamborough Basin: Depth isochore (seabed-top Cretaceous) (Stewart and Bailey 1996).



Possible pull-apart structure within the Dogger fault zone.

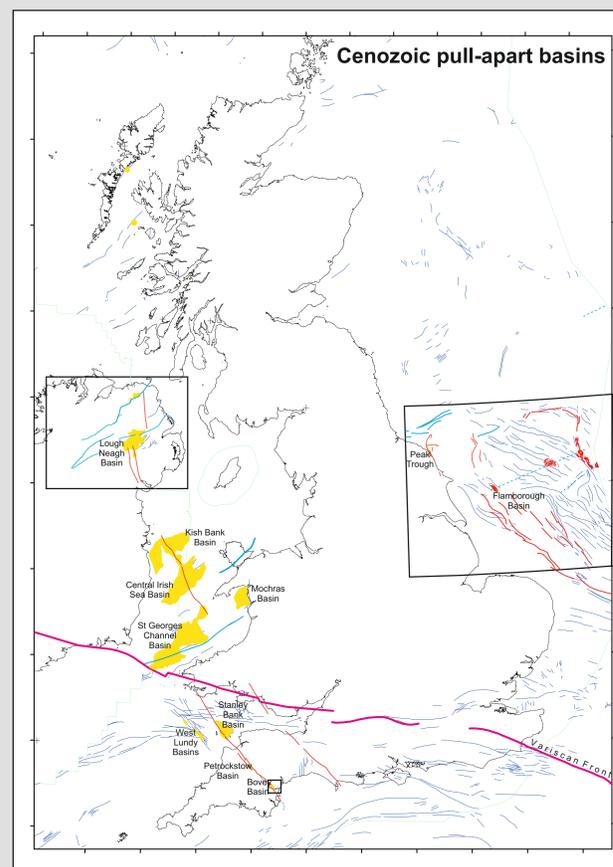


Pre-Permian subcrop map of part of the southern North Sea showing the relationship between late Palaeozoic structures and the overlying Cenozoic deformation revealed at top Cretaceous level. Cenozoic anticlines, synclines and dykes all follow pre-existing structures at Carboniferous level. The Silverpit Crater lies above the intersection of ENE- and NW-trending late Palaeozoic faults, which were reactivated during Cenozoic deformation (Smith 2004). Low angle detachments exploiting Zechstein and Triassic evaporite horizons partly decouple the basement deformation from its cover. The pattern of pervasive late Palaeozoic conjugate faulting in the southern North Sea (Cameron *et al.* 2005), can also be recognised onshore in the Carboniferous of Northumberland (De Paola *et al.* 2005) and in the east Pennine coalfield (Bailey *et al.* 2005).

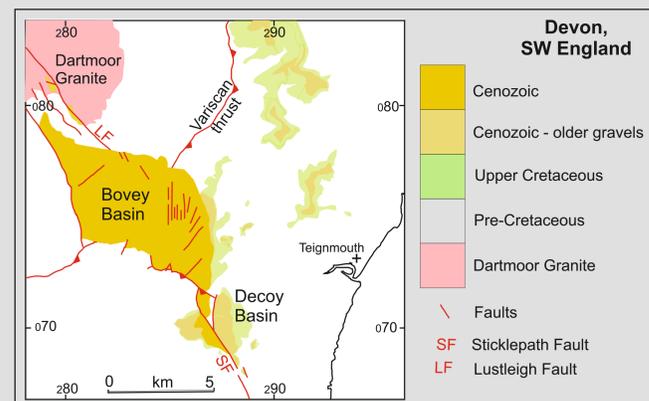


Palaeostress analysis indicates that Palaeogene maximum horizontal stress was oriented broadly N-S in the UK (N. Ireland, Geoffroy *et al.* 1996; southern England, Vandyke 2002). Rotation of the maximum stress direction from mid Paleocene to Oligocene times can be linked to changes in the nature of continental collision in southern Europe, as the main site of orogenic deformation shifted from the Alps to the Pyrenees. Associated deformation in the UK is dominated by uplift and basin inversion, which generated regional unconformities during the mid Paleocene and late Eocene (the 'Laramide' and 'Pyrenean' events).

While this deformation was taking place, strike-slip reactivation of pre-existing Palaeozoic faults caused dextral pull-apart basins to form locally along NW-trending faults. Evidence of contemporaneous sinistral movement along NE- and ENE-trending structures is consistent with a previously proposed interpretation of Cenozoic basin formation in Cardigan Bay (Turner 1997). In this model, structural domains bounded by pre-existing Palaeozoic faults distribute Cenozoic deformation by rotating clockwise in response to N-S directed maximum stress (McKenzie and Jackson 1986).



Location of Cenozoic pull-apart basins in the British Isles with highlighted faults and other Cenozoic structures adapted from Pharoah *et al.* 1996.



The Bovey Basin is one of several Cenozoic pull-apart basins located along the Sicklepath-Lustleigh fault zone. Other basins include the Petrockstow and Stanley Banks basins (Bristow and Robson 1994).