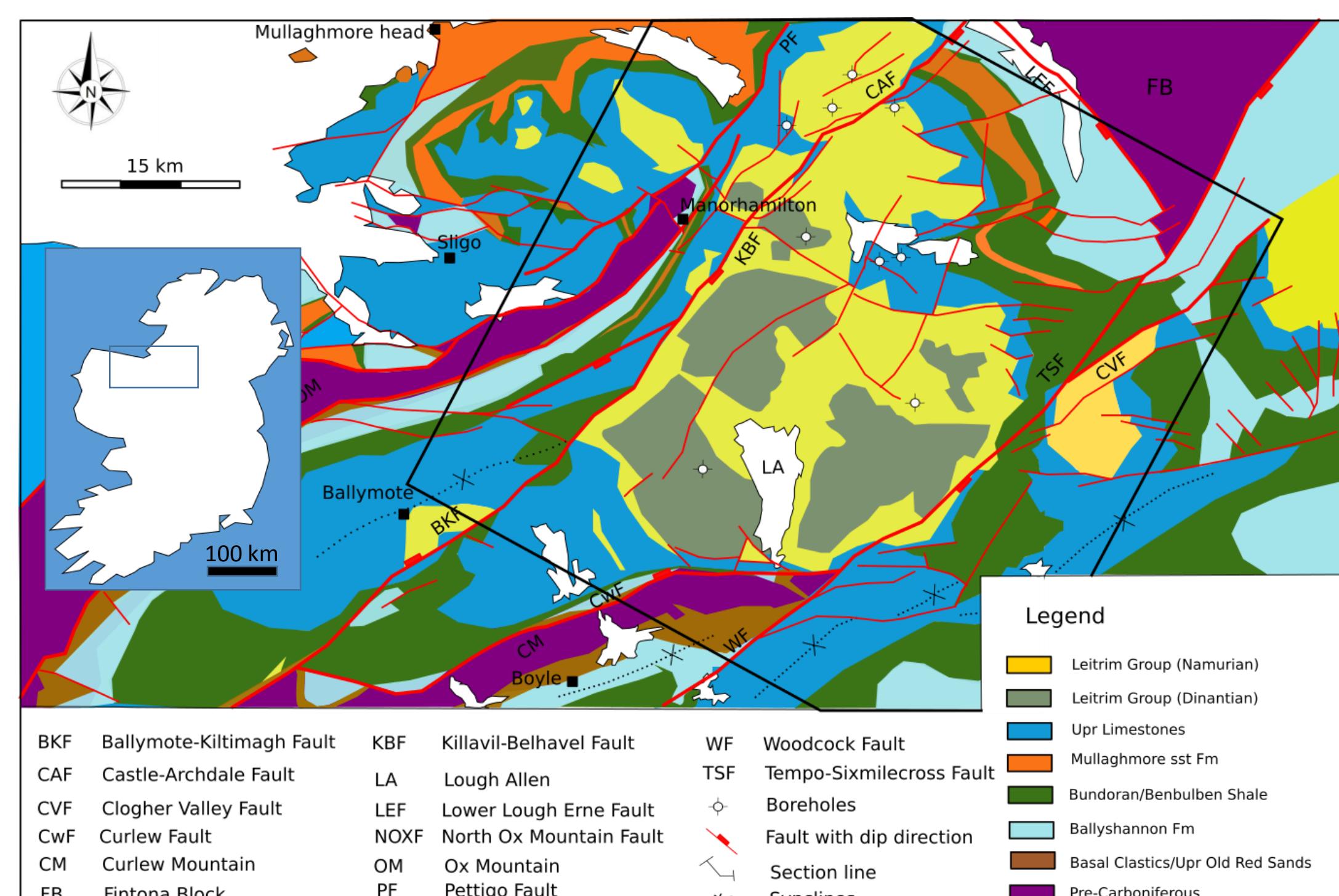


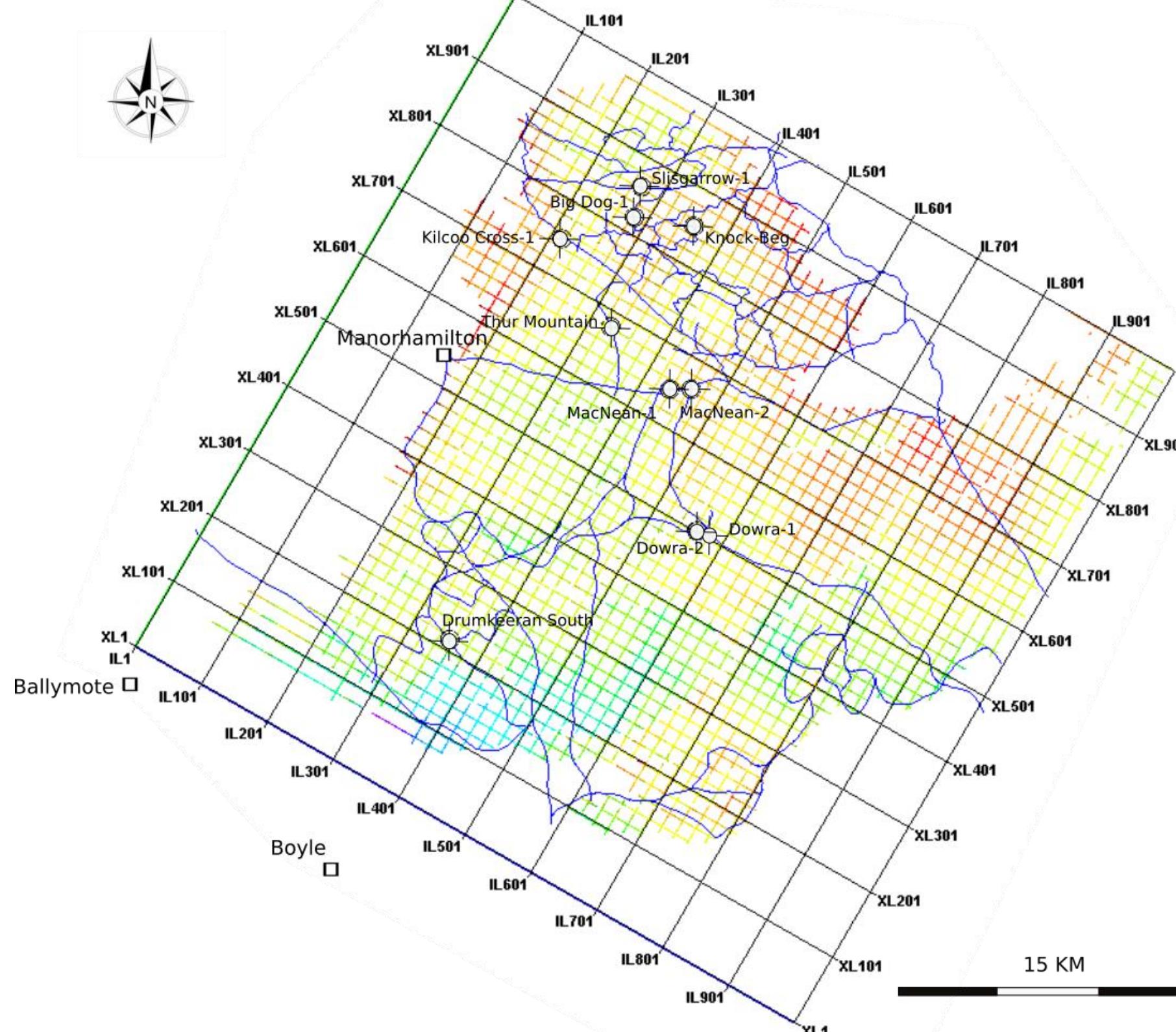
Jiulin Guo & John Walsh

Basin Overview



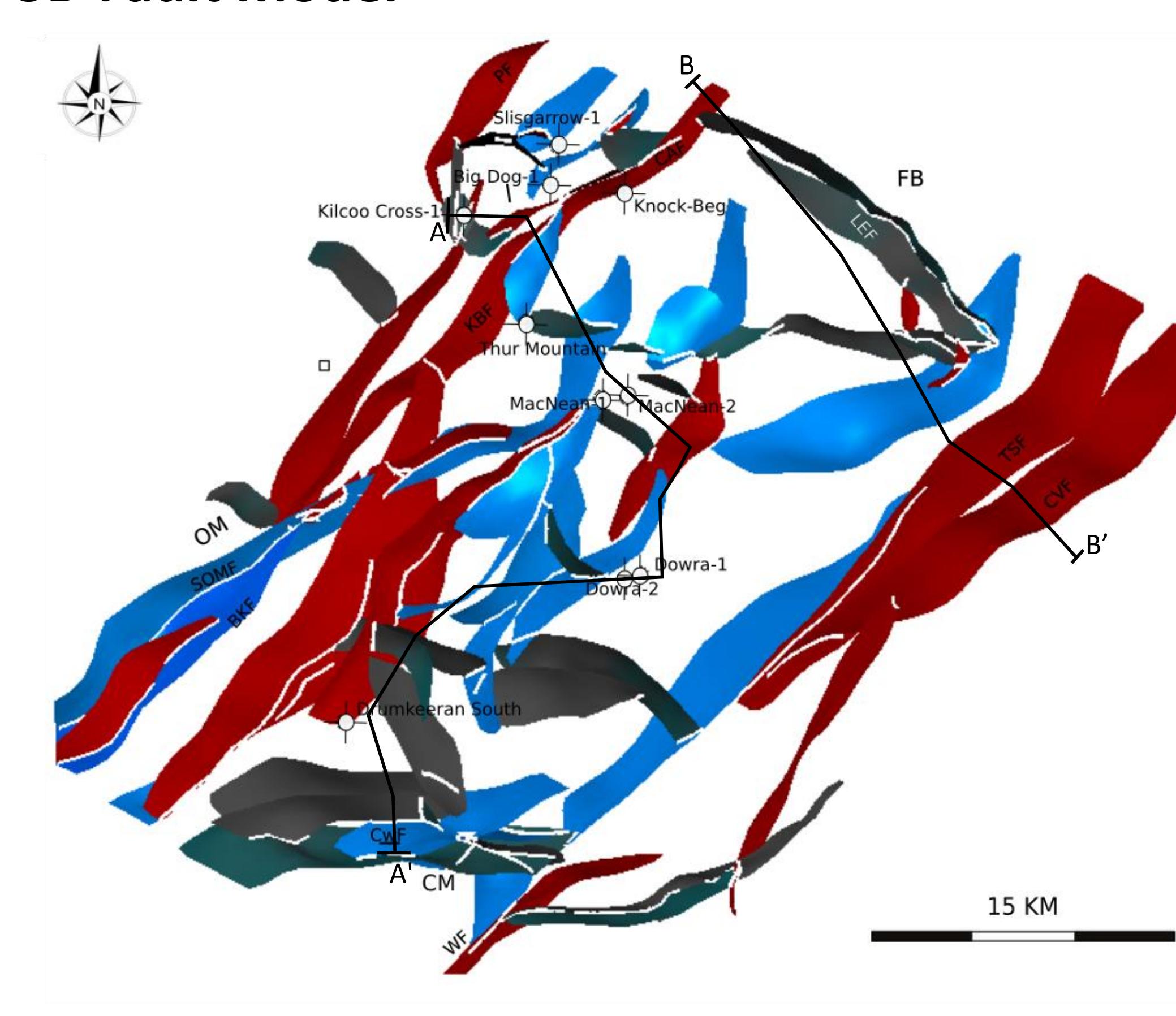
The Lough Allen Basin is part of the Irish NW Carboniferous basin. It is contained between major faults aligned parallel to NE-SW trending Caledonian terrane boundaries. These long lived structures have been subjected to repetitive reactivation into as recently as Tertiary times (Palaeocene and perhaps Oligocene). The area for which we have developed a 3D model is shown by the square black box.

Seismic Mapping



"3D volume" superimposed on the available 2D seismic lines (in blue) provides the framework for our definition of a 3D model incorporating the main faults and structures of the basin.

3D Fault Model

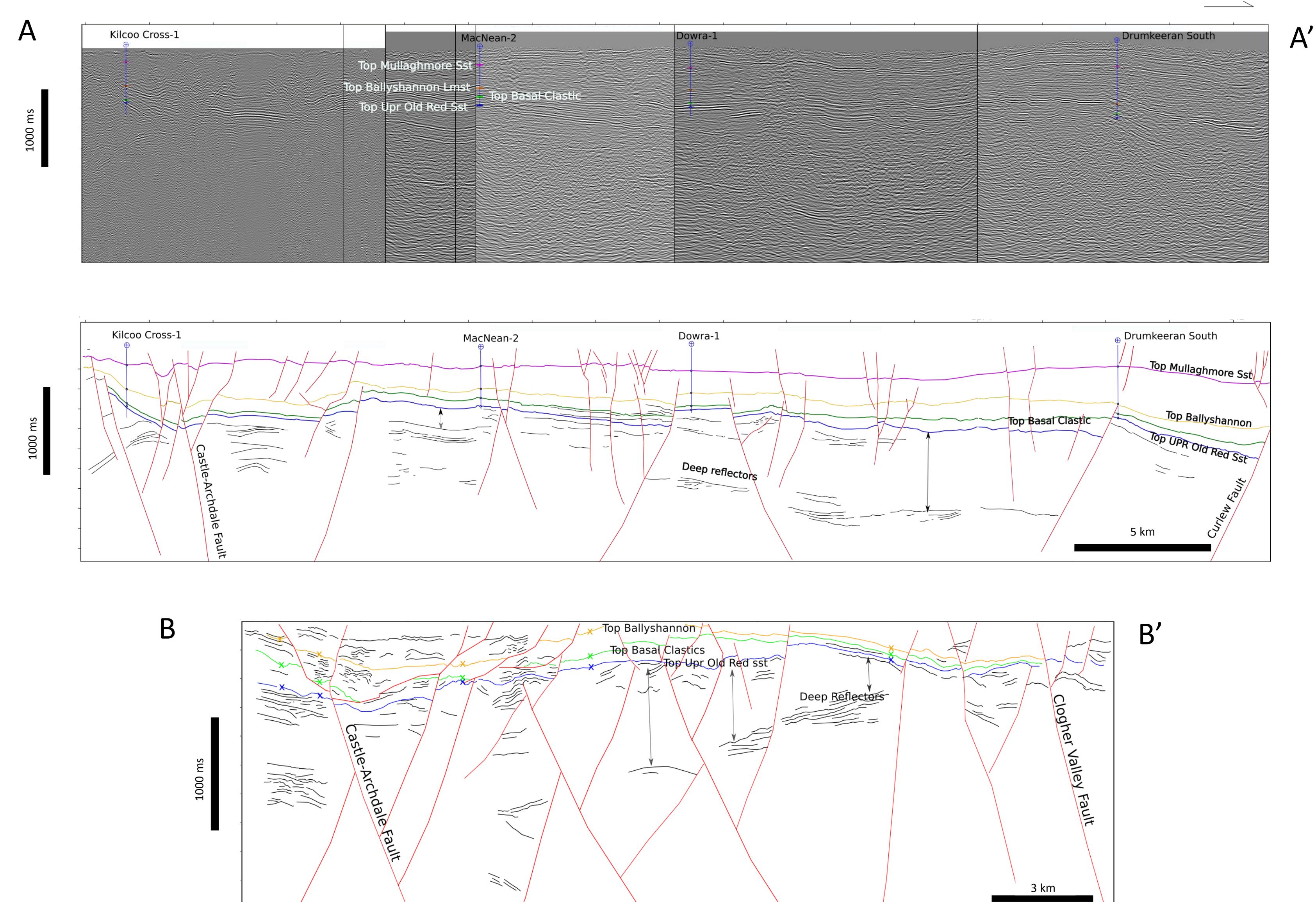


Fault model of the Lough Allen Basin illustrating the overall grabenal architecture, with straight basin bounding Carboniferous faults strongly mirroring the NE-SW Caledonian terrane boundaries. The intrabasinal faults, by contrast, have more variable strikes and a rhombic geometry.

Abstract

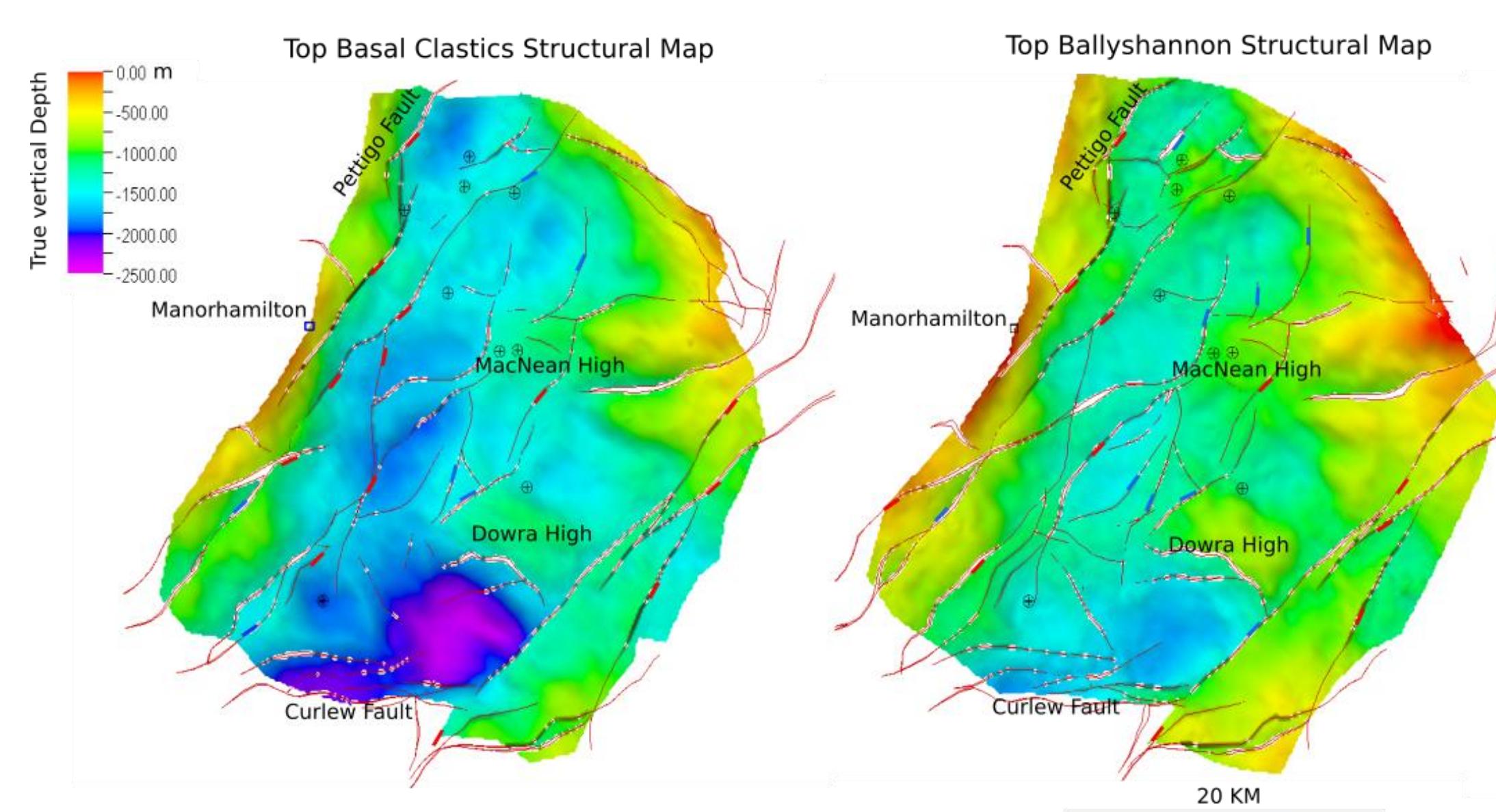
A 3D model has been developed for the Lough Allen Basin from available seismic and aeromagnetic data and from geological mapping constraints. The model shows that the Carboniferous Lough Allen Basin, though broadly grabenal towards its centre changes in polarity from north-facing faults in the SW to south-facing faults in the NE, a distinctive geometry which may be responsible for its preservation. The basin has arisen from the localisation of normal faults along the locus of major terrane boundaries, with the lateral extension of the Highland Boundary Fault responsible for the NW basin margin. The two main bounding faults have been subjected to multiple reactivations which extend into Tertiary times during which sinistral strike-slip reactivations of several hundreds of metres are linked to Alpine-related approximately N-S compression. Similar aged faults elsewhere in Ireland are associated with accentuated groundwater and hydrocarbon flow, a scenario which has negative implications for shale gas activity.

Seismic Interpretation



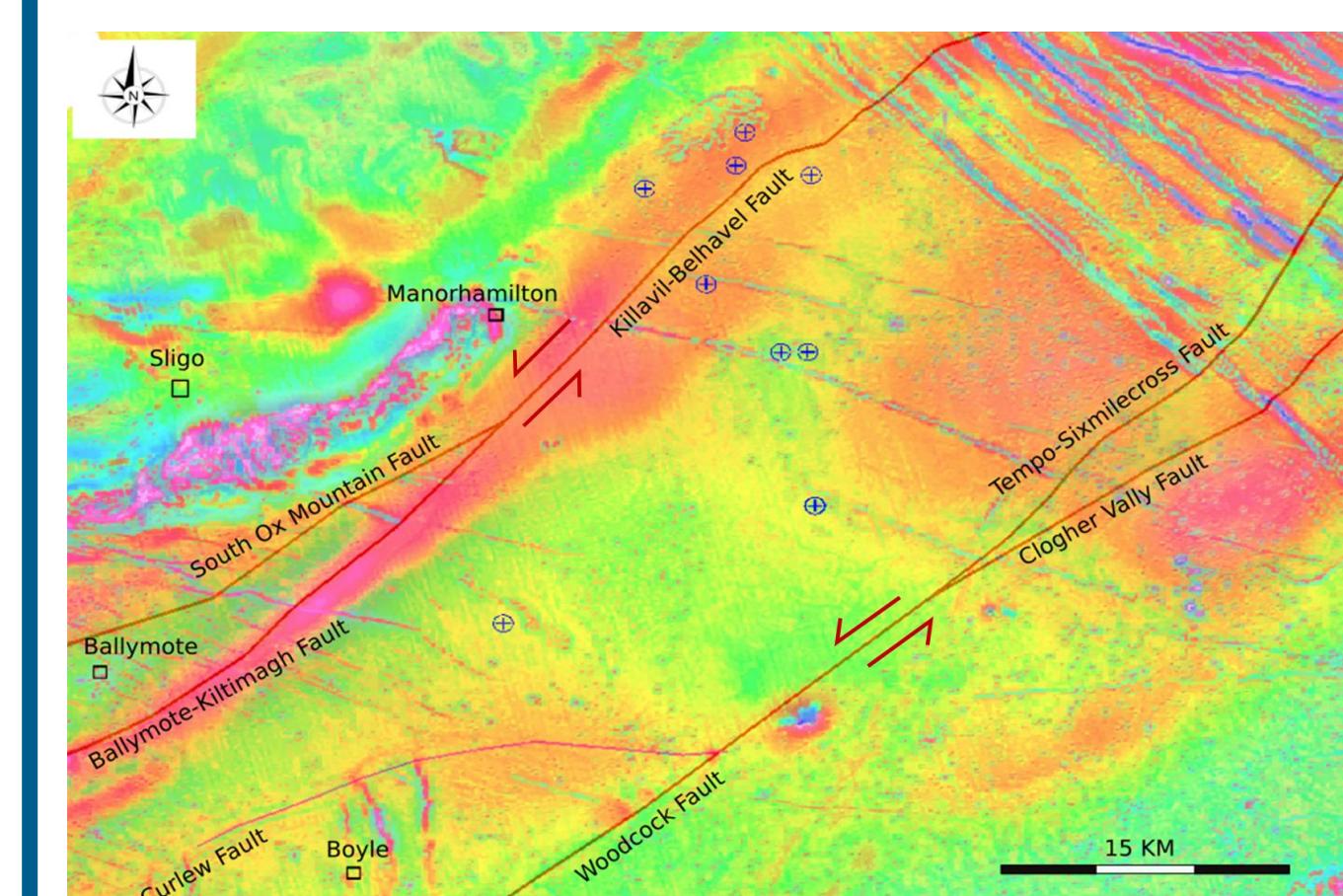
Seismic and related interpretations showing a broad thickening toward the Curlew Fault in the south (A-A') and Castle-Archedale Fault in the north (B-B'), reflecting a change in polarity of the basin from south-facing faults in the NE to north-facing faults in the SW of the basin, a configuration which appears to have been defined since Upper Devonian-Lr Carboniferous times. Syn-faulting sequence growth is visible particularly at sub-Ballyshannon level.

Top Structure Maps



Structural maps show the present day geometry of the mapped horizons from top Basal Clastics to top Ballyshannon Fm. The latter was deposited towards the end of the early Carboniferous rifting event. The basin deepens to the south with a broadly asymmetric synformal geometry. The throw on the north-dipping Curlew Fault transfers onto south-dipping faults in the NW (Pettigo fault) and SE (Clogher Valley/Tempo-Sixmilecross) of the area.

Tellus Aeromagnetic Map



Tellus aeromagnetic data highlighting the sinistral offset of NW-SE striking Tertiary dykes by the main bounding faults to the Lough Allen basin. On a larger scale to the NE, these faults have a gentle left hand bend which could have imparted a transtensional strain to the Lough Allen Basin (see also Anderson et al. (2016) – In: 'Unearthed - Impacts of the Tellus surveys of the north of Ireland', M. Young (ed.), Royal Irish Academy).

Conclusions

- We have built a 3D digital structural model of the Lough Allen Basin by integrating interpretations of seismic and aeromagnetic data with constraints from borehole data and geological mapping.
- The Lough Allen Basin is mainly controlled by a series of deeply rooted faults localised in the vicinity of NE-SW trending Caledonian terrane boundaries that have experienced periodic reactivation over a protracted period of time.
- The Carboniferous basin is characterised by a change in fault polarity along its length – a regional change marked by north facing faults dominating along strike to Clew Bay and south facing faults extending to the east coast of Northern Ireland.
- Tertiary reactivation of earlier Carboniferous faults as sinistral strike-slip faults is profound and could have a major negative impact on shale gas production.

Acknowledgements:

Seismic and borehole data were provided by the Petroleum Affairs Division, and Tellus data were provided by Geological Survey of Ireland – both of the Department of Communications, Climate Action and Environment. We thank them both for providing access to the data which underpins our study. We also thank all of our industry and government partners for their support of iCRAG.