

A potential polycyclic provenance for sandstones of the Tullig Cyclothem, mid-Carboniferous, Clare Basin

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Background and Rationale

The Clare Basin consists of a deep-water to shallow marine mid-Carboniferous (315-330Ma) siliciclastic infill. The Tullig Cyclothem is the first of five deltaic cyclothem forming the shallow marine part of the basin. The basin depocentre lies along the Shannon Estuary, above the Iapetus Suture (**top left**). Potential sources for the basin infill are: 1) Laurentian terranes to the north of the basin (900-2500Ma); 2) peri-Gondwanan terranes to the south (550-650Ma) and 3) local granites associated with the Caledonian Orogeny (395-475Ma). Previous studies based on the basin's geometry and on palaeocurrent indicators interpret contradictory basin infill histories for the Tullig Cyclothem, suggesting sourcing either from the northwest or from the southwest (**bottom left**)^{1,2,3,4,5,6,7}. Previous zircon U-Pb geochronology was performed on one sample from the Tullig Cyclothem⁸, identifying sources both from Laurentian and peri-Gondwanan terranes (**bottom right**). Recent results presented below can help better constrain the provenance of sandstones from the Clare Basin.

Methodology

Field work was conducted at three localities: Liscannor, Killard and Kilkee (**top right**).

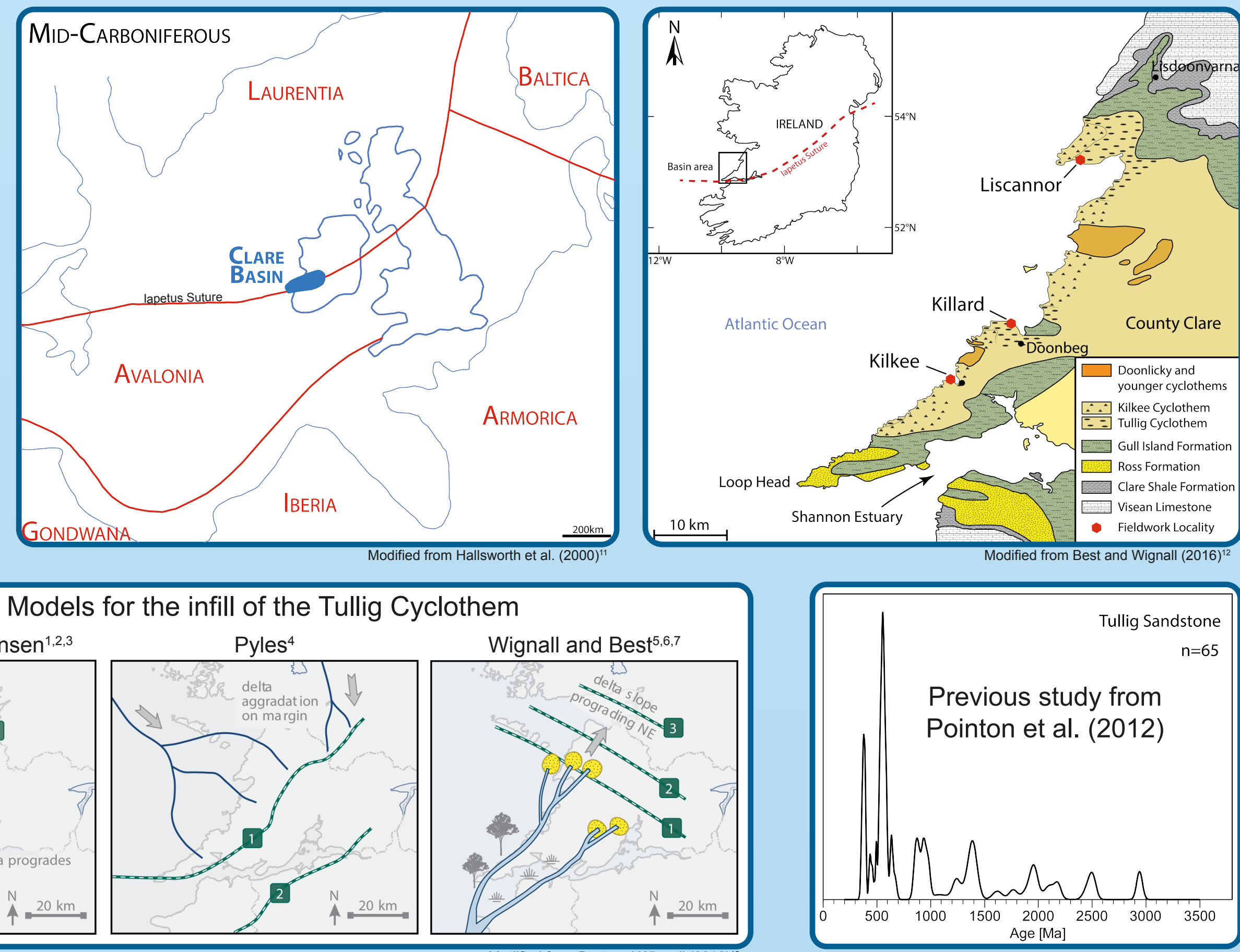
Coastal outcrops were logged in detail and sandstone samples were collected.

Petrographic analysis was performed on 35 samples using the setup and software PetrogLite™.

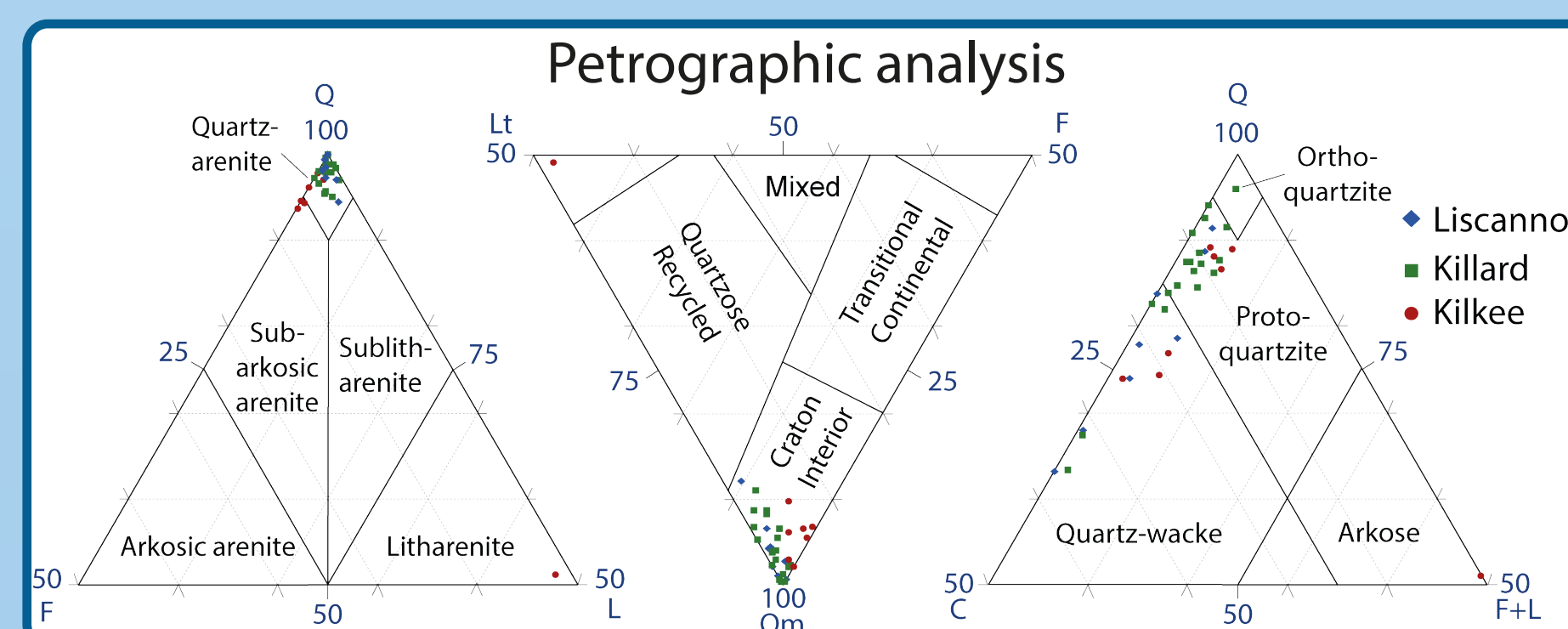
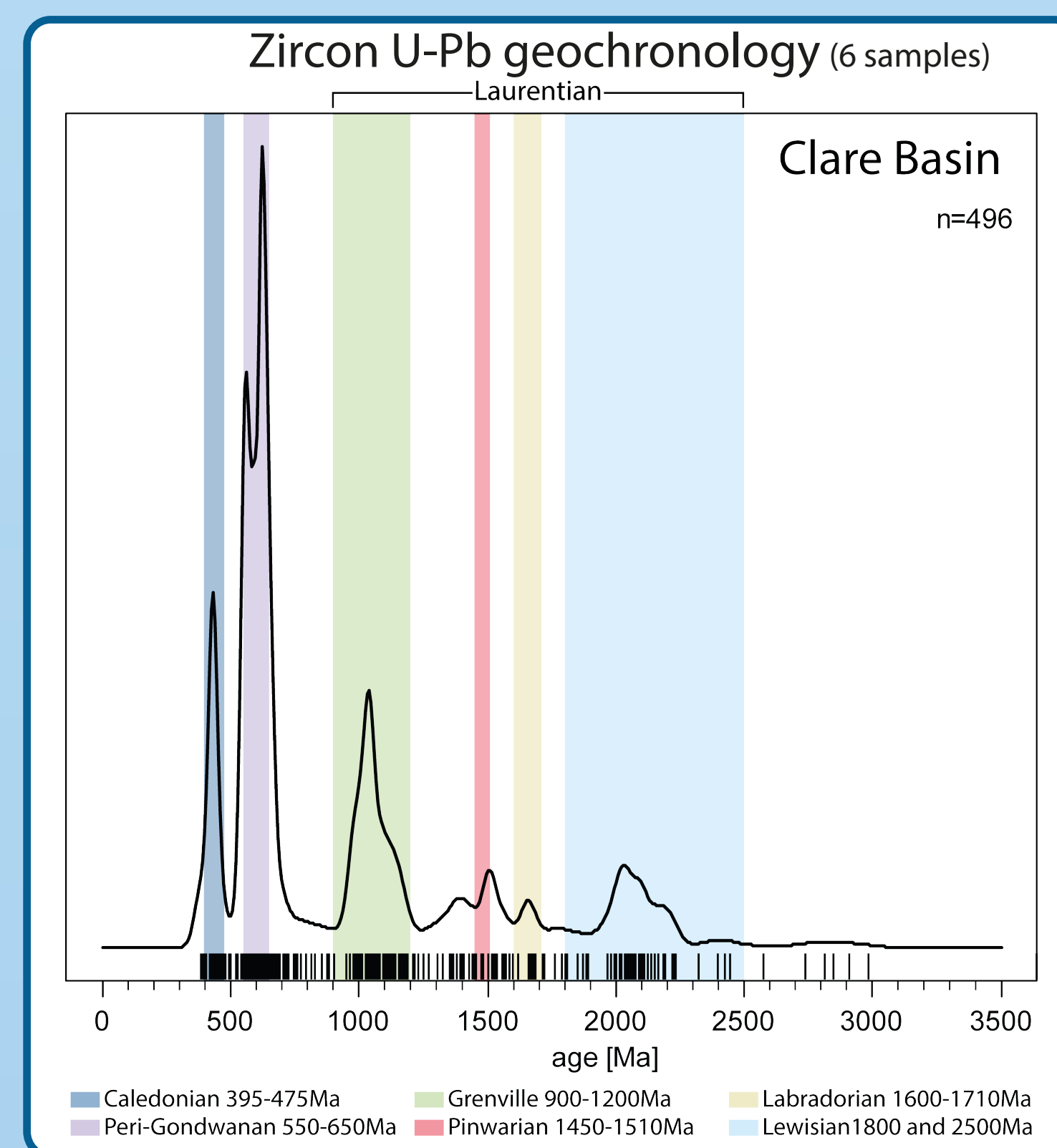
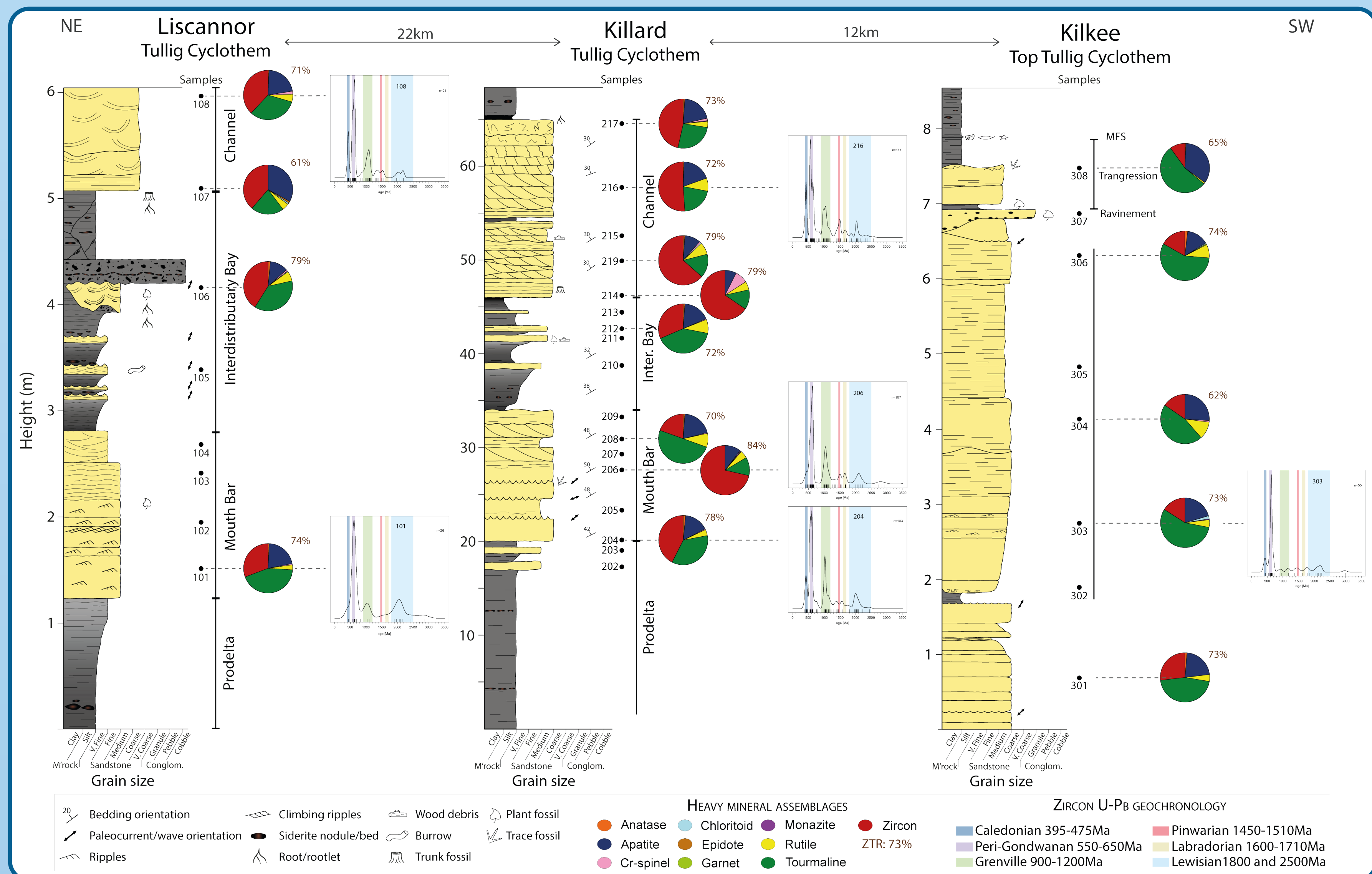
Heavy mineral assemblages of 17 samples were determined through optical microscopy.

Zircon picking for six selected samples was performed with the assistance of Raman spectroscopy.

Zircon U-Pb geochronology was carried out on six samples on a LA-ICP-MS in TCD.



Results



Sedimentary logs display similar facies sequences at Liscannor and Killard. Prodelta muds are overlain by wave-influenced sandy mouth bars, interbedded mud/silt/sand from interdistributary bay deposits, and channelised sandstones. These facies successions are interpreted as being part of a delta progradation. At Kilkee, the top of the Tullig Cyclothem is characterised by a 7-meter thick succession of wave-influenced shelf sand bodies overlain by a transgressive facies and a goniatite-bearing marine band corresponding to an MFS (**top left**).

Petrographic studies highlight both mineralogically and texturally mature quartz-arenites (**top right**).

Heavy mineral assemblages show some variation between the samples (**top left**), potentially linked with facies. The zircon-tourmaline-rutile index (ZTR) is relatively high (avg. 73%), probably indicative of recycled sandstones⁹.

Zircon U-Pb geochronology results are similar over the six samples, indicating no change of provenance over the various facies and the outcrops (**top left**). Results from all six samples have been regrouped on the same diagram (**top right**). The dominant zircon population corresponds to peri-Gondwanan terranes (550-750Ma). A second population seems to be derived from the Caledonian granites (400-470Ma). Older grains are believed to correspond to orogenic events which took place on the Laurentian continent (Grenville, Pinwanian, Labradorian) or to the Lewisian Complex of northwest Scotland.

Tullig Cyclothem Provenance Interpretation

U-Pb geochronology results concur with previous zircon geochronology data⁸. A recent study on the Devonian Old Red Sandstone at the Dingle Peninsula¹⁰ (south of Clare Basin) presented similar zircon populations as in the Clare Basin, with a relatively lower amount of peri-Gondwanan materials in the Dingle Peninsula (**right**). Our provenance interpretation, based on the petrographic characteristics of the sandstones, the high ZTR indices and U-Pb geochronology results involves a **sourcing from the south with recycling of older sedimentary basins and a fresh input of peri-Gondwanan sediments**.

Highlights and Future Work

- Tullig Cyclothem sourced from the south.
- Potential polycyclic origin for sandstones deposited in the shallow marine part of the Clare Basin.
- Apatite, less stable than zircon, is less likely to survive recycling. The next step of this study is to date apatite grains from the same samples in order to better test the polycyclic origin theory.

