Sedimentary provenance of the Devonian Munster Basin and the Mesozoic North Celtic Sea Basin: evidence from detrital zircons

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Introduction

- Understanding the source of sediments can provide insights into basin development.
- Interbasinal comparison of detrital zircon age signals provides a means to:
  - a) determine sediment cycling events
  - b) find analogues that are well studied and understood
  - c) understand local- to regional-scale palaeogeography
- The Munster Basin was filled during the Upper Devonian to Mississippian by terrestrial sediments of the Old Red Sandstone Supergroup.
- The North Celtic Sea Basin lies adjacent to the Munster Basin and consists of Triassic to Cretaceous sediment fill.
- The aim of this study is to establish the provenance of the eastern Munster Basin and North Celtic Sea Basin with focus on understanding the sedimentological relationship between them.

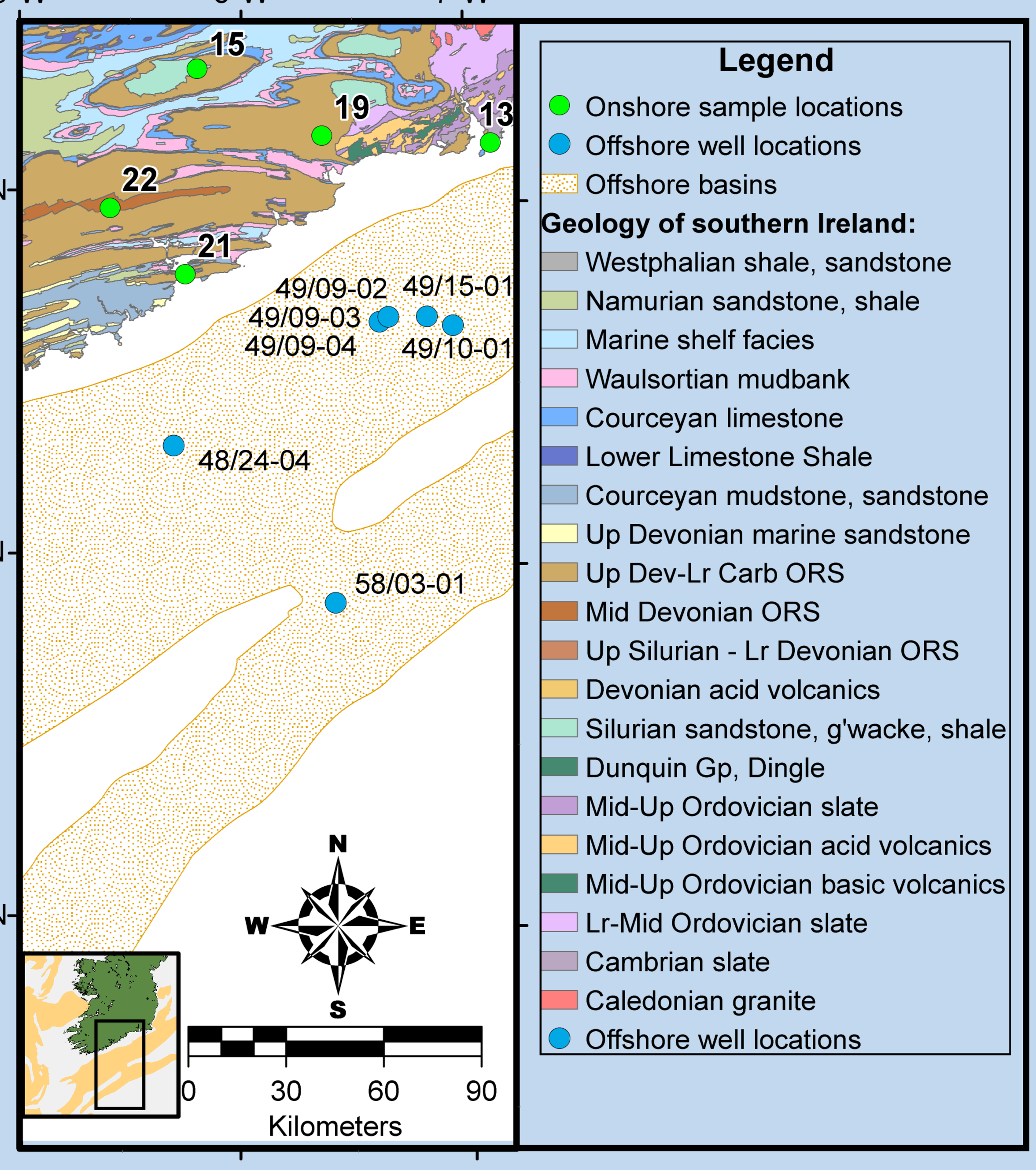

Figure 1: Map outlining offshore basins and geology of the eastern Munster Basin. Onshore and offshore sample locations are also given.

Sampling and Methods

- Five samples have been analysed from the eastern Munster Basin, six samples from the North Celtic Sea Basin and one sample from the South Celtic Sea Basin (Figure 1)
- Zircon separates were mounted and imaged (CL)
- U-Th-Pb analysis was undertaken at the Senckenberg Museum, Dresden using a LA-ICPMS.
- Data was reduced and concordant analyses plotted using Kernel Density Estimation of Vermeesch (2012).
- KDE plots were constructed with a bandwidth of 20 Ma and histograms have a binwidth of 50 Ma.
- All plots were normalised to have an equal area under the curve for improved comparison between samples.

The North Celtic Sea Basin

- Figure 3 shows KDE spectra for concordant ages of detrital zircons in seven offshore samples.
- The Kimmeridgian-aged samples in the North Celtic Sea Basin show broadly similar KDE plots with dominant late Neoproterozoic components and strong late Palaeo- and late Mesoproterozoic components.
- Samples from well 49/9-03 and 49/10-01 also show mid-Palaeoproterozoic and Palaeozoic components.
- The youngest Jurassic sample (49/15-01) is dominated by late Mesoproterozoic zircons but also shows zircon input from late Palaeoproterozoic and Palaeozoic sources.
- Sample 58/03-01 predominantly consists of zircons from a late Neoproterozoic source with strong Palaeozoic input.
- Sample 49/09-02 is dominated by zircons which range in age from late Palaeoproterozoic to early Neoproterozoic with minor late Neoproterozoic and early Palaeozoic input.
- Sample 48/24-04 shows major input from late Neoproterozoic and early- to mid-Palaeozoic sources.

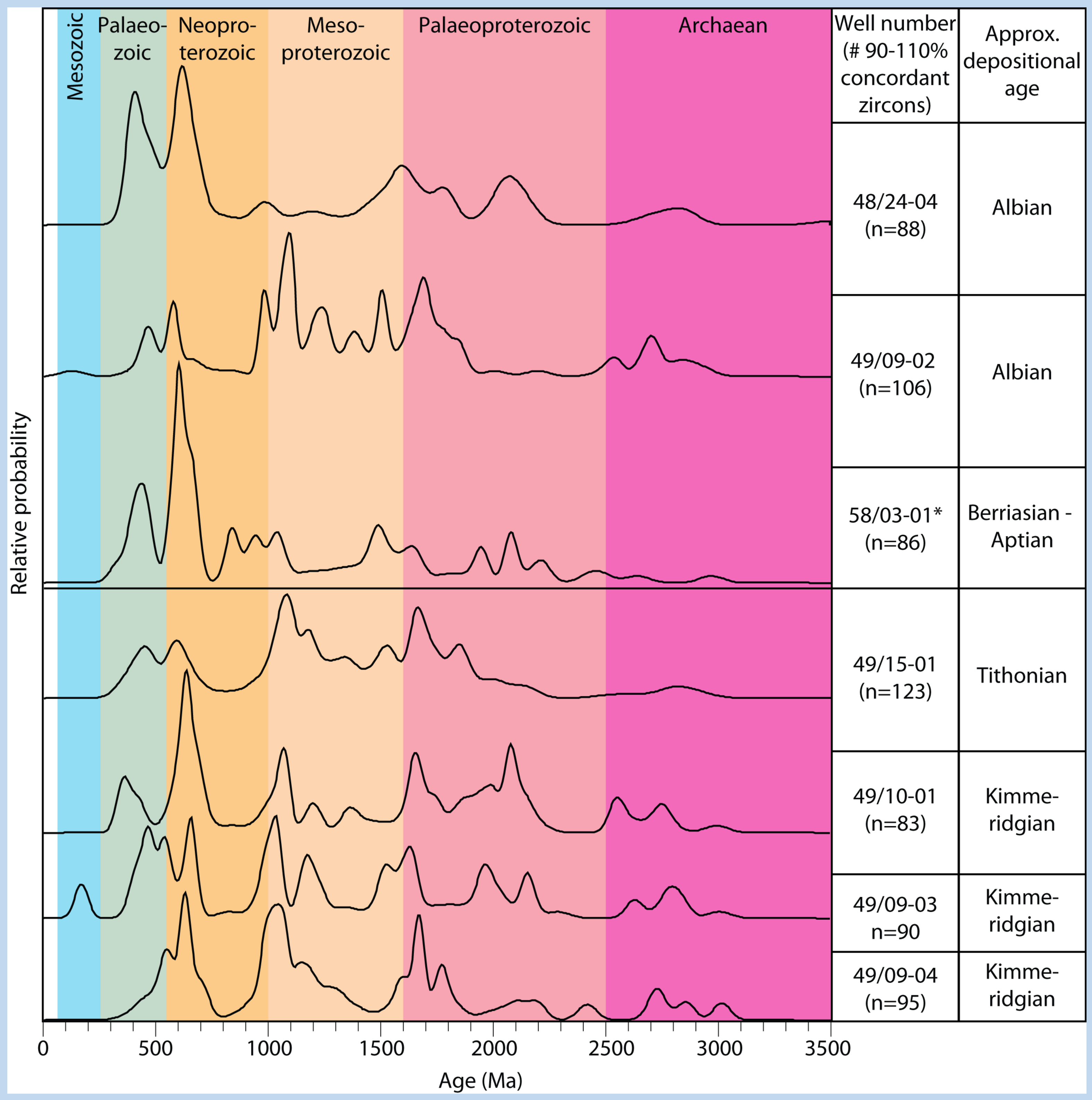

Figure 3: Stacked KDE plots from the North Celtic Sea Basin (*sample from South Celtic Sea Basin)

The Munster Basin

- The onshore sedimentary rocks sampled in this study are represented in Figure 2.
- Sample 22 and 19 (Figure 2A) represent two of the oldest formations (Gortanimill Fm. and Kilnafrehan Cong. Fm. respectively) in the Munster Basin and both show strong early- to mid-Palaeozoic zircon input. Sample 22 shows a dominant late Palaeoproterozoic source of zircons.
- Sediment from the younger (Frasnian) sample 15 (Figure 2B) is dominated by early- to mid-Palaeozoic zircons with minor input from late Palaeoproterozoic and late Mesoproterozoic sources.
- Sample 13 (Fammenian), from the Harrylock Fm., (Figure 2C) is dominated by Neoproterozoic zircons with minor Palaeo- and Mesoproterozoic input.
- Sample 21 (Old Head Ss. Fm.) (Figure 2D) represents the Devonian-Carboniferous transition. The majority of zircons are Proterozoic in age with late Palaeoproterozoic zircons being dominant.

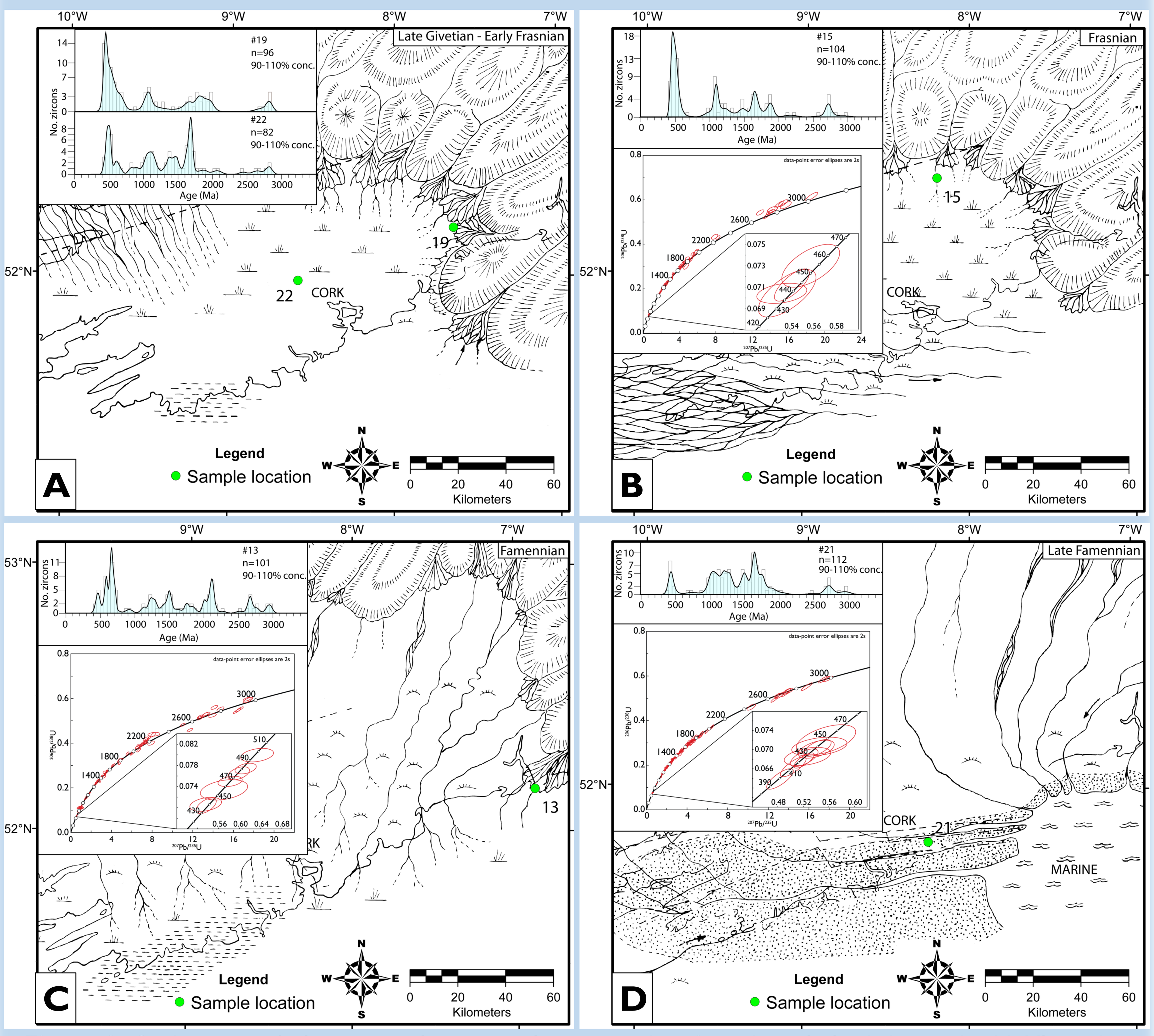

Figure 2: Onshore sample locations relative to palaeogeography of southern Ireland during the Middle to Late Devonian with histograms (overlain with KDE plots) and concordia diagrams inset (modified after MacCarthy, 1990).

Discussion

- Figure 4 summarizes the data reported in this study.
- The bulk of sediment in the eastern Munster Basin was sourced from Palaeozoic rocks, including the Leinster Granite as well as Ordovician volcanics in County Wexford.
- The Devonian-Carboniferous transitional samples show greater complexity in KDE plots and represent depositional sites that are distal to the ultimate source of detritus.
- The presence of Palaeozoic zircons in the NCSB could represent recycling of Munster Basin sedimentary rocks during Jurassic to Cretaceous times. Alternatively, Palaeozoic zircons may have been shed directly off the afore-mentioned sources.
- Late Neoproterozoic zircons are particularly abundant in offshore samples and are typical of Avalonian sources.
- Late Mesoproterozoic zircons are characteristic of a Laurentian source. Potential Mesoproterozoic sources in Ireland can be found in County Donegal and include rocks such as the Doolough Gneiss. Another potential source for these zircons, as well as Palaeoproterozoic zircons, is the Welsh Massif.

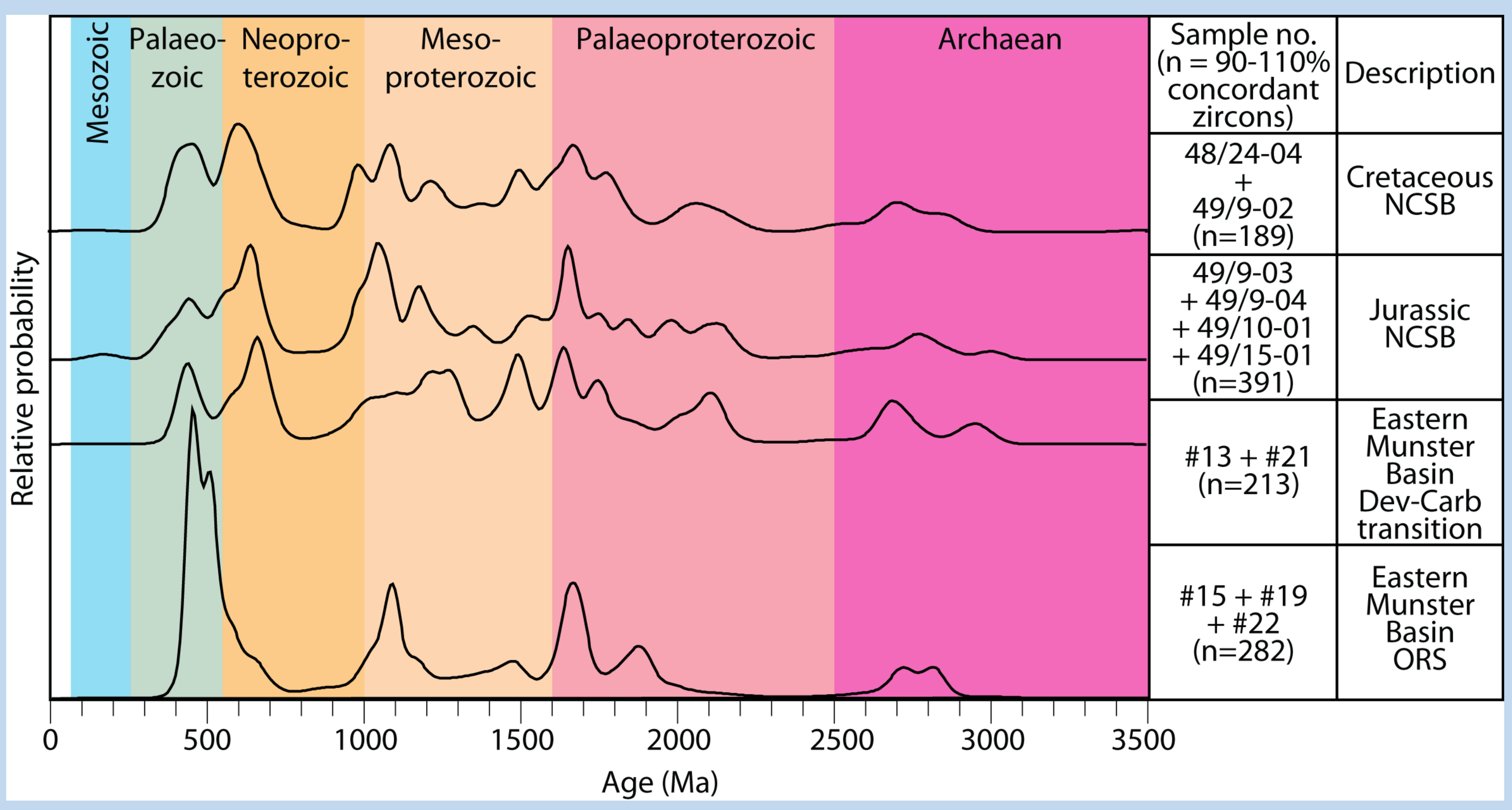

Figure 4: Stacked KDE plots for combined detrital zircon ages for each major depositional time period

References

- MacCarthy IAJ, 1990. Alluvial sedimentation patterns in the Munster Basin. *Sedimentology* 37, 685-712.
- Vermeesch P, 2012. On the visualisation of detrital age distributions. *Chemical Geology* 312-113, 190-194.

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The maps in this project were produced using ArcGIS.