Provenance and sediment routing of onshore and offshore southwestern Ireland

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Introduction

Provenance studies are powerful tools in determining the nature of sedimentary transport systems. They give valuable information on the geological history of an area and often show that sedimentary pathways can have a greater control on provenance than proximity to a source area (Sircombe, 1999). This may particularly be more important for sedimentary basins that are unexposed at the surface, which do not allow for accurate field interpretations to be made. The Mesozoic offshore basins of southwestern Ireland are situated among a complex series of failed-rifts, forming half graben structures geometrically along pre-existing Caledonian, Acadian and Variscan structural lineaments (Welford et al., 2012). This study aims to determine source to sink sediment movements during Triassic, Jurassic and Cretaceous times into the offshore basins of southwestern Ireland. We also aim to comment on the overall provenance of sediments within the Devonian Dingle, Munster and South Munster basins of onshore Ireland and determine if sedimentary recycling is also evident between these sediments.

Dingle and Munster Basins Detrital Zircon Geochronology

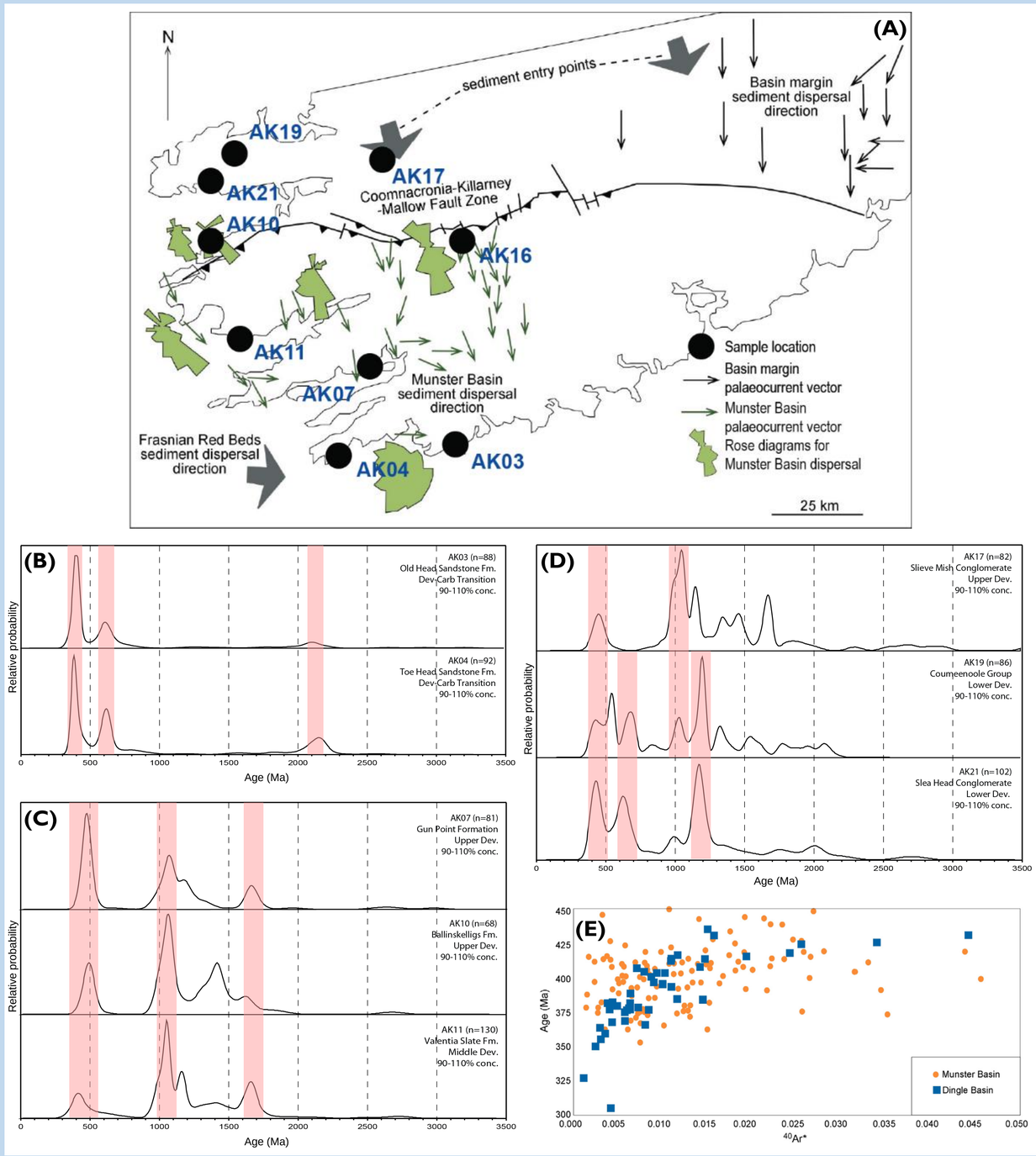

Figure 2. (A) Palaeocurrent and sedimentary dispersal systems for the Munster Basin with sample locations, altered from Ennis et al., 2014 and references therein. U-Pb age kernel density estimation plots of detrital zircon grains for (B) Dev-Carb transition, (C) Mid-Upper Devonian, (D) Lower-Upper Devonian. Red, highlighted regions indicate significant correlating age intervals between formations. (E) Plot of ^{40}Ar concentration vs. age to highlight relationship between Dingle and Munster Basin micas (Ennis et al., 2014).

- All Dingle Basin samples exhibit a strong Silurian (~440 Ma) and Mesoproterozic (~1200 Ma) peak. Samples show varying Cambrian to Early Proterozoic input and gradual influx of new source regions over time.
- Slieve Mish Conglomerate (AK17) is strongly comparable to the bulk of Munster Basin units.
- Mid-Devonian samples (AK11) from the western Munster Basin contain syn-deposition zircons. Minor tuffs present within these samples.
- Cadomian (~600 Ma) and minor Palaeoproterozoic (~2200 Ma) peaks of Devonian-Carboniferous transition sediments in the Munster Basin likely reflect recycling of an eastern Avalonian basement. No ca. 600 Ma peak present in mid-Devonian rocks of the Munster Basin.
- All Munster Basin samples also have input from Avalonian arc-related volcanism during the Ordovician to Silurian (Linnemann et al., 2012).

Offshore Detrital Zircon Geochronology

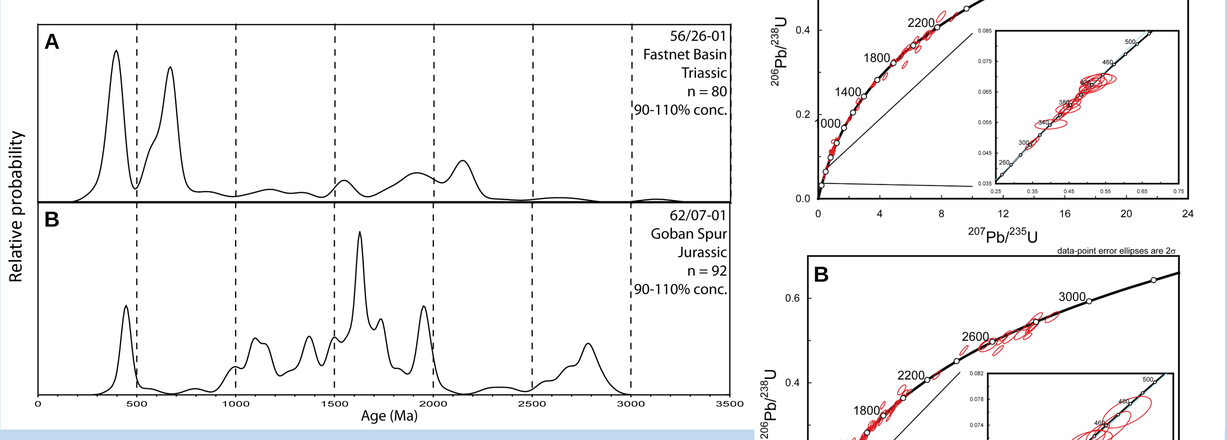

Figure 3. U-Pb age kernel density estimation plots of detrital zircon grains and U-Pb Concordia diagrams for from (**A**) well 56/26-01 and (**B**) well 62/07-01, from North Celtic Sea Basin and Goban Spur respectively.

Sampling and Methods

Sandstones were sampled across onshore Devonian Dingle, Munster and South Munster basins, and offshore Mesozoic western North Celtic Sea, Fastnet and southern Porcupine basins (Goban Spur). Onshore samples were collected from the field and offshore samples were collected from wells with formations with abundant sandstone. No core was available for sampling within these basins and therefore chips were collected. Both onshore and offshore samples were crushed, milled to <500µm and then sieved to <250µm. Samples were then separated using heavy-liquid and magnetic techniques to produce zircon concentrates. These were picked and resin-mounted for CL-imaging and analysis by LA-ICP-MS to determine their U-Pb ages.

By comparing onshore Munster Basin and offshore North Celtic Sea and Fastnet basins and the Goban Spur, we aim to determine whether sediment recycling has occurred from the Irish Massif into these offshore Mesozoic basins.

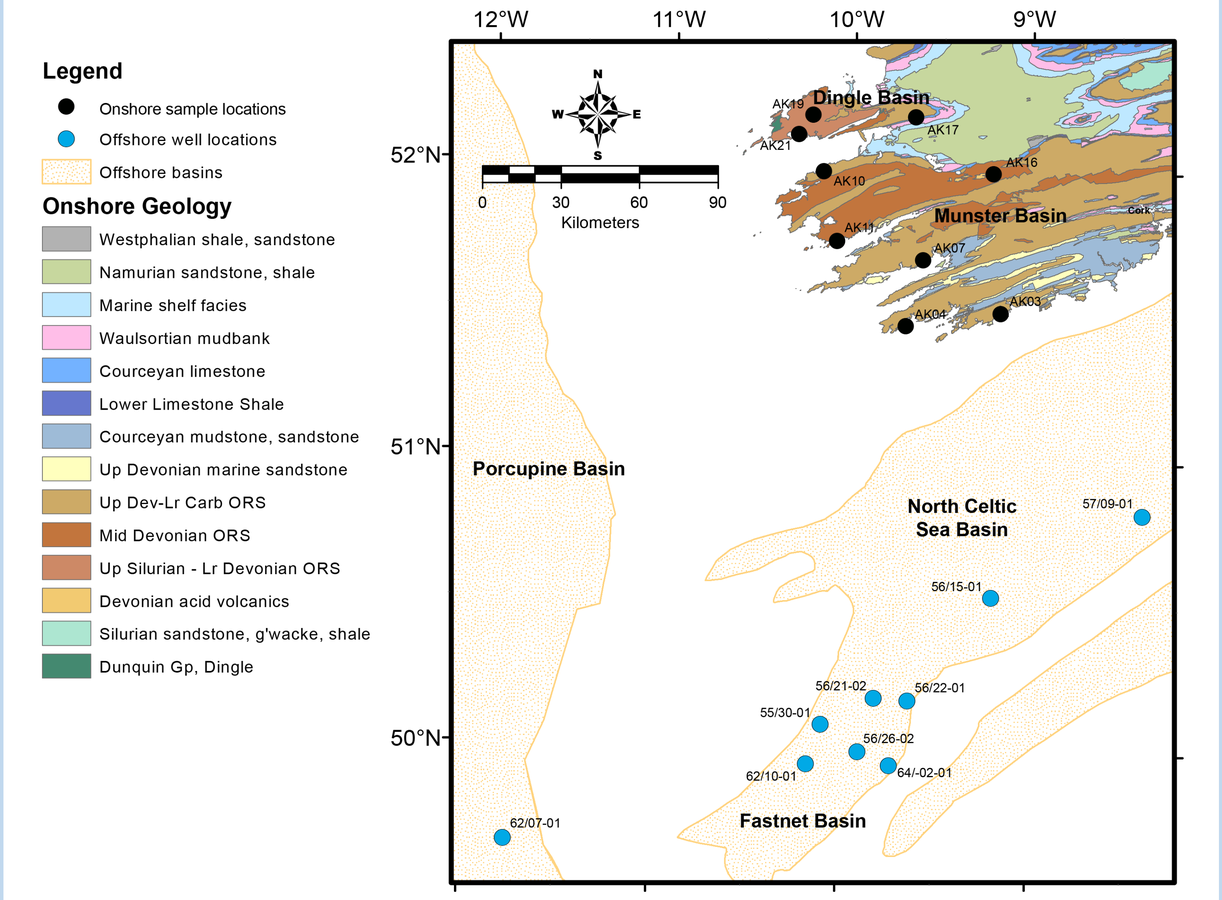

Figure 1. Geological map of southwestern Ireland showing distribution of onshore and offshore sample locations for detrital zircon geochronology. Onshore basement geology map supplied by Geological Survey of Ireland.

Recycling Onshore into Offshore?

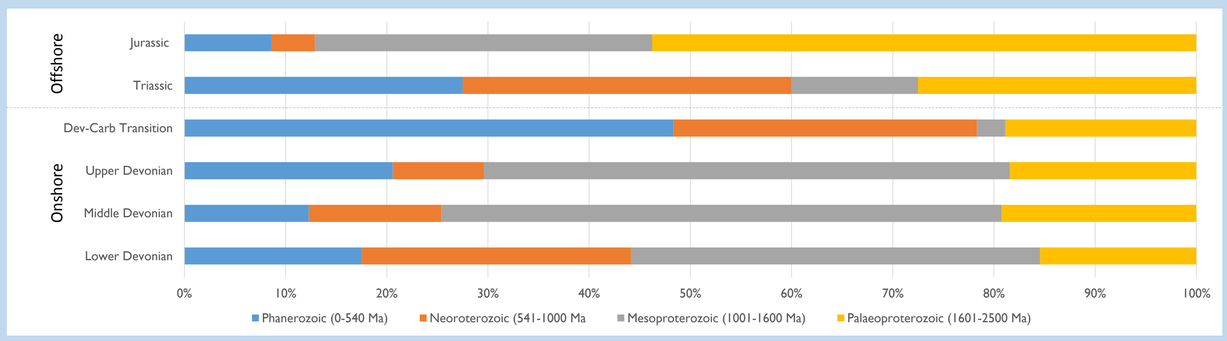

Figure 4. Stacked bar graph comparing grouped detrital zircon U-Pb ages for associated depositional ages.

U-Pb LA-ICP-MS analyses of detrital zircon from the onshore Devonian Dingle, Munster and South Munster basins, and the Goban Spur, Fastnet and western margin of the North Celtic Sea basins show few similarities as seen in Figure 4.

- Triassic fluvial sediments sampled in the Fastnet Basin are consistent with recycling of the Carboniferous sediments to the north (Irish Massif). Increase Mesoproterozoic source from the Cornubian Massif to the south? (Tyrrell et al., 2012).
- There is no obvious detrital zircon signature linking the onshore Devonian sediments to the Goban Spur (well 62/07-01).
- Well 62/07-01 represents broad-scale sedimentary recycling of a Laurentian terrane, not Avalonian basement as interpreted by Welford (2012).
- Well 62/07-01 shows few similarities to the spectra observed in coeval sediments of the North Celtic Sea Basin (see Fairey et al., this conference). Suggesting a palaeo-high separated the basins during Jurassic times.

Wells 56/22-01 (Cretaceous), 56/26-02 (Cretaceous), 57/09-01 (Triassic) and 63/10-01 (Jurassic) have been analysed for U-Pb geochronology and are awaiting data reduction. Geochrononlogy methods with lower reset temperatures (i.e. white mica Ar/Ar or apatite U/Pb) would be useful tests to determine if sediment within the well 62/07-01 are sourced north of the Iapetus suture, as these rocks would not exhibit Variscan reset (see Ennis et al., 2014). No white mica or apatites were recovered from the chip sample taken from the Jurassic of well 62/07-01 in this study.

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Acknowledgements

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