

Long-term sand supply to NE Atlantic Margin basins: New insights from new approaches

S. Tyrrell^{1,2,5}, J. Franklin^{1,2,5}, M. Nauton-Fourteu^{1,2,5}, A. Blowick^{1,2, 5}, B. Anders^{1,2},
D. Chew^{3,5}, C. Mark^{3,4,5}, G. O'Sullivan^{3,5}, P.D.W. Haughton^{4,5}, J.S. Daly^{4,5}, P.M.
Shannon^{4,5}, E. Badenzski^{4,5}, R. Raine⁶ and A. Morton^{7,8}



NUI Galway
OÉ Gaillimh



sediment origins research team



**Trinity
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GSNI

Geological
Survey of
Northern
Ireland

Celebrating 70 years: 1947–2017

hm research
correlation and provenance of reservoir sandstones



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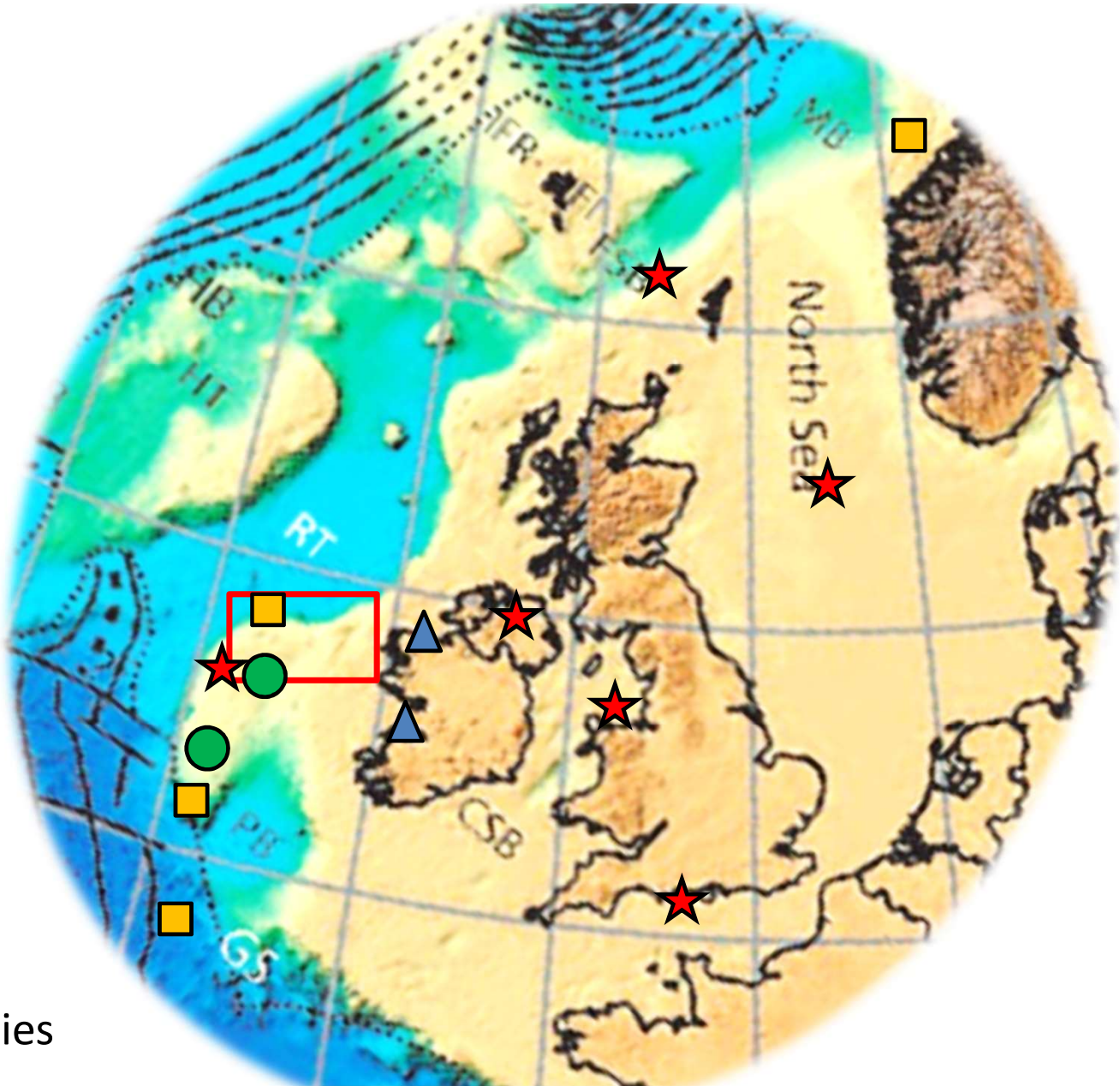
Which basins?

Work has been ongoing for the last decade...

Small and larger scale projects...

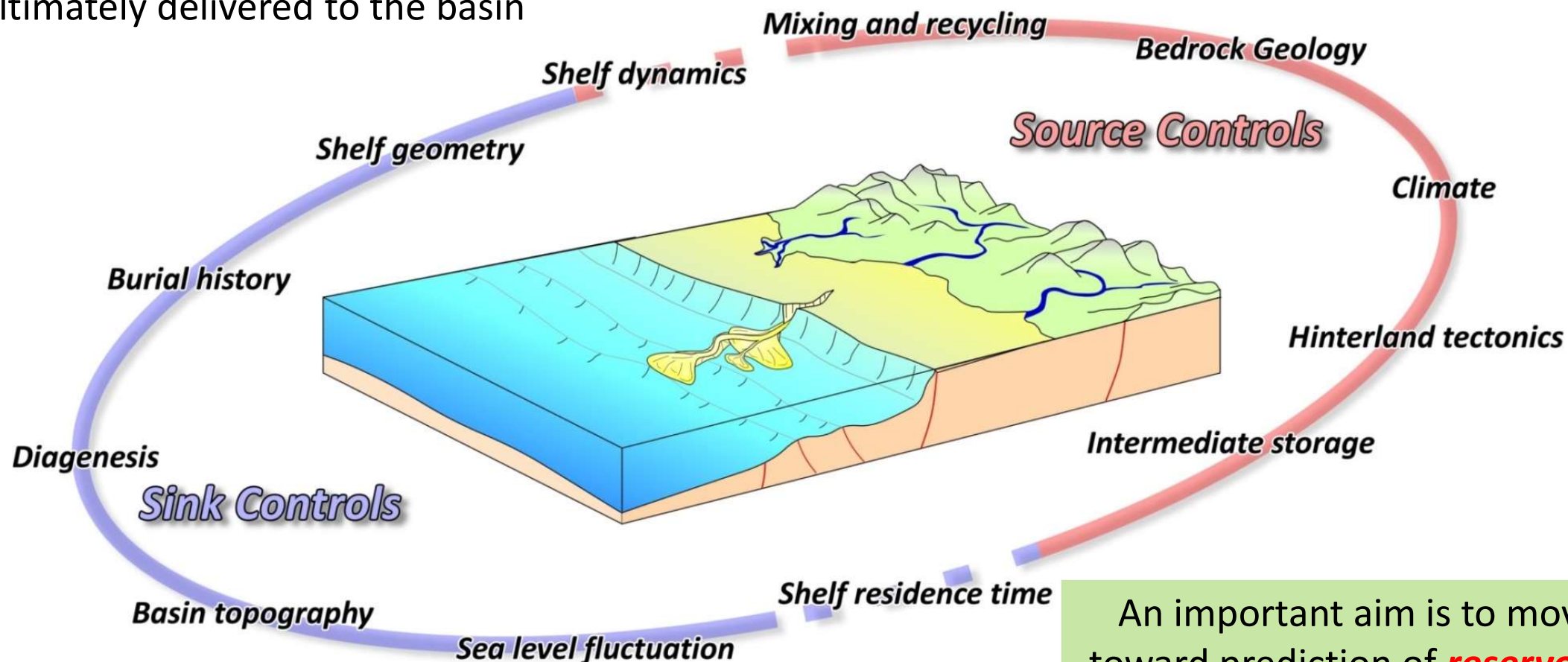


- Cretaceous
- Jurassic
- ★ Triassic
- ▲ Carboniferous
- Basement studies



Provenance analysis – *why?*

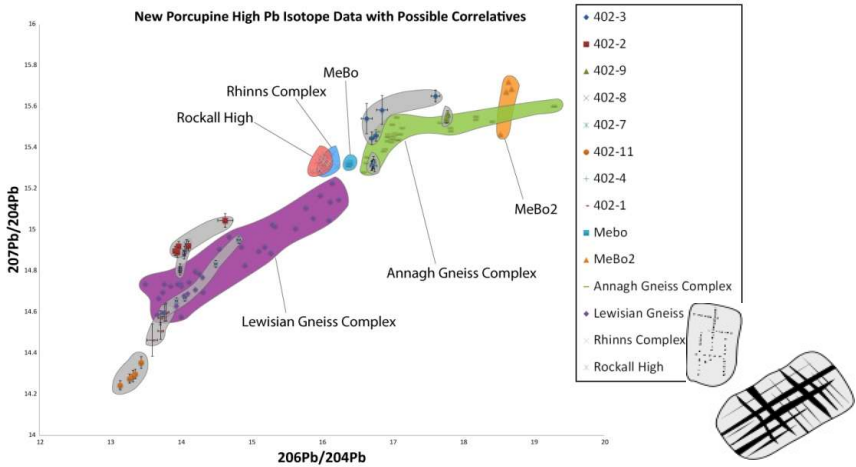
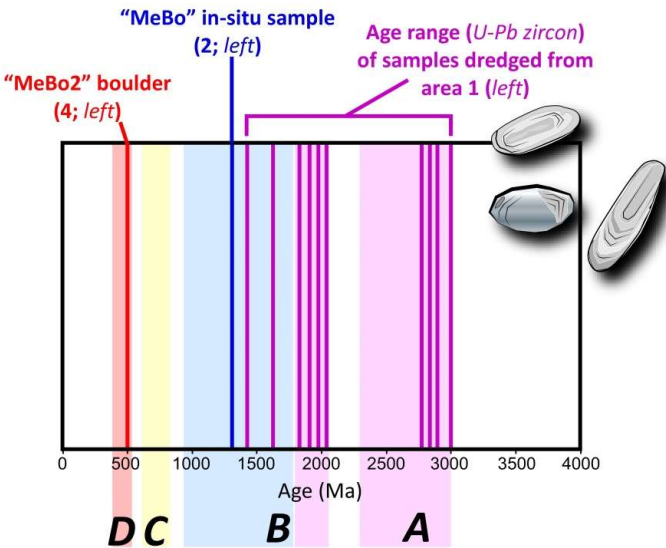
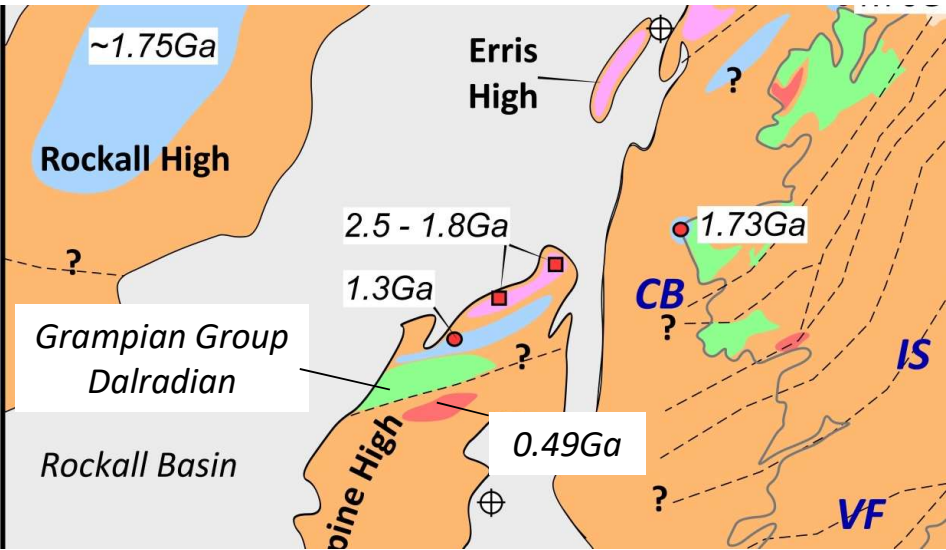
Helps constrain palaeogeography and palaeodrainage – and assessing the impact of **source** and **sedimentary processes** (e.g. mixing, storage) on the calibre of sand ultimately delivered to the basin



An important aim is to move toward prediction of **reservoir distribution and quality**

Provenance analysis – *why?*

Helps us constrain regional basement sources and aids in reconstructing conjugate margins

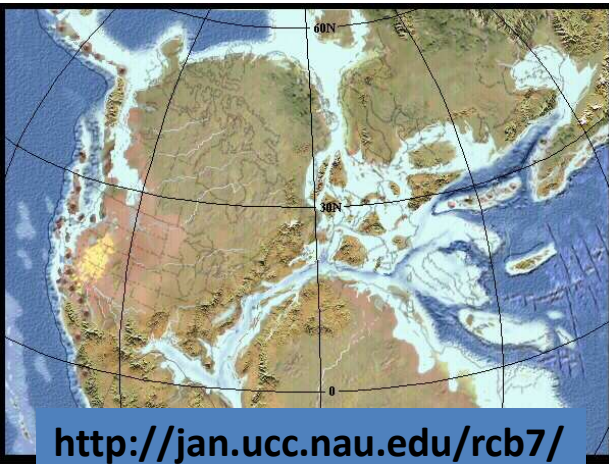


Northern part of the Porcupine High comprises:

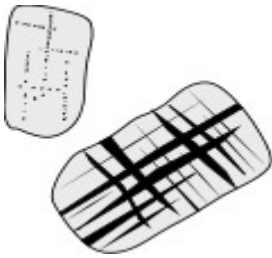
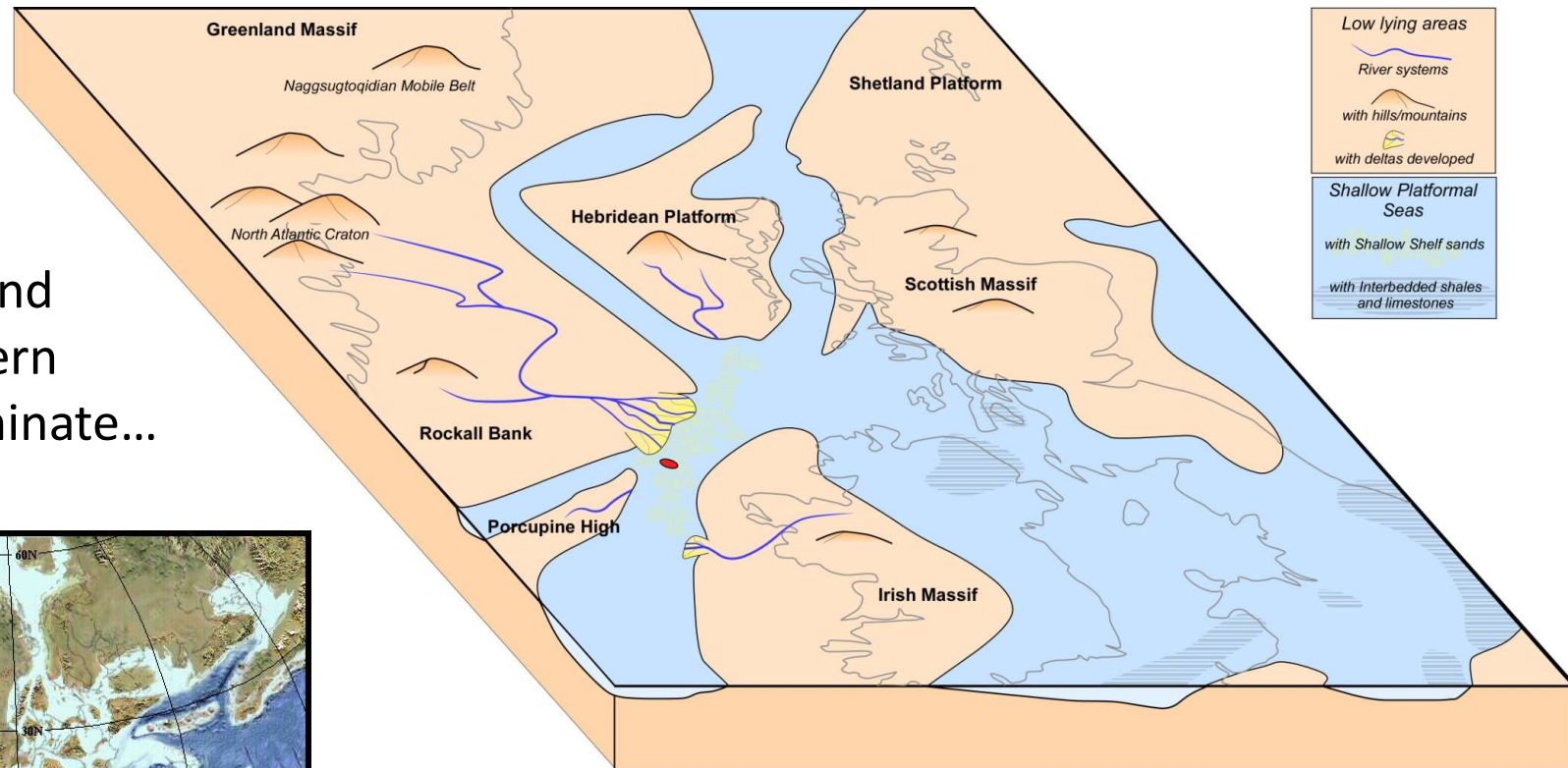
- Archaean – Palaeoproterozoic basement
- 1.3 Ga orthogneiss
- Dalradian supergroup equivalents
- Grampian granitic gneiss

Lower Jurassic

Greenland and other northern sources dominate...



<http://jan.ucc.nau.edu/rcb7/>



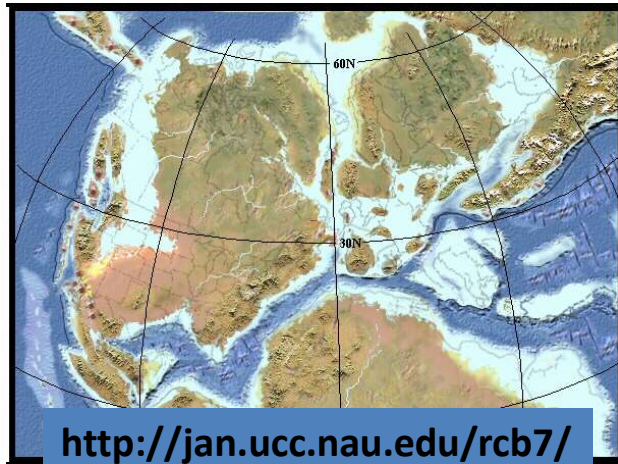
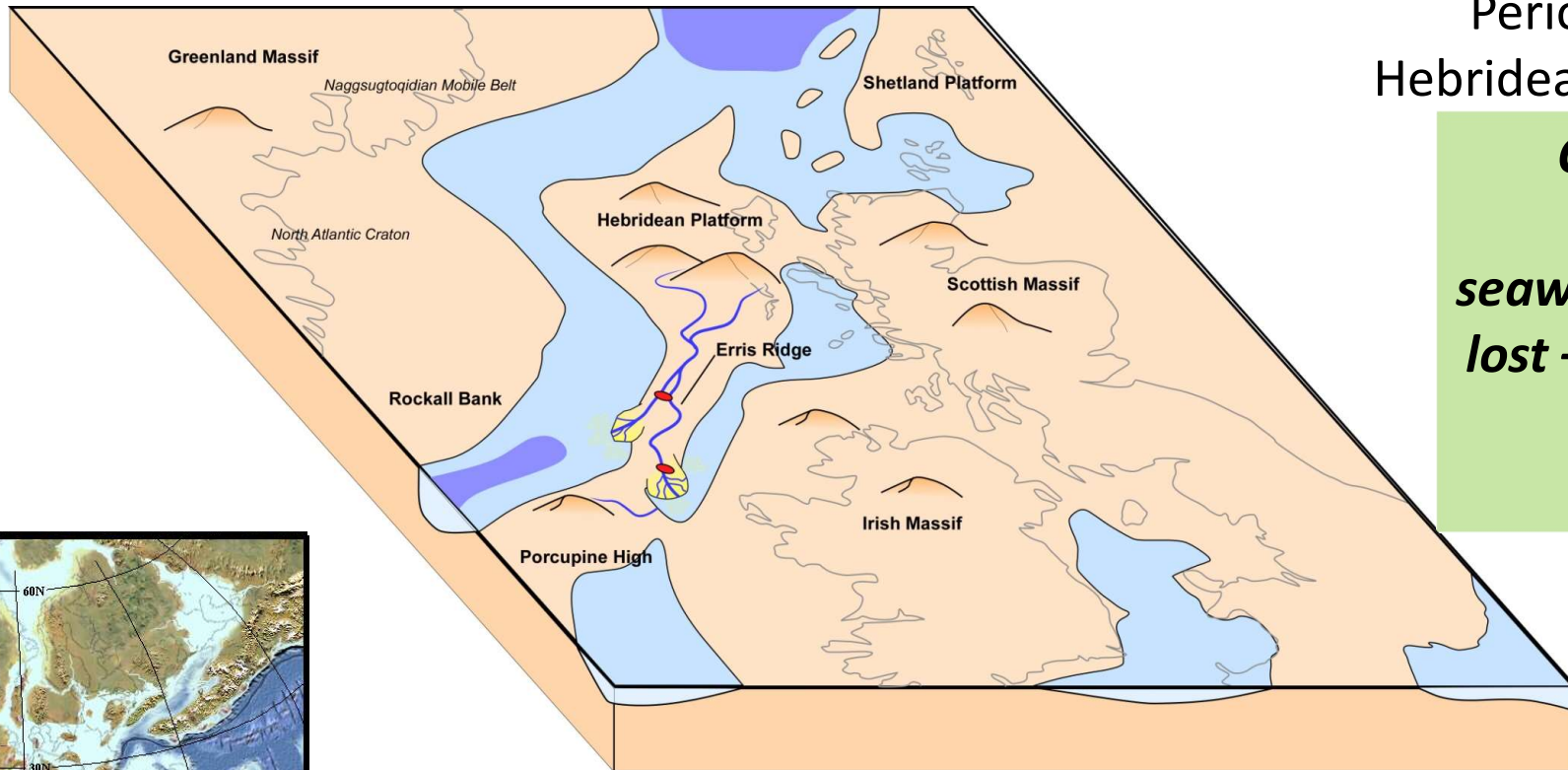
Palaeogeography after Cope et al., 1992

Lower Jurassic → Middle Jurassic

Shutoff of northern sources?

Periodic uplift of Hebridean Platform?

Connectivity between seaways is being lost – also noted from biomarkers

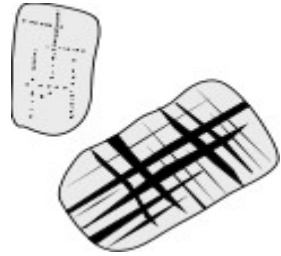


<http://jan.ucc.nau.edu/rcb7/>

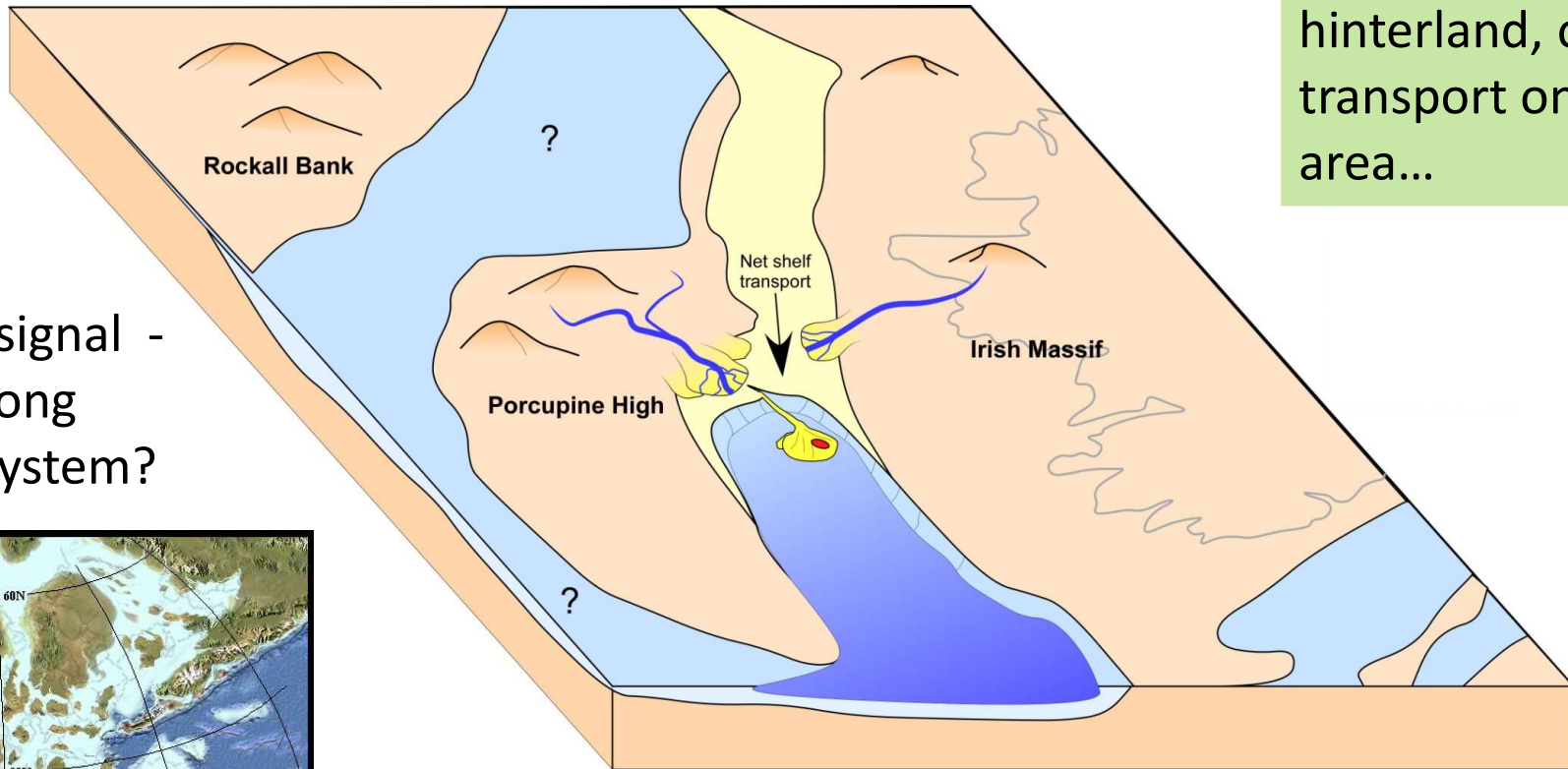
Implications for source rock distribution and quality?

Palaeogeography after Cope et al., 1992

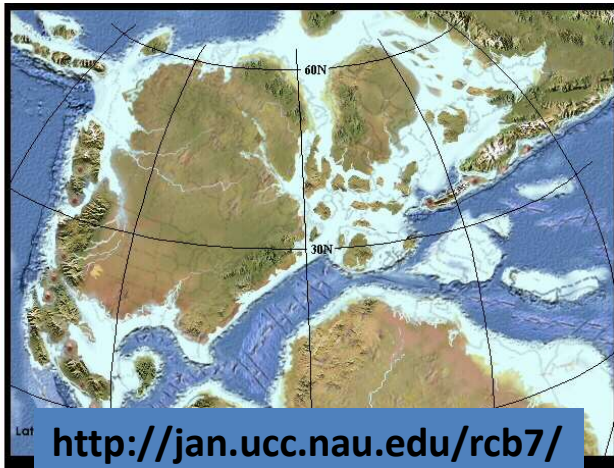
Lower Jurassic → Middle Jurassic → Upper Jurassic



Fluctuating signal -
transport along
Slyne Erris system?



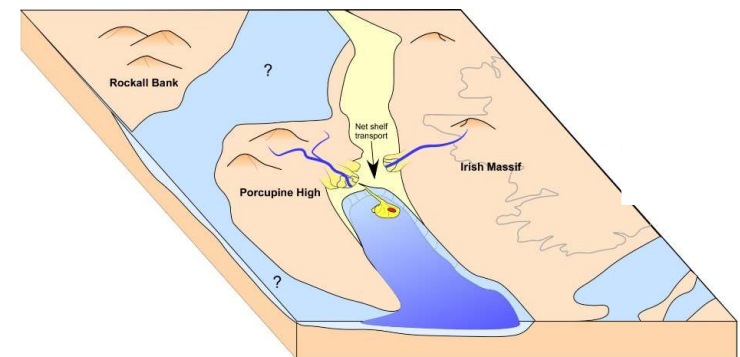
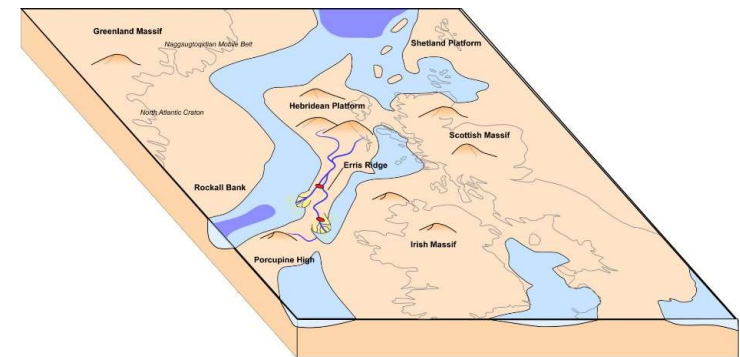
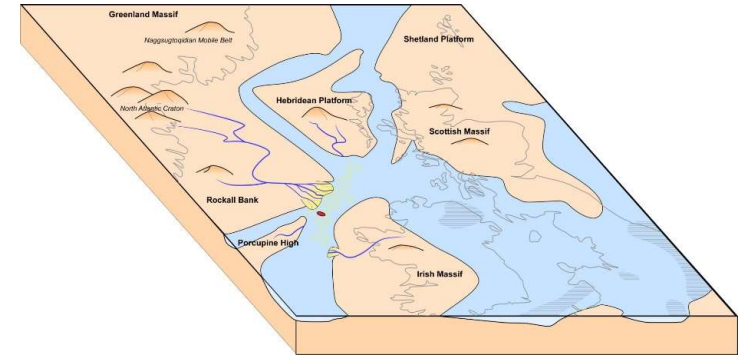
Uplift in the proximal
hinterland, or less net
transport on the shelf
area...



Good agreement with the by the thermal modelling
work carried out at TCD

Palaeogeography after Cope et al., 1992

BUT – these models are based on one provenance proxy...



Multi-proxy provenance analysis – old and *new approaches*



A particular assemblage of distinct minerals with distinct chemical signatures – *new detailed imaging and CCSEM/Raman*

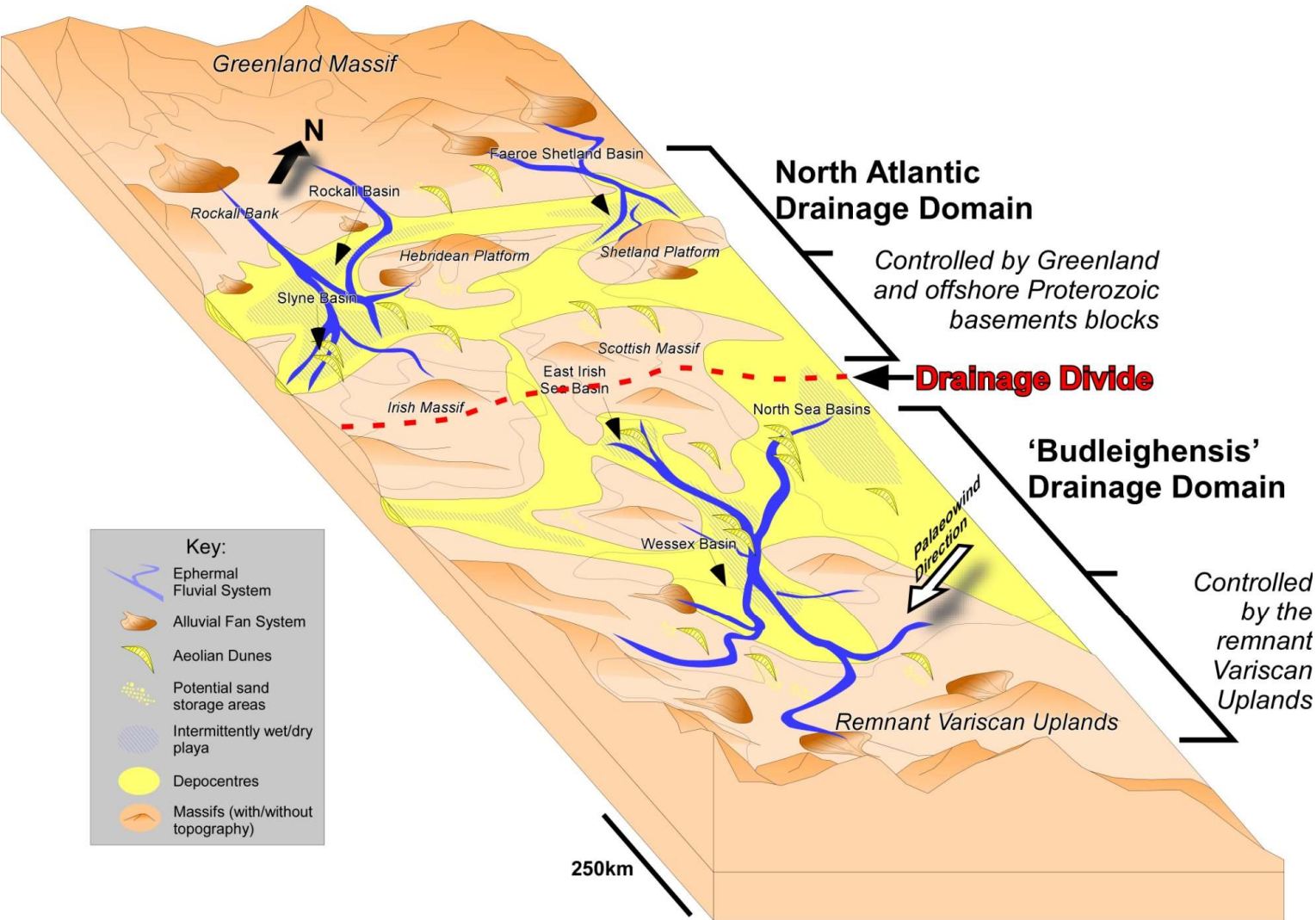
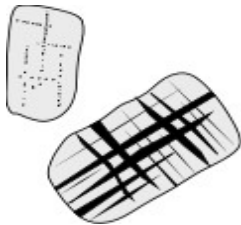


The measured radiogenic age of certain accessory minerals (e.g. zircon, apatite, rutile) - *validation and further application of new proxies*



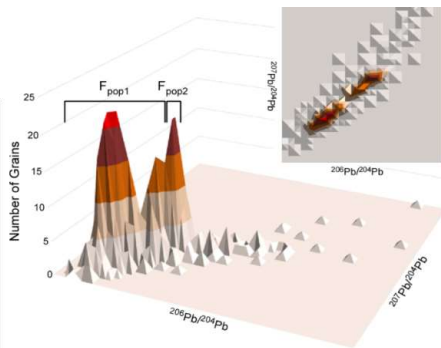
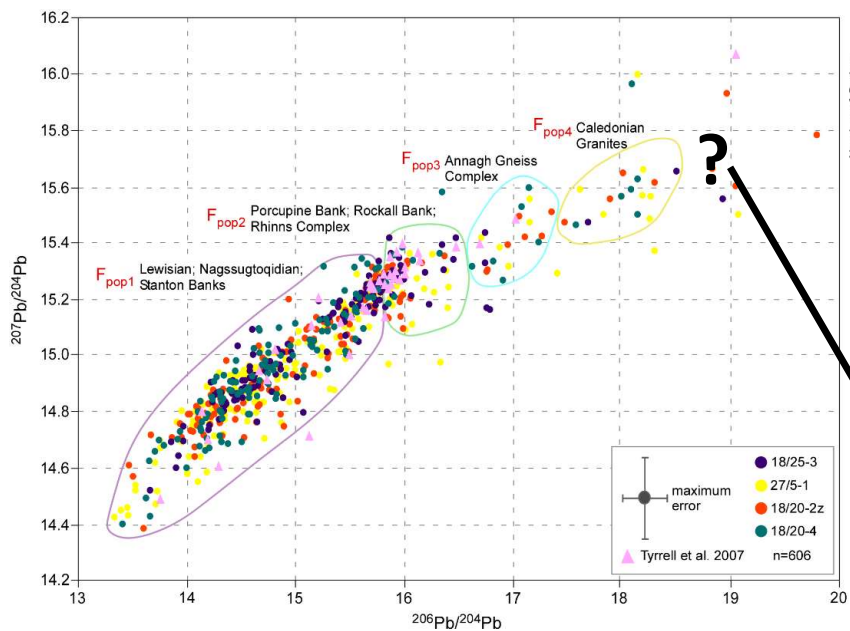
The isotopic composition of certain common minerals (e.g. Pb in feldspar) – *validation of plagioclase as a new tool*

Triassic Palaeogeography?

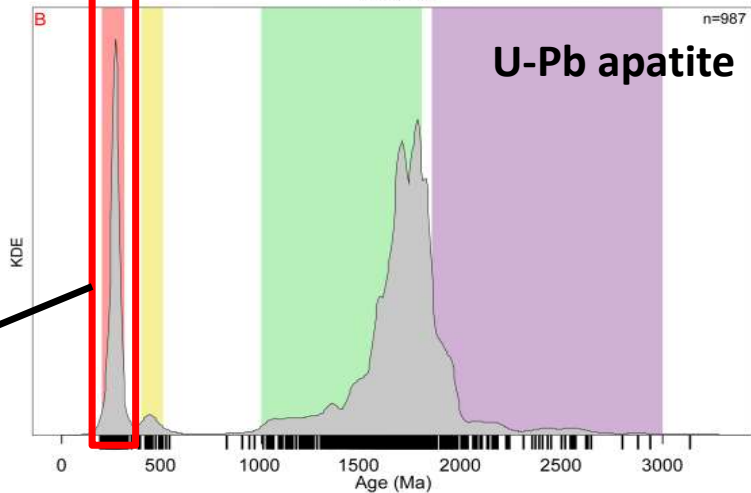
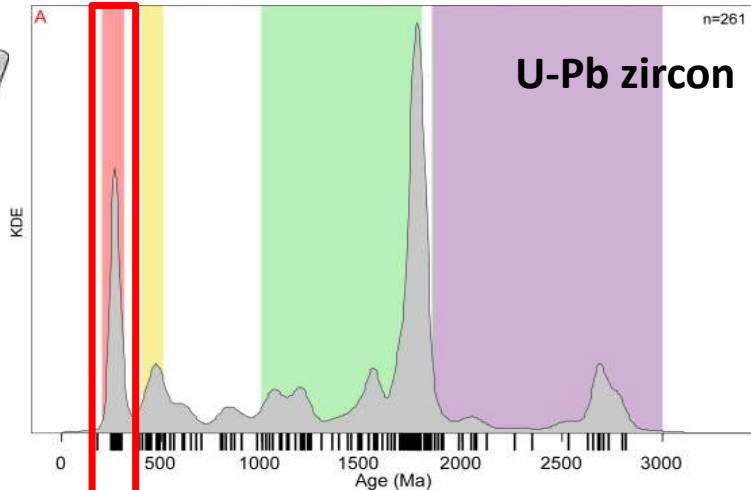


Triassic Palaeogeography – *Multi-proxy provenance*

Slyne Basin - Corrib Sandstone Formation



250 – 300Ma
aged grain
population

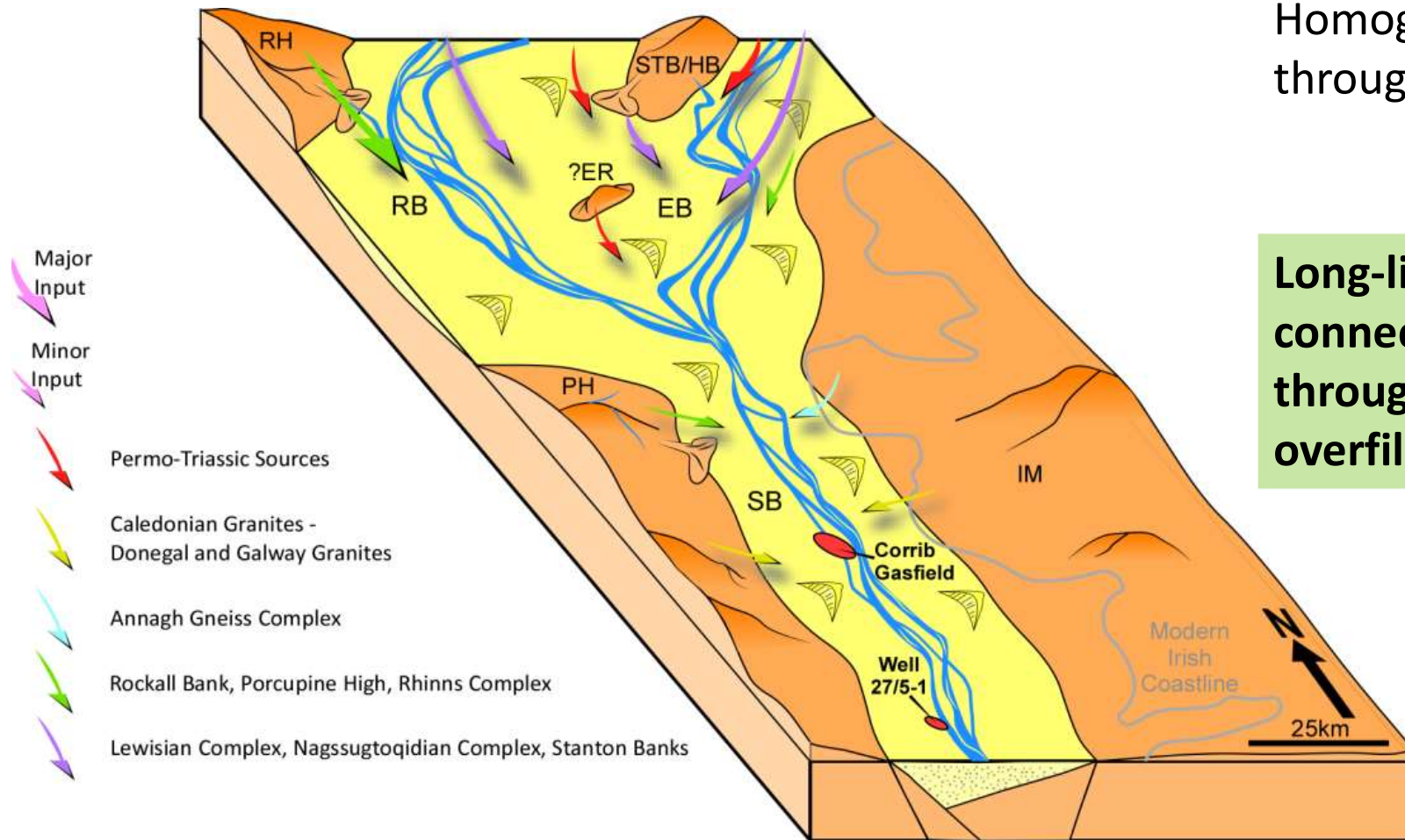


Population (s)	Age range	Source terrane (s)
$A_{\text{pop4}}; Z_{\text{pop5}}$	300 - 250Ma	Permo-Triassic Sources
$A_{\text{pop3}}; Z_{\text{pop4}}$	500 - 400Ma	Caledonian Granites
$A_{\text{pop2}}; Z_{\text{pop2}}$	1.8-1Ga	Porcupine Bank; Rockall Bank; Rhinns Complex; Laurentian terranes, such as Ketildian, Grenvillian, Pinvarian, Labradorian
$A_{\text{pop1}}; Z_{\text{pop1}}$	>1.85Ga	Lewisian; Nagssugtoqidian; Stanton Banks



PhD - Jess Franklin

Triassic Palaeogeography

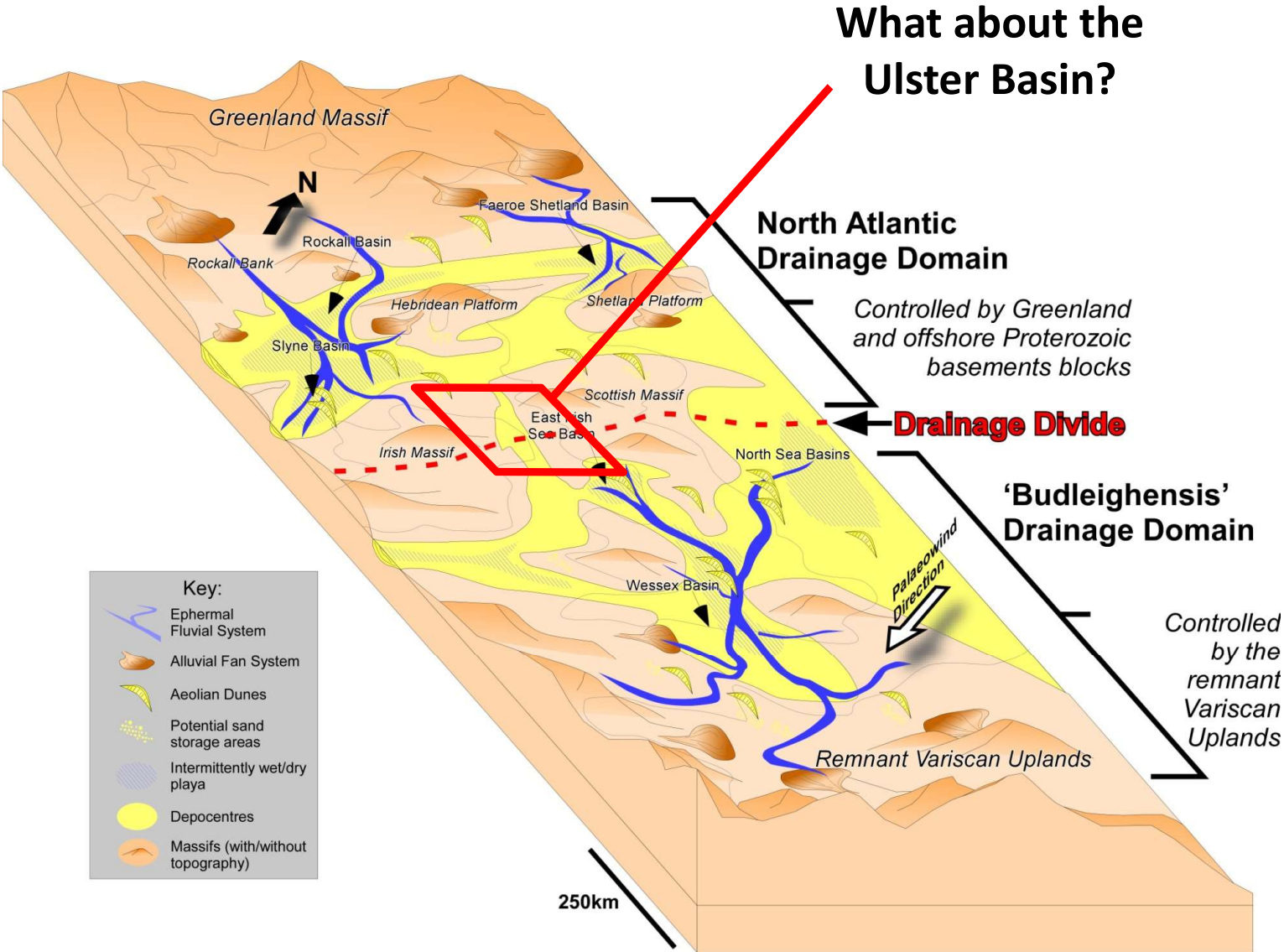


Homogeneity of signal through the Slyne?

Long-lived system – connectivity between and through rifts – basins are overfilled?

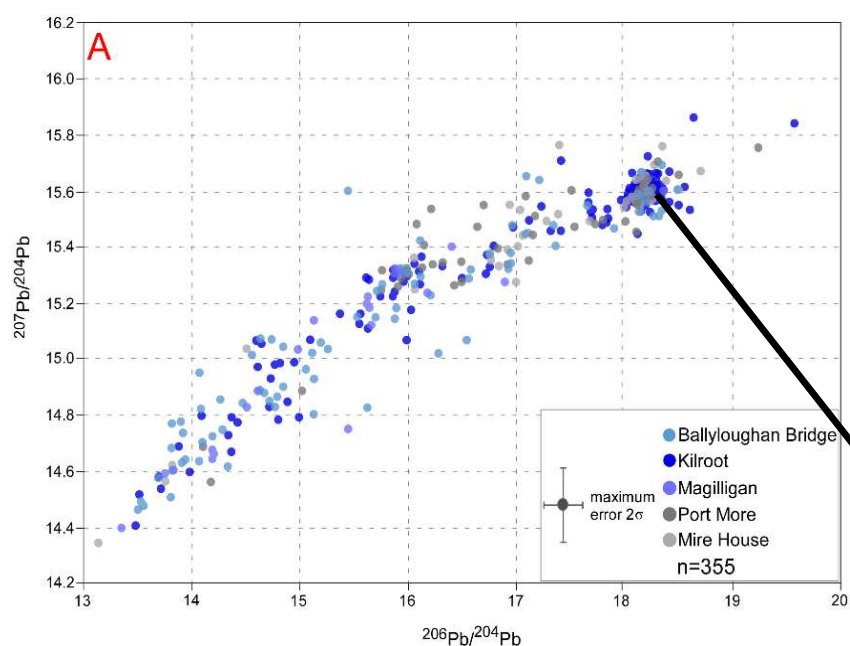
From Franklin et al., 2019

Triassic Palaeogeography?

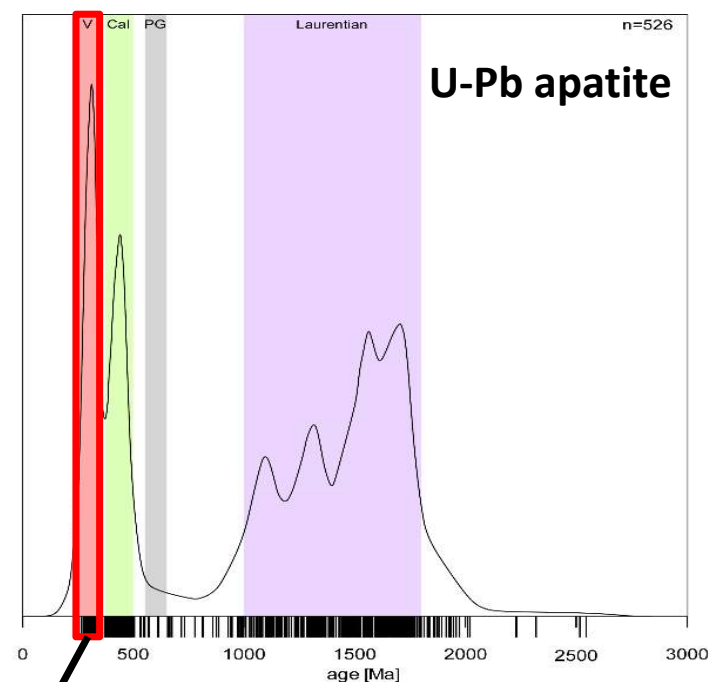


Triassic Palaeogeography – *Multi-proxy provenance*

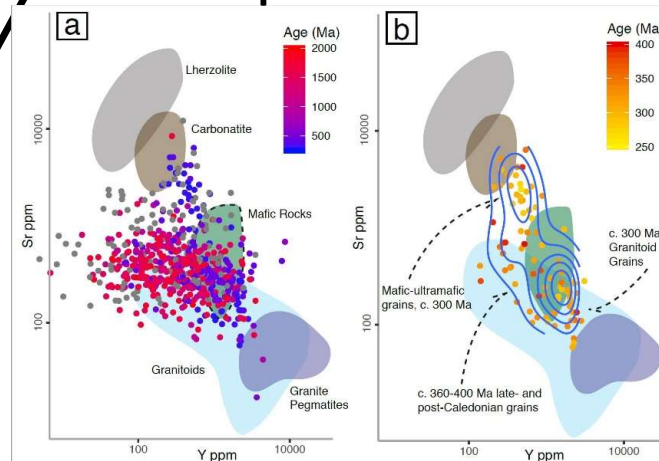
Ulster Basin - Sherwood Sandstone Formation



**Young
unradiogenic
grains match with
Variscan sources**



Apatite trace elements



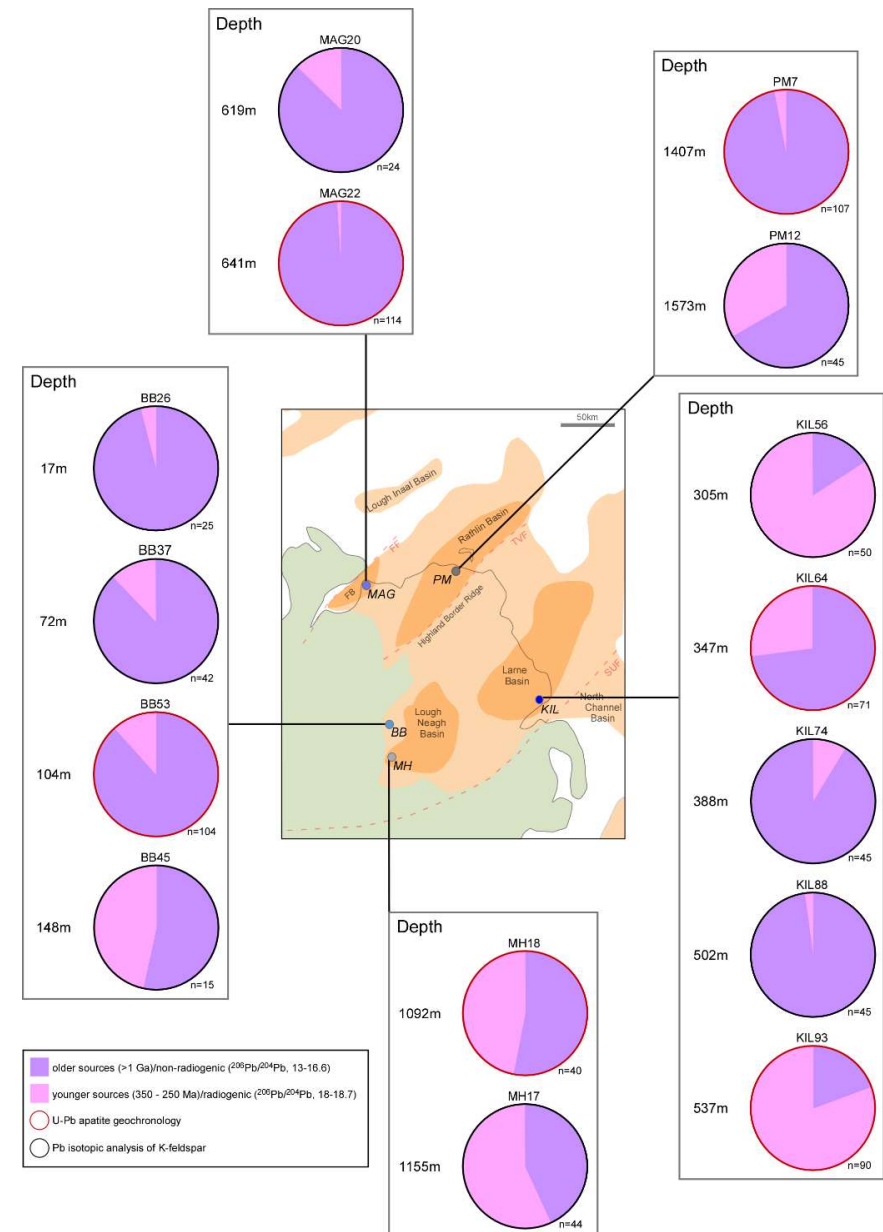
PhD - Jess Franklin

Triassic Palaeogeography – *Multi-proxy provenance*

Ulster Basin - Sherwood Sandstone Formation

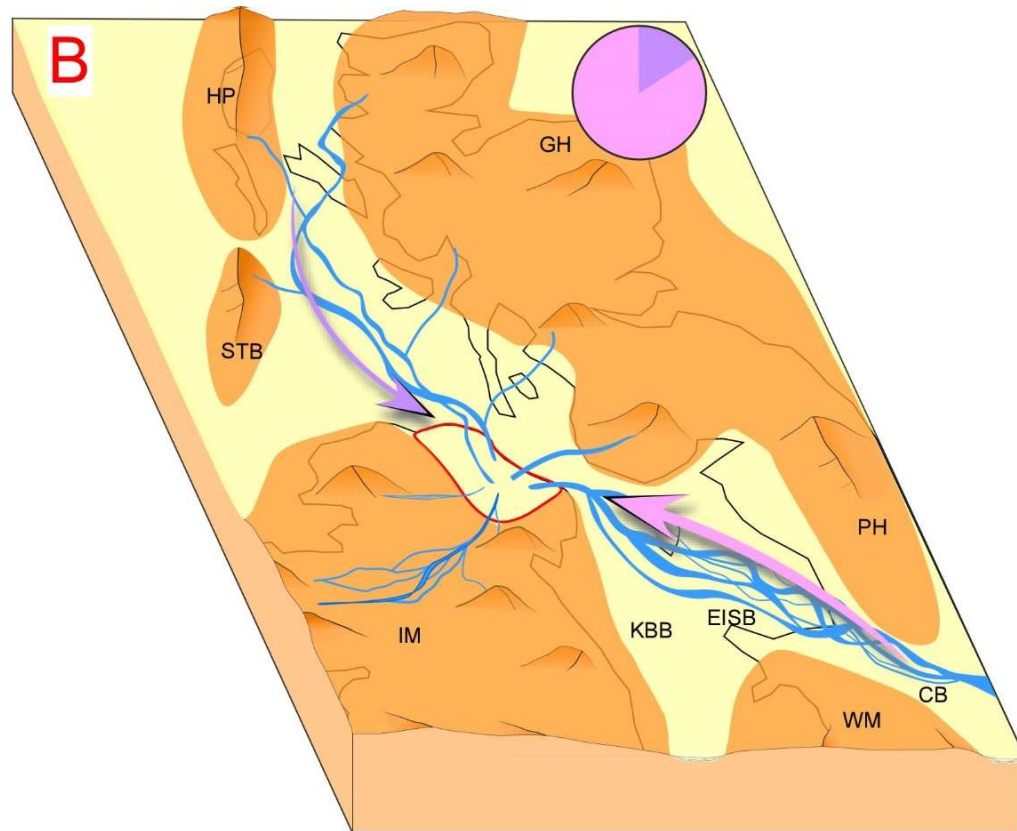
Signal fluctuates intermittently
across the basin

Highland border ridge may form a
buffer for sediment at certain
times



Triassic Palaeogeography – *Multi-proxy provenance*

Ulster Basin - Sherwood Sandstone Formation

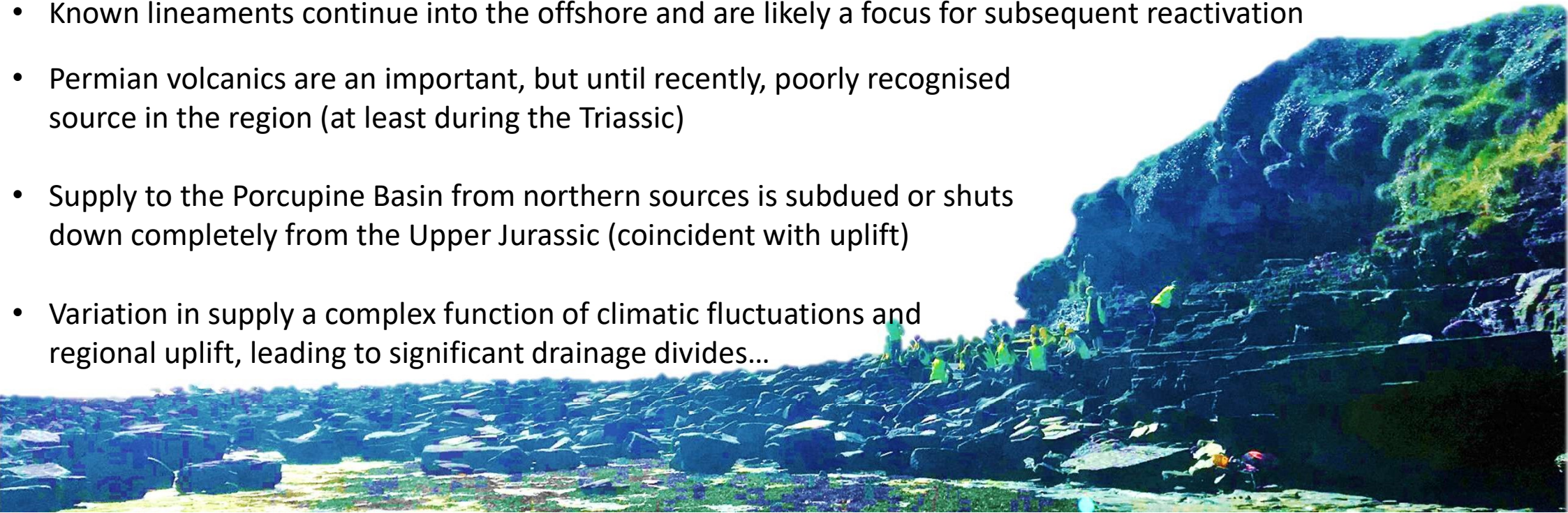


- *Sourcing from northern and southern sources – from as far south as northern France*
- *Intermittent connectivity to Budleighensis system*
- *Similar scale to system feeding Slyne Basin*
- *BUT no transmission of sand across the basin*

CLIMATE *versus* TECTONICS

General observations:

- The same source areas supply sediment to Northeast Atlantic Margin basins over a very long period of time
- Offshore basement highs are important sources for sediment, have a complex uplift history and can be important buffers controlling supply
- Known lineaments continue into the offshore and are likely a focus for subsequent reactivation
- Permian volcanics are an important, but until recently, poorly recognised source in the region (at least during the Triassic)
- Supply to the Porcupine Basin from northern sources is subdued or shuts down completely from the Upper Jurassic (coincident with uplift)
- Variation in supply a complex function of climatic fluctuations and regional uplift, leading to significant drainage divides...



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