Coupling colour CL of quartz with multiple geochronological proxies in an attempt to determine extent of sediment recycling in Devonian and Mesozoic basins of southern Ireland

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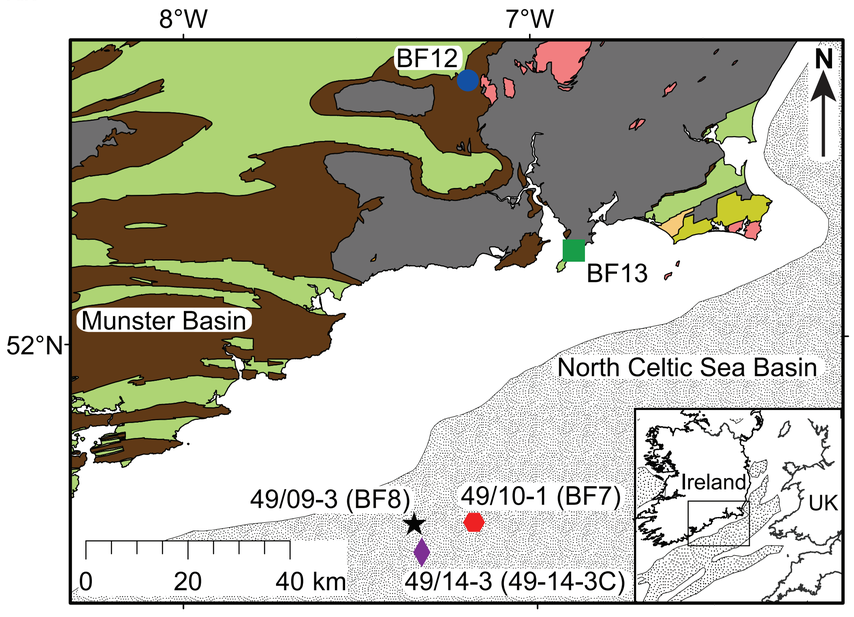
1. Introduction

Can the phenomenon of cathodoluminescence (CL) in quartz aid in the sedimentologist's struggle to determine the contribution of recycled sediment to a sedimentary package?

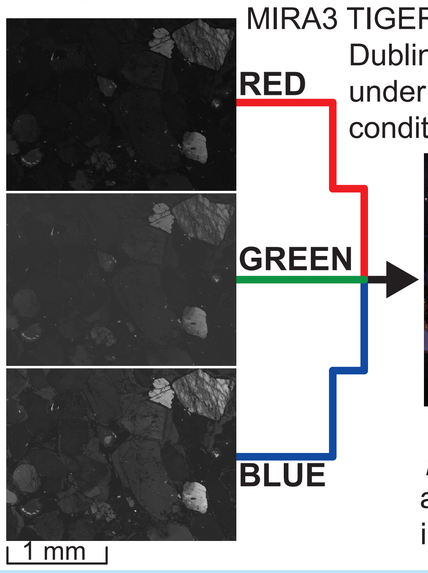
We test the applicability of **colour CL in quartz** as an **indicator of sediment recycling** by making the simplistic assumption that all quartz in three samples from the Mesozoic North Celtic Sea Basin (NCSB) was derived solely from recycling of Upper Devonian Old Red Sandstone (ORS) in southern Ireland.

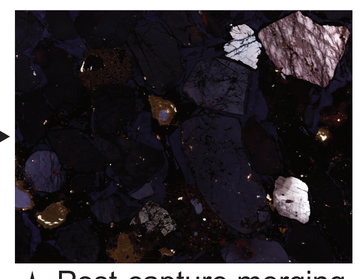


Geological map of the study area showing sample locations. The symbols indicated on the map are used throughout the poster. **Three Upper Jurassic samples** were taken from the North Celtic Sea Basin and **two from the Upper Devonian ORS** of the Munster Basin (inset: regional setting of study area).

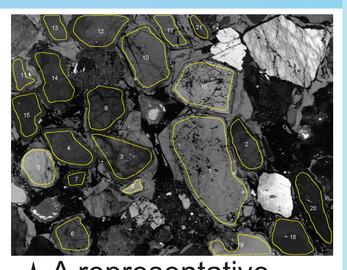
2. Methods

Follows a similar procedure to Boggs et al. (2002). Simultaneous capture of 16-bit greyscale CL images through red, green and blue filters using a Tescan MIRA3 TIGER SEM at Trinity College Dublin. All images were taken under the same operating conditions.



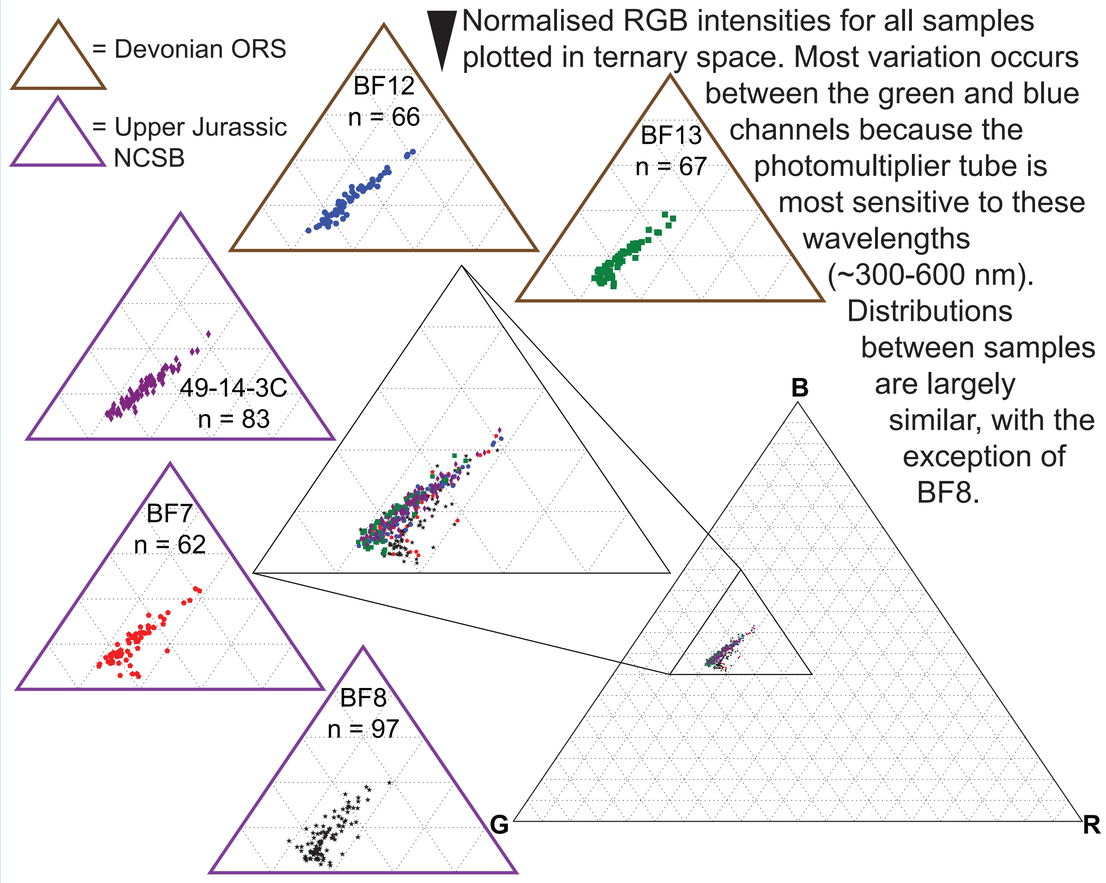


Post-capture merging of RGB channels allows false-colour CL images to be developed.

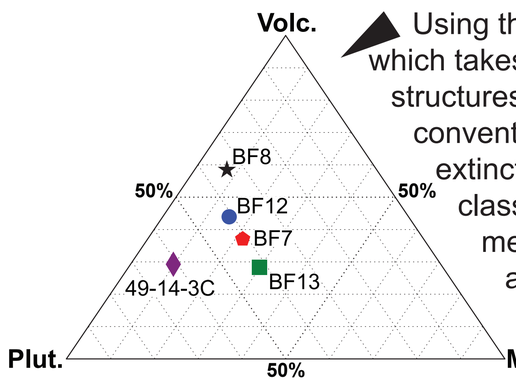


A representative area from each quartz grain in each colour channel is selected and a mean grey value (0-65535) is calculated in ImageJ. CL structures and transmitted light microscope features are also recorded.

3. Results

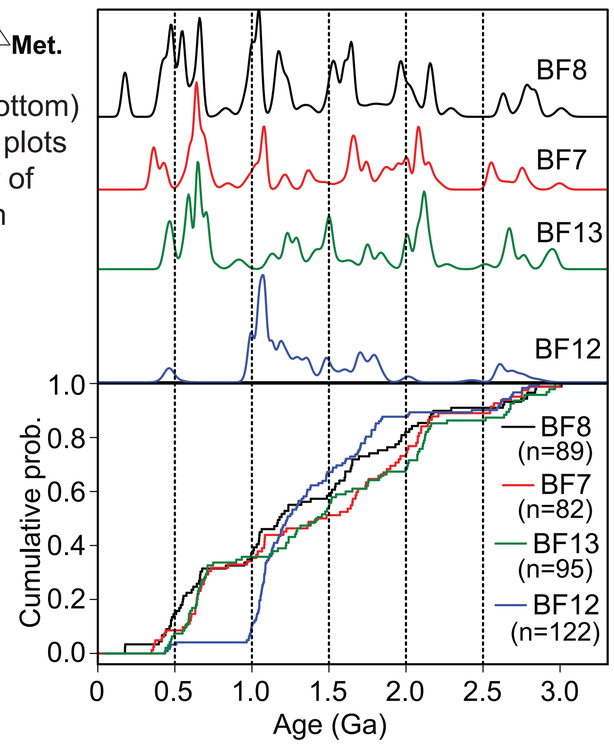


Normalised RGB intensities for all samples plotted in ternary space. Most variation occurs between the green and blue channels because the photomultiplier tube is most sensitive to these wavelengths (~300-600 nm). Distributions between samples are largely similar, with the exception of BF8.

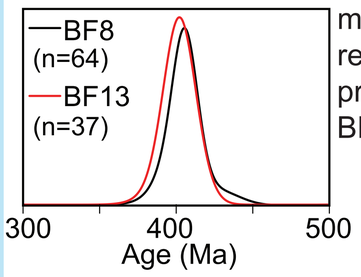


Using the flowchart of Bernet and Basset (2005) which takes into consideration total CL intensity, CL structures (microcracks, zoning, etc) and conventional microscopic observations (e.g. extinction behaviour), quartz grains were classified as being volcanic, plutonic or metamorphic. Samples BF13, BF12 and BF7 are most closely related.

Cumulative age distributions (bottom) and kernel density estimation (KDE) plots (top) of detrital zircon ages from four of the five analysed samples (data from Fairey et al., In prep. a,b).



Area-normalised KDE plots of detrital mica ages for two of the five samples showing close similarity - possibly indicating a common Acadian source of white micas - recycled or primary in BF8?



4. Conclusions

This is the first study to attempt to use the variety of CL colours in quartz to assess similarities/differences in sediment provenance between samples.

The presence of Laurentian detrital zircons in the Upper Jurassic NCSB possibly indicates recycling of Devonian ORS in the Munster Basin (which contains an abundance of Laurentia-derived detritus). In an attempt to elucidate processes of sedimentary recycling in the study area, we test the CL colour of quartz as a potential proxy.

We show that **similarity in the distribution of CL colour in detrital quartz grains between samples does not necessarily indicate a common source**. This is supported by the marked difference in quartz type when internal CL structures are taken into consideration. Additionally, detrital zircon age distributions show clear differences (especially sample BF12) which are not apparent in the analysis of CL images.

Based upon the relatively few samples analysed in this study, the **CL colour in quartz does not serve as a robust means by which to determine the extent of sedimentary recycling**. However, CL imaging of quartz in general remains useful for broad source determination.

Finally, this work would benefit from CL-image- and single-grain geochronological analysis of source and sink in a modern sedimentary basin for which the source is known to be solely of sedimentary origin.

5. Acknowledgements

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Maps of Ireland were reproduced with the permission of DCENR and Government of Ireland.
Maps were produced using ESRI's ArcGIS.
KDE and CDA plots were produced using the R package `provenance` (Vermeesch, 2016).
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6. References

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