U-Pb dating of carbonate-fluorapatite: a potential chronological tool for ancient marine sediments

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1 Carbonate Fluorapatite (CFA) is a relatively widespread early diagenetic component precipitated in sub-aqueous sediments. Nodules, laminae and shell overgrowths or infills composed of CFA are relatively common features in phosphorites, carbonates and other marine sediments. Sedimentary phosphate typically has very high U-concentrations. CFA U-Pb ages thus has potential application as a chronometer in a wide variety of ancient marine sediments, particularly in those marine sections lacking diagnostic faunal and/or floral assemblages, or well-dated volcanogenic horizons.

We have analysed several samples of phosphorite, or phosphate-bearing sediments in order to characterise CFA for dating by the U/Pb method. These measurements were made by LA-Q-ICPMS at the National Centre for Isotope Geochemistry in University College Dublin. These include samples of Carboniferous phosphorite chalk from southern England, phosphatic nodules from the Carboniferous of western Scotland, and several samples from a laterally extensive Carboniferous phosphorite in western Ireland. These Carboniferous samples are discussed here.

2 Results: Clare Shales Phosphate member, Co. Clare, Ireland
Stratigraphic age is between 330 - 323 Ma based upon conodont and goniatite biostratigraphy (Barham et al., 2015). Further information, further required work.

3 U-Pb geochronology

For both samples, precision on acquired ages could be increased by analysis of co-generic Pb-bearing phases (e.g. pyrite). For sample A, the current precision of the stratigraphic U-Pb age using a quadrupole instrument is 1.25%. For a hypothetical 60 Ma sample this would yield an error of ± 0.75 Ma - without any analytical improvements, use of multiple collector ICPMS etc. U-Pb ages were acquired using fluorapatite U-Pb reference materials (Madagascar; Durango; and McClure Mountain apatite). Further characterisation of CFA may be required to assess whether there are differences in ablation behaviour between fluorapatite standards and carbonate-fluorapatite.

4 Further information, further required work
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REFERENCES
Walsh, J.J., Moore, P.F., Bunce, C., Hollis, S.P., Kelly, J. and Menuge, J.F., 2019. The origin and nature of hydraulic fractures in analysing sedimentary phosphate. Sedimentary phosphate can thus retain stratigraphic age information, but is vulnerable to fluid-overprinting; potentially rendering it a viable low-temperature thermochronological or fluid ingress tracing tool.

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