Time-series for mid-ocean ridge magmas from sediment hosted volcanic glasses

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A major hindrance to studies of mid-ocean ridge (MOR) processes is the lack of a temporal perspective on ridge magmatism. Models of MOR evolution often invoke variations in magmatism over timescales of 10s-100s of ka, but few compositional time-series exist for MOR magmas over these timescales, and none have good temporal constraints. Older samples on the ridge flanks are difficult to sample using traditional methods as they quickly become covered by sediments (accumulating at ~1 cm/ka) and even when obtained cannot be precisely dated. Existing compositional time-series for periods >10 ka therefore tend to have very coarse sample resolution (i.e. a handful of samples per ~100 ka) and imprecise age constraints. The recent discovery that MOR eruptions commonly disperse numerous pyroclastic fragments of volcanic glass onto the surrounding sea-floor, which can be sampled in abundance from surficial axial sediments, has opened a new avenue to sampling MOR magmas [1]. We previously demonstrated that these glasses are also preserved in older sediments (i.e. >500 ka), in this case sampled from cores taken on the flanks of the Juan de Fuca ridge, NE Pacific [2]. Each individual sediment core that impacts basement contains glasses deposited over a period of ~50-100 ka, the ages of which can be quantified using established stratigraphic techniques on the host sediments. Combining individual time-series from cores of different creates a composite time-series stretching over many 100s of ka. Here we report the first continuous time series data from a suite of cores on the flanks of the ridge that encompass 350ka. There are indications of variations in the extent of fractionation at the ridge axis that corresopnd to glacial cycles. This method has the potential to transform our understanding of ridge evolution by revealing the detailed history of magma compositions over the last ~1 Ma or more.

[1] Clague et al. (2009) *J. Volcanol. Geotherm. Res*, **180**, 171-181
[2] Ferguson et al. (2017) *Geology*, **45**, 491-494.