

2.54–2.65 Ma time-series geochemical variation in sediment-hosted glasses at Reykjanes ridge

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Sediment-hosted glasses provide valuable time-series records of mid-ocean ridge compositional evolution, (Ferguson et al., 2019), but there has been a question of how far back in time such studies are possible. In this study, we analyzed the major and trace element compositions of mid-ocean ridge (MORB) glass chips recovered from the bottommost sediment core U1555H from IODP Expedition 395C (60°13.6924'N, 28°30.0240'W) on the off-axis Reykjanes Ridge. The studied interval spans 167–178 meters below the seafloor (mbsf), corresponding to an age of 2.54–2.65 Ma. Fresh glasses are preserved throughout this time interval providing a continuous 100 ka record of basalt compositions.

The MORB glasses have MgO contents ranging from 7.0 to 8.5 wt% and closely resemble present-day Reykjanes Ridge basalts (58°–61°N), suggesting a persistent mantle source and temperature over 2.5 Ma. Concentrations of incompatible elements vary by about a factor of two, correlating with fluctuations in La/Sm, Nb/Zr, K/Ti, and Sm/Yb ratios. The entire range occurs at the same MgO content and time interval, appearing consistent with small variations in the extent of melting.

No Iceland-derived volcanic glass has been identified within the studied time interval, in contrast to younger sediment cores where abundant Icelandic compositions are present.

These results demonstrate that ocean ridge basalt glasses can be preserved in sediments as old as 2.6 million years, greatly expanding the potential of such glasses for constructing long, continuous time series that are impossible to achieve for subaerial volcanoes. The glasses hold the potential for reconstructing variations in mantle processes, crustal fractionation and potential responses of ocean ridge volcanism to glacial cycles, as well as temporal variations in subaerial compositions when cores are near ocean islands. Further investigations with higher data density will reveal whether there are correlations with the 40 kyr glacial cycles that were prevalent during this time period.