# Timescales of olivine re-equilibration by diffusion in primitive basalts from Shatsky Rise (IODP Site U1349)

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The Shatsky Rise oceanic plateau respresents a large igneous province (LIP) that originated from a fast-spreading triple junction during the Late Jurassic and Early Cretaceous [1]. Although significant progress in understanding the origin and evolution of this oceanic plateau has been made in recent years, some aspects of LIP volcanism remain poorly understood [2]. One tool to investigate the temporal evolution of such an extraordinary igneous system is the study of chemical and isotopic zoning patterns in magmatic crystals, e.g. olivine, as those can be used to estimate timescales of magma evolution by diffusion modeling [e.g. 3]. Here, we investigated normally zoned (in Mg#) olivine grains from primitive basalts recovered in the Ori massif (Site U1349) of the Shatsky Rise oceanic plateau that have been sampled during IODP Expedition 324. The chemical zoning is most pronounced at the rims of the crystals ($Fo_{84\text{-}87}$ to $Fo_{\sim 70}$). Their Fe and Mg isotope compositions were analyzed *in situ* by fs-LA-MC-ICP-MS [4].

The acquired Fe-Mg chemical and isotopic profiles across these olivines exhibit significant Fe-Mg isotopic zoning that is clearly coupled to the chemical zoning at the olivine rims, which is a strong evidence for chemical exchange diffusion of Fe and Mg between olivine and melt [3]. Furthermore, some olivines show a pronounced enrichment of light Fe isotopes in their cores (down to $\delta^{56}$Fe=−1.2‰ relative to IRMM-014) that is positively correlated with Mg# and negatively with $\delta^{26}$Mg. This indicates that the cores of these olivines have also been affected by diffusive re-equilibration which cannot be deduced from their chemical zoning patterns alone. Reproducing the normal zoning at the rims of the olivines by Fe-Mg diffusion modeling yields timescales of diffusive re-equilibration at T=1175°C between 90 and 250 days. Re-equilibration of crystal cores may have taken much longer (on the order of several years) and can be explained by a model that combines crystal growth- and diffusive processes. These findings provide further constraints on magma evolution processes during the formation of the Shatsky Rise LIP.

[1] Sager et al. (2010) *Proc. Integr. Ocean Drill. Progr.* **324**, 1-69. [2] Sager et al. (2016) *Earth-Sci. Rev.* **159**, 306-336. [3] Oeser et al. (2015) *GCA* **154**, 130-150. [4] Oeser et al. (2014) *GGR* **38**, 311-328.