Shatsky Rise: magma transport and storage conditions

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Our understanding of sub-volcanic magmatic systems has shifted away from models of large-scale, long-lived, liquid-dominated magma chambers towards one where melt exists mainly as small pockets within a framework dominated by crystals. Here magma bodies are transient features created by rearrangement and reactions within the crystal mush. During melt migration from deep magma chambers towards Earth's surface, minerals may experience vertical transport and storage at different levels. Crystals can grow compositionally distinct zones in each different magmatic environment. By doing this they effectively record the internal dynamics and the architecture of plumbing systems beneath volcanoes. In this study, we investigate trans-crustal melt transport and the conditions of magma storage beneath Shatsky Rise (Pacific Ocean), a large igneous province of Cretaceous age where typical oceanic basalts erupted through a thick crust.

Complex anorthite zoning (An; Ca/(Ca+Na)) in plagioclases with An=40-90% indicates that crystallization took place in at least three magmatic environments. Systematics in the sequence of growth zones are interpreted to reflect transport pathways between magmatic environments and they reveal magma transport along multiple different routes. Additionally, complex dissolution and re-precipitation textures indicate repeated injection of liquids not in equilibrium with the crystal mush.

This study of mineral populations and compositional zoning highlights the transient and dynamic nature of crystal mushes and can ultimately be used to construct models for volcanic plumbing systems (e.g., depth and temperature of magma storage regions) and their temporal evolution.