Tracing seawater contamination within a MORB pillow

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Halogens and noble gases are critical tracers of volatile interaction between geological reservoirs. The incompatibility of the heavy halogens (Cl, Br, I) coupled with their unique elemental composition and concentrations within surface reservoirs make them ideal tracers of recycled volatiles [1]. Analysis of noble gases within pillow basalts has shown that there is an exchange of atmospheric volatiles from seawater into erupting basalts [2]. Halogens are concentrated within seawater and other marine reservoirs so it is possible that they are also incorporated and concentrated within basalts during eruption. To further understand and quantify the potential extent of seawater contamination within volcanic samples we have determined the halogen abundance and elemental ratios within 7 sections spaced at 2.5 mm intervals along a transect of a pillow basalt.

The glassy rim of the pillow shows an enrichment in the halogens compared to the rest of the pillow which have distinctly MORB like I/Cl and Br/Cl ratios. The outermost section (#1) shows enrichment in iodine with an I/Cl ratio similar to marine pore fluids whilst below the surface, section #2 shows a significant enrichment in chlorine compared to other sections and has a I/Cl ratio more akin to seawater.

Halogen concentrations and elemental ratios within this MORB pillow indicate that the glassy rim of the pillow has incorporated a marine halogen signature. The outermost section (#1) has an I/Cl signature greater than that of MORB and therefore may have incorporated some sedimentary pore fluids during eruption. Further into the glass rim the halogen concentration changes to a lower I/Cl than the rest of the pillow and a higher $Cl/^{36}Ar$ ratio. This implies there has been a degree of seawater and sedimentary volatiles incorporated into the first 5mm of the glassy rim. This seems to contradict the conclusion from the noble gases which has shown the most magmatic $^{40}Ar/^{36}Ar$ ratios within the glass rim [2]. Therefore there must be a mechanism which can incorporate seawater halogens without loss of magmatic noble gases.

[1] Sumino *et al* (2010) *EPSL*, **294**, 163 – 172 [2] Kumagai and Kaneoka (1998) *Geophys. Res. Lett.* **25**(20), 3891 - 3894