Recycled material in magma sources of Shatsky Rise; noble gas evidence

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Early Cretaceous is a period that is marked by the emplacement of several gigantic oceanic plateaus in the Pacific Ocean. Shatsky Rise is one of those oceanic plateaus, consisting of three main massifs, Tamu, Ori, and Shirshov, that was constructed by intense volcanism around 140 Ma. In order to explore the sources of this oceanic plateau, we present noble gas compositions from fresh quenched glasses cored by ocean drilling at Site U1347 on the Tamu Massif and Site U1350 at the Ori Massif. The studied glasses are normal type basalts with relatively low incompatible element (e.g., U, Th, and K) concentrations. Noble gas compositions were determined by applying gentle crushing technique for gas extraction to minimize post-eruption radiogenic noble gases, and the validity of this technique for aged glasses is assessed by stepwise crushing and subsequent fusion. $^{3}He/^{4}He$ in glasses from Site U1347 are variously low relative to the atmospheric ratio, presumably owing to magma degassing coupled with radiogenic ingrowth of ^{4}He. In contrast, glasses from Site U1350 show very uniform $^{3}He/^{4}He$ (5.5-5.9 Ra) for all stepwise crushing fractions in each sample and for glasses from different lava units. Considerably uniform $^{3}He/^{4}He$ cannot be achieved if gases in glass vesicles have been affected by secondary contamination or post-eruption radiogenic ingrowth. Moreover, gases in glass matrix extracted by fusion show variously low $^{3}He/^{4}He$ relative to those in vesicles, precluding diffusive exchange of He between vesicles and glass matrix. Therefore, the uniform $^{3}He/^{4}He$ in the normal type basalts from Site U1350 is assigned as a feature for their source. The slightly low $^{3}He/^{4}He$ in these glasses compared to MORB values suggests the involvement of recycled slab material in the source of the normal type basalts. However, the depleted radiogenic isotope signatures are inconsistent with recycled slab being a distinct melting component. Our preferred model is that the source of the normal type basalts of Shatsky Rise is a heterogeneous mantle domain where subducted fertile material is dispersed in the mantle material. Such a source could exist either in the mantle transition zone or in the D" layer in the lower mantle.