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Diamond with alloy + chloride mineral inclusions discovered in the 5.9 Ma Mid–Ocean Ridge Taitao ophiolite, Chile, and its implications for the mantle heterogeneity

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The traditional view of ophiolites having formed under low–pressure (<60 km) conditions beneath seafloor spreading centers has been challenged recently by the existence of diamonds and ultra-high-pressure (UHP) minerals discovered within ophiolitic peridotites and chromitites. Here, we report on the occurrence of diamonds recovered from the upper mantle harzburgites of the Chile Rise mid–ocean ridge (MOR) lithosphere, currently exposed in the 5.9 Ma Taitao ophiolite in the Chilean Patagonia (South America). The Taitao ophiolite diamonds yield typical Raman spectra with a shift at ~1332 cm^{-1}, and are mostly light yellow to yellow in color, transparent, 100 to 250–μm across in length, with a range of surface morphologies. These diamonds share the same physical characteristics with ophiolite-hosted diamonds reported from other suprasubduction zone (SSZ) ophiolites[1]. Using transmission electron microscopy (TEM) analyses, we have found multi-phase mineral inclusions consisting of NiMnCo–alloy and $CaCl_2$ chloride in the Taitao diamonds. In detail, the NiMnCo–alloy was enclosed by an elliptical $CaCl_2$ nanocrystal (approximately 150×250 nm in length). The oval shape of the inclusions indicates that the composition of the multi-phase inclusions may represent melts responsible for the growth of the Taitao diamonds. Based on these findings, we infer that the Taitao diamonds grew from a C-saturated, NiMnCo-rich melt, which was derived from melting of deeply–subducted and altered oceanic crust in the metal-saturated field of the mantle. The first occurrence of ophiolite-hosted diamonds discovered in the Miocene-Pliocene oceanic mantle, together with previous similar discoveries in the Paleozoic and Mesozoic oceanic mantle, suggest that the ophiolite-hosted diamonds may be ubiquitous in the oceanic mantle, at least in the Phanerozoic. Continued in-depth research should provide us with valuable opportunities to further understand the nature and scale of mantle heterogeneities.

[1] Diamonds in Ophiolites, Yang et al. (2014), *Elements* 10, 127-130.