

Wehrlite from Hess Deep equilibrated with an ultra-depleted primary melt in East Pacific Rise

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Wehrlite, containing about 20 volume % of clinopyroxene, was found in harzburgite in a drill core of ODP Leg 147 from Hess Deep near the East Pacific Rise. Minerals are as refractory (olivine, Fo_{90.7}; spinel, Cr_#=0.52) as those in the harzburgite. The clinopyroxene is depleted in REE (rare earth elements), being similar in chondrite-normalized pattern for middle to heavy REE to that of the harzburgite. The calculated melt in equilibrium with the clinopyroxene is as depleted as ultra-depleted MORB melts ever documented. We interpret that the wehrlite was precipitated from an ultra-depleted MORB almost in-situ segregated from residual harzburgite around the depth of final release of partial melt beneath EPR. In this case, the melt was almost in equilibrium with harzburgite because of absence of dunite around the boundary and presence of orthopyroxene within wehrlite. The presence of a small amount of clinopyroxene in the depleted harzburgite indicates that the highest-degree melting may be around clinopyroxene-out beneath a mid-ocean ridge. For such a depleted melt, we expect diopsidic clinopyroxenes to crystallize after olivine at this condition, taking the pressure-dependent shift of liquidus boundary lines in the peridotite system into account. Since the only cumulate (wehrlite) has been left within the harzburgite, an open-system crystallization process probably occurred. Dimension of individual masses of the ultra-depleted MORB involved may be at least as large as a few tens of centimeters. The Hess Deep wehrlite is different from the lower crustal wehrlite from the ocean floor or some ophiolites, which is either a cumulate or a peridotite/melt reaction product.