Evolutionary history of the diamond-bearing mantle peridotites of the Luaobusa ophiolite, southern Tibet

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The Luobusa ophiolite in southern Tibet is well-known for the discovery of diamond and other ultrahigh pressure (UHP) minerals, which challenge the genesis model of ophiolites. Evolutionary history of mantle peridotites is of great importance for constructing a genesis model of the Luobusa ophiolite, but remains unclear. Here we report geochemical data of the Luobusa mantle peridotites to reveal their complex histories. Whole rock Re-Os isotopes suggest that most Luobusa peridotites have subjected to ancient melting events, as old as 1.9 billion years. Clinopyroxene trace elements indicate that they might have experienced partial melting in garnet-facies field. In contrast, Sr-Nd-Hf isotopes of clinopyroxene do not preserve any information of ancient melting but record metasomatism by subduction-related agents. Consequently, we argue that protoliths of the Luobusa peridotites originated from ancient mantle domains in the asthenosphere, with historical contingency of subduction-related metaomatism. Such metasomatized mantle domains entered into the mid-ocean ridge and have been subjected low-pressure spinel-facies melting during the Early Cretaceous, which gave rise to the Luobusa ophiolite. Considering the UHP minerals, these mantle domains were probably exhumed from the mantle transition zone (MTZ), before their entering the mid-ocean ridge.