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Discovery of the deepest rock from the Indian shield: insight from a kimberlite-borne eclogite xenolith from the Dharwar craton

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Deciphering the evolution and dynamics of the upper mantle is obscured due to the scarcity of the exhumed ultra-high-pressure (UHP) rocks from a depth of more than 100 km. These UHP rocks, especially the subduction-related pre-Mesoproterozoic eclogites, are very rarely exhumed back to the surface from the upper mantle. Due to such rarity of the exhumed UHP rocks, our understanding regarding the evolution and recycling of subducted crust within the upper mantle during the pre-Mesoproterozoic era is limited. However, the subduction-related eclogite xenoliths hosted in Mesoproterozoic or pre-Mesoproterozoic kimberlites, lamproites, lamprophyres, or alkali basaltic dykes are the ideal candidates to unravel pre-Mesoproterozoic evolution of the subducted crust within the upper mantle. Here, we report an eclogite xenolith hosted in a Mesoproterozoic (~1.1 Ga) kimberlite from the Kalyandurg kimberlite cluster of Eastern Dharwar craton, India, which contains a plethora of UHP minerals. These UHP minerals were identified by the characteristic *in situ* XRD and laser Raman spectra and EPMA analysis. The presence of coesite points to the subduction origin of the eclogite. The geothermobarometric estimations involving garnet-omphacite-kyanite-coesite revealed that such eclogitic assemblage equilibrated at ~5–8 GPa pressure during ultra-deep subduction up to ~175–280 km in the pre-Mesoproterozoic era. Subsequently, the subducted crust sank deeper within the upper mantle as evident from the development of majoritic garnet on omphacite. The textural relationship between omphacite and majoritic garnet combined with the EPMA and laser Raman spectroscopical data obtained from the majoritic garnet demonstrated that the majoritic garnet formed at ~8–19 GPa pressure between ~280–660 km due to the disassociation of omphacite during the increment of pressure. Thus, the mineralogical and geothermobarometric data suggest that the subducted crust traveled down to the base of the mantle transition zone before it was entrained in a Mesoproterozoic kimberlite as an eclogite xenolith. Hence, the discovery of this sample not only suggests that this is the deepest rock ever found in India, but also opens a new window to study the dynamics of the pre-Mesoproterozoic upper mantle.