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Extremely carbon-rich mantle beneath eastern China revealed by olivine phenocrysts within nephelinite

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Carbon can be transported into the mantle via subduction, thereby affecting the physical properties of the mantle, such as lowering the solidus, reducing the seismic velocity, and enhancing the electrical conductivity. However, the quantity of recycled carbon in the mantle is difficult to constrain. Here we present data for olivine phenocrysts from Cenozoic nephelinites in eastern China and develop a method to quantificationally estimate the source CO_2 of mantle-derived rocks using their compositions. Experiments have shown that the CO_2 concentration of the basalt source is a function of the bulk partition coefficient of Ca between melt and its source. Based on the extremely high Ca contents of olivine phenocrysts, our calculations indicate that nephelinites from eastern China were derived from a mantle source containing 2.1–4.7 wt% CO_2. This is two orders of magnitude higher than the inferred CO_2 concentration in the MORB mantle. Our results shed light on the estimation of recycling carbon concentration in the mantle and indicate that part of the mantle beneath eastern China is extremely carbon-rich, which also provides an alternative explanation for the observed low seismic velocity and high electrical conductivity in the mantle.