

SiC-dominated ultra-reduced mineral assemblage in carbonatitic xenolith from the Dalihu basalt, Inner Mongolia, China

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SiC and associated ultra-reduced minerals are reported in various geological settings; however, the genesis of SiC, the origin of the extremely low $\delta^{13}\text{C}$ value (-18‰ to -35‰) [1] of SiC and the preservation mechanism of the ultra-reduced phases in their host rock are poorly understood at present. We discovered a SiC dominated ultra-reduced mineral assemblage, including SiC, TiC, native metals (Si, Fe, Ni) and iron silicide, from carbonatitic xenoliths in Dalihu, Inner Mongolia. Most of the ultra-reduced minerals were identified in-situ in polished/thin sections, except several SiC grains separated for in-situ C isotope analysis. The in-situ SiC was 20-50 μm in size, blue to colorless in color, and usually identified in the micro-cavities within the carbonatitic xenolith. The in-situ SiC grains have four types of polytypes, dominated by β -SiC (3C polytype) and 4H polytype followed by 15R and 6H. The Dalihu SiC has significant ^{13}C -depleted isotopic composition ($\delta^{13}\text{C} = -13.2\text{‰}$ to -22.8‰ , average = -17.7‰) with obvious spatial variation.

We provide a numerical modeling method to prove that the C isotope composition of the Dalihu SiC can be well-yielded by shallow degassing. Our modeling results showed that the very low $\delta^{13}\text{C}$ value of the Dalihu SiC can be readily produced by the reaction between graphite and silicate with degassing, and the spatial variation in C isotope composition could have been formed in the progressive growth process of SiC. The detailed in-situ occurring information was beneficial for our understanding of the preservation mechanism of the Dalihu ultra-reduced phase. The Dalihu SiC occurs predominantly in micro-cavities that result from the exsolution of the volatile phase during the diapir rising process of carbonatitic melt. Filling of CO and/or CO_2 in the micro-cavities could have buffered the reducing environment and separated SiC from the surrounding oxidizing phases. The fast cooling of host rock, which would leave insufficient time for the complete elimination of SiC, could have also contributed to the preservation of SiC.

[1] Trumbull *et al.* (2009) *Lithos* **113**, 612-620.