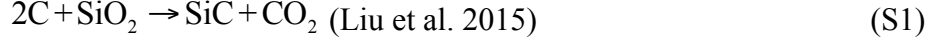


*Appendix**Modeling Method*

C isotope compositions of SiC formed by degassing of CO and CO₂ were modeled based on reaction formulas:



Because the reactions involve three carbonaceous components, the $\delta^{13}\text{C}$ value of SiC cannot be simply calculated using the Rayleigh fractionation formula. Instead, numerical simulation was used to model the C isotope composition of SiC. We divided the reaction into sufficiently short reaction processes in which the C isotope composition of SiC can be readily calculated by

$$R^{\text{SiC}} = R^{\text{C}} \times \alpha_{\text{SiC/C}} \quad (\text{S3})$$

Where R^{SiC} and R^{C} are the C isotope ratio of SiC and graphite, $\alpha_{\text{SiC/C}}$ is the C isotope fractionation factor between SiC and graphite. Thus, $\delta^{13}\text{C}$ of SiC at every increment i of instantaneous reaction with degassing of CO₂ can be calculated by

$$\left\{ \begin{array}{l} R_{i+1}^{\text{SiC}} = R_i^{\text{C}} \times \alpha_{\text{SiC/C}} \\ R_i^{\text{C}} = \frac{R_{i-1}^{\text{C}} - R_i^{\text{SiC}} \times \frac{X}{X_i^{\text{C}}} - R_i^{\text{CO}_2} \times \frac{2}{X_i^{\text{C}}}}{1 - \frac{X}{X_i^{\text{C}}}} \\ R_i^{\text{CO}_2} = R_{i-1}^{\text{C}} \times \alpha_{\frac{\text{CO}_2}{\text{C}}} \\ R_i^{\text{SiC}} = R_{i-1}^{\text{C}} \times \alpha_{\frac{\text{SiC}}{\text{C}}} \end{array} \right. \quad (\text{S4})$$

and degassing of CO can be calculated by

$$\left\{ \begin{array}{l} R_{i+1}^{\text{SiC}} = R_i^{\text{C}} \times \alpha_{\frac{\text{SiC}}{\text{C}}} \\ R_i^{\text{C}} = \frac{R_{i-1}^{\text{C}} - R_i^{\text{SiC}} \times \frac{X}{X_i^{\text{C}}} - R_i^{\text{CO}} \times \frac{2X}{X_i^{\text{C}}}}{1 - \frac{X}{X_i^{\text{C}}}} \\ R_i^{\text{CO}} = R_{i-1}^{\text{C}} \times \alpha_{\frac{\text{CO}}{\text{C}}} \\ R_i^{\text{SiC}} = R_{i-1}^{\text{C}} \times \alpha_{\frac{\text{SiC}}{\text{C}}} \end{array} \right. \quad (\text{S5})$$

where \mathbf{R}_i^C , $\mathbf{R}_i^{CO_2}$, \mathbf{R}_i^{CO} , \mathbf{R}_i^{SiC} are the C isotope ratio of graphite, CO_2 , CO and SiC at stage i , respectively. X is the graphite consumption molar proportion relative to original graphite (we use $X = 0.001$ here), \mathbf{X}_i^C is the remnant graphite proportion relative to original graphite at stage i . The $\alpha_{SiC/C}$ and α_{SiC/CO_2} are the C isotope fractionation factors between SiC and graphite and between SiC and CO_2 , respectively. There is no experimental data about $\alpha_{SiC/C}$ and α_{SiC/CO_2} , therefore, we calculated the fractionation factor through reduced partition function ratios (β -factors) by

$$10^3 \ln \alpha_{\frac{A}{B}} = 10^3 \ln \beta_A - 10^3 \ln \beta_B \quad (\text{Horita and Polyakov 2015}) \quad (S6)$$

Thus $\alpha_{SiC/C}$, α_{SiC/CO_2} and $\alpha_{SiC/CO}$ can be expressed by

$$10^3 \ln \alpha_{\frac{CO_2}{C}} = 10^3 \ln \beta_{CO_2} - 10^3 \ln \beta_C \quad (S7)$$

$$10^3 \ln \alpha_{\frac{SiC}{C}} = 10^3 \ln \beta_{SiC} - 10^3 \ln \beta_C \quad (S8)$$

$$10^3 \ln \alpha_{\frac{CO}{C}} = 10^3 \ln \beta_{CO} - 10^3 \ln \beta_C \quad (S9)$$

β_{SiC} is from (Horita and Polyakov 2015), β_{CO_2} and β_{CO} are from (Richet et al. 1977) and β_C is from (Polyakov and Kharlashina 1995), which are all temperature dependent. Assuming temperatures of 700, 900, 1100, and 1300 °C, C isotopic compositions of SiC were calculated (Fig. 7).