Moissanite in volcanic systems: Super-reduced conditions in the mantle

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Moissanite (SiC) occurs in mantle and mantle-generated rocks from different tectonic settings. SiC is stable only at low oxygen fugacity (fO_2) <ΔIW-5, while fO_2 of upper mantle (<7 GPa) is normally >ΔIW.

Israeli SiC is assiociated with corundum, Fe globules, native V and other phases in Cretaceous pyroclastic rocks from Mt Carmel and associated alluvial deposits[1]. The SiC grains contain inclusions of Si metal, $FeSi_2$, $FeTiSi_2$, $FeAlSi_2$ and $CaSi_{2+x}Si_{2-x}$, which were liquids before being trapped during SiC crystallization. SiC has been found included in corundum, associated with Fe-Ti silicides, connecting the formation of SiC, reduced melts in corundum and conrundum itself. All grains are of the 6H polytype. $\delta^{13}C$ ranges from -32.1 to -24.5‰ and $\delta^{30}Si$ from -0.68 to +1.42‰. These SiC grains are one product of the interaction of basaltic magma and mantle methane in a volcanic plumbing system. SiC crystallized from metallic melts that became immiscible during the reduction of the magma. Its low $\delta^{13}C$ may reflect Rayleigh fractionation under reduced conditions; the variation in Si isotopes may reflect fractionation between SiC and immiscible metallic melts. SiC samples from the Udachnaya and Mir kimberlite pipes contain inclusions of Si metal, $FeSi_2$, FeSi, $FeTiSi_2$, Si(N,O). The SiC has $\delta^{13}C$ ranging from -28.5 to -24.8‰, and $\delta^{30}Si$ from -1.72 to +1.42‰. SiC from harzburgites, chromitites and pyroxenites of the Tibetan Zedang ophiolites have inclusions of Si metal and unmixed Fe-Ni-Ti-Si alloy. Their $\delta^{13}C$ ranges from -30.6 to -24.7‰ and $\delta^{30}Si$ from -0.85 to +1.26‰.

SiC samples from these different settings show very similar characteristics, implying that they may be formed in similar mantle conditions, where the flux of mantle methane gradually reduces magmas and interacts with them to produce different reduced phases at different stages.

Reference:

Griffin et al., 2016. *Geology* 44, 815-818.

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