Moissanite (SiC) with metals and silicides inclusions (Israel) – search for primary source

L. DOBRZHINETSKAYA[1], P. MUKHIN[1], L. EPPELBAUM[2], R. WIRTH[3], Q. WANG[4], AND W. ZHAO[5]

[1]Univ. of California Riverside (*corresp: larissa@ucr.edu)
[2] Tel Aviv University, Israel (levap@post.tau.ac.il)
[3]GFZ , Potsdam, Germany (richard.wirth@gfz-potsdam.de)
[4]Nanjing University, China (qwang@nju.edu.cn)
[5]Sun Yet Sen University, China (zhaowx@mail.sysu.edu.cn)

Moissanite (SiC) until recently was considered as a high pressure mineral occurred in meteorite, kimberlite and as inclusions in diamonds. In the 70s, there were inexplicable reports of findings of SiC in pegmatites, granites, sedimentary rocks, and polymetallic deposits in EuroAsia. Those SiC samples were found in mineral separates, and their relationships with other minerals remained uncertain. Last decade there were new findings of SiC in ophilolites, with unconstrained suggestions of lower mantle or mantle-core boundary origins; or, alternatively, suggestions that SiC may be formed in the shallow Earth. The most common feature for terrestrial SiC is that although its formation requires extremely reduced conditions of 4.5-6 log units below the IW fugacity buffer, SiC always occurs in associations with highly oxidized phases. We present here studies of SiC from tuff related to the Miocene alkalii basalt volcanism of Israel. Raman spectroscopy and TEM studies revealed that SiC occurs as 4H- and 6H- polytypes of hexagonal symmetry, wurtzite structure, with 4H-SiC as a dominant phase. Larger crystals of SiC (0.2-1.8 mm) contain inclusions of metallic Si, and silicides. The droplet-like inclusions of nm-micron size (phase #1) have $Si_{47}V_{34}Ti_{11}Cu_5Cr_2Fe_1$ composition. They are hosted by phase #2 ($Si_{40}Fe_{23}Ti_{19}Ni_6Cu_6V_4Zr_2$) and phase #3 ($Si_{42}Fe_{39}Ni_{16}Cu_3$), and also cross their interface. The crystalline structure of all silicides was confirmed with TEM-SAED, however, some tiny amorphous domains were also detected within phase #2 and #3, and may be interpreted as rapid transportation of the material out from the melting point. The Cu and Zr elements included in silicides probably originate from crustal source, suggesting, therefore, mixture of mantle - crustal materials. Given that T^{melt}_{Fe}=1538°C, and T^{melt}_{Ni}=1453°C, we believe that melt/fluid environment with a local reducing buffer domains (rich in H, CH_4) is a realistic place for SiC formation. SEM and FIB-TEM data coupled with geologic/tectonic background of the host rocks suggest that formation of SiC and its metal and siliside inclusions is related to an interplate or active continental margin magmatic reservoirs from which alkalii basalt volcanism took place.