中央スリランカ、ハイランド岩体のグラニュライト中のザクロ石中の「ナノ花崗岩」および「珪長岩包有物」に見出されたグランディディエライトと高温型石英の仮像

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Grandidierite and pseudomorphs of high quartz in “nanogranite” and “felsite inclusion” enclosed in garnet in granulite of the Highland Complex, central Sri Lanka

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Grandidierite, $(Mg,Fe)_3O_2(BO_3)SiO_4$, and pseudomorphs of high quartz occur with biotite, plagioclase and alkali feldspar in “nanogranite” enclosed in garnet in basic-intermediate orthopyroxene-bearing garnet-rich granulite (Sp. G89082204C) from central Sri Lanka (Fig. 1). The pseudomorphs are six-pointed areas resembling asterisks that show blue bright cathodoluminescence (CL) within anhedral quartz grains, though the whole quartz grains are inferred to have formed as high quartz originally. Dendritic crystals of high quartz resembling asterisks have been synthesized during dynamic crystallization experiments (supercooling and subsequent isothermal treatment) of granitic melts in the stability field of high quartz (e.g., 0.2 GPa and 700℃) (Fig. 2) (e.g., Sun et al., 2012), whereas the occurrence of such crystals in nature is extremely rare (e.g., Hiroi et al., 2014). The blue CL of inner areas is due to relatively high Ti concentration, as is observed in euhedral quartz phenocryst surrounded by low Ti dark overgrowths in “felsite inclusions” in the same rock (Fig. 3). The sharp boundary between blue bright inner and dark outer areas of quartz grains indicates limited modification of Ti zoning by diffusion over a short duration of high-temperature condition, or rapid cooling. Grandidierite, an uncommon phase in pegmatites, granulite-facies paragneisses, pelitic hornfels and calc-silicate rocks, is present only in the “nanogranite”; borosilicate minerals are absent in the matrix in the host granulite. We suggest that traces of boron in the precursor to the host granulite may have been sufficiently concentrated by melting, relics of which were captured in garnet.

スリランカ中央部に産出する、ザクロ石に富む塩基性～中性グラニュライト（Sp. G89082204C）中のザクロ石中のナノ花崗岩包有物中に黒雲母や斜長石、アルカリ長石とともにグランディディエライトと高温型石英の仮像が出現する（図１）。「高温型石英」は他形の石英粒の内部に、SEM-CL 観察で青色に明るく光る「六花」として確認される。天然の石英結晶でこのような形態を示すものはほとんどないが、花崗岩質メルトを過冷却した後、高温型石英の安定領域内（例えば、0.2 GPa で 700℃）で等温処理する実験 (dynamic crystallization experiment）では比較的よく出現する（図２） (例えば、孫羽ら、2012)。SEM-CL で石英が青色に発光するのは、比較的高い Ti 含有量のためであろう（図３に同じグラニュライト中の珪長岩包有物中の斑晶状石英の Ti 累帯構造の例を示した）。グランディディエライトは高温変成岩にまれに出現するホウ素珪酸塩鉱物であるが、本グラニュライトではナノ花崗岩包有物中だけに出現する。本岩が部分溶融した時、岩石中のホウ素が液に濃集したことの反映であろう。

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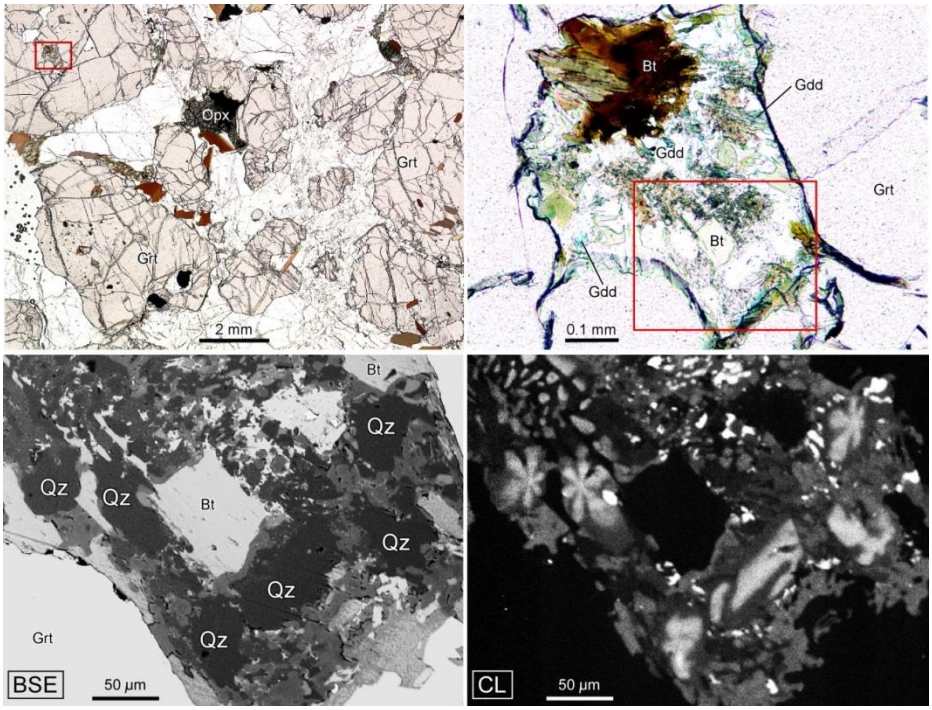

Figure 1. Photomicrographs, SEM-BSE and -CL images of "nanogranite" enclosed in garnet in orthopyroxene-bearing garnet-rich granulite (G89082204C) from central Sri Lanka. Note the CL-bright six-pointed areas resembling asterisks in anhedral quartz grains – these are interpreted to be pseudomorphs of high quartz. Bt=biotite, Gdd=grandidierite, Grt=garnet, Opx=ortho-pyroxene, Qz=quartz

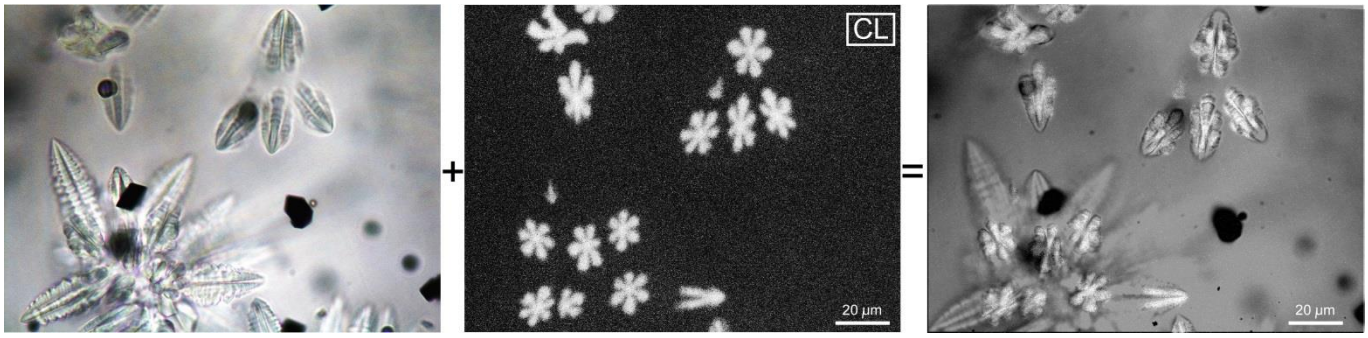

Figure 2. Photomicrograph and SEM-CL image of run product from dynamic crystallization experiments of granitic melt (Run No. 52; at 0.2 GPa, 950℃, then quenched at 700℃ , followed by isothermal treatment at 700℃ for 300 h.). Note that 6-pointed bright CL areas resembling asterisks in SEM-CL images are cross sections of dendritic crystals of high quartz.

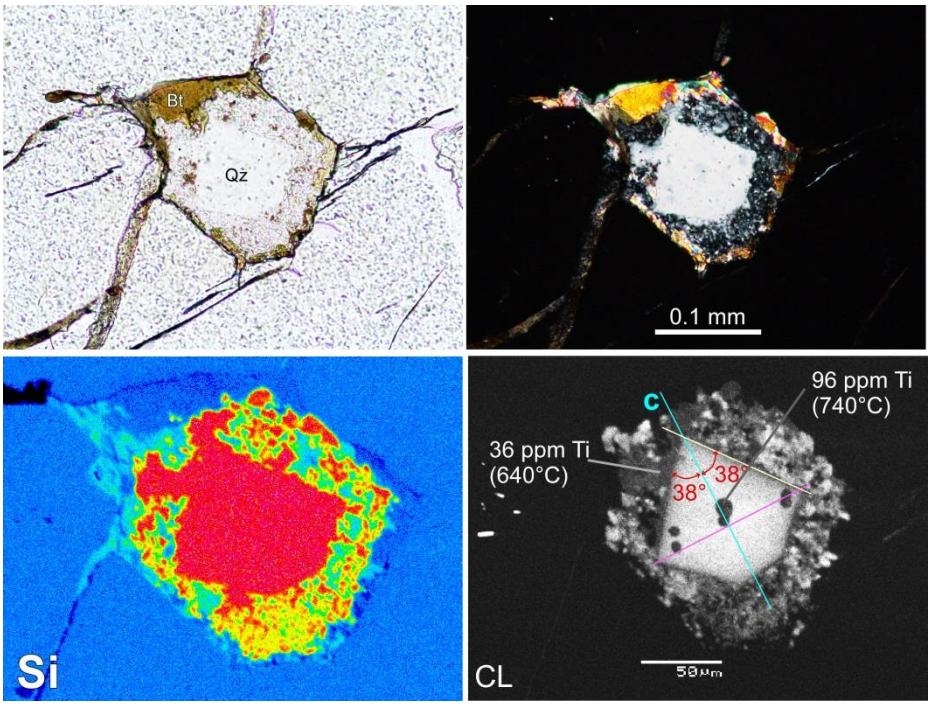

Figure 3. Photomicrographs, elemental map (Si), and SEM-CL image of "felsite inclusion" in garnet in the same granulite (G89082204C). CL-bright euhedral quartz phenocryst is surrounded by dark over-growths. Note that bright inner area is rich in Ti compared to dark outer areas and that the boundary between them is sharp. Ti contents and temperatures estimated by titanium-in-quartz thermometer are also shown. These are interpreted to be pseudomorphs of high quartz cut almost parallel to c-axis.