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Rare occurrence of Gahnite in Main Central Thrust zone of Western Arunachal Himalaya, Arunachal Pradesh, India: implications for Shear heating

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The western Arunachal Himalaya exposes thrust bound lithounits. The lesser Himalayas bounded between the Main Boundary Thrust and the Main Central Thrust is represented by granite gneiss termed Bomdila Granite, dolomite and quartzite belonging to the Proterozoic Bomdila Group and the metapelite and meta basite sequences of Dirang Group. Gahnite is reported from the Dirang Meta pelite very near to MCT (Bhattacharjee & Nandy, 2008). Gahnite occurrence in Ternary spinel system $(Fe, Zn, Mg)Al_2O_4$ is a relatively rare phenomenon. Gahnite $[(Zn, Fe, Mg)Al_2O_4]$ occurs in various geological settings and rock types.

Generally Zn prefers tetrahedral coordinated cation sites (Neumann, 1949; Albee, 1972; Griffen, 1981). Staurolite is one of the most suitable mineral for Zn partitioning as ionic radius of Zn is very close to that of IVth fold coordinated Fe^{+2} . Zn also prefers the tetrahedral sites in the (normal) spinel structure (Burns, 1970). During prograde metamorphism within the stability regime of staurolite, dispersed Zn in the bulk is concentrated in the tetrahedral site of the mineral but with increase in temperature staurolite dehydrates and accordingly Zn is re-dispersed into suitable tetrahedral site of spinel and forms Gahnite (Loomis, 1972; Stoddard, 1976 and Atkin, 1978).

The Gahnite bearing metapelite of Dirang exhibits equilibrium assemblage of zincian staurolite, garnet, biotite and muscovite indicate an Al-rich and Ca-poor pelitic assemblage in intermediate P/T gradient of Barrovian zonal scheme in the Arunachal Himalayas. Zincian Staurolite and garnets occur as porphyroblasts in the matrix of biotite, muscovite, alkali feldspar and quartz. Gahnite occurs along with biotite surround the zincian staurolite porphyroblasts at places indicating staurolite breakdown reaction. ZnO content in Staurolite is 5-6wt% and gahnite contains 30-50 wt % of ZnO. Biotite of the matrix contains very low ZnO whereas biotite occurring with spinel has 0.2 to 2 % of ZnO.

The formation of Gahnite in this active thrust zone is mainly due to breakdown of staurolite ($Zn-St + Bt + Qtz + H_2O = Chl + Ms + Zn-Spl$) (Stoddard, 1979) as well as biotite (Dietvorst, 1980) due to prograde metamorphism, which may be triggered by increase in temperature due to shear heating (Molnar, 1990) as well as inverted metamorphism along MCT zone in this area.

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