

Fingerprint of Prograde Metamorphism from Indus Suture Zone, Ladakh, Himalaya

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In spite of long return trip from the depth of ~ 120 km, as robust mineral the garnet within eclogite preserves the variable events of prograde and peak metamorphism, in the Indus Suture Zone, the Tso- Moriri Crystalline Complex of Ladakh-Himalaya. The eclogite rocks of TMC complex retain the signature of Ultra- high pressure mineral assemblages principally garnet and omphacite with minor phengite, carbonate, kyanite and silica- coesite etc.

The garnet porphyroblasts having strong compositional zonation reflecting three parts: Garnet-core \sim Alm 62.9-67.6, Pyr 8.6-11.5, Grs. 17.8-24.5, Sps. 2.1-5.2 Garnet-mantle \sim Alm 52.7-65.6, Pyr 14.2-23.1, Grs 14.7-19.3, Sps 0.4-1.2 Garnet-rim \sim Alm 42.8-56.3, Pyr 28.0-34.6, Grs 4.4-21.2, Sps 0.2-0.8. The each preferential zone has its own characteristic mineralogy the core and inner mantle part contains omphacite- Jadeite \sim 44% and phengite having Si pfu value \sim 3.59 whilst mantle and rim part having omphacite- Jadeite \sim 59% and phengite of Si pfu value \sim 3.59. The zircon, rutile and carbonate showing homogeneity but occurrence of amphibole- glaucophane are dominated in the core part.

Most noticeable solid inclusions enclosed in garnet porphyroblast are silica inclusions. The garnet contains three characteristic types of silica inclusions Type 1- Monomineralic or monocrystalline quartz. It has euhedral quartz having distinct undulatory extinction ranging in size from 20-100 μ m. Type 2 - Bimineralic or polycrystalline quartz+coesite. The relict of coesite surrounded by palisade fine-grained quartz aggregate. Type 3- Monomineralic or monocrystalline coesite: It has angular and sharp outline strong relief as compared to quartz and size ranges from 30 to 80 μ m.

The cores of large garnet porphyroblast contain numerous inclusions of euhedral monomineralic quartz having well defined face without showing any fracturing and deformation in the host garnet. Unlike the cores of the garnet, the inner mantle part of garnet contains bimineralic quartz+coesite inclusion display intense strong radiating and concentric fracture in the host garnet. The monomineralic coesite generally restricted to outer mantle of garnet. They are subhedral and lenticular usually no or very faint radiating fracture are noticed in host garnet.

The compositional zoning profile of garnet and other co-existing minerals is worth for interpretation of the thermal and possibly the basic history of metabasic-eclogite rock of TMC. The eclogitic garnet showing wide range of compositional pattern over a P-T condition. The correlation between these growth stages with the inclusions mineralogy along with silica distribution shows that, the core part grew at low metamorphic condition within quartz stability field whereas the rim part grown during UHPM and coesite stability field i.e. P \sim 28 kbar at T \sim 750°C seemingly the chemical variation in garnet also proven the progressive type of metamorphism, while preserve in the continental material, although it traveled a long return path from the mantle depth during India -Asia collision.