Garnet response diamond pressure metamorphism from Tso-Morari region, Ladakh, India

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Garnet is most promising container for the metamorphic event. The significance of garnets from metamorphic rocks as container of primary mineral inclusion and its uniqueness due to act as pressure vessels is noticed in coesite-eclogite by giving Diamond pressure or facies metamorphism (UHP) in the Tso-Morari Region. The Tso-Morari dome in eastern Ladakh stretches 500 Km^2 NW to SE. The dome is surrounded by Indus suture zone rocks to the north by Zildat detachment fault and south by low-grade sedimentary rocks. Structurally, the lowest rocks exposed in the complex are Puga Gneisses within that boudinaged eclogite have unidirectional pattern, which is parallel to the foliation of host gneisses.

The Tso-Morari eclogites hosted by peletic and paragneisses, occur as two types- massive, dark-coloured type and crystalline light-coloured type. The fresh crystalline type eclogites are coarser (>500 micron in size), having biminerallic component of garnet and clinopyroxene. The hexagonal to octahedral garnet porphyry contains inclusions of carbonates including magnesite, calcite/aragonite, dolomite, phengite, paragonite, kyanite, magnesiostaurolite, rutile and silica phases like quartz, coesite etc.

The garnet consisting essentially of almandine-pyrope-grossular solid solution were in the alm~67-42%, pyr~8-35%, gros~4-25%, whereas spessrtine component always being less than 5%, and usually less than 1%. The reversible pattern of Mg/Mn exhibits increase of Mg and decrease of Mn and Ca, from core to rim support strong prograde zonation, except the outer rim of garnet showing retrograde pattern due to exchange of Fe/Mg during cooling and exhumation. Furthermore the mantle portion is rich in pyrope and grossular, which marked and favoured the maximum pressure zone within the garnet porhyroblast.

The inclusions phase assemblages markedly noticed by quartz coesite, magnesite-quartz-talc, kyanite-paragonite-jadeite component in pyroxene, magnesiostaurolite-pyrope-kyanite, talc-staurolite-kyanite-pyrope, coesite -dolomite-diopside, coesite-magnesite-enstatite etc. within the garnet as in hetrogenity.

A peak and prograde P-T estimation by sequential geothermobarometry of UHP metamorphic rocks of TMC region documented by the presence of Mg-Qz-Tlc is stable in the range of T~ 400-600 °C and P~ 4-28 kbar, Pg-Ky-Jd is stable at 440-650 °C and P~13-22 kbar whereas Tlc-St-Ky-Py in which, the Mg-rich staurolite(Fe/Mg in tetrahedral coordination) could be high pressure phase in T>700 °C, P>25 kbar and it remains stable in the diamond facies i.e., >30 kbar ~800 °C favoured Fe/Mg in octahedral coordination side in case of staurolite. These assemblages are supposed to grow during the growth of core and inner mantle of garnet porphyry. The peak stage assemblages Co-Dol-Di, polycrystalline coesite associated with kyanite-eclogite yielded T~820 °C and 34-39kbar has been restricted in the outer mantle and inner rim portion of garnet porphyry moderately within the limit of diamond formation pressure. Nevethless there has no record of diamond crystallization even though the system under diamond facies metamorphism.

The possible stabilization for diamond requires C host mineral with cold subduction of geotherm about ~7 °C/Km at depth ~120 Km, i.e., deep subduction. Since such condition are essential transient during decompression of such long way back on surface, virtually no chance to survive through tectonic processes. One possibility for the survival of mantle pressure or diamond formation, recite enough stationary period, when the system in peak stage, as in the form of inclusion and armoring in the mechanically strong, pressure container like garnet and zircon.