

Formation of sapphirine-spinel-corundum gemstones within black-wall amphibolites from Cauvery Shear system, Southern India

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The occurrence of sapphirine-spinel-corundum (SSC) in metamorphic rocks generally indicates high to ultra-high temperature conditions. However, metasomatic origin of these minerals is also reported which often lead to formation of gemstone quality SSC. The Southern Granulite Terrane, India is dissected by Cauvery shear system (CSS). The CSS exposes diverse variety of mafic and ultramafic enclaves, hosted within felsic orthogneiss, all metamorphosed to granulite facies. In the eastern part of the CSS, pods of SSC-bearing black-wall rocks (amphibolites) has been observed which hosts a variety of mineral assemblages.

Assemblage A: Orthoamphibole (25%)+ garnet (20%)+ hornblende (25%)+ plagioclase (15%)+ quartz (13%)+ rutile (2%); showing a reaction texture: garnet+ hornblende + quartz = orthoamphibole + plagioclase

Assemblage B: Orthoamphibole (98%) + rutile (2%).

Assemblage C: Orthoamphibole (20%)+ garnet (25%)+ cordierite (20%)+ sapphirine (10%)+ sillimanite (10%)+ spinel (4%)+ plagioclase (3%)+ rutile (4%)+ ilmenite (2%)+ corundum (2%); showing reactions: garnet = orthoamphibole + cordierite, and garnet/orthoamphibole+ sillimanite= sapphirine+ spinel+ cordierite± corundum± plagioclase

Assemblage D: Orthoamphibole (85%)+ spinel (5%) + orthopyroxene (10%); showing reaction orthopyroxene+ H₂O= orthoamphibole

Assemblage E: Orthoamphibole (85%) + spinel (10%) + Sapphirine (5%)

Meter-thick bands of these assemblages grade from A to E within a distance of ~50 mt. Majority of the assemblages are monomineralic having orthoamphibole as the dominant (>80%) minerals with local domains rich in aluminous minerals like sillimanite+ spinel+ sapphirine+ corundum. In mesoscopic scale, the orthoamphibole/garnet crystals are large (upto 10 cm long/in diameter). All these features, combined, suggest involvement of fluid in genesis of these rock suits. The adjacent area exposes ultramafic granulite enclave (45% clinopyroxene+ 35% garnet+ 10% hornblende+ 10% plagioclase) hosted within felsic biotite-gneiss. The hornblende and garnet in assemblage A has overlapping composition as in the ultramafic enclave rocks (X_{Mg}^{Garnet} : 0.37-0.43; $X_{Mg}^{Hornblende}$: 0.65-0.77) suggesting a possible genetic link. X_{Al} in orthoamphibole shows gradual and consistent increase from assemblage A to E. Chemical potential diagrams and mass balance reveal that addition of Si and removal of Ca from the ultramafic enclave resulted in the formation of assemblage A-E. Compositional contrast driven mass transfer between the felsic gneiss and the ultramafic