

GARNET CLINOPYROXENITE AND ASSOCIATED ECLOGITE FROM THE SULU UHP TERRANE, EASTERN CHINA: ORIGIN AND METAMORPHIC EVOLUTION

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Garnet clinopyroxenite (Grt + Cpx + Ilm ± Ol) and minor eclogite from Rizhao occurs as lenses or layers in serpentinitized, mantle-derived peridotite body that is faulted against gneiss in the Sulu ultrahigh-pressure (UHP) terrane, eastern China. The Grt clinopyroxenites have Al₂O₃ vs. MgO plots within the field of mantle xenoliths and are characterized by mantle isotopic compositions of ⁸⁷Sr/ ⁸⁶Sr (0.7038 - 0.7044), ¹⁴³Nd / ¹⁴⁴Nd (0.5127 - 0.5128), δ ¹⁸O in Grt (4.83 - 5.64 ‰) and Cpx (4.99 - 5.64 ‰). Garnets exhibit LREE depleted pattern characterized by increasing in abundance from La to Sm with maxima at the middle REE (Sm-Eu-Gd). In contrast, all Cpx show humped patterns. The crossovers of Grt and Cpx patterns are in Nb to Sm. Clinopyroxenites vary from those rich in megacrystic and/or porphyroblastic Grt through Ilm-rich, coarse-grained Cpx-bearing to Grt-poor fine granoblastic varieties. Megacrystic garnets 2 - 14 cm across contain inclusions of Cpx, Ilm ± Dol with minor Spl; the Cpx inclusions show exsolved lamellae of Grt, Ilm ± Amp. Garnets show large variation in composition, and contain high Grs component: megacryst (Alm₁₈₋₂₅GrS₃₄₋₅₁Prp₂₆₋₄₇), porphyroblast (Alm₂₀₋₂₅GrS₃₆₋₄₇Prp₂₈₋₄₃), exsolution (Alm₁₉₋₂₀GrS₃₂₋₆₆Prp₁₆₋₄₇) and matrix (Alm₁₈₋₂₄GrS₄₆₋₅₇Prp₂₂₋₃₂). Cpx is diopside containing < 2 wt% Al₂O₃ and < 0.8 wt% Na₂O. Coarse-grained Cpx contain abundant exsolution of Grt + Ilm, Amp + Ilm, and Spl + Ilm + Amp. Exsolved garnet and ilmenite in Cpx may be up to 25 vol% and 4 vol%, respectively. The coexisting Cpx host and Grt rods yields recrystallization temperatures of 1000 ± 50 °C at an assumed *P* of 5 GPa. The exsolved phases were recrystallized to form fine-grained matrix assemblage at 800 ± 50 °C and 3 GPa. Typical eclogites consist of Grt (Alm₃₈₋₄₁GrS₂₆₋₃₉Prp₂₄₋₃₂) + Omp (Jd₂₄₋₂₉) + Coe/Qtz + Rt with porphyroblastic texture. Coarse-grained garnets (up to 5 mm) contain inclusions of quartz pseudomorphs after coesite and exsolved rutile rods. Rare strong foliated eclogite contains additional zoisite and very minor Omp; orientated grs-rich, coarse-grained garnets are wrapped by elongated laths of zoisite (0.5 - 2 mm long, 0.02 - 0.15 mm wide), garnet and apatite. Mg-Fe partitioning of Grt-Cpx yields equilibrium - *T* of 690 - 720 °C at a minimum *P* (3 GPa).

One Ilm-rich Grt clinopyroxenite was used for high *P* experiments at 5 and 15 GPa at 1400 °C. The results indicate the titanium solubility in garnet and Grt_{Ti}/Cpx_{Ti} ratio have a pronounced positive correlation with pressure and the coexisting Cpx contains low Ti, and shows no significant pressure effect. Petrological data and experiments suggest that the parental phase of exsolved Grt + Ilm and Cpx host probably was a majoritic garnet, and coupled substitutions of Ca²⁺Ti⁴⁺ → 2Al³⁺ and Si⁴⁺Mg²⁺ → 2Al³⁺ increase the majorite component with pressure. The protolith of Grt clinopyroxenite was derived from very deep convecting mantle and was included within host peridotite in the upper mantle. During Triassic continent subduction, the Grt pyroxenite-bearing peridotite was inserted into the subducting slab, and subjected to UHP metamorphism together with host gneissic country rocks.