Prograde P–T evolution and partial melting of a Variscan high-temperature eclogite, French Massif Central, Haut-Allier

Luc de Hoÿm de Marien [1], Pavel Pitra [*1,2], Florence Cagnard [3], Benjamin Le Bayon [3], Jean Van Den Driessche [1]

[1] Univ Rennes, CNRS, Géosciences Rennes - UMR 6118, Rennes, France
[2] Česká geologická služba, Prague, Czech Republic
[3] Bureau de Recherches Géologiques et Minières – BRGM, Orléans, France

A detailed analysis of the petrographic relations and mineral chemical zoning combined with the use of calculated psuedosections is a powerful tool to unravel cryptic, yet important details of the P–T evolution of rocks, with a potential impact on the interpretation of the geodynamic context.
A mafic kyanite-bearing eclogite from the Haut-Allier displays garnet-rich layers that have intriguing similarities and differences with respect to the surrounding eclogites. Chemical zoning of garnet inside and outside the layers is similar, but the layers are enriched in rutile and ilmenite, and lack kyanite, common in the eclogite. Three successive metamorphic stages, M1, M2 and M3, are characterized by assemblages comprising garnet1-omphacite-kyanite, garnet2-plagioclase, and amphibole-plagioclase, respectively, and define a clockwise P–T path. These events occurred at the conditions of eclogite (M1; ~ 20 kbar, 650 °C to ~ 22.5 kbar, 850 °C), high-pressure granulite (M2; 19.5 kbar and 875 °C) and high-temperature amphibolite facies (M3; < 9 kbar, 750– 850 °C), respectively. Phase-diagram modelling of garnet growth zoning and mineralogy of the inclusions reveal a prograde M1 stage, first dominated by burial and then by near-isobaric heating. Subsequent garnet1 resorption, prior to a renewed growth of garnet2 is interpreted in terms of a decompression during M2. High-pressure partial melting is predicted for both the M1 temperature peak and M2, due to focussed influx of H_2O-rich fluids or external melts, probably associated with localized deformation. It is inferred that subsequent melt loss resulted in the formation of the garnet-rich layers. Despite the absence of clear accumulations of crystallised melts in the eclogite, high-pressure melting may he linked to the existence of HP trondhjemitic melts, described elsewhere in the Massif Central. M3 testifies to further strong decompression associated with limited cooling. The preservation of garnet growth zoning indicates the short-lived character of the temperature increase, decompression and cooling cycle. We argue that such P–T evolution is compatible with the juxtaposition of the asthenosphere against the subducted crust prior to exhumation driven by slab rollback.

Mots-Clés : eclogite, prograde PT path, HP melting, Massif Central, Variscan orogen

Merci de ne rien inscrire dans cette zone et ne pas modifier les marges des pieds de page et entêtes.