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Dating high-grade south European Variscan evolution: constraints from trace element chemistries of garnet, zircon and orthopyroxene on U-Pb zircon ages.

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Trace elements in garnet, zircon and orthopyroxene from a Grt-Opx-bearing granulite were determined on a polished section in the order to timely constrain the U-Pb spot analyses on zircons from different textural sites.
The rock consists of plagioclase, garnet, biotite, orthopyroxene, quartz, K-feldspar and, as accessory phases, zircon, apatite and opaques. The matrix shows layers containing different abundances of biotite and orthopyroxene. Single porphyroblastic garnet (about 3 cm in diameter) with lobate contours and rimmed by a Opx+Pl+Bt+opaques+Zrn+Ap symplectitic corona occurs. Zircon is widespread in matrix, corona and rim of garnet.
Ten zircon grains (250-50 μm in dimensions) were exposed in the polished thin section: eight in the Bt-rich matrix, one within the corona and one in the rim of the porphyroblastic garnet.
Zircon grains show generally core-rim structures and some crystal cores are "invaded" by homogeneous lobate rims, evidencing dissolution and re-growth, commonly referred to interaction with fluids and/or melts. Some zircon cores appear chaotic consistently with modification induced by the high-grade metamorphism.
U-Pb geochronological data on all zircons have been performed by LA-ICP-MS. Ten zircon grains have been analysed producing 9 concordant ages (% concordance > 83%) covering a span of time from 357$\pm$11 to 300$\pm$9 Ma. The core domains of zircons in the matrix give the oldest concordant ages: 357$\pm$11 and 334$\pm$12 Ma. Five concordant data ranging from 324$\pm$12 to 320$\pm$11 Ma relative to outer core zircon domains from different textural sites give a mean concordia age of 323$\pm$2 Ma (MSWD=0.002). Younger concordant ages of 305 and 300 Ma are relative to low luminescent inner rims invading cores of zircons in matrix; similar apparent ages have been determined on luminescent rim of zircon grains from matrix, symplectitic corona and rim of garnet.
Trace element compositions (Th, U, Y, Sc, Hf, Ti, Nb and REE) were collected on specific domains of zircon and orthopyroxene in the different textural sites using LA-ICP-MS. Two trace element profiles (rim-core-rim) relative to porhyroblastic garnet were also performed. Garnet is particularly rich in middle-REE and shows nearly flat profile in the core and fractionated pattern in rim. Zircon is characterized by a steep pattern with low LREE and high HREE contents both in cores and rims in which, however, the MREE and HREE are lower. The orthopyroxenes show fractionated patterns of MREE and HREE.
The apparent DHREE between zircon-garnet and orthopyroxene-garnet pairs have been compared with the data relative to natural samples and experimental results to evaluate the possible equilibrium between specific domains of pairs. The linear positive trends with different steep on core regions have been interpreted as suggestive of variable DHREE and indicative of equilibrium under different physical conditions.
The results allow to fix some chronologic constraints to the P-T path of South European Variscides: i) about 334$\pm$12 Ma granulite facies conditions were already stabile and probably began before (357$\pm$11 Ma); ii) around 323$\pm$2 Ma, the Variscan basement was already in decompression; iii) at 300 Ma, and perhaps later, the Variscan decompression staged.