Petrology and U-Pb zircon geochronology of a late-Hercynian subalkalic granitic massif, NW Iberian Peninsula

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The Peneda-Gerês massif is a late-Hercynian pluton that outcrops across the border between northwestern Portugal and Spain. It intruded syn- and late-tectonic granites and Silurian metasediments ans is composed of four petrographic units, three of which are roughly concentric. The most external is the Gerês granite, a porphyritic coarse to medium-grained generally pink-coloured biotite granite. It surounds the Paufito granite, a porphyritic medium-grained biotite granite whose porphyritic character and grain-size decrease towards the innermost unit, the Illa granite, a two mica medium to fine-grained granite. Irregular masses of fine-grained biotite granite (the Carris granite) with slightly variable texture and mineralogy occur in the two outermost units but mainly in the Gerês granite. Field relations suggest a synchronous emplacement for all granites.

Mineralogical data and major and trace-element compositions of 40 representative whole-rock samples[1,2] reveal the compositional individuality of the Gerês granite while the two innermost granites of the massif (Paufito and Illa) display a compositional and evolutionary continuity, with the Illa granite being the most evolved. For the Carris granite, all available data suggest that the majority of these fine-grained masses are chemically identical to the Paufito granite while others have very evolved compositions. This geochemical variability is in accordance with the petrographic variability referred to above.

Biotite composition and zircon typology, evidenced a subalkalic ferropotassic magmatic affinity for the Gerês granite. With the exception of the biotite composition, these criteria also indicate a subalkalic nature for the Paufito and Illa granites. The geochemical and morphological study of zircons from these two granites showed that they register a process of magma contamination by more aluminous components which took place late in their magmatic history[3]. The contamination is reflected in the more aluminous character of the biotites and explains the discrepancy between the typological indicators.

The distinct chemical-mineralogical compositions and evolutions of the Gerês granite and he Paufito and Illa granites suggest that the whole massif is the result of the roughly contemporaneous ascent and emplacement of two distinct granitic magmas. During its ascent the Gerês magma would have surrounded and transported masses of Paufito magma, represented by some of the fine-grained granitic bodies (Carris granite).

In order to constrain the time of emplacement of this intrusion, conventional U-Pb analysis of multi-grain zircon fractions were carried out for the Gerês, Paufito and Carris granites. For each granite, four fractions were selected. The handpicked grains were free of opaque inclusions, visible cores and fractures. Air abrasion[4] was applied to zircon fractions with overgrowths. Polished epoxy mounts of fractions similar to those analysed were observed by BSEM. The analytical procedures followed were adapted from Parrish et al.[5]. The common Pb correction was based on the Pb terrestrial isotopic evolution curve of Stacey and Kramers[6] and on the blanks measured during the analysis. The decay constants used were those of Steiger and Jäger[7]. Discordia-line intercepts and associated errors were calculated using a Macintosh version of the Ludwing' program[8] proposed by Nemchin et al.[9].

The data from the Paufito granite show a good linear relationship (MSWD=0.2) with an upper intercept at 290±2.5 Ma. The zircon fractions from the Gerês granite are more scattered but define a best-fit line (MSWD=3.6) whose upper intercept indicates the age of 297±7 Ma. For the Carris granite a reverse discordance was obtained with a lower intercept at 280±5 Ma (MSWD=1.5), interpreted as a minimum age for the granite emplacement. The distribution of zircons along a reverse-discordia indicate the presence of an inherited component, corroborated by BSEM imaging showing inherited cores in some zircons, the minimum age of which being at 1222±72 Ma (upper intercept).

For the Gerês and the Carris granites previous Rb-Sr whole-rock geochronological results are available and are in the same age range of those obtained in this study: 287±4 Ma (MSWD=0.3)[10] and 293±8 Ma (MSWD=0.45)[11,12] for the Gerês granite; 302±4 Ma (MSWD=1.16)[12] for the Carris granite.

The results of this study together with available data from other late-Hercynian plutons of the northwestern Iberian Massif seem to put in evidence that, similarly to the northwestern Armorican Massif, the northeastern Central Massif and the Vosges[13], magmatism of subalkalic affinity was dominant during this late-Hercynian period.

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