SHRIMP age-constraints for the calc-alkaline volcanism in the Olivenza-Monesterio Antiform (Ossa Morena, SW Spain)

B. Ordóñez-Casado
D. Gebauer
Department of Earth Sciences, ETH Zürich, Sonneggstrasse 5, CH-8092 Zürich, Switzerland

L. Eguíluz
Departamento de Geodinámica, Universidad del País Vasco, C.P. 644, E-48080 Bilbao, Spain

Cathodoluminescence (CL) based ion-microprobe ages are reported for zircons from a reworked tuff within the Malcocinado formation as well as two porphyric rhyolites and a rhyolite porphyry of the Bodonal-Cala complex. Both volcanic successions, the Malcocinado and the Bodonal-Cala formation overly discordantly the Precambrian Tentudía sediments (uppermost part of the Serie Negra). Although these successions are located in independent areas to the N and S of the Olivenza-Monesterio antiform, they can be correlated mainly in terms of lithostratigraphic and geochemical affinities. They were considered to be of Upper Riphean to Vendian age (Eguíluz, 1987).

The youngest detrital grain found in the Malcocinado formation indicates a maximum age of deposition of the sedimentary precursor at 522 ± 8 Ma ($^{206}Pb/^{238}U$ age, 95% c.l. as all other errors given below, unless stated otherwise). As the nearby Monesterio anatectic gneiss dome was dated at 524 ± 7 Ma (Ordóñez *et al.*, 1997) followed by rapid exhumation, the provenance of the zircons of the Malcocinado formation may be close to the depositional sites.

The presence of Pan-African detrital zircons around 600–500 Ma indicates the derivation from Gondwana sources. Concordant ages were also found at 2–2.3 Ga and one grain yielded an age of 3442 ± 10 Ma ($^{207}Pb/^{206}Pb$ age, 1σ). All these ages are also reported in other parts of the European Hercynides (e.g. Gebauer, 1993).

The zircons of the porphyric rhyolite of the Bodonal-Cala complex show, under CL, inherited cores overgrown by euhedral rims with oscillatory growth zoning, indicating new crystallization during a magmatic process. The age of magmatic formation of these rims is at 514 ± 9 Ma. Previous multi-grain analyses of the same zircon sample (Schäfer, 1990) demonstrated the presence of a very heterogeneous zircon population containing a mixture of differently old zircon components.

The zircon population from an adjacent porphyric rhyolite sample reveal the presence of zircon domains that suffered complete Pb loss by leaching without any reorientation of the crystal lattice that give ages of 324 ± 6 Ma. This Carboniferous age is interpreted as representing a metasomatic process during low to very low grade metamorphism, demonstrated also by the presence of ore fluids.

The zircons of the Cala porphyry reveal, under CL, the presence of rounded cores overgrown by dark, trace element rich rims with or without oscillatory patterns. The isotopic analyses in these euhedrally terminated rims yielded an age of 512 ± 8 Ma, interpreted as the age of formation of the porphyry. This age is not in agreement with the Early Ordovician age reported by U/Pb multi-grain zircon data (lower intercept age, Schäfer, 1990), revealing the combined effects of inherited cores and post-magmatic Pb loss in the conventional multi-grain data.

Discussion and conclusions

The volcanic sequences studied overly the Tentudía succession, the youngest detrital zircons of which are 564 ± 15 Ma (Schäfer *et al.*, 1993), thus representing a maximum age of deposition of the Tentudía sediments. On the other hand, pebbles of the Ahillones granite (552 ± 10 Ma, Ordóñez in prep.) are embedded in the Malcocinado formation. The deposition of the sedimentary precursor of the Malcocinado formation must be at the most Lower Cambrian or younger as the age of the youngest detrital zircon grain is 522 ± 8 Ma. On the other hand, the porphyric rhyolites with similar geochemical and lithostratigraphic affinities indicate volcanism around 514 ± 9 Ma, in tune with the age of the subvolcanic Cala-porphyry 512 ± 8 Ma that cuts the rhyolite layering. This volcanism was interpreted as synorogenic calcalkaline, representing the volcanic products at an active continental margin above a SW directed

subduction zone (Eguíluz, 1987). In the absence of further geochemical data, the dated volcanics are interpreted here to be rather late- to post-collisional, and coeval with the formation of anatectic gneiss domes around 520 Ma (Ordóñez *et al.*, 1997).

Metasomatic overprinting of the volcanics, probably related to low grade metamorphism, occurred 324 Ma ago.

The dated Malcocinado volcanic series are overlain unconformably by the Lower Palaeozoic Torreárboles formation. Its age is palaeontologically constrained to be Lower Cambrian (Liñán *et al.*, 1984). Our data rather favour a Middle Cambrian or younger age. Thus, more work is necessary to unambiguously define the stratigraphy of the Lower Palaeozoic in the Ossa Morena Zone. Based on the SHRIMP-data the dated volcanics are Middle to Upper Cambrian in age.

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