

Zircon Ion-Probe Dating the Maximum Age of Deposition of the Montemolín Succession (Lower Serie Negra) in the Ossa Morena Zone, Spain

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INTRODUCTION.

Zircon-dating was proposed to obtain magmatic ages. Zircon is a refractory mineral which can survive both weathering and transport processes as well as high temperature metamorphism and anatexis.

Cathodoluminescence (CL) studies on polyphased rocks have shown (e.g. Ordóñez-Casado, 1999) that the internal structures of zircons are often independent of their morphology. Consequently, there is no possibility to establish whether a zircon is a magmatic grain or not without this CL study.

Sequential overgrowths can record a history of events provided temperatures are high enough to precipitate new zircon overgrowths. The microanalysis of distinct domains within the same zircon by SHRIMP (Sensitive High Resolution Ion Microprobe) is considered to be among the most reliable methods to obtain radiometric data from magmatic, and metamorphic rocks. Dating the zircons from meta-sedimentary rocks we can determine maximum depositional ages of the sedimentary precursor.

GEOLOGICAL SETTING.

The Ossa-Morena Zone (OMZ) is a NW-SE elongated belt that extends from Portugal to South Spain. One of the most distinctive features within this zone is the presence of Precambrian rocks first shown by MacPherson (1879) and since then this has been a subject of intense debate.

The Precambrian rocks within the OMZ, have been grouped in pre-orogenic and

synorogenic successions (Quesada, 1990) according to their relationships with the tectonic events that the region underwent in late Precambrian times. In the present work, we are dealing with the first ones.

The pre-orogenic successions are mainly the Serie Negra. It is widely represented throughout the OMZ, but it is best known in the central area of the Zone, where Eguíluz (1987) distinguished two members, a lower one, Montemolín and an upper one, Tentudía.

The 1000-2000 m thick, Montemolín succession consists of graphite-rich pelites and quartzwackes, with abundant amphibolites towards the top. Lenticular interbeds of black chert and, locally, marbles are frequent.

The Tentudía succession overlies the former, apparently with a conformable contact. It consists of: a) an alternating monotonous shale and greywacke suite with some intercalations of black quartzites and carbonates; and b) various types of volcano-sedimentary rocks, (meta)tuffs and greenschist-facies metabasites of variable thickness (Eguíluz, 1987).

STRATIGRAPHIC AND RADIOMETRIC CONSTRAINTS.

Acritarchs have been reported in different parts of the Serie Negra, allowing an imprecise attribution to the Middle-Upper Riphean (1350-850 Ma) (Arriola et al., 1984; Chacón et al., 1984). However, these acritarchs have been reported (Eguíluz personal com.) to be the product of contamination of the samples studied. Later studies (Schäfer et al., 1993) established the deposition

of the Tentudía formation as $< 564 \pm 30$ Ma ago (SHRIMP-technique, youngest detrital zircon). On the other hand, the overlying volcano-sedimentary sequences (Malcocinado, Bodonal-Cala) were considered as Late-Proterozoic in age (Upper Riphean to Upper Vendian; Liñán and Schmitt, 1980; Liñán et al., 1984), and Lower-Cambrian (Ordóñez-Casado, 1999).

ANALYTICAL TECHNIQUES.

Minerals for isotope analyses were separated, after crushing, sieving, heavy liquids as well as a Frantz isodynamic separator. Final selection of zircons was carried out by hand-picking according to colour, size and morphology. The zircons selected were mounted in epoxy and polished until quasi-central sections were reached. Cathodoluminescence (CL) technique was used to identify distinct zircon domains. The same epoxy mounts were then used for in situ ion-microprobe analyses (SHRIMP- II).

GEOCHRONOLOGICAL RESULTS.

The Montemolín metasedimentary sequence corresponds to the lower part of the Serie Negra. A deformed graphite-rich metapelite was collected. This is a biotitic schist with quartz, biotite, muscovite and plagioclase. Chlorite, opaques, graphite, zircon, apatite and titanite occur as accessory minerals.

The examined zircons are mainly colourless, pink or orange, from transparent to turbid, with many inclusions. They vary from euhedral or subhedral to rounded.

The CL-images show inner cores, often rounded with an oscillatory pattern

palabras clave: Ossa Morena, Montemolín, SHRIMP-zircon, Depósito.

key words: Ossa Morena, Montemolín, SHRIMP-zircon, Deposition.

surrounded by planar oscillatory domains, that in some cases are CL-white and structureless. There are some CL-dark domains with no visible zoning.

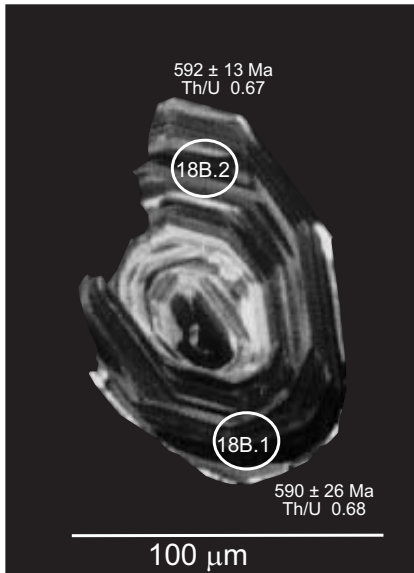


fig 1. CL image of zircon 18 section. Circles show the analyzed area.

In terms of SHRIMP-analyses, there is a positive correlation between U and Th contents.

The inner cores reveal the presence of distinct provenance ages. The inherited zircons yield concordant U-Pb ages around 1.5, 1.8, 2.0 Ga and 2.5 Ga, and a discordant $^{206}\text{Pb}/^{238}\text{U}$ age of 2.65 Ga with a $^{207}\text{Pb}/^{206}\text{Pb}$ age around 2.8 Ga.

The main age group clustered around 600 Ma. The average age for the youngest detrital grain is 591 ± 11 Ma (concordia diagram Fig. 2). This age was obtained by two spots in the comagmatic oscillatory domains that surround the inner core of zircon 18B.

The domains analysed have Th/U ratios of 0.67-0.68 and U contents of 420-416 ppm. Th/U ratios are typically magmatic, even in younger domains. Still, we can not exclude some partial Pb loss in these domains. The age of 591 ± 11 Ma was obtained in two spots in the comagmatic part of the zircon without any evidence of Pb loss, would represent the maximum age of deposition of the dated Montemolín metasediment.

The second group of zircon domains (CL-dark, with high U and Th contents with values up to 2595 ppm and up to 1448 ppm, respectively) yields ages that represent domains that partially lost

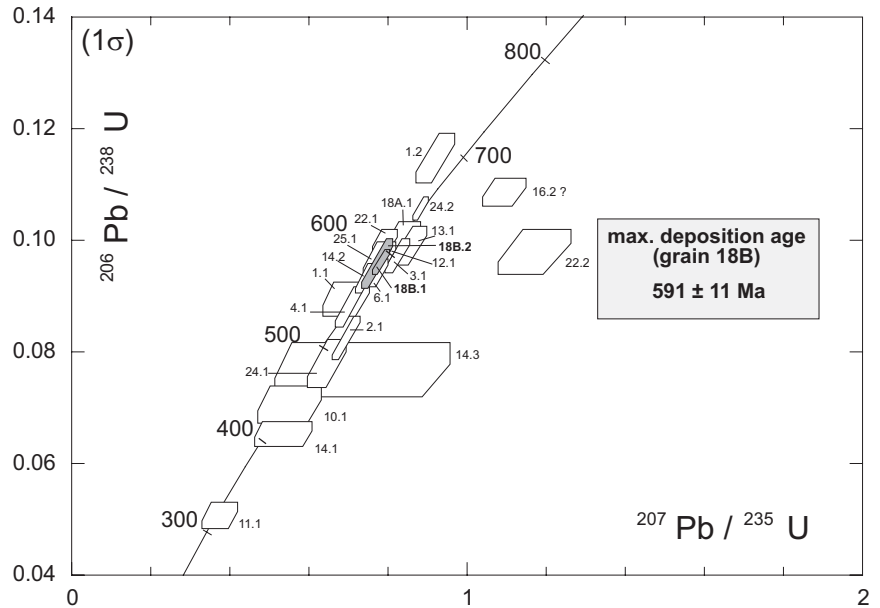


fig 2. a) U-Pb Concordia diagram for zircons from a metasediment of the Montemolín succession. Only ages younger than 800 Ma are shown. Mean age obtained from the comagmatic part of the zircon 18B.

lead. In general, they have higher Th/U ratios than the normal oscillatory domains (up to 1.6).

CONCLUSIONS.

Results from the present study allow pointing out that the age of deposition of the sedimentary precursor of the Montemolín succession is Precambrian or post Precambrian as the youngest detrital grain provides a maximum deposition age of about 591 Ma. This succession corresponds to an external platform with continental-derived sediments containing zircons of various provenances. On the other hand, all the ages around 600 Ma support a derivation from Gondwana.

ACKNOWLEDGEMENTS.

The authors would like to thank W. Compston, I. Williams and M. Fanning for their help at various stages of ion-probe data collection and evaluation. This study was financed by the Swiss National Science Foundation to D.G., and B.O.C. for her PhD work and Spanish Ministry of Science project CGL2008-01130/BTE. All this support is gratefully acknowledged.

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