# First shrimp-ages on pyroxenites, eclogites and granites of the Ronda complex and its country-rocks

## *Primeras dataciones con SHRIMP de piroxenitas, eclogitas y granitos de las Peridotitas de Ronda y rocas encajantes*

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ABSTRACT

*U-Pb shrimp dating of magmatic and metamorphic domains of zircons from various rocks of the Ronda Peridotites (Betic Cordilleras, SE Spain) and their country rocks gave the following results: An extensional stage at ca 180 Ma is reported by the crystallization of a HP-garnet pyroxenite and the LP-protolith of a country-rock eclogite. Miocene subduction (20.1±2.0 Ma) caused the formation of the country-rock eclogites. Very fast uplift and emplacement of the ultramafic rocks into middle crustal level produced contact anatectic granites at 22.9±3.4 Ma implying very fast uplift rates (>2 cm/y).*

RESUMEN

*Dataciones con SHRIMP de areas magmáticas y metamórficas en circones de rocas de la Peridotita de Ronda(cordilleras Béticas, SE España) y de rocas del encajante han proporcionado los siguientes resultados: Las edades de cristalización de una piroxenita con granate (de alta presion) y de el protolito de una eclogita de las rocas encajantes, revelan la existencia de un periodo extensional hace ca.180 Ma. Un episodio compresivo con subducción, en el Mioceno Inferior, (20.1±2.0 Ma), es responsable de la eclogitización. El rápido ascenso y emplazamiento de las rocas ultramáficas en niveles intermedios de la corteza produce granitos anatécticos, con una edad de 22.9±3.4 Ma. Se calcula una velocidad de ascenso superior a 2 cm/a.*

**Key words:** *Ronda peridotite, Shirimp-dating, Zircon.*

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The Ronda peridotites include a group of orogenic peridotite massifs, that outcrop in the W of the Alpujárride Complex, (internal part of the Betic Chain, SE Spain). The peridotites form the lower part of an allochtonous unit (Los Reales nappe) whose emplacement developed a metamorphic aureole in the underlying rocks of the Ojén nappe consisting of migmatites, amphibolites with eclogite relics and some granitic bodies. Overlying the peridotites there is a metasedimentary sequence which varies from granulite to greenschists facies.

In order to determine ‚protolith, metamorphic and inherited' ages of two types of pyroxenites, one country-rock eclogite and a leucocratic rock, zircons of four samples from the Sierra Alpujata and Sierra Bermeja massifs have been dated so far. The zircons were studied by cathodoluminiscence (CL) to identify distinct magmatic and metamorphic domains that were then dated by SHRIMP II at ANU in Canberra.

Country-rock eclogite: This rock occurs as a metamorphic relic within rutile-bearing amphibolites that are interlayered with migmatites below the Sierra Alpujata Massif (Ojén nappe). Zircons of this eclogite have magmatically zoned cores which yield concordant ages at 184±3 Ma (95 % c.l., as all other ages cited below). The low-U and low Th/U rims are structureless in CL and give concordant ages at 20.1±2.0 Ma.

Gar-pyroxenite: This rock occurs as a concordant layer within the upper part of the Ronda peridotite (Los Reales nappe. Sierra Bermeja). Zircons have grown magmatically at 180±5 Ma. Two inherited, also magmatically zoned zircons yield ages at 281±8 Ma.

Corundum bearing gar pyroxenite: This sample was taken from a 2 m thick, concordant layer close to the gar pyroxenite sample containing the 180 Ma old zircons. It corresponds to the Al-rich suite of Garrido and Van der Wal, (1995). Zircons show magmatic zoning and yield concordant ages at 131±5 Ma.

Leucocratic rock: This sample was taken from an irregular pod within the peridotites not far from the dated pyroxenites and near the contact with the overlying metasedimentary granulites. The zircons display magmatically grown rims at 22.9±3.4 Ma and magmatically zoned, inherited cores that yield ages of 171±11 Ma and 255±5 Ma (1s).

The coincidence of Middle to Lower Jurassic ages obtained for both the low-pressure protolith of the country-rock eclogite (184±3 Ma) and the HP or UHP gar-pyroxenite (180±5 Ma) argues for an origin in a similar geotectonic scenario. As there is no evidence of any subduction event at ca 180 Ma, extension related partial melting of the mantle

is the most likely geotectonic setting. This is in tune with coeval rift and oceanization processes in more eastern parts of the Tethyan ocean. The presence of inherited zircons in the gar-pyroxenite supports, but does not prove the evidence for the contribution of, or the formation from crustal sources (e.g. Pearson *et al.*, 1993). Various speculations on the origin of these inherited zirons are possible resulting in different geodynamic scenarios.

The 131±5 Ma old magmatic zircons in the corundum bearing gar-pyroxenite can be explained in two ways: 1) they may represent the age of magmatic formation of a HP or UHP cumulitic pyroxenite during continued rifting and oceanization or 2) they may, according to the hypothesis of Kornprobst *et al.*, (1990), represent plagioclase-rich oceanic gabbros. Hypothesis 2 implies closed U-Pb zircon systems during Miocene subduction and transformation of the Lower Cretaceous gabbro into the corundum bearing gar-pyroxenite, which is not impossible.

An Oligo-Miocene subduction episode is inferred from the Lower Miocene age of recrystallization of zircon from the country-rock eclogite (T = ca 750° C; P > 15 kbar; Tubia and Gil Ibarguchi, 1991). This in turn implies rapid subduction with plate tectonic speeds and probably even faster uplift (> 2 cm/y) and cooling, which is in line with existing geochronolgical and other data. The 22.9±3.4 Ma age of the contact anatectic, leucocratic pod within the peridotite adds to this. However, the so far obtained ages on the inherited grains do not support an exclusive Variscan or pre-Variscan source of the leucocratic melts. They rather demonstrate the presence of Middle Jurassic, inherited zircons in the source. Unless the source is of Middle Jurassic mantle origin including oceanic igneous rocks, Middle Jurassic felsic rocks of continental sources (bimodal, rift related?) may have occurred in the source. This implies that the metasedimentary country-rocks, the presumed source of the leucocratic pod, are at least in parts syn- or post Middle Jurassic. This is so, as the youngest detrital (or volcanic) zircon grains, now occuring as cores in the melt-precipitated zircons of the Miocene leucocratic pod, are Middle Jurassic.

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