First U/Pb detrital zircon age populations from the Eastern Variscan Moroccan Meseta

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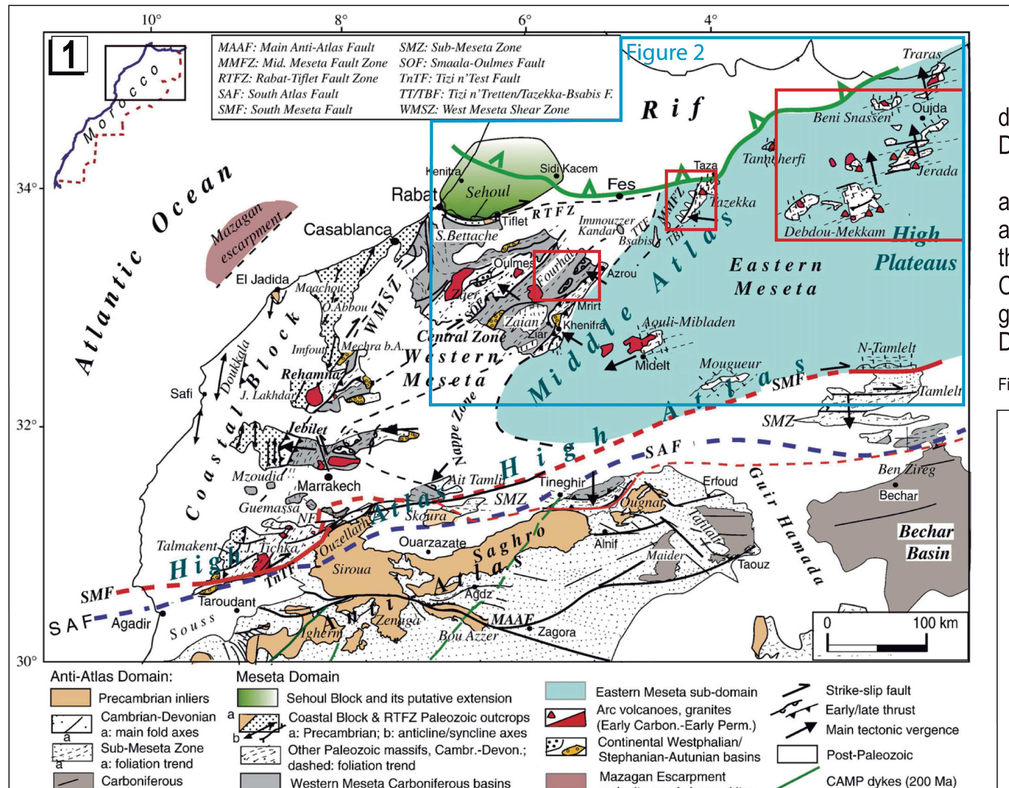

1. INTRODUCTION AND GEOLOGICAL SETTING

The paleogeographic and tectonic evolution of the Variscan terranes cropping out in Morocco is still a matter of study and discussion (e.g. Michard et al., 2010a, 2010b, Simancas et al., 2009 and 2010) in particular within the so called Meseta Domain (Eastern Meseta, Western Meseta and Coastal Block; Figure 1).

Recently, a few U-Pb geochronological data on magmatic and detrital zircon populations were published (El Houicha et al., 2018; Letsch et al., 2018) adding new insight into the geodynamic evolution of the Meseta Domain and correlating it with a number of peri-Gondwanan terranes (e.g. Bousquet et al., 2008; Caby et al., 2008; Gasquet et al., 2008). Nevertheless, the geochronological data available for the Meseta Domain are still scarce and concentrated in the Western Meseta and Coastal Block. This work is focused on the Eastern Meseta (Figure 1), and it presents the first results of U-Pb geochronological analyses on detrital zircons from Silurian-Devonian sedimentary rocks sampled in the Oujda, Debdou-Mekkam, Tazekka and Azrou areas (Figure 2).

Figure 1 (left): Structural map of the Variscan Meseta Domain (modified from Michard et al. 2010b); the red boxes show the sampling areas; the blue box shows the detail area in Figure 2.

2. METHODOLOGY

Twelve samples of Paleozoic quarzitic sandstones and arkoses were collected in the Eastern Meseta (Oujda, Debdou-Mekkam, and Tazekka areas) and in the boundary between Eastern and Western Meseta (Azrou area). Their approximate location is shown in Figures 1 and 2.

For each sample, an average of 120 zircon grains (minimum 65; Figure 3) were hand-picked and dated by U-Pb laser ablation (LA-ICPMS); the smallest grains were dated using SHRIMP. The analyses were carried out in the John the Laeter Centre of the Curtin University in Perth (Australia) and they were realised, where possible, both in cores and rims.

The results are plotted in Figure 2 using pie-charts (A) and Kernel Density Estimation diagrams (B).

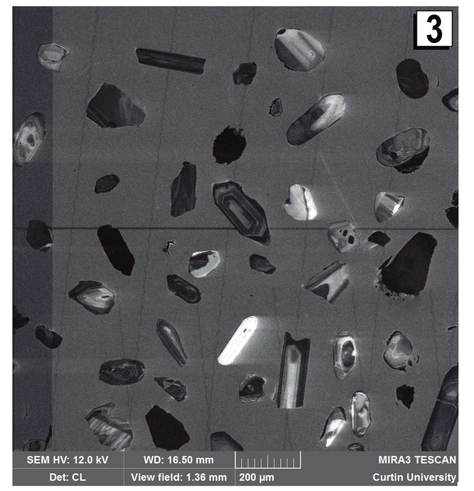

Figure 3: Cathodoluminescence image of a few zircons from sample OUJ11 showing the internal structure of the grains.

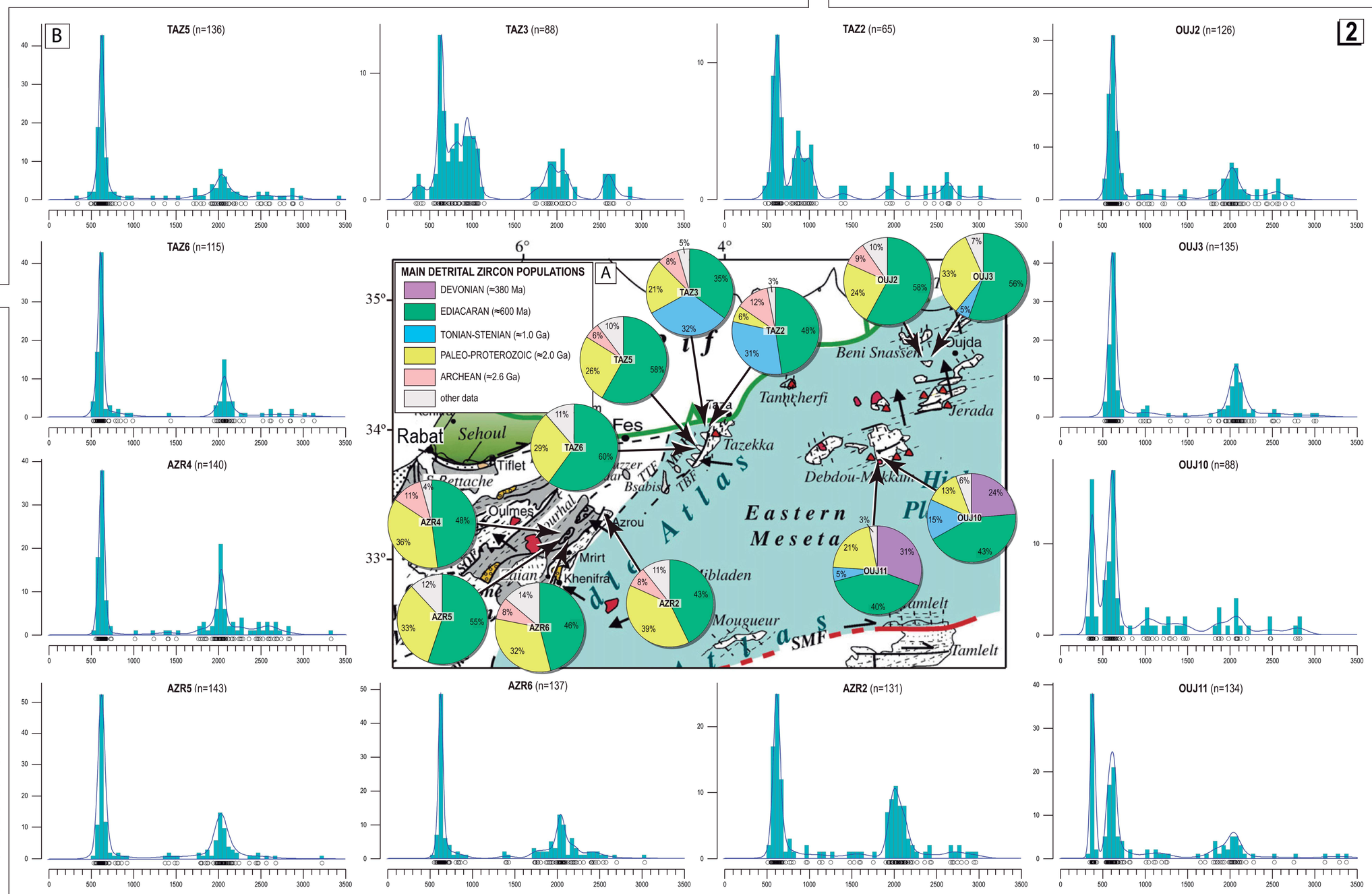

Figure 2 (left): A) Geological map (modified from Michard et al. 2010b) showing the location of the samples in the Eastern Meseta and the boundary with the Western Meseta. The pie-charts show the principal detrital zircon populations recognised in each sample. B) Kernel Density Estimation diagrams (blue line) and relative histograms (in cyan) based on the U-Pb data from each sample; abscissas show ages in millions of years and ordinates the number of data in each category of the histogram.

3. RESULTS

The statistical analysis of the geochronological data show the presence of five main detrital zircon populations (Figure 2):

DEVONIAN (≈380 Ma)
It represents 24-31% of the analyses in two samples from Debdou-Mekkam area (OUJ10 and OUJ11); in other samples this population is not present or not representative (TAZ3).

EDIACARAN (≈600 Ma)
It is the most representative population in all the samples (35-60% of the analyses).

TONIAN-STENIAN (≈1.0 Ga)
This population is present in five samples from Oujda, Debdou-Mekkam and Tazekka areas; this population usually represents 5-15% of the analyses except in the Tazekka area where it reaches 32% of the analyses (TAZ2 and TAZ3).

PALEOPROTEROZOIC (≈2.0 Ga)
It is the second most common population in the studied area, representing up to 39% of the analyses.

NEOARCHEAN (≈2.6 Ga)
This population ranges from 6 to 12% of the analyeses, except in the Debdou-Mekkam area where it is very scarce.

4. DISCUSSION

The Ediacaran, Paleoproterozoic, and Neoarchean detrital zircon populations are easily referable to the Cadomian-Pan-African, Eburnean, and Liberian-Leonian orogenies. Source areas are frequent in the Western African and Sahara Cratons (Figure 4; Naidoo et al., 2018).

The Tonian-Stenian detrital zircon population is generally common, together with other Mesoproterozoic populations, in Avalonian and Amazonian terranes (Dostal et al., 2005; Naidoo et al., 2018), affected by the Greenvillian Orogeny. A few Tonian-Stenian magmatic rocks were found within the Trans-Saharian Belt, the Saharan Metacraton, and the Arabian-Nubian Shield (Bea et al., 2010; Avigad et al., 2012). In our case, a North-Eastern African provenance is more plausible than the distant Amazonian craton.

The significant Devonian detrital zircon population identified in the samples of the Debdou-Mekkam area has not been described until now. The possible source areas, on the basis of the present data, are yet to be identified. Pereira et al. (2012) found similar ages in samples from South-Western Iberia and they proposed the presence of a Mid- to Late-Devonian magmatic arc related to the Rehic Ocean consumption, then completely eroded during the Variscan orogeny. On the other hand, Late Devonian (≈367 Ma) granitoids were dated in the Sehoul Block (Avalonia?) by Tahiri et al. (2010). These two hypotheses need further structural and geochronological data to be confirmed.

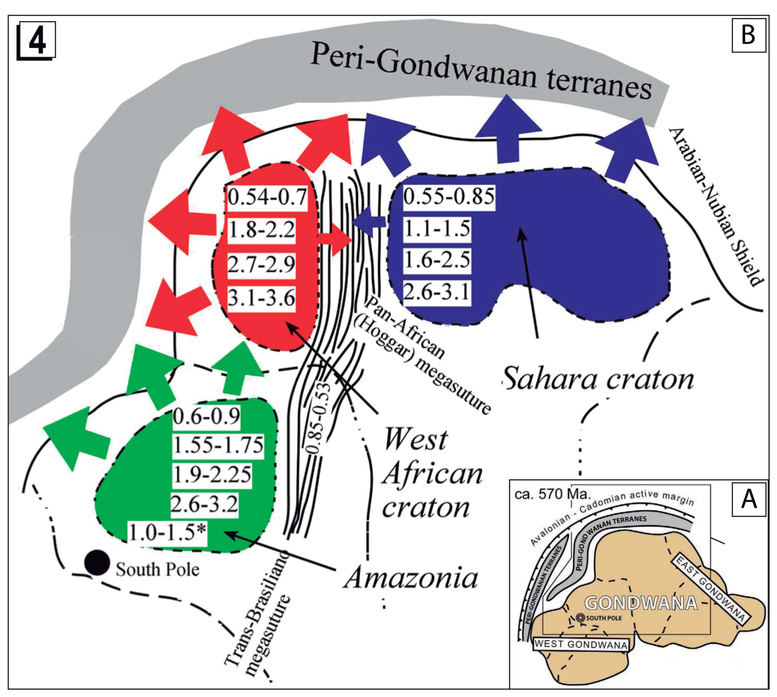

Figure 4: A) Paleogeographic setting of Gondwanan and Peri-Gondwanan terranes (modified from Diez Fernández et al., 2010); B) detail of the North-Gondwanan terranes: the coloured areas indicate the main source areas and the numbers are ages (in Ga) of zircon populations; (*) local western Amazonian orogeny and magmatism with limited dispersion of detrital zircons (modified from Naidoo et al., 2018).

5. CONCLUSIONS

Detrital zircons from twelve samples of the Eastern Meseta were analysed with U-Pb laser ablation (LA-ICPMS) and SHRIMP identifying five main populations.

Most of the samples are in agreement with a North-Gondwanan provenance; in particular, some of the samples from the Eastern Meseta contain variable proportions of Tonian-Stenian ages that suggest a North-Eastern African source.

In addition , around 30% of the analyses in two samples from the Debdou-Mekkam yielded Devonian ages (≈380 Ma) which are unknown in Northern Africa, and then they might have been sourced from the North-West: from the Devonian Rehic oceanic magmatic arc, as proposed by Pereira et al. (2012) based on data from SW Iberia, or from Late Devonian granitoids in Avalonian terranes, dated by Tahiri et al. (2010) in the Sehoul Block.

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