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First evidence for Cambrian rift-related magmatism in the West African Craton margin: The Derraman Peralkaline Felsic Complex

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ABSTRACT

West of the southern, Archean, part of the Reguibat Rise of the West African Craton the Oulad Dlim Massif consists of metamorphic nappes stacked during the Mauritanides (Variscan) orogeny. In the Derraman region, about 12 km west of the nappes, we have found strongly deformed hypersolvus aegirine-riebeckite A1-type granites with SHRIMP zircon U–Pb ages of ca. 525 ± 3 Ma, $\varepsilon(Nd)_{525Ma}$ (−5.2 to −6.8.) and Nd model ages $T_{CR} \approx 1.85$ Ga. These granites define two km-sized bodies and a few smaller satellites. One body is emplaced within a 3.12 Ga leucocratic gneiss. The other body and its satellites are emplaced within an Archean low-grade metasedimentary sequence with detrital zircons that have ages that peak at 2.84 Ga, 2.91 Ga, and 3.15 Ga. These Archean gneisses and metapelite rocks define a tectonic unit, hereafter called the Derraman-Bulautad-Leglat (DBL) unit, which was formed from the Reguibat basement at the very margin of the WAC. The ~525 Ma Derraman granites are the oldest post-Archean rocks in this unit and were generated in an intraplate rifting environment from melting of crustal fenites during the ubiquitous Cambrian rifting event that affected this part of northern Gondwana. At the present level of knowledge, however, we cannot decide whether the "old" Nd isotope signature of Derraman granites resulted from melting of an old (Paleoproterozoic) fenite source or reflects the signature of the mantle-derived metasomatising fluids. The just-discovered Derraman granites are strikingly similar to other rift-related Cambrian–Ordovician hypersolvus aegirine–riebeckite granites widespread in North Gondwana. Understanding the potential connections between them would help to understand the Cambrian–Ordovician breakdown of northern Gondwana.

1. Introduction

The western boundary of the West African Craton (WAC) that crops out between N 21° and N 23° is marked by a narrow SSW–NNE belt of Paleozoic sediments overlying the south-western Reguibat Rise (Fig. 1A–D). West of the Paleozoic cover units, the Oulad Dlim (or Adrar Souttouf) massif is currently described as a west-to-east accumulation of tectonic nappes emplaced during the Mauritanides (Variscan) orogeny (Sougy, 1969; Sougy and Bronner, 1969; Villeneuve and Cornée, 1994; Le Goff et al., 2001; Villeneuve et al., 2006, 2010, 2015; Michard et al., 2008, 2010; Rjimati et al., 2011). The limit of the WAC at depth is somewhere beneath the Oulad Dlim massif or to the west of it (Ennih and Liégeois, 2008; Villeneuve et al., 2015). The geology of the Oulad Dlim massif itself is still poorly known: the only complete geological map is the 1985 1:1,000,000 Geological Map of Morocco (Hollard et al., 1985) it is also partly covered by recent geological maps 1:50,000 (Rjimati et al., 2002a,b,c,d,e; Rjimati and Zemmouri, 2011). Petrographic knowledge about the rocks of this region hardly improved since the syntheses by Alia Medina (1960) and Arribas (1968). There is little robust geochronological data, except some LA-ICPMS zircon work by Gärtner et al. (2013), Gärtner et al., 2016 in the southern part of the region. These authors found Mesoproterozoic and late Pan-African ages. Montero et al. (2014) also determined a couple of Archean SHRIMP zircon ages by Montero et al. (2014) in areas close to the northeast boundaries of the massif.

In the Leglat-Derraman region 12 km west of the alignment of Paleozoic remnants (Fig. 1C) we have recently found two km-sized bodies of gneissified riebeckite–aegirine hypersolvus granites remarkably similar to the ones associated with Cambro–Ordovician rifting in other areas of North Gondwana (e.g., Montero et al., 1998; Montero et al., 2009a; 2009b). Given that granites with such characteristics are excellent tectonic markers we have studied them in detail, presenting here the most relevant results concerning their field relationships, petrography, geochemistry, Sr and Nd isotopes, and SHRIMP zircon U/Pb ages.

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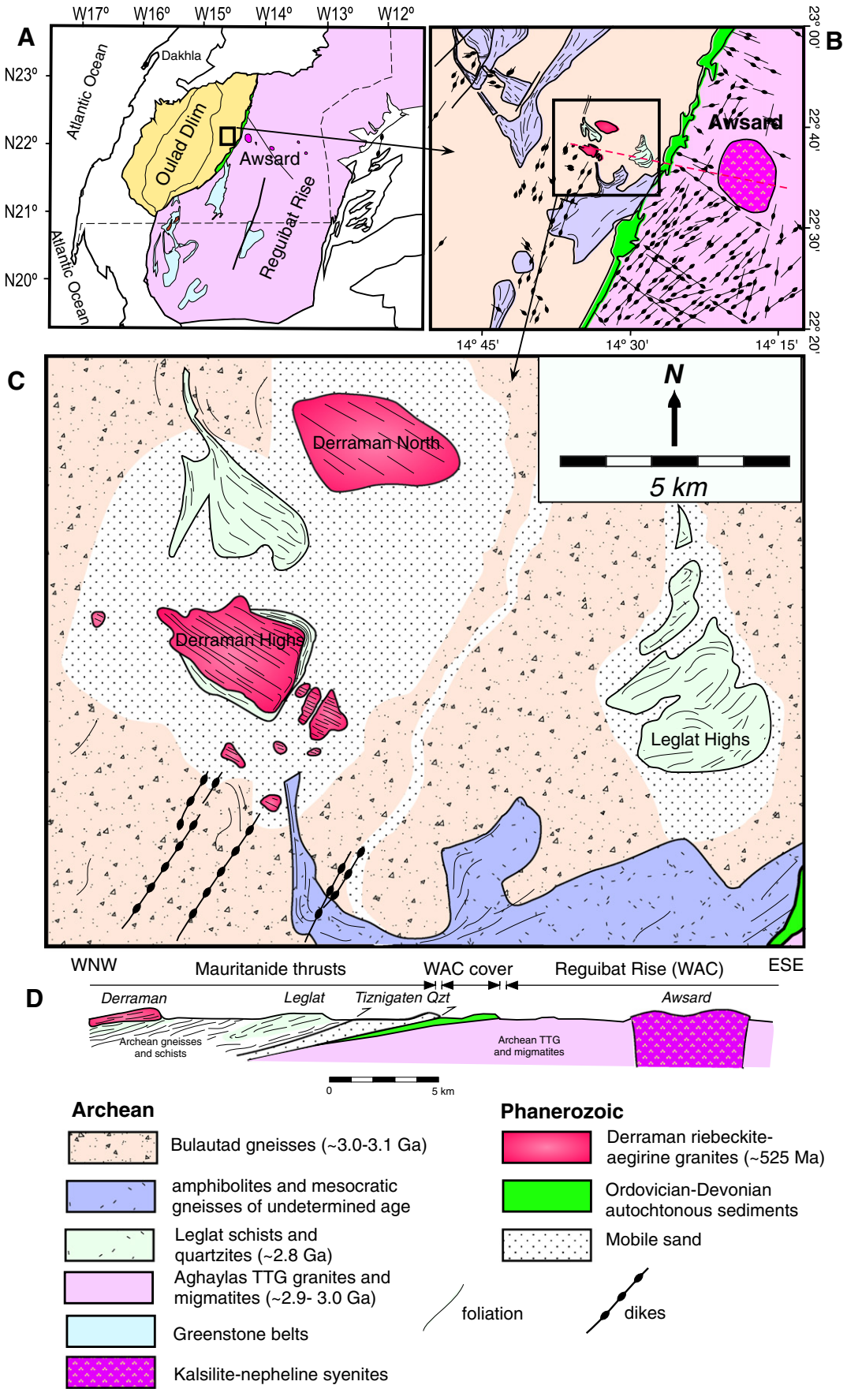
A
W17º
W16º
W15º
W14º
W13º
W12º
N23º
N22º
N21º
N20º
Atlantic Ocean
Dakhla
Oulad Dlim
Awsard
Reguibat Rise
Atlantic Ocean
B
23º 00'
22º 40'
22º 30'
22º 20'
Awsard
14º 45'
14º 30'
14º 15'
C
N
5 km
Derraman North
Derraman Highs
Leglat Highs
WNW
Mauritanide thrusts
WAC cover
Reguibat Rise (WAC)
ESE
D
Derraman
Leglat
Tiznigaten Qzt
Awsard
Archean gneisses and schists
Archean TTG and migmatites
0
5 km
Archean
Bulautad gneisses (~3.0-3.1 Ga)
amphibolites and mesocratic gneisses of undetermined age
Leglat schists and quartzites (~2.8 Ga)
Aghaylas TTG granites and migmatites (~2.9- 3.0 Ga)
Greenstone belts
Kalsilite-nepheline syenites
Phanerozoic
Derraman riebeckite-aegirine granites (~525 Ma)
Ordovician-Devonian autochtonous sediments
Mobile sand
foliation
dikes