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U–Pb age of the coesite-bearing eclogite from NW Borborema Province, NE Brazil: Implications for western Gondwana assembly

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ABSTRACT

The Late Neoproterozoic assembly of western Gondwana played an important role in the subduction of oceanic and continental lithospheres. Such event was also a source of arc magmatism, reworking of cratonic margins and development of ultra-high pressure (UHP) suture zones. In the Borborema province, NE Brazil, we have described for the first time UHP rocks enclosed within gneiss migmatite and calc-silicate rocks. They bear coesite included in atoll-type garnet from metamafic rocks, identified by petrographic study and Raman microspectroscopy analysis. U–Pb zircon dating of the leucosome of the migmatites and the calc-silicate rock displays, concordant ages of 639 ± 10 Ma and 649.7 ± 5 Ma, respectively, here interpreted as the minimum age of the eclogitization event in the region. U–Pb zircon dating of the coesite-bearing rock defined a concordia age of 614. 9 ± 7.9 Ma that comprised the retrograde eclogitic conditions to amphibolite facies. The UHP rocks, mostly retrograded to garnet amphibolites, occur enclosed in the Paleoproterozoic continental block composed of calc-silicate rocks, migmatized sillimanite gneiss, mylonitic augen gneiss and granitic and tonalitic gneiss along a narrow N–S oriented belt between the Santa Quitéria magmatic arc and the Transbrasiliano lineament. This block was involved in the subduction to UHP eclogite depths, and was retrogressed to amphibolite during its exhumation and thrusting. Our data indicate an important Neoproterozoic transcontinental suture zone connecting the Pharusian belt with Borborema Province, and probably with the Brasília belt in central Brazil.

1. Introduction

One of the basic questions in global tectonics is to determine the location of old suture zones. On the eastern margin of the West Africa craton a Pan-African suture zone is evident in northern Mali, Togo, Benin, and Ghana due to the presence of remnants of oceanic crust, arc magmatism, and ultra-high pressure (UHP) rocks, also attested by geophysical data (Lesquer et al., 1984; Caby, 1989; Affaton et al., 1991; El-Hadj Tidjani et al., 1997; Jahn et al., 2001; Duclaux et al., 2006). Several studies have proposed a correlation between the Pharusian belt and the Borborema Province, in which two transcontinental lineaments, the Transbrasiliano in Brazil and the Hoggar 4°50 — Kandi in Africa, comprise the first-order correlation (Fig. 1A) (Castaing et al., 1994; Trompette, 1994; Brito Neves et al., 2002; Arthaud et al., 2008; Santos et al., 2008a; Kalsbeek et al., 2012; Archanjo et al., 2013; Cordani et al., 2013a,b).

Occurrence of high-pressure (HP) and UHP rocks, particularly associated with coesite-bearing eclogite, is important in the reconstruction of supercontinents, providing information on lithosphere subduction, residence and exhumation processes (Maruyama et al., 1996; Carswell and Zhang, 1999; Ernst, 2001). Uncontested Neoproterozoic suture zones are well defined in Africa, mainly by the occurrence of HP and UHP mafic and ultramafic rocks (Caby, 2003 and references therein). In contrast, suture zones in Brazil remain unclear, mainly due to the lack of UHP rocks, which led to interpretations of these zones bordering the São Luís craton (Trompette, 2000) or connecting with the Araguaia belt (Fig. 1A) (Tohver et al., 2006; Cordani et al., 2009) or assumed to being buried beneath the Phanerozoic Parnaíba basin where some high density gravity anomalies may represent hidden remnants of an oceanic suture (Lesquer et al., 1984; Fetter et al., 2003).

While the understanding of such features is provided by HP-UHP rocks, dating of a UHP metamorphic peak using the U–Pb method is problematic, mainly due to the closure temperatures of some minerals, such as sphene and rutile, which are usually lower than those of the metamorphic peak.

In central Brazil, remnants of an Early Neoproterozoic oceanic crust and a Neoproterozoic magmatic arc (Pimentel et al., 1991; Pimentel and

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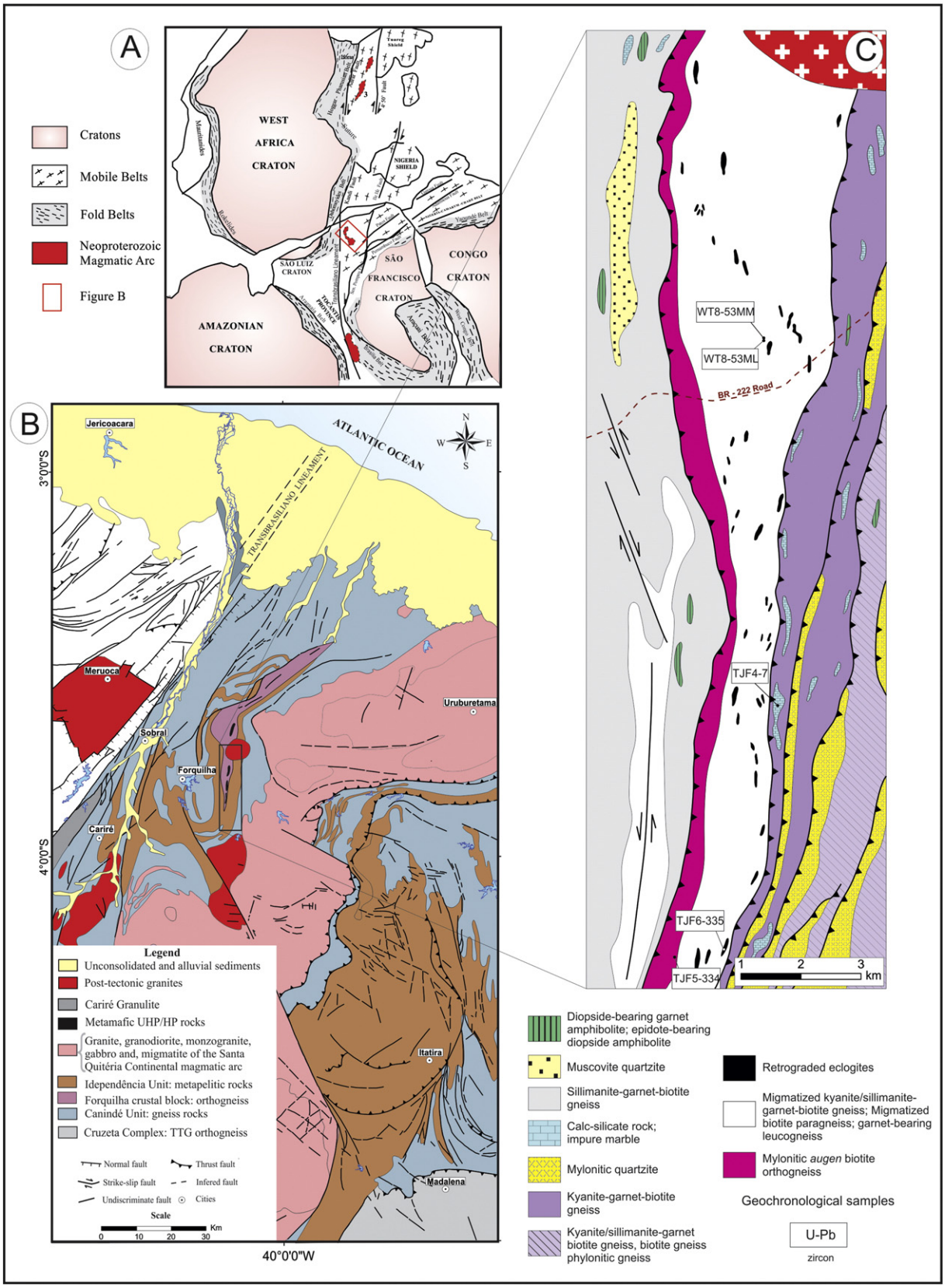

Fig. 1. Geologic setting of the study area. (A) Gondwana assembly during the Late Neoproterozoic; (B) NW portion of the Borborema Province showing the Santa Quitéria continental magmatic arc and the Transbrasiliano Lineament (modified after Cavalcante et al., 2003); (C) Detailed geological map of the FEZ (after Ancelmi et al., 2013).

Fuck, 1992; Pimentel et al., 2000; Valeriano et al., 2008) attest to subduction and ocean closure (Goianides Ocean). Based on the characterization of the Santa Quitéria continental magmatic arc (SQCMA) (Fig. 1B), Fetter et al. (2003) proposed the continuity of the Goianides Ocean northeastwards, into the Borborema Province. In addition to that, recent studies conducted by Santos et al. (2009b) and Amaral et al. (2011), involving