



Late Paleozoic subduction and exhumation of Cambro-Ordovician passive margin and arc rocks in the northern Acatlán Complex, southern Mexico: Geochronological constraints

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ABSTRACT

The origin and age of high pressure (HP) rocks are crucial for paleogeographic reconstructions because they either define an oceanic suture or an extrusion zone within the upper plate. HP rocks in the San Miguel Las Minas area in the northern part of the Acatlán Complex, southern Mexico have been inferred to be of early Paleozoic age and to mark oceanic sutures. However, blueschists in the northern part of the complex have yielded Mississippian ⁴⁰Ar/³⁹Ar plateau ages of 344 ± 5 Ma for glaucophane and 338 ± 3 Ma and 337 ± 2 Ma for muscovite. These ages are slightly younger than recently published ages: a U–Pb zircon age of 353 ± 1 Ma from associated eclogite, and a 347 ± 3 Ma muscovite age from the tectonically overlying, greenschist facies Las Minas Unit. Taken together, these data indicate rapid cooling between 700° and 340° C in ca. 17 Myr. On the other hand, associated Ordovician Anacahuite Amphibolite cooled through ca. 500° C at 299 ± 6 Ma (⁴⁰Ar/³⁹Ar on hornblende) suggesting a second, Permian phase of exhumation. Protoliths of the high grade rocks include Cambrian–Ordovician, rift–passive margin, psammites, pelites, and tholeiitic dykes, an Ordovician mafic intrusion (Anacahuite Amphibolite dated at 470 ± 10 Ma: U–Pb zircon) and megacrystic granite (dated at 492 ± 12 Ma: U–Pb zircon), and arc-related mafic rocks of unknown age. These rocks are interpreted to have been part of the upper plate rocks that was removed by subduction erosion and taken to depths between 35 and 55 km where they underwent blueschist–eclogite facies metamorphism. This was followed by rapid extrusion along a channel bounded by an easterly dipping, Mississippian, listric normal shear zone, and a thrust modified by a Permian dextral fault. Rocks above and below the extrusion zone are mainly Cambro-Ordovician rift–passive margin units, but a small vestige of the arc is preserved as dikes cutting rocks lying unconformably beneath the fossiliferous latest Devonian–Lower Permian Patlanoaya Group. Since faunal data indicate that Pangea had begun amalgamation by the Mississippian, at which time the Acatlán Complex lay 1500–2000 km south of the Ouachita collisional orogen between Gondwana and Laurentia, it is inferred that subduction and extrusion of the high pressure rocks occurred on the active western margin of Pangea.

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1. Introduction

Understanding the origin of high pressure (HP) rocks in the Acatlán Complex of southern Mexico is crucial to Paleozoic paleogeographic reconstructions because they could represent either oceanic sutures or an extrusion zone within the complex (Keppie et al., 2010). There is currently much debate on age and tectonic significance of the HP metamorphism, with ages of HP metamorphism variously assigned to the Ordovician, Silurian and Carboniferous. This contro-

versy has led to the assignment of the HP rocks to a variety of oceans including the Iapetus, Rheic and paleo-Pacific (Ortega-Gutiérrez et al., 1999; Talavera-Mendoza et al., 2005; Nance et al., 2006; Vega-Granillo et al., 2007; Keppie et al., 2008a; Vega-Granillo et al., 2009a,b; D.F. Keppie et al., 2009; J.D. Keppie et al., 2009). Ortega-Gutiérrez et al. (1999 and references therein) proposed that the HP rocks occurred in a nappe that was thrust eastwards over low-grade rocks during the Ordovician. This interpretation was based on the inference that earliest Silurian, megacrystic granitoids associated with the eclogites were the result of decompression melting following the HP metamorphism. The lower intercept, U–Pb zircon age of 440 ± 14 Ma reported for these granitoids by Ortega-Gutiérrez et al. (1999) has since been re-dated at 471 ± 6 Ma (concordant U–Pb analysis:

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Sánchez-Zavala et al., 2004), implying a pre-Late Ordovician age for the HP metamorphism. This conclusion was apparently confirmed by Talavera-Mendoza et al. (2005) and Vega-Granillo et al. (2007), who proposed an Early Ordovician age (490–477 Ma) for the HP metamorphism at Mimilulco, also in the northern Acatlán Complex (Fig. 1), based on the inference that a 461 ± 9 Ma granitoid post-dates the HP metamorphism. An older age limit for the HP metamorphism was provided by the 691 ± 51 Ma age of the youngest detrital zircon cluster in the associated metasedimentary rocks of the informal El

Rodeo “formation/suite” (Talavera-Mendoza et al., 2005; Vega-Granillo et al., 2007). Vega-Granillo et al. (2007) suggested a further two periods of HP metamorphism: (i) Late Ordovician–Early Silurian (ca. 458–443 Ma) at Ixcamilpa (Fig. 1), and (ii) Late Silurian (419–418 Ma) at Santa Cruz Organal. A 430 ± 10 Ma $^{40}\text{Ar}/^{39}\text{Ar}$, amphibole age at Santa Cruz Organal was inferred to closely post-date the 458–443 Ma phase of HP metamorphism (Vega-Granillo et al., 2007, 2009a,b), however these data are highly discordant, probably the result of excess argon (D.F. Keppie et al., 2009; J.D. Keppie et al., 2009).

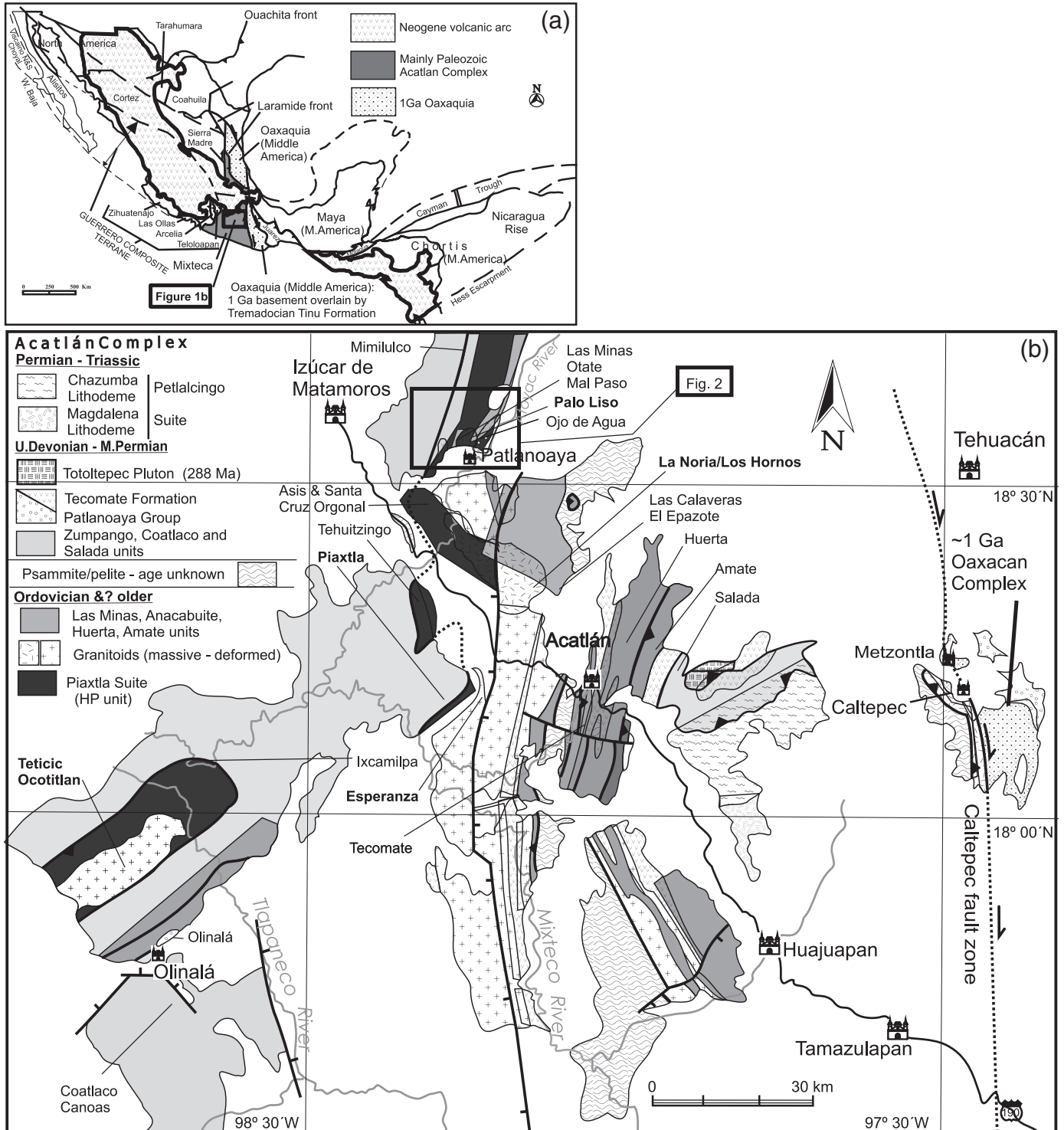


Fig. 1. Maps of Mexico showing: (a) terranes (modified after Keppie, 2004), and (b) a geological map of the Acatlán Complex (modified after Ortega-Gutiérrez et al., 1999; Keppie et al., 2008a).

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