



# The Berriasian–Valanginian (Early Cretaceous) boundary transition at Santa Catarina Ticuá, Oaxaca state, southern Mexico: Ammonites, bivalves, calpionellids and their paleobiogeographic significance



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## ABSTRACT

Ammonites, bivalves and calpionellids of the late Berriasian–early Valanginian from southern Mexico are poorly known; those here described are from the Sabinal Formation at Santa Catarina Ticuá, Oaxaca state. Samples were collected and analyzed bed-by-bed. Ammonite assemblages correlate to the West Mediterranean late Berriasian *Subthurmannia boissieri* and early Valanginian *Thurmanniceras pertransiens* and *Neocomites neocomiensiformis* zones and contain taxa, which are majorly endemic, although a few European species are also identified. The bivalve *Arctotis cretacea* (Felix, 1891) is common in several horizons throughout the section. Calpionellids are present in the upper part of the Santa Catarina Ticuá section and are indicative of the middle Berriasian *Remaniella cadischiana* Subzone, the late Berriasian *Calpionellopsis* Zone (including the *Calpionellopsis simplex* and *Cs. oblonga* subzones) and the early Valanginian *Calpionellites darderi* Subzone. Our data indicate that biogeographic correlation of faunal and environmental changes is possible across the Berriasian–Valanginian boundary between southern Mexico and faunal realms of the southwestern Gulf of Mexico and the western Tethys, and thus throughout the western hemisphere.

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## 1. Introduction

### 1.1. Paleogeographical and geological setting

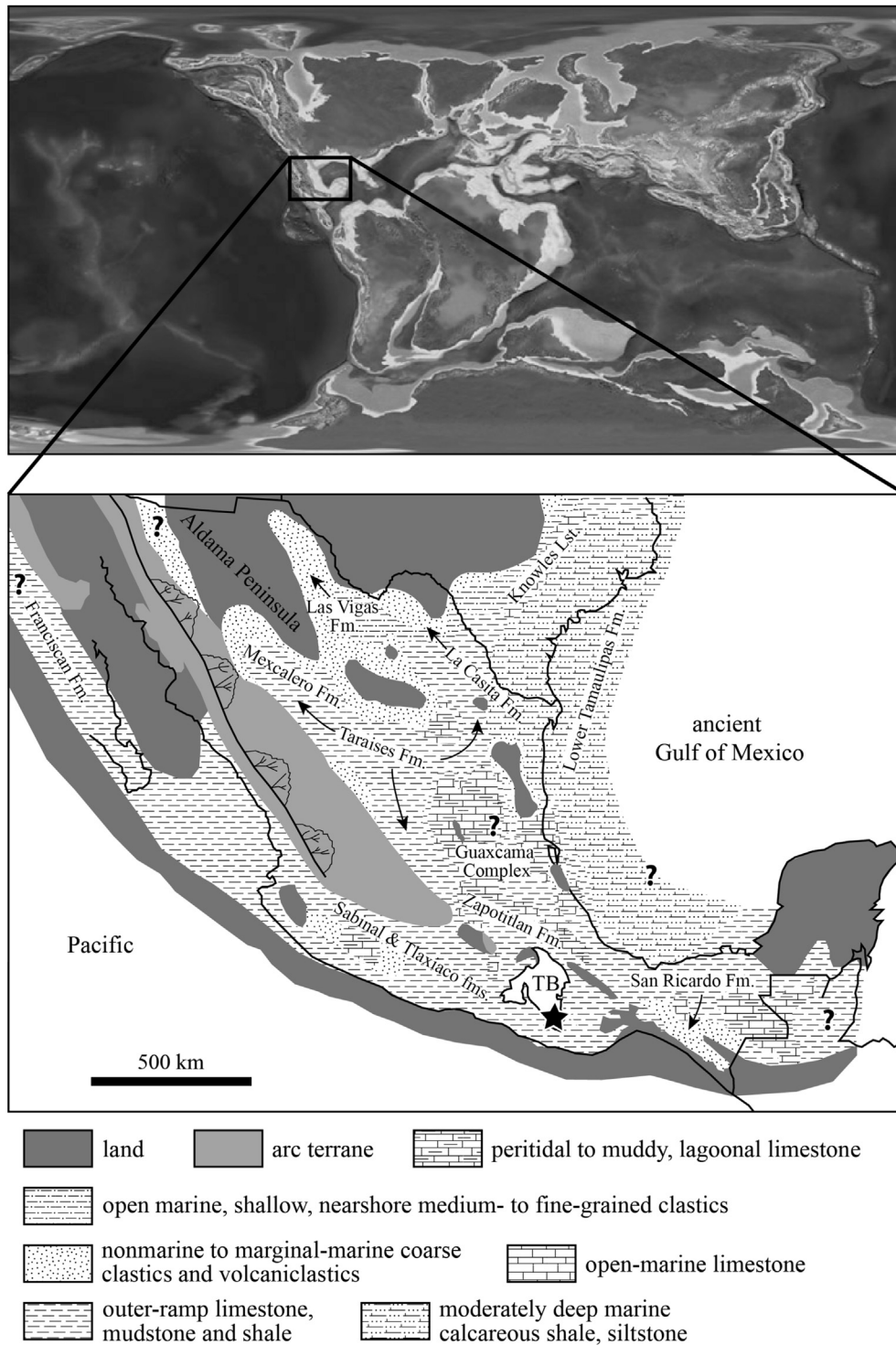
During the Berriasian–Hauterivian stages of the Early Cretaceous, the central part of the Mexican basin was majorly below sea-level (Fig. 1), but NW–SE trending bathymetric highs and islands were situated in northern and western Mexico (López-Ramos, 1981; Goldhammer and Johnson, 2001), while other islands extended to the northeastern, eastern and southern part of the country (López-Ramos, 1981; Wilson, 1990; Goldhammer and Johnson, 2001). In near-shore areas of this archipelago, deposition was majorly siliciclastic, while thin-bedded limestone and marl deposition characterize distal basinal regions (Imlay, 1944; Stinnesbeck and Frey, 2014).

The fossil site described here is located in the southern part of the Tlaxiaco Basin (Fig. 1), a geological depression on the Acatlan–Oaxaca block, which extends from southern Puebla, via central and north Oaxaca, to eastern Guerrero states (Cantú-Chapa, 2001b;

Nieto-Samaniego et al., 2006; Alvarado-Ortega et al., 2014, fig. 2). The Tlaxiaco Basin was active during the Jurassic and Cretaceous, receiving alternating continental and marine input (Rueda-Gaxiola et al., 2007), but the majority of these sedimentary units are still under informal nomenclature. The Lower–Middle Jurassic sedimentary sequence is known as the Consuelo (Erben, 1956; Alencáster, 1963; Meneses-Rocha et al., 1994; Rueda-Gaxiola, 2002) and Tecocoyuncan groups (Erben, 1956), while overlying Upper Jurassic–Lower Cretaceous (Kimmeridgian–lower Valanginian) sediments are documented as the Sabinal Formation, a unit of marine bituminous shales that crop out in the regions of Tezoatlán, Huajuapán de León, Chalcatongo, Huamuxtitlán and Tlaxiaco (Meneses-Rocha et al., 1994; Alvarado-Ortega et al., 2014). Overlying the Sabinal Formation, lower Valanginian–Aptian calcareous breccias, lime- and sandstones are known as the Tlaxiaco Formation (Ortega-González and Lambarria-Silva, 1991). They underlie Albian–Coniacian limestones of the Caliza Teposcolula Formation (Salas, 1949) and Turonian–Maastrichtian marls of the Yucunama Formation (Ferrusquía-Villafranca, 1976). Marine deposition in the Tlaxiaco Basin ended during the Paleogene, but deposition of continental and volcanic sediments continued into the Neogene (Martiny et al., 2000).

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**Fig. 1.** Paleogeographic map of the Early Cretaceous world (Blakey, 2014) with inset of Mexico based on models of López-Ramos (1981) and Goldhammer and Johnson (2001), with additional data from Ticha (1985), Wilson (1990) and Nieto-Samaniego et al. (2006). An asterisk marks the Santa Catarina Ticuá site; TB = Tlaxiaco Basin.

1.2. The Sabinal Formation

The marine Sabinal Formation is up to 1000 m thick and is predominantly siliciclastic, conforming mud- and wackestones, clay, marl and bituminous shale with calcareous concretions (Meneses-Rocha et al., 1994). Age assignment of the formation is here extended to the Early Cretaceous (Valanginian), but the unit

was long considered to be restricted to the Upper Jurassic (Kimmeridgian-Tithonian) (López-Ticha, 1969; Servicio Geológico Mexicano, 2000; Cantú-Chapa, 2001b; Alvarado-Ortega et al., 2014). An erosional unconformity was identified at Mogote de los Ramírez southwest of Tlaxiaco, which separates the Sabinal from the overlying Tlaxiaco Formation. Time-equivalent strata, known as the Mapache and Morelos formations, were reported from

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