THE AGE OF THE TIBETAN 'CALCAIRES À ORBITOLINES ET À *RADIOLITES*' OF DOUVILLÉ, 1916

Dedication in memory of my ancestors Hermann, Adolf and Robert Schlagintweit

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Abstract. The orbitolinid- and rudist-bearing carbonates of Tibet were informally named 'Calcaires à Orbitolines et à *Radiolites*' by Douvillé and assigned to a broad age range, notably Barremian to early Cenomanian. The material studied and illustrated by Douvillé represents a mixture of samples from the Lower-mid-Cretaceous Langshan Formation of southern Tibet (Lhasa Terrane) and the Upper Cretaceous Tielongtan Group of northwestern Tibet (Aksai Chin area) notably the Dongluokezong Formation both bearing orbitolinids as well as rudists. An Aptian-Albian age is confirmed for the Langshan Formation although a late Barremian (or even earlier) age at the base, or an early Cenomanian at the top, might be possible locally but needs further evidence. '*Praeradiolites' hedini* Douvillé, a typical rudist of the 'Calcaires à Orbitolines et à Radiolites' was described from orbitolinid-bearing samples of the Aksai Chin area with an assumed early Cenomanian age. This stratigraphic assignment is here considered misleading to be due to the incorrect identification of *Neorbitolinopsis conulus* (Douvillé) with Upper Cretaceous forms such as *Calveziconus lecalvezae* Caus & Cornella, described more than half a century later from the Campanian of the Spanish Pyrenees. The occurrence of orbitolinids is still today sometimes taken as an argument for parts of the Tielongtan Group to belong to the Lower to mid-Cretaceous interval, a view that has to be corrected. The determinable larger benthic foraminiferan assemblages provide evidence for a Campanian age; however, older strata at the base or younger at the top still lack micropalaeontological data. Compared with the time-equivalent Yigeziya Formation of the western Tarim Basin, the microfauna of the Tielongtan displays only a few common but several unique taxa.

Keywords: Orbitolinidae, Radiolitidae, biostratigraphy, palaeobiogeography, Langshan Formation, Tielongtan Group, Cretaceous.

INTRODUCTION

Early scientific expeditions (among geological, palaeontological, geophysical studies) of the Himalayan-Tibetan region were conducted by the German brothers Herrman, Adolf and Robert Schlagintweit (1854-1857), the Italian De Filippi (1913-1914) and the Swedish Sven Hedin (four expeditions in the period 1893-1935) (e.g. Finkelstein, 2000; Weinberg & Green, 2002; Sha et al., 2020). Within a period of about 42 years (1893-1935), Sven Hedin conducted four expeditions to Central Asia including Pamir and Tibet (Weinberg & Green, 2002). Thin-sections were prepared from the samples of different rock types collected by Hedin in the years 1906-1908, that are now stored at different places notably in Sweden (Stockholm, Uppsala) and China (Nanjing) (Weinberg & Green, 2002). In the book 'Southern Tibet' volume 5 (Hedin, 1916, editor), Douvillé (1916) addressed rudist- and orbitolinid-bearing carbonate samples from different localities of the 1905-1906 expedition as a typical facies informally named 'calcaires à Orbitolines et à *Radiolites*'. He assigned these samples to different ages by means of orbitolinids. Douvillé (1916) described the new rudist species *Eoradiolites hedini* from a sample that he assigned to the early Cenomanian. It should be noted that in the early 20th century formal lithostratigraphic nomenclature (e.g. formations) were not available for this region. Moreover the taxonomy of larger benthic foraminifera and their biostratigraphic importance has continuously progressed since then. However, the presence of orbitolinids is still considered as evidence for a Lower to mid-Cretaceous age in the literature from the Himalayan region still today, a view that needs to be corrected as orbitolinids are well reported from the Upper Cretaceous (e.g. Schlagintweit, 2022). The purpose of the present contribution is to re-asses the biostratigraphy and lithostratigraphy of the carbonate rock samples collected by Sven Hedin during his 1905-1906 excursion and analyzed by Douvillé (1916) supplemented also by our own material (see section Material).

GEOLOGICAL BACKGROUND

The 'Calcaires à Orbitolines et à *Radiolites*' sensu Douvillé (1916) as summarized here includes a mixture of the Lower-mid-Cretaceous Langshan Formation and the Upper Cretaceous Tielongtan Group both bearing Orbitolinidae but of different taxa and age. Summary geological information for the two lithostratigraphic units

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is provided below. The stratigraphy is based on the literature and partly our own data and treated in detail in the 'Results' section. It is important to note that occurrences of both lithostratigraphic units are mutually exclusive in their palaeotectonic positions (Fig. 1A).

Langshan Formation

The Lower to mid-Cretaceous Langshan Formation is represented by predominantly shallow-water carbonates cropping out in a WNW-ESE-oriented stripe along the northern Lhasa subterrane of Central Tibet (e.g. Pan et al., 2004; Zhang, 2000; BouDagher-Fadel, et al., 2017; Xu et al., 2022) (Fig. 1A). The dark-grey limestones with intercalated marls attain a thickness of up to 1,000 meters and either conformably overly the Lower Cretaceous siliciclastic Duoni Formation or (unconformably) volcanic rocks of the Zelong Group (Sun et al., 2015). The Langshan Formation itself can be further subdivided into three informal members (for details see Xu et al., 2020). The Langshan Formation is well known for its richness in Orbitolinidae, especially taxa of the subfamily Orbitolininae (i.e., with a complex megalospheric embryo) (Douvillé, 1916; Fossa-Mancini, 1928; Cotter, 1929; Zhang, 1982, 1986, 1994; Cherchi & Schroeder, 1980; Marcoux et al., 1987; Rao et al., 2015; BouDagher-Fadel et al., 2017; Schlagintweit & Le Coze, 2023; Schlagintweit, 2024). The microflora is represented mainly by dasycladalean algae (Mu, 1982, 1986; Sun et al., 2025). Based on the orbitolinids, the Langshan

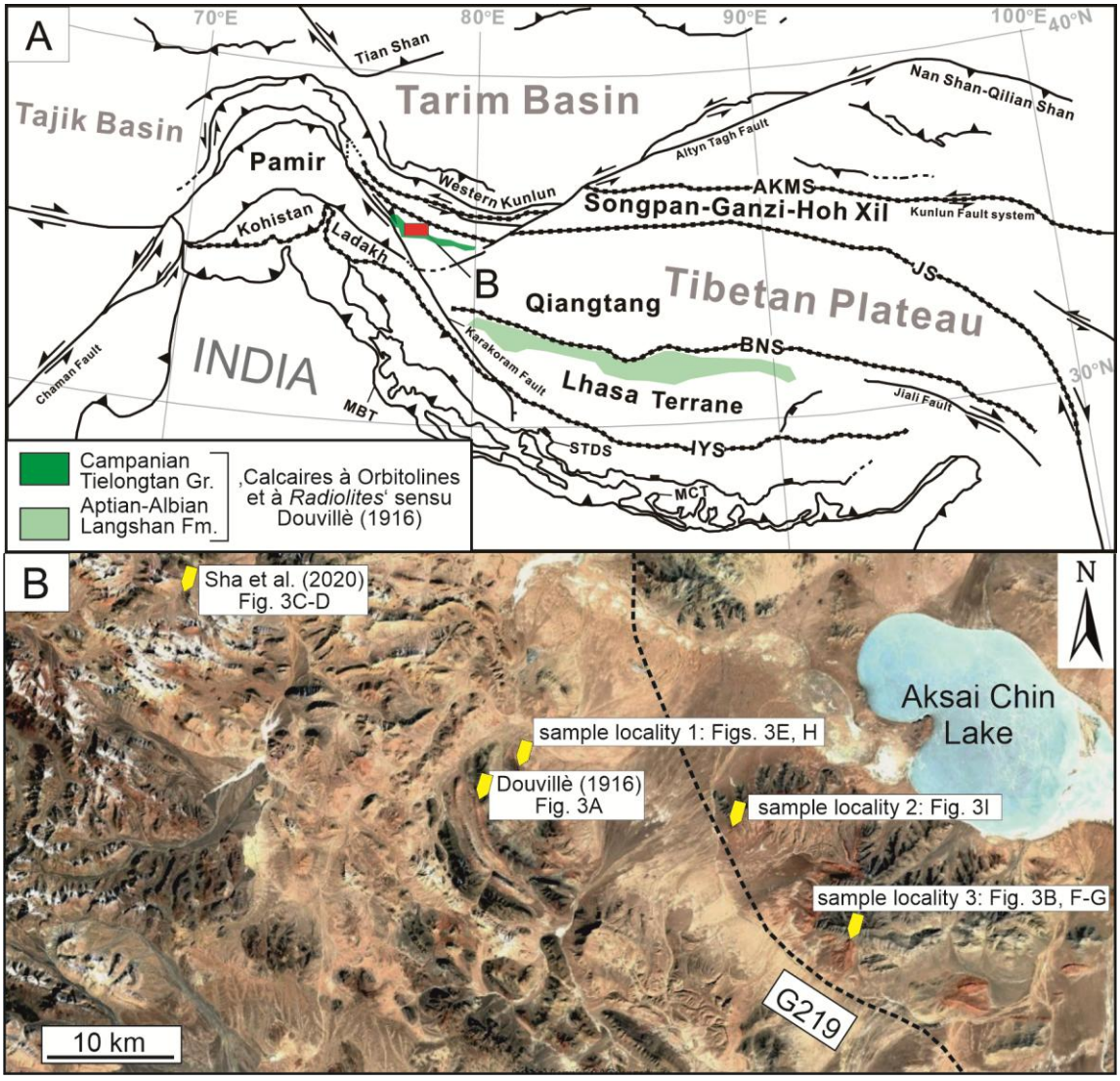

Figure 1. A. Simplified geotectonic map of the Himalaya-Tibet region (modified after Yin & Harrison 2000; Robinson et al., 2004; Gao et al. 2023, fig. 1B) showing the areas with outcrops of the Langshan Formation (e.g. Xu et al. 2022, fig. 1A) and the Tielongtan Group (e.g. Gao et al. 2022, fig. 1B). AKMS = Ayimaqin–Kunlun–Mutztagh Suture; BNS = Bangong–Nujiang Suture; IYS = Indus–Yalung Zangbo Suture; JS = Jinsha Suture; MBT = Main Boundary Thrust; MCT = Main Central Thrust; Mts. = Mountains; STDS = Southern Tibet Detachment System. **B.** Detail from A (red rectangle) with the sample locations of the Tielongtan Group shown in Fig. 3 in the Aksai Chin area. Literature: Sha et al. (2020) and Douvillé (1916); own data: Locality 1, and 2 (Schlagintweit & Gao, 2026), 3 (new collected samples) (modified from Google Earth). Dotted line = China National Highway G219.

Formation was assigned to the early Barremian-early Cenomanian (Rao et al., 2015) or the early Aptian-early Cenomanian (BouDagher-Fadel et al., 2017). An early Turonian age for the top of the Langshan Formation was also proposed (Guo & Shi, 1998). Among the macrofossils described from the Langshan Formation, the rudists are the most important biostratigraphically, including '*Praeradiolites*' *hedini* Douvilé (e.g. Gou & Shi, 1998; Scott et al., 2010; Rao et al., 2015, 2017; Sha & Cestari, 2016). Other macrofossil groups include gastropods (e.g., Wen, 1983) and corals (Löser & Liao, 2001).

Tielongtan Group

The Late Cretaceous Tielongtan Group represents the youngest marine sedimentary unit recognized in the northwestern part of the Tibetan Plateau and exceeds 3,000 meters in thickness (Wen et al., 2000; Sha et al., 2020; Xi et al., 2024; Gao et al., 2025). Outcrops are known from a tectonic unit located at the northwestern end of the Tibetan Plateau and referred to as the Tianshuihai Terrane (e.g. Yin & Harrison, 2000; Sun et al., 2023, fig. 1 therein) or Qiangtang Microplate or Terrane (e.g. Gaetani et al., 1990, fig. 1 therein). The Tielongtan Group is primarily composed of conglomerate, sandstone, gypsum and mudstones in the lower part, and mostly mixed-siliciclastic carbonates in the upper part. It is a transgressive unit which unconformably lies upon metamorphic rocks (slates) of the Carboniferous Qiatier Formation and (locally) Upper Jurassic marly sediments of the Hongqilafu Formation (Matte et al., 1996; Sha et al., 2020). Abundant marine fossils are found within the limestone layers of the upper part of the Tielongtan Group, including rudist bivalves, gastropods, benthic foraminifera, stromatoporoids, ostracods, anomuran microcoprolites and other taxa (Gou & Shi, 1998; Wen et al., 2000; Sha et al., 2020; Gao et al., 2023, 2025; Schlagintweit & Gao, 2026). Among the macrofossils, the rudists are by far the most studied group (Douvillé, 1916; Parona, 1917; Guo & Shi, 1998; Sha et al., 2020; Gao et al., 2025). In the literature different ages and subdivisions of the Tielongtan Group can be found (from base to top): Xiluokezong Formation (Cenomanian to ~early Turonian), Litian Formation (~late Turonian to ~early Campanian) and Dongluokezong Formation (~middle Campanian to ~early Maastrichtian) (Xi et al., 2019, fig. 7 therein). The bipartite subdivision of the Bureau of Geology and Mineral Resources of Xizang province (BGMRXJ, 1999) differentiates a lower Sandstone Formation and an upper Limestone Formation. The recent '*Cretaceous integrative stratigraphy…of the Qinghai-Tibetan Plateau and its surrounding areas*' shows a late Albian-early Maastrichtian range for the Tielongtan Group (Xi et al., 2024, fig. 3 therein). It appears that the presence of *Orbitolina* (e.g. Zhang, 2007; Luo, 2010) was the reason for this assumption, notably the age of the basal parts (Xi et al., 2024, p. 1242).

MATERIAL

The material and data addressed in the present contribution include those from the literature and our own data. Reference is made to own research (Schlagintweit, 2024; Schlagintweit & Li, 2024; Sun et al., 2026) and to literature data (e.g. BouDagher-Fadel et al., 2017; Xu et al., 2022) for the Langshan Formation. The literature data refer especially to the illustrations provided by Douvillé (1916) in the book by Sven Hedin (editor) about 'Southern Tibet' volume 5 and Sha et al. (2020). Our own data from the Upper Cretaceous Tielongtan Formation includes previously published research (e.g. Schlagintweit & Bintao, 2026; localities 1 and 2 in Fig. 1) and some newly collected rock samples (from Fig. 1, locality 3). The four localities (i.e., ours and that of Douvillé 1916) are all from an area ~10 to ~55 km west southwest of Aksai Chin Lake, some of them accessible via the China National Highway G219 (Fig. 1). The following discussion appears unevenly weighted, in favour of the Langshan Formation, which is solely due to the fact that much more literature is available about it compared with the Tielongtan Group.

RESULTS AND DISCUSSION

Biostratigraphic review of the Langshan Formation (Fig. 2)

Many samples collected by Hedin and from which thin-sections were prepared belong to the Aptian-Albian Langshan Formation (Douvillé, 1916, pl. IX, fig. 3, pl. X, figs. 1-3, pl. XI, fig. 1).

Referring to the orbitolinids, Douvillé (1916) mentioned *Orbitolina conoidea* Gras, *Orbitolina discoidea* Gras, and *Orbitolina bulgarica* Boué all regarded as junior synonyms of *Palorbitolina lenticularis* (Blumenbach) according to Schroeder (1963). This species would point to a late early Barremian to early Aptian age (Schroeder et al., 2010; Granier et al., 2013) although Marcoux et al. (1987) recorded *P. lenticularis* with mesorbitolinids in strata assigned to the late Aptian. The illustrations provided by Douvillé (1916) however appear undiagnostic even to generic level. The orbitolinid packstone illustrated by Douvillé (1916, pl. X, fig. 2) shows the often observed mixture of high-conical and flat-discoidal orbitolinid tests, the latter showing adult chambers bending upwards referred to as 'reflexed conico-concave' by Henson (1948, fig. 12k-l) (Fig. 2A). Although thin-sections of the megalospheric embryo are needed for genus and species identification (e.g. Schroeder, 1962), the flat-discoidal forms are generally best referred to *Palorbitolinoides hedini*, described from the Langshan Formation by Cherchi & Schroeder (1980). Some samples from the Langshan Formation show

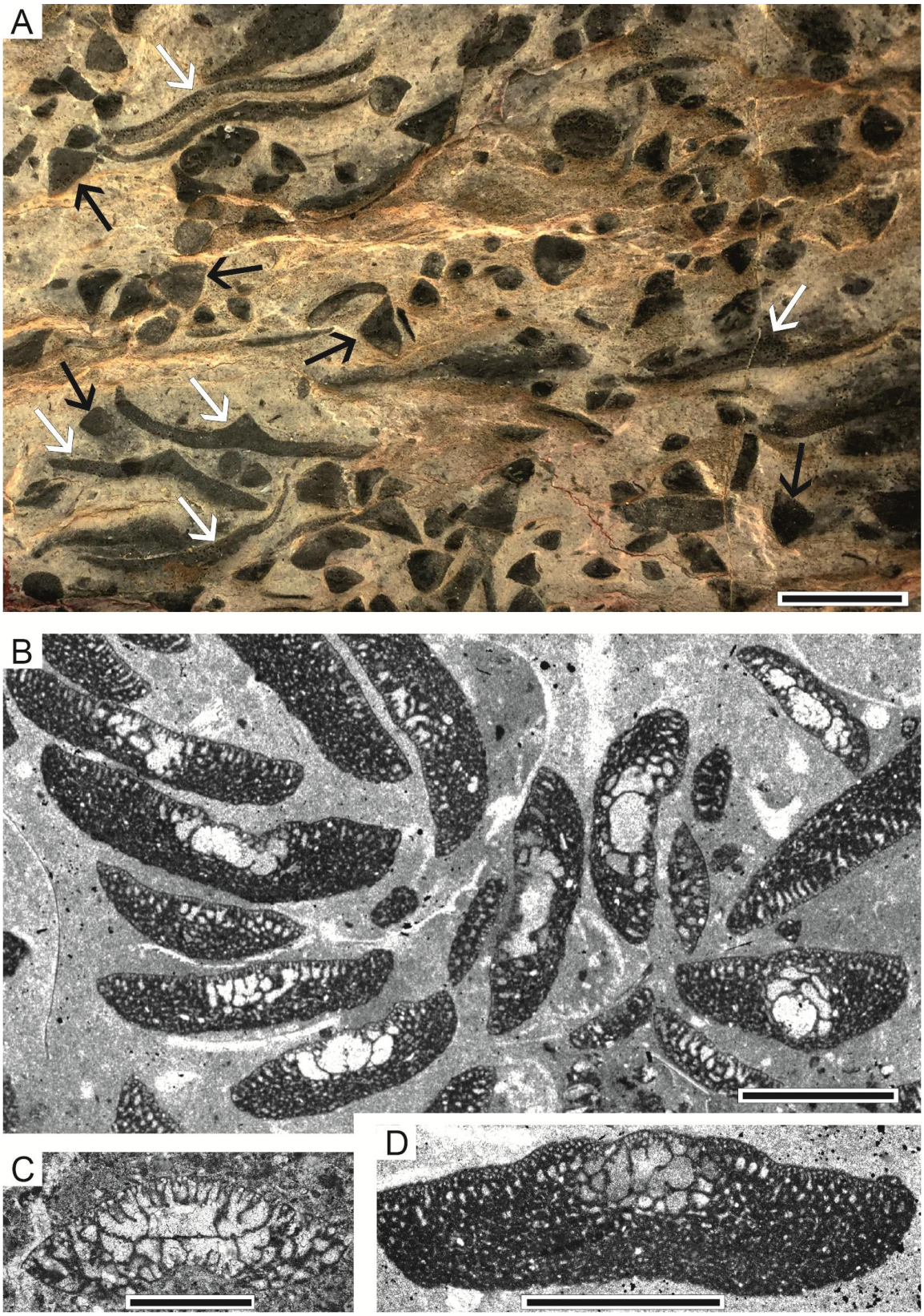

Figure 2. 'Calcaires à Orbitolines et à *Radiolites*': Aptian-Albian Langshan Formation. **A**. Weathered rock surface with abundant small high-conical (black arrows) and large often reflexed-conical orbitolinids (white arrows) (from Sun et al. 2025, fig. 1, Mendang section, Lhasa Terrane, scale bar = 1 cm). **B.** Monospecific assemblage of megalospheric specimens of *Palorbitolinoides pileus* (Fossa-Mancini) (from Schlagintweit 2024, fig. 2, Xiongmei section, Lhasa Terrane, see Xu et al. 2022, scale bar = 1 mm). **C**. *Mesorbitolina* cf. *aperta* (Erman), axial section of a megalospheric specimen, same locality as for B, scale bar = 0.5 mm. **D.** *Palorbitolinoides pileus* (Fossa-Mancini), subaxial section through the periembryonic chambers of a megalospheric specimen, same locality as in B and C, scale bar = 1 mm.

monospecific assemblages with taxa such as *Palorbitolinoides* (ex *orbiculatus*) *pileus* (Fossa-Mancini) (Fig. 2B, D). The high-conical forms can be assigned for example to different species of *Mesorbitolina* Schroeder (e.g. Rao et al., 2015; BouDagher-Fadel et al., 2017). An exact age cannot be given for the orbitolinids illustrated by Douvillé (1916), but the fact of their belonging to the Langshan Formation (from the northern part of the Lhasa Terrane) can thereby tentatively assume a general Aptian-Albian age. Based on samples from the 1901 and 1906 excursions of Sven Hedin, Weinberg & Green (2002, fig. 4b-d) illustrated some orbitolinids as '*Orbitolina* (*Mesorbitolina*) *texana* (= not determinable based on our assessment), *Orbitolina* (*Conicorbitolina*) *conica* (= *Mesorbitolina* gr. *tibetica-texana*) and *Orbitolina* (*Neorbitolinopsis*) *conulus* (= most likely *Mesorbitolina* gr. *tibetica-texana*).

Base of the Langshan Formation

Concerning the age data provided in the literature there are still some incongruencies especially referring to the base including Barremian parts. Baud et al. (1994) illustrated specimens of *Dictyoconus arabicus* Henson (= *Montseciella arabica*) from the northern part of the Lhasa Block from the Zigetang Formation, rarely mentioned in the literature. *M. arabica* is known from the late Barremian and ranging into the earliest Aptian (Schroeder et al., 2010, figs. 3, 10). This species appears to be very rare in the Langshan Formation and was illustrated also by Zhang (1991, pl. 2, figs. 5-6) as *Palaeodictyoconus* sp. and assigned to the late Aptian (Zhang, 1991, fig. 1). *Eopalorbitolina charollaisi* Schroeder was illustrated by Zhang (1991, pl. 2, fig. 4) and re-illustrated by Rao et al. (2015, fig. 14A). Zhang (1991, text-fig. 1) indicated a late Barremian age while Rao et al. (2015) concluded an early Barremian age. Interestingly, the mentioned specimen of '*E. charollaisi*' comes from the same sample (no. H31588) from which '*Mesorbitolina lhünzhubensis*' (Zhang, 1982) was also reported. *M. lhünzhubensis* was considered as a junior synonym of *Mesorbitolina tibetica* (Cotter) by Schlagintweit & Le Coze (2023), both taxa would distinctly exclude each other in time. *M. parva* (a junior synonym of *M. tibetica*) is known from the early late Aptian (Schroeder et al., 2010). In the stratigraphic chart of Cherchi & Schroeder (2013, fig.1) the range of '*M. parva*' is slightly different with a possible range into the latest early Aptian and thus overlapping with the one of *Praeorbitolina cormyi* Schroeder a species to which the section of '*E. charollaisi*' by Rao et al. (2015) might belong to and then would make sense in the overall stratigraphic context.

Top of the Langshan Formation

Concerning the age data provided in the literature there are some inconsistencies referring also to the top of the Langshan Formation including the part(s) attributed to the early Cenomanian based for example on the presence of *Orbitolina concava* (Lamarck), *Orbitolina qatarica* (Henson) (e.g. Ho et al., 1976; Zhang, 1994; Zhang et al., 2002, tab. 6, not figured) or conicorbitolinids (Ho et al., 1976; Yang et al., 1982; Zhang, 1982, 1994; Sun et al., 2015; BouDagher-Fadel et al., 2017; Xu et al., 2020). These records are either unconfirmed by record or misidentified. The material was reasonably considered to be of the *Palorbitolina ultima* - *Palorbitolinoides hedini* and/or *Praeorbitolina cormyi* - *Mesorbitolina aperta* lineages by Rao et al. (2017) and thus pre-Cenomanian (see also Bidgood et al., 2024, p. 37). Notably the assumed co-occurrence of some typical Albian taxa together with the early Aptian praeorbitolinids (BouDagher-Fadel et al., 2017, fig. 8) was also critically discussed by Schlagintweit (2021). Moreover the original description of *O. qatarica* by Henson (1948) included a mixture of taxa which comprised what is now *Mesorbitolina aperta* (Erman), a late Albian-middle Cenomanian taxon (Simmons et al., 2000; Bidgood et al. 2024; own observation).

In addition to the orbitolinids, BouDagher-Fadel et al. (2017) reported several taxa which suggested an early Cenomanian age namely *Nezzazata conica* (Smout) (fig. 12.10 not 12.11) and *Daxia cenomana* Cuvillier & Szakall (not illustrated). The specimen illustrated as *N. conica* belongs to *Nezzazatinella* ex gr. *picardi* (Henson), a long-ranging taxon (Simmons et al., 2025: late Barremian to top Maastrichtian). *Daxia cenomana* is already present in the Langshan Formation together with species of *Palorbitolinoides* (own observations), and therefore having its first appearance in the middle Albian (see also Simmons et al., 2025, p. 12). Zhang (1994, pl. 6, figs. 10-13) illustrated *Conicorbitolina* cf. *conica* (D'Archiac) from strata assigned to the late Albian. This species has a questionable latest Albian but verified early-middle Cenomanian range according to Schroeder & Neumann (1985, tab. 1). However, Zhang's specimen might also belong to *Conicorbitolina corbarica* Schroeder which is restricted to the latest Albian? - earliest Cenomanian (ibidem). In any case, it seems to be the only evidence for a possible ranging of the Langshan Formation into the early Cenomanian.

Biostratigraphic review of the Tielongtan Formation (Fig. 3)

Unlike the Langshan Formation, the available data from the Tielongtan Group do not allow for detailed differentiation between base and top. Of the rock samples studied by Douvillé (1916), sample no. 40 (limestone thin-section) and nos. 43-62 (rudist described as *Praeradiolites hedini* sp. nov.) are here considered to belong to the Tielongtan Group, specifically the mixed siliciclastic-carbonatic Dongluokezong Formation. These samples are from a locality ~37 km west of the Aksai

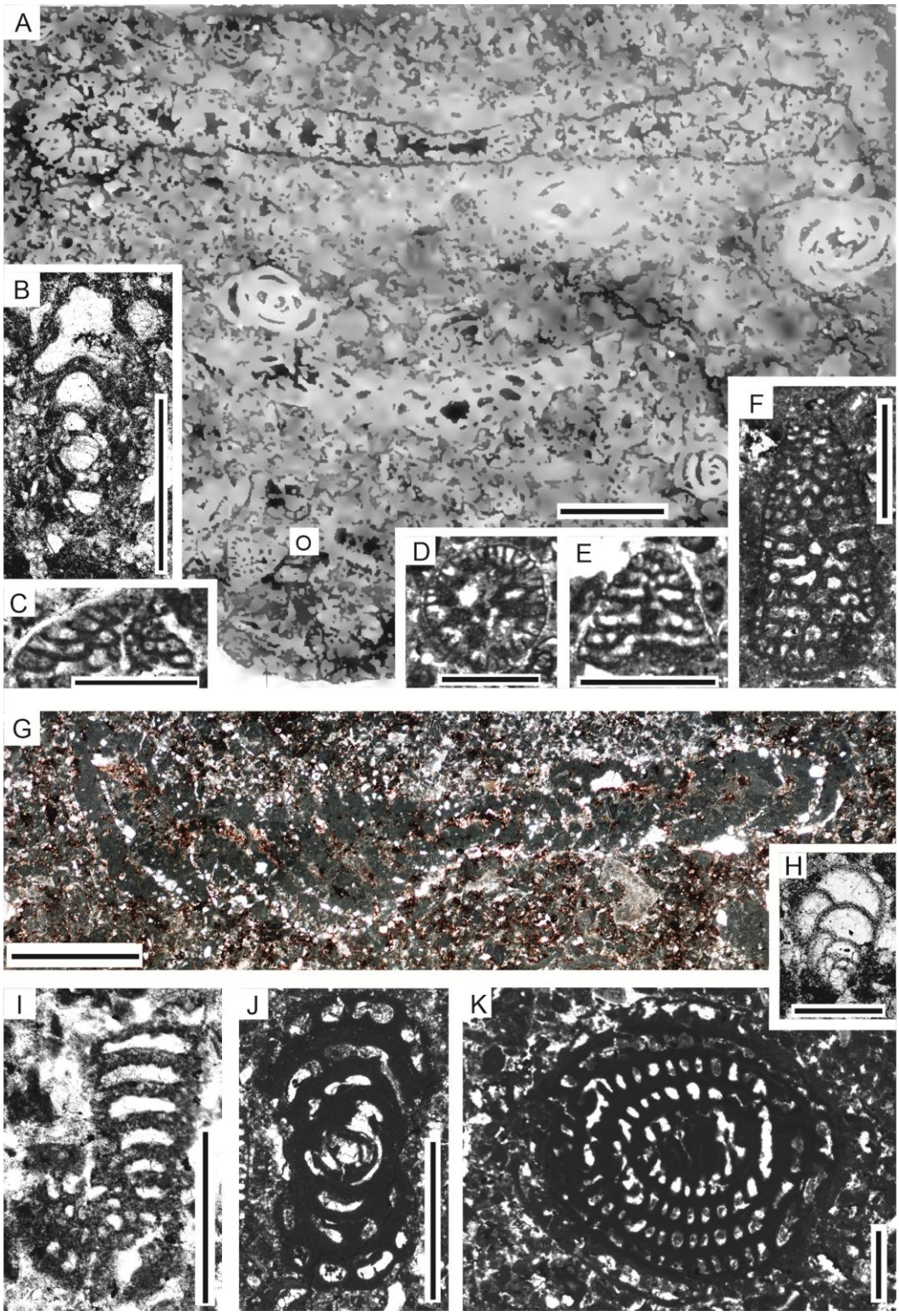

Figure 3. 'Calcaires á Orbitolines et à *Radiolites*': Campanian Tielongtan Group of the Aksai Chin area. **A**. Foraminiferan packstone with miliolids, orbitolinids (O) and '*Choffatella* ? n. sp.' in subaxial section (from Douvillé 1916, pl. IX, fig. 1, scale bar = 2 mm). **B.** *Charentia* cf. *cuvillieri* Neumann, slightly oblique axial section, locality 3, scale bar = 0.5 mm. **C.** *Dictyopselloides tarimiensis* Sun & Schlagintweit, tangential section, locality 3, scale bar = 0.5 mm. **D-E.** Orbitolinid *Abrardia mosae* (Hofker), slightly oblique transverse and subaxial sections (from Sha et al., 2020, figs. 9g and 10b), scale bars 0.5 mm. **F.** Orbitolinid *Calveziconus lecalvezae* Caus & Cornella in subaxial section, sample locality 1, scale bar 0.5 mm. **G.** Mixed carbonate-siliciclastic packstone with large-sized benthic foraminifera (compare with A) in oblique section, sample locality 3, scale bar = 2 mm. **H.** *Minouxia* cf. *lobata* Gendrot, axial section, locality 3, scale bar = 0.3 mm. **I.** *Braciana jelaskai* Schlagintweit & Cvetko Tešović, slightly oblique equatorial section; sample locality 3, scale bar = 0.5 mm. **J-K.** *Senalveolina aubouini* Fleury, axial and tangential sections, sample localities 1 and 2, scale bars = 0.5 mm. For sample localities see Figure 1B.

Chin Lake where this lithostratigraphic unit outcrops (Fig. 1B). Sample number 40 represents a foraminiferal packstone with miliolids, conical orbitolinids originally ascribed to *Orbitolina conulus* Douvillé and a large-sized *Choffatella*, probably a new species as emphasized by Douville (1916, pl. IX, figs. 1-3, pl. X) and was assigned to the Barremian (Fig. 3A). However, Schroeder (1965, p. 584), excluded Douvillé's specimens from *Neorbitolinopsis conulus* (Douvillé), a late Albian marker taxon (Schroeder, 1985, p. 584), and assumed that they belonged to Lower Cretaceous *Orbitolinopsis*, – a view previously discussed by Silvestri (1932, footnote p. 160) and Henson, 1948, p. 68). Notwithstanding this, all these authors accepted the Lower Cretaceous age (i.e., Barremian) as stated by Douvillé (1916). Recent investigations however have shown that some of the orbitolinids observed in the Tielongtan Group, are attributable to *Calveziconus lecalvezae* Caus & Cornella, an early-middle Campanian marker taxon (Sha et al., 2020; Schlagintweit & Gao, 2024). This conclusion refers to the inner structure of the specimens in question insofar as *C. lecalvezae* (the species to which the poorly illustrated and small-sized forms of Douvillé might belong) shows a similar pattern of cross-wise, oblique, diagonally running foramina as *Orbitolinopsis* and both were therefore thought to be very similar by Caus & Cornella (1982). However, in contrast to the Lower Cretaceous *Orbitolinopsis*, *Calveziconus* posseses regular rafters (one per chamber) in the marginal zone besides other differences (Fig. 3F).

The Barremian age proposed by Douvillé (and accepted by others – see above) was recently doubted by Sha et al. (2020, p. 253) and this view is discussed here. A few samples from the Tielongtan Group of the same mountain range and located about 34 km SE of Hedin's locality (Fig. 1B) show a similar microfacies, notably a foraminiferan packstone. The fauna includes miliolids, *Calveziconus lecalvezae* (Fig. 3F), other high-conical indeterminabile orbitolinids, *Cuneolina* gr. *parva* d'Orbigny, *Nezzazatinella* gr. *picardi* (Henson), *Murgeina apula* (Luperto Sinni), *Charentia* cf. *cuvillieri* Neumann (Fig. 3B), *Dictyopselloides tarimiensis* Sun & Schlagintweit (Fig. 3C), *Abrardia mosae* (Hofker) (Fig. 3D-E), *Minouxia* cf. *lobata* Gendrot (Fig. 3H), *Braciana jelaskai* Schlagintweit & Cvetko Tesovic (Fig. 3I), *Senalveolina aubouini* Fleury (Fig. 3J-K) and the same large-sized '*Choffatella*' sensu Douvillé (1916) (Figs. 3A, G). The latter however does not belong to the exclusively Lower-mid Cretaceous genus *Choffatella* Schlumberger but to a new taxon that is – like the orbitolinids currently under study. In the western Neotethys realm, *C. lecalvezae* is a typical early-middle Campanian taxon (Caus & Cornella, 1982 and Villalonga et al., 2019: Spain; Cvetko Tešović et al., 2001: Croatia). A further taxon that supports a Campanian age for the Tielongtan carbonates is by the alveolinoid *Senalveolina aubouini* Fleury. described from the Campanian of Greece (Fleury, 1984). The Tielongtan record is the first finding outside the Greek type-locality (Fig. 4). The relatively small-sized orbitolinid *Abrardia mosae* (Hofker) (Figs. 3D-E) is known from the Campanian-Maastrichtian interval (Hofker, 1955; Neumann & Damotte, 1960; Blanc & Neumann, 1975; Bilotte, 1984; Kennedy, 1986; Kennedy & Bilotte 2002) (see Fig. 4 for countries). Having also one rafter per chamber, like *C. lecalvezae*, but a different arrangement of the intraseptal foramina, *A. mosae* probably does not belong to the orbitolinids reported by Douvillè (1916) in his sample no. 40 (see above). The occurrence of *A. mosae* in the Tielongtan Group however is interesting not only from a biostratigraphic viewpoint but also palaeobiogeographically since *A. mosae* is known from the eastern palaeo-Atlantic coastline [Netherlands, Aquitaine (western France)] and the French Pyrenean Mountains (Fig. 4). *B. jelaskai* was originally described from the late Santonian?-early Campanian (Schlagintweit & Cvetko Tešović, 2016). The taxon was observed also in the Campanian-Maastrichtian of Mexico (Michaud 1987, pl. 13, figs. 1-8 as "*Pseudocyclammina* sp."). Other taxa such as *Minouxia* cf. *lobata* described by Gendrot (1963) from the late Santonian of southern France (Fig. 3H) or *Murgeina apula* (Luperto Sinni) described from the Upper Cretaceous of southern Italy (Luperto Sinni, 1969) have a greater stratigraphic range and are therefore not of specific importance in the case of the Tielongtan Group (e.g. Schlagintweit et al., 2023; Simmons & Bidgood, 2023). The total stratigraphic range of *Dictyopselloides tarimensis* Sun & Schlagintweit is unknown because the Tielongtan occurrence represents the first record outside its type-locality the Campanian Yigeziya Formation of the western Tarim Basin (Sun & Schlagintweit, 2024) (Fig. 4). Post-Cenomanian (notably Campanian) occurrences of *Charentia* cf. *cuvillieri* Neumann have so far been recorded only from Spain, Croatia, the Tarim Basin (Villalonga, 2009; Sun & Schlagintweit, 2024) and the Tielongtan Group (Sha et al., 2020, fig. 9C therein as *Navarella* sp.).

A preliminary comparison of the microfauna of the Tibetan Tielongtan Group and the Yigeziya Formation of the western Tarim Basin shows several shared species but more unique taxa reported in the former (Tab. 1). The reasons for this discrepancy may be facies controlled (e.g., proximal, distal) and/or due to limited sample material in the case especially for the Yigeziya Formation. The possible dispersal routes (East-West or West-East) refer to the two main prevailing oceanic current systems: the southern "westward circumglobal equatorial current system" (WCES) of the Neotethys and the northern more or less epicontinental "Eastward current system" (ECS) (see Hernández-Molina & Scotese, 2026) (Fig. 4).

The rudist specimens of *Praeradiolites hedini* were sampled at the locality where sample no. 40 had been obtained (Douvillé, 1916, p. 147). Notwithstanding Douvillé (1916) assigned sample no. 40 (see above) to

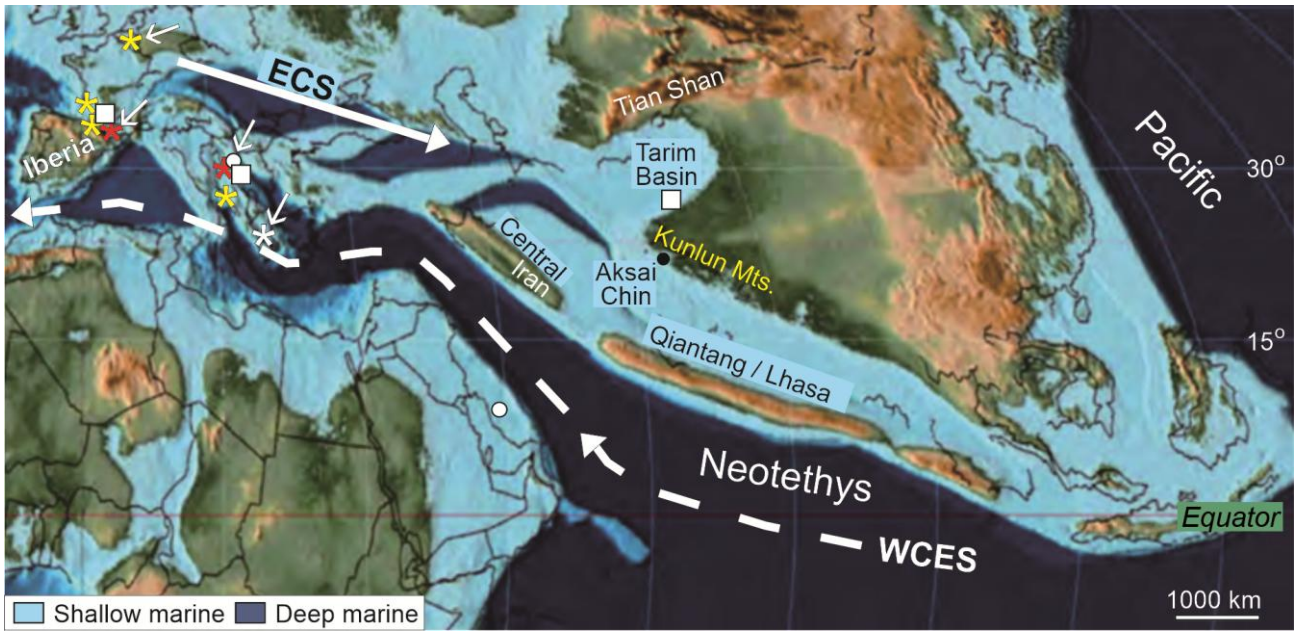

Figure 4. Palaeogeographic map of the Neotethys realm and its surroundings during Campanian times with approximate location of the Aksai Chin area (modified from Scotese 2016). The type-locality of *Senalveolina aubouini* Fleury (Fleury, 1984; white asterik), and the occurrences of *Calveziconus lecalvezae* Caus & Cornella (Caus & Cornella 1982, Bilotte 1984, Cvetko Tešović et al. 2002; red asteriks), *Braciana jelaskai* Schlagintweit & Cvetko Tešović (Schlagintweit & Cvetko Tešović, 2016; white dot), *Abradia mosae* (Hofker) (Hofker, 1955, Bilotte, 1984, Neumann & Damotte, 1960, Luperto Sinni & Richetti, 1978; yellow asteriks) and *Charentia* cf. *cuvillieri* Neumann (Campanian occurrences: Villalonga, 2009, Sun & Schlagintweit, 2024; white square). All type-localities are additionally marked by an arrow. References are included within the text. Note the two main oceanic current systems: the southern "westward circumglobal equatorial current system" (WCES) and the northern "Eastward current system" (ECS) adopted from Hernández-Molina & Scotese (2026).

Table 1. Microfauna (benthic foraminifera) of the Campanian Tielongtan Group compared (shared and unique taxa) with the Yigeziya Formation of the western Tarim Basin (see Sun & Schlagintweit, 2024).

Yigeziya Formation Tarim Basin	Tielongtan Group Aksai Chin Area
Shared taxa	
Charentia cf. *cuvillieri* Neumann, *Cuneolina* gr. *parva* Henson, *Dictyopselloides tarimensis* Sun & Schlagintweit, *Nezzazatinella* gr. *picardi* (Henson), *Tetrataxiella floriforma* Schlagintweit & Sanders	
Unique taxa	
possibly Orbitolinid indet. sensu Sun & Schlagintweit 2024	*Abrardia mosae* (Hofker), *Braciana jelaskai* Schlagintweit & Cvetko Tesovic, *Calveziconus lecalvezae* Caus & Cornella, Gen. et sp. indet. 1-4 (under study), *Minouxia* cf. *lobata* Gendrot, *Murgeina apula* (Luperto Sinni), *Senalveolina aubouini* Fleury

the late Barremian whereas those with *P. hedini* were assigned to the early Cenomanian based on its similarities to the Mediterranean *Eoradiolites* but without any confirming stratigraphic data. This apparent contradiction, is in any case irrelevant because of the presumed early-middle Campanian age of the Tielongtan Formation notably the carbonates. It is worth to mention that the Campanian represents the stage of the Cretaceous with the greatest diversity of rudists (Steuber & Löser, 2000, fig. 5). It is also important to note that based on rudists, an Aptian age was indicated for the base of the Tielongtan Group (Matte et al., 1996; Gou & Shi, 1998). The relationship between the specimens of *P. hedini* from the Aptian-Albian Langshan Formation (e.g. Scott et al., 2010; Rao et al., 2017) and the Campanian Tielongtan Group needs further study.

All samples studied from the shallow-water carbonates of the Tielongtan Group that yielded

stratigraphically important microfossils indicate a Campanian age. Concerning the top parts of the Tielongtan Group, an early Maastrichtian age was stated by Gao et al. (2025) based on findings of the rudist *Biradiolites boldjuanensis* Bobkova. Further study of this part of the Group would be desirable.

CONCLUSIONS

The informal 'Calcaires à Orbitolines et à *Radiolites*`of Douvillé (1916) were originally assumed to be exclusively Lower to mid-Cretaceous in age based on the presence of orbitolinids. Based on modern orbitolinid taxonomy and biostratigraphy, however, it can be shown that Douvillé's unit represents a mixture of two distinguishable lithostratigraphic units: the Langshan Formation of the Lhasa Terrane and the Tielongtan Group of the western part of the Qiangtang Terrane, both containing completely different orbitolinid assemblages respectively of Aptian-Albian and Campanian ages. Therefore, the name 'Calcaire à Orbitolines et à *Radiolites*' should be dropped. The presence of orbitolinids in the Tielongtan Group is still today incorrectly taken by some workers as an argument that the lower part might include Lower-mid-Cretaceous sediments. Therefore, further micropalaeontological and biostratigraphical investigations for both units are still desirable for refinement of the exact stratigraphic ranges, notably the base and the top that might be diachronous. First comparisons between the micropalaeontological content of the Tielongtan Group notably the Dongluokezong Formation and the roughly coeval Yigeziya Formation of the western Tarim Basin are further interesting topics for future research (e.g. common and unique taxa and their palaeobiogeographic relevance).

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REFERENCES

Baud, A., Cherchi, A. & Schroeder, R., 1994. *Dictyoconus arabicus* Henson (Foraminiferida) from the late Barremian of the Lhasa Block (Central Tibet). Rivista Italiana Paleont. Strat., 100 (3): 383-394.

Bidgood, M., Schlagintweit, F. & Simmons, M.D., 2024. The genus *Orbitolina* d'Orbigny, 1850 (larger benthic foraminifera) and its constituent species: Notes on identity and stratigraphic ranges. Acta Palaeontologica Romaniae, 20 (2): 33-59.

Bilotte, M., 1984. Les grands foraminifères benthiques du Crétacé Supérieur Pyrénéen. Biostratigraphie. Réflexion sur les corrélations Mésogéennes. Benthos '83, 2nd Int. Symp. Benthic Foraminifera (Pau, April 1983): 61-67.

Blanc, P.-I. & Neumann, M., 1975. Précisions sur le genre *Abrardia* Neumann et Damotte. Revue de Micropaléontologie, 17 (4): 159-163.

BouDagher-Fadel, M., Hu, X., Price, G.D., Sun, G., Wang, J.-G. & An, W., 2017. Foraminiferal biostratigraphy and palaeoenvironmental analysis of the mid-Cretaceous limestones in the southern Tibetian Plateau. Journal for Foraminiferal Res., 47 (2): 188-207.

Bureau of Geology and Mineral Resources Xinjiang Autonomous Region (1999) - Lithostratigraphy of the Xinjiang Autonomous Region (in Chinese). Wuhan, China University of Geosciences Press: 1-430.

Caus, E. & Cornella, A., 1982. *Calveziconus lecalvezae* n. gen. n. sp., Orbitolinidé Campanien de la bordure méridionale des Pyrénées. Cahiers de Micropaléontologie, 4: 27-34.

Cherchi, A. & Schroeder, R., 1980. *Palorbitolinoides hedini* n. gen. n. sp., grand foraminifère du Crétacé du Tibet méridional. Comptes Rendus hebdomadaires des Séances de l'Académie des Sciences, série D. 291: 385-388.

Cherchi, A. & Schroeder, R., 2013. The *Praeorbitolina*/*Palorbitolinoides* Association: An Aptian biostratigraphic key-interval at the southern margin of the Neo-Tethys. Cretaceous Research, 39: 70-77.

Cotter, G. De P., 1929. Some Orbitolinae from Tibet. India. Records of the Geological Survey of India, 61: 350-357.

Cvetko Tešović, B., Gušić, B., Jelaska, V. & Bucković, D., 2001. Stratigraphy and microfacies of the Upper Cretaceous Pučišća Formation, Island of Brač, Croatia. Cretaceous Research, 22 (5): 591-613.

Douvillé, H., 1912. Les Orbitolines et leurs enchaînements. Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, 155: 567-571.

Douvillé, H., 1916. Les calcaires à orbitolines et à Radiolites du Thibet. In: Hedin, S. (Ed.), Southern Tibet. Discoveries in former times compared with my own researches in 1906–1908. Stockholm, vol. 5: 145-147.

Finkelstein, G., 2000. Conquerors of the Künlün? The Schlagintweit mission to High Asia, 1854-1857. History of Science, 38 (2): 179-218.

Fleury, J.J., 1984. *Senalveolina aubouini* n. gen. n. sp., Alveolinidae nouveau du Sénonien de Grèce. Revue de Micropaléontologie, 27 (3): 171-188.

Fossa-Mancini, E., 1928. Foraminifere del calcare grigio di Sciusciùl (Lago Pancong). Spedizione Italiana De Filippi nell'Himàlaia, Caracorùm e Turchestàn Cinese (1913-1914), Ser. 2 6: 189-223.

Gaetani, M., Gosso, G. & Pognante, U., 1990. A geological transect from Kun Lun to Karakorum (Sinkiang, China): the western termination of the Tibetan Plateau. Preliminary note. Terra Nova, 2 (1): 23-30.

Gao, B.T., Zhang, Q.-H., Ding, L., Zhang, H.-J. & Fang, P.-Y., 2023. Age of the latest marine sedimentation in the western Kunlun area constrained by planktic foraminifera. Palaeoworld, 32 (3): 490-508.

Gao, B.T., Zhang, Q., Rao, X. & Ding, L., 2025. Persistence of a shallow-marine environment in the western Kunlun area (northwestern Tibet) until the early Maastrichtian: Evidence from radiolitid rudist bivalves. Cretaceous Research, 167: 106035.

Gendrot, C., 1963. Quelques foraminifères nouveaux du Sénonien inférieur des Martigues (Bouches-du-Rhône). Revue de Micropaléontologi, 6 (1): 67-72.

Gou, Z.H. & Shi, H., 1998. Rudists (Bivalvia) from the Cretaceous of Tibet, China, with descriptions of new species. In: Johnson, P.A. & Haggart, J.W. (Eds), Bivalves: an eon of evolution – paleobiological studies honoring Norman D. Newell, University of Calgary Press: 255-266.

Granier, B., Clavel, B., Moullade, M., Busnardo, R., Charollais, J., Tronchetti, G. & Desjaques, P., 2013. L´Estellon (Baronnies, France), a "Rosetta Stone" for the Urgonian biostratigraphy. Carnets de Géologie, Article 2013/04 (CG 2013_A04): 139-183.

Henson, F.R.S., 1948. Larger imperforate Foraminifera of south-western Asia. Families Lituolidae, Orbitolinidae and Meandropsinidae. Monograph British Museum (Natural History): 1-127.

Hernández-Molina, F.J. & Scotese, Ch.R., 2026. Mesozoic and Cenozoic oceanic gateway evolution and global tectonics: palaeoceanographic and sedimentary implications. Geological Society, London, Spec. Pub., 533 (1): https://doi.org/10.1144/gslspecbub2025-10

Hofker, J., 1955. Foraminifera from the Cretaceous of southern Limburg, Netherlands. IX: *Dictyoconus mosae* nov. spec.. Natuurhistorisch Maandblad, Limburg, 44 (11-12): 115-117.

Ho, Y., Zhang, P.K., Hu, L. & Sheng, J., 1976. Mesozoic and Cenozoic foraminifera from the Mount Jolmo Lungma region. In: Scientific investigation to the Mount Jolmo Lungma region (1966–1968), Paleontology. Scientific Publishing House, China: 1-76.

Kennedy, W.J., 1986. Campanian and Maastrichtian ammonites from northern Aquitaine, France. Special Papers in Palaeontology, 36: 1-145.

Kennedy, W.J. & Bilotte, M., 2002. *Baculites ovatus* Say, 1820, a North American ammonite from the Maastrichtian of Roquefort, Landes, France. N. Jb. Geol. Paläont. Mh., 2002 (3): 159-170.

Löser, H. & Liao, W., 2001. Cretaceous corals from Tibet (China) – stratigraphic and palaeobiogeographic aspects. Journal of Asian Earth Sciences, 19 (5): 661-667.

Luo, Y.P., 2010. An Preliminary Study of Origins of Red-white Limestone of Late Cretaceous' Tielongtan Group, Aksai Chin Lake Areas, Northwest Tibet (M.A. Thesis). China University of Geosciences, Beijing: 1-63 (in Chinese with English abstract).

Luperto Sinni, E., 1969. *Nummofallotia apula* n. sp. Foraminifero del Cretaceo superiore delle Murge. Bollettino della Società dei Naturalisti in Napoli, 77 (1968): 93-101.

Luperto-Sinni, E. & Ricchetti, G., 1978. Studio micropaleontologico-stratigrafico di una successione carbonatica del Cretaceo Superiore rilevata nel sottosuolo delle Murge Sud-Orientali. Rivista Italiana di Paleontologia e Stratigrafia, 84 (3): 561-666.

Marcoux, J., Girardeau, J., Fourcade, E., Bassoullet, J.E.P., Philip, J.M., Jaffrezo, M., Xuchan, X. & Cengfa, C., 1987. Geology and biostratigraphy of the Jurassic and lower Cretaceous series to the north of the Lhasa Block (Tibet, China). Geodinamica Acta, 1: 313-325.

Matte, P., Tapponnier, P., Arnaud, N., Bourjot, L., Avouac, J.P., Vidal, P., Liu, Q., Pan, Y. & Wang,Y., 1996. Tectonics of Western Tibet, between the Tarim and the Indus. Earth and Planetary Science Letters, 142: 311-330.

Michaud, F., 1987. Stratigraphie et Paléogéographie du Mésozoïque du Chiapas (Sud-est du Mexique). Memoires de Stratigraphie, 6: 1-301.

Mu, X., 1982. Some Calcareous Algae from Xizang. Palaeontology of Xizang, Book V, 205-240.

Mu, X., 1986. Lower Cretaceous calcareous algae from Xainza and Baingoin, N. Xizang. Bulletin of Nanjing Institute of Geology and Paleontology, Academia Sinica, 10: 79-99. (In Chinese with English abstract).

Neumann, M. & Damotte, R., 1960. *Abrardia*, nouveau genre du Crétacé Supérieur d'Aquitaine. Revue de Micropaléontologie, 3: 60-64.

Pan, G.T., Ding, J., Yao, D.S. & Wang, LQ., 2004. Guide Book of 1:1,500,000 Geologic Map of the Qinghai Xizang (Tibet) Plateau and Adjacent Areas. Cartographic Publishing House, Chengdu: 1-148.

Parona, C.F., 1917. Faune cretaciche del Caracorum e degli Altipiani tibetani. Rendiconti Reale Accademia dei Lincei, 26: 53-57.

Rao, X., Skelton, P.W., Sha, J., Cai, H.W. & Iba, Y., 2015. Mid-Cretaceous rudists (Bivalvia: Hippuritida) from the Langshan Formation, Lhasa Block, Tibet. Papers in Paleontology, 1 (4): 401-424.

Rao, X., Skelton, P.W., Sano, S.-I., Li, C., Pan, Y., Luo, H., Cai, H., Peng, B. & Sha, J., 2017. Evolution and palaeogeographical dispersion of the radiolitid rudist genus *Auroradiolites* (Bivalvia, Hippuritida) with

descriptions of new material from Tibet and archived specimens from Afghanistan. Papers in Palaeontology, 3 (2): 297-315.

Robinson, A.C., Yin, A., Manning, C.E., Harrison, T.M., Zhang, S. & Wang, X., 2004. Tectonic evolution of the northeastern Pamir: constraints from the northern portion of the Cenozoic Kongur Shan extensional system, western China. Geological Society of America Bull., 116 (7-8): 953-973.

Robinson, A.C., Ducea, M. & Lapen, T.J., 2012. Detrital zircon and isotopic constraints on the crustal architecture and tectonic evolution of the northeastern Pamir. Tectonics, 31: TC2016, doi:10.1029/2011TC003013.

Schlagintweit, F., 2021. Orbitolinids and other larger benthic foraminifera from the Aptian-Albian of Tibet: Critical discussion of some recently published data. Acta Palaeontologica Romaniae, 18 (1): 17-23.

Schlagintweit, F., 2022. Late Cretaceous Orbitolinidae (Larger Benthic Foraminifera): Taxonomy, determination, biostratigraphy and palaeobiogeography. Newsletters on Stratigraphy, 55 (4): 427-450.

Schlagintweit, F., 2024. Nomenclatural status of *Orbitolina pileus* Fossa-Mancini, 1928 (Foraminifera) from the Lower Cretaceous of the Himalaya. Historical Biology, 36 (7): 1295-1301.

Schlagintweit, F. & Cvetko Tešović, B., 2016. *Braciana jelaskai* n. gen., n. sp., a new larger benthic foraminifera from the Upper Cretaceous (Santonian?-lower Campanian) of the Dinaric-Hellenic realm. Cretaceous Research, 72: 32-38.

Schlagintweit, F. & Gao, B., 2026. *Fundalutum tielongtanensis* isp. nov., the first record of anomuran microcoprolites from the Upper Cretaceous Tielongtan Group of the Western Kunlun area, NW Tibet. Ichnos, doi: 10.1080/10420940.2026.2629803

Schlagintweit, F. & Le Coze, F., 2023. *Orbitolina tibetica* Cotter, 1929 and *Tibetella tibetica* Zhang, 1994: taxonomic review of two 'lost' orbitolinids (Foraminifera) from the Lower Cretaceous of Tibet. Revue de Micropaléontologie, 81: 10728.

Schlagintweit, F. & Li, X., 2024. Enhanced juvenile mortality of orbitolinids (larger benthic foraminifera) in the late early Aptian of the Langshan Formation, Tibet: a possible link to OAE1? Lethaia, 57 (4): 1-15.

Schlagintweit, F., Yazdi-Moghadam, M. & Cvetko Tesovic, B., 2023. Upper Cretaceous foraminifera *Murgeina apula* (Luperto Sinni, 1968): A Methusalem and Cenomanian-Turonian boundary survivor taxon. Acta Palaeontologica Romaniae, 19 (2): 25-38.

Schroeder, R., 1962. Orbitolinen des Cenomans Südwesteuropas. Paläontologische Zeitschrift, 36 (3-4): 171-202.

Schroeder, R., 1965. *Neorbitolinopsis* n. gen. und ihre systematische Stellung innerhalb der Orbitoliniden (Studien über primitive Orbitolinidae II). Eclogae Geologicae Helvetiae, 58 (1): 579-589.

Schroeder, R., 1985: *Neorbitolinopsis conulus* (H. Douvillé), 1912. In: Schroeder R. & Neumann M. (coords.), Les grands Foraminifères Moyen de la région Méditerranénne, Geobios, mém. Spéc., 7: 50-52.

Schroeder, R. & Neumann, M., 1985. Les grands Foraminifères Moyen de la région Méditerranénne, Geobios, mém. Spéc., 7: 1-160.

Schroeder, R., Van Buchem, F.S.P., Cherchi, A., Baghbani, D., Vincent, B., Immenhauser, A. & Granier, B., 2010. Revised orbitolinid biostratigraphic zonation for the Barremian–Aptian of the eastern Arabian Plate and implications for regional stratigraphic correlations. GeoArabia Spec. Publ., 4: 49-96.

Scott, R.W., Wan, X., Sha, J. & Wen, S., 2010. Rudists of Tibet and Tarim Basin, China: significance to Requieniidae phylogeny. Journal of Paleontology, 84 (3): 444-465.

Scotese, Ch.R., 2016. PALEOMAP PaleoAtlas for GPlates and the PaleoData Plotter Program, PALEOMAP Project. http://www.scotese.com

Sha, J. & Cestari, R., 2016. Late Aptian–Albian Yasin-type rudist assemblage in the Himalayas: palaeobiogeographic implications. Cretaceous Research, 65: 34-47.

Sha, J., Fabbi, S., Cestari, R. & Consorti, L., 2020. Stratigraphic and taxonomic considerations on the Late Cretaceous rudist fauan of Aksai Chin (Western Tibet, China) from the De Filippi Collection. Carnets de Geologie, 20 (13): 249-272.

Silvestri, A., 1932. Foraminiferi del Cretacea della Somalia. Palaeontographica Italica, n. ser., 32: 143-204.

Simmons, M.D.,Whittaker, J.E.& Jones, RW., 2000. Orbitolinids from Cretaceous sediments of the Middle East—a revision of the F.R.S. Henson and associated collection. In: Hart, M.B. & Smart, C.W. (Eds.), Proceedings of the Fifth International Workshop on Agglutinated Foraminifera. Gybrowski Foundation Special Publication, 7: 411-437.

Simmons, M.D., Bidgood, M., Consorti, L. & Schlagintweit, F., 2025. A review of the identity of and biostratigraphy of Cenomanian "larger" benthic foraminifera: Part 1 – the Nezzazatoidea. Acta Paleontologica Romaniae, 21 (1): 5-57.

Steuber, Th. & Löser, H., 2000. Species richness and abundance patterns of Tethyan Cretaceous rudist bivalves (Mollusca: Hippurtitacea) in the central-eastern Mediterranean and Middle East, analysed from a palaeontological database. Palaeogeogr., Palaeoclimatol., Palaeoecol., 162: 75-104.

Sun, Q. & Schlagintweit, F., 2024. First record of Upper Cretaceous (Campanian?) larger benthic foraminifera from the Yigeziya Formation of the southwestern

Tarim Basin, China. Acta Palaeontologica Romaniae, 20 (2): 131-144.

Sun, Q., Schlagintweit, F. & Li, X., 2025. New records of Dasycladales (green algae) from the Aptian-Albian Langshan Formation of Tibet. Comptes Rendus Palevol, 24 (20): 381-395.

Sun, G., Hu, X., Sinclair, H.D., BouDagher-Fadel, M.K. & Wang, J., 2015. Late Cretaceous evolution of the Coqen Basin (Lhasa terrane) and implications for early topographic growth on the Tibetan Plateau. GSA Bulletin, 127 (7-8): 1001-1020.

Sun, H., Ouyang, H., Wu, Y. & Zhang, Y., 2023. Sulfide Pb-Zn mineralization in the Tianshuhai terrane, northwest Tibetan Plateau: A case study of the Huoshaoyun Pb-Zn deposit. Ore Geology Reviews, 163: 105789.

Villalonga, R.V., 2009. Los Macroforaminíferos de la Plataforma Campaniense sur del margen de la Cuenca Pirenaica (Unidad Surpirenaica Central, NE de la Península Ibérica). PhD Thesis University of Barcelona: 1-216.

Villalonga, R.V., Boix, C., Frijia, G., Parente, M., Bernaus, J.M. & Caus, E., 2019. Larger foraminifera and strontium isotope stratigraphy of middle Campanian shallow-water lagoonal facies of the Pyrenean Basin (NE Spain). Facies, 65: 20.

Weinberg, R.F. & Green, O.R., 2002. The Central Asiatic (Tibet, Xinjiang, Pamir) petrological collections of Sven Hedin (1865-1952) – Swedish explorer and adventurer. Journal of Asian Earth Sci., 20: 297-308.

Wen, Y., 1983. Cretaceous gastropod assemblages from Xizang (Tibet) with reference to their paleozoologeographical significance. Bolletino della Società Paleontologica Italiana, 22 (1-2): 179-183.

Wen, S.X., Sun, D.L., Yin, J.X., Chen, T.E. & Luo, H., 2000. Stratigraphy. In: Comprehensive Scientific Expedition to the Tibetan Plateau, Chinese Academy of Sciences (Ed.), Geological evolution of the Karakorum-Kunlun Mountains, Science Press, Beijing: 6-92 (in Chinese).

Xi, D., Wan, X., Li, G. & Li, G., 2019. Cretaceous integrative stratigraphy and timescale of China. Science China Earth Sciences, 62 (1): 256-286.

Xi, D., Li, G., Jiang, S., Rao, X., Jiang, T., Wang, T., Qin, Z., Wang, Y., Jia, J., Kamran, M., Shi, Z., Wu, Y., Wang, P., Sun, L., Zeng, Q. & Wan, X., 2024. Cretaceous integrative stratigraphy, biotas, and paleogeographical evolution of the Qinghai-Tibetan Plateau and its surrounding areas. Science China Earth Sciences, 67: 1229-1289.

Yin, A. & Harrison, T.M., 2000. Geologic Evolution of the Himalayan–Tibetan Orogen. Annual Review of Earth Planetary Sciences, 28: 211-280.

Xu, Y.W., Hu, X.M., BouDagher-Fadel, M.K., Sun, G.Y., Lai, W., Li, J. & Zhang, S.J., 2020. The major Late Albian transgressive event recorded in the epeiric platform of the Langshan Formation in central Tibet. In: Wagreich, M., Hart, M.B., Sames, B. & Yilmaz, I.O. (Eds.), Cretaceous Climate Events and Short-Term Sea- Level Changes. Geological Society, London, Spec. Pub., 498: 211-232.

Xu, Y.W., Hu, X., Garzanti, E., BouDagher-Fadel, M., Sun, G., Lai, W. & Zhang, S., 2022. Mid-Cretaceous thick carbonate accumulation in Northern Lhasa (Tibet): eustatic vs. Tectonic Control? GSA Bull., 134: 389-404.

Zhang, B.G., 1982. *Orbitolina* (Foraminifera) from Xizang. In: The series of the scientific expedition to the Qinghai–Xizang (Tibet) Plateau, Paleontology of Xizang (Tibet), 4, Science Press, Beijing: 51-80 (in Chinese with English abstract).

Zhang, B.G., 1986. Early Cretaceous Orbitolinids from Xainza and Baingoin, Xizang. Bulletin of Nanjing Institute of Geology and Palaeontology, Academia Sinica, 8: 101-122 (in Chinese with English abstract).

Zhang, B.G. (1994) - Cretaceous larger foraminifera orbitolines from Ngari, Western Xizang (Tibet). In: Sun, D.L. et al. (Eds,), Stratigraphy and palaeontology of Permian, Jurassic and Cretaceous from the Rutog region, Xizang (Tibet). Nanjing University Press: 68-87 (in Chinese with English abstract).

Zhang, K.J., 2000. Cretaceous palaeogeography of Tibet and adjacent areas (China): tectonic implications. Cretaceous Res., 21: 23-33.

Zhang, K.J., 2002: Mesozoic-Paleogene sedimentary facies and paleogeography of Tibet, western China: tectonic implications. Geological Journal, 37: 217-246.

Zhang, H.J., 2007. Sedimentary geology of the Upper Cretaceous Tielongtan Group, Karakoram and West Kunlun Mountains (Postdoctoral Report). Institute of Geology and Geophysics, Chinese Academy of Sciences, 103 pp. (in Chinese with English abstract).