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## Late Barremian–early Aptian charophytes from the Arrifes section (Algarve). Biostratigraphy and correlation with marine domain

### Carófitas do Barremiano Superior–Aptiano Inferior da secção dos Arrifes (Algarve). Bioestratigrafia e correlação com o domínio marinho

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**Sumário:** A secção estratigráfica dos Arrifes (Albufeira, Algarve) foi estudada, em detalhe, para bioestratigrafia de carófitas. Este estudo permitiu-nos reconhecer duas associações distintas: i) A primeira, composta por *Echinochra lazarii*, *Atopchara trivolis triquetra*, *A. trivolis trivolis*, *Clavator grovesii jiuquanensis*, *Clavator harrisii harrisii* e *C. harrisii zavalensis*, pertence à biozona de *Clavator grovesii* var. *jiuquanensis* do Barremiano superior–Aptiano inferior da Eurásia; ii) A segunda, com *A. trivolis trivolis*, *Clavator grovesii corrugatus* e *C. harrisii zavalensis*, é atribuída à biozona de *Clavator grovesii* var. *corrugatus* do Aptiano superior–Albiano médio. Estas biozonas de carófitas correlacionam-se com dados de palinórfos publicados recentemente. Com base nessa correlação, a base da Zona *Corrugatus* é atribuída ao Aptiano inferior, considerando a sua ocorrência em estratos que contêm quistos do dinoflagelado *Odontochinia operculata*, pelo que é um pouco mais antiga do que se pensava previamente.

**Key words:** Charophyta, Clavatoraceae, Lower Cretaceous, biochronology, Iberia

**Palavras-chave:** Charophyta, Clavatoraceae, Cretáceo Inferior, biocronologia, Iberia

Charophyte fructifications (utricles) of the family Clavatoraceae are one of the main fossils used for the biostratigraphic characterization of the Lower Cretaceous non-marine record (e.g., Grambast, 1974; Riveline et al. 1996). However, only in few cases, these continental biozones could be correlated with the coeval marine domain (e.g., Martín-Closas et al., 2009), which are those used as standard biozones.

The present work studied the charophyte succession in the Arrifes section (Algarve Basin). The section is ca. 200 m-thick and it is composed of the interbedding of marine and continental facies that contain marine and continental palynomorphs, including spores, pollen grains and dinoflagellate cysts, being the latter used as biostratigraphic markers (Mendes et al., 2023).

The present work is focused on the charophyte succession in this stratigraphic section with the

objective of correlate it with the dinoflagellates. Two charophyte assemblages, with biostratigraphic interest are distinguished. The lower one is between the 65 and 135 m, and is formed by *Echinochra lazarii*, *Atopchara trivolis* var. *triquetra* and *A. trivolis* var. *trivolis*, *Clavator grovesii* var. *jiuquanensis* (and few, <5% *C. grovesii* var. *corrugatus*), *Clavator harrisii* var. *harrisii*, and *C. harrisii* var. *zavalensis* (Fig. 1A–F). This association belongs to the late Barremian–early Aptian Eurasian Jiuquanensis biozone (Pérez-Cano et al. 2022), and to the late early Barremian–early Aptian European *Asciadiella cruciata*-*Pseudoglobator paucibracteatus* biozone (Martín-Closas et al., 2009; Pérez-Cano et al., 2022). The charophyte assemblage is found in beds with *Subtilisphaera scabrata* (early–earliest late Barremian) and *Odontochinia operculata* (late Barremian upwards) dinoflagellate cysts.

The upper assemblage is found from the 135m upwards and includes *Atopochara trivolvis* var. *trivolvis*, *Clavator grovesii* var. *corrugatus* populations, and *C. harrisii* var. *zavialensis* (Fig. 1G–L). This biozone was associated to the late Aptian–middle Albian (Riveline et al. 1996). In the Arrifes section this assemblage is found interbedded in levels with *O. operculata* dinoflagellate cyst. The top of this dinoflagellate cyst biozone is in the First Occurrence (FO) of the *Criboperidinium teuniceras* (Leereveld, 1997). Thus, according to the data given in the early Aptian stratotype, where the FO of this dinoflagellate cyst is correlated with the standard ammonite biozonation (Masure et al., 1998), the FO of this

species is in the early–late Aptian boundary, at the base of *Furcata* ammonite biozone. Thus, following the dinoflagellate correlation against ammonites, the base of the *Corrugatus* biozone must be early Aptian. Martín-Closas et al., (2009) found charophytes of the *Jiuquanensis* and *Cruciata-Paucibracteatus* biozones in levels that are correlated with the early Aptian *Weisii* (present-day *Forbesii*) ammonite biozone. This data encloses the base of the *Corrugatus* biozone to the interval between *Forbesii* and *Furcata* biozones. This is the first time that charophyte biozones and dinoflagellate cysts are correlated. More studies are needed to establish with higher precision the base of the *Corrugatus* biozone.

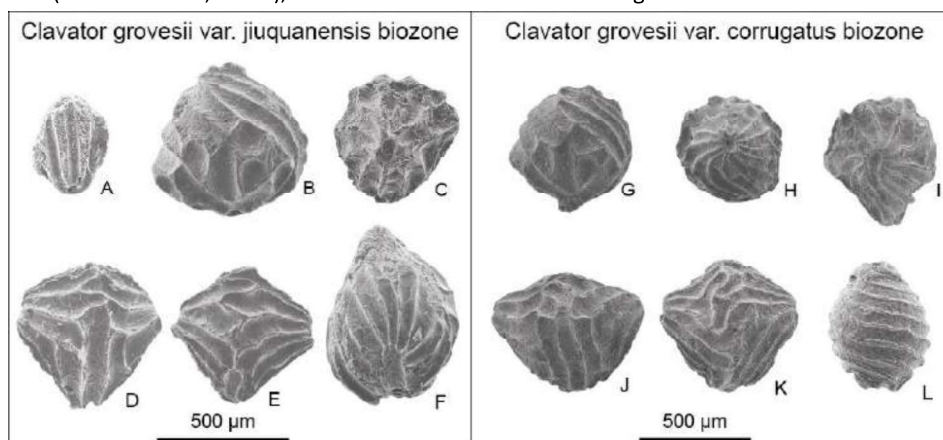


Fig. 1. Charophytes (fructifications) from the Arrifes section. A–F) Species of the *Jiuquanensis* biozone. A) *Echinochara lazarii*; B) *Atopochara trivolvis* var. *triquetra*. C–E) *Clavator grovesii* var. *jiuquanensis*. C) Lateral view; D) Adaxial view; E) Abaxial view. F) *Clavator harrisii* var. *harrisii*. G–L) Species of the *Corrugatus* biozone. G) *Atopochara trivolvis* var. *trivolvis*; H–K) *Clavator grovesii* var. *corrugatus*. H–I) Lateral views; J) Adaxial view; K) Abaxial view. L) *Clavator harrisii* var. *zavialensis*. All the samples will be housed at Museu Geológico de Lisboa.

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