

Short note

Cyclotella alvarniensis (Stephanodiscaceae): Modern or fossil diatom?

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Abstract. *Cyclotella alvarniensis* is considered a fossil species of diatom from the Upper Miocene. The occurrence of this species is usually associated with the proximity of diatomite exploitation areas. Frustules have been found in some regions of Spain (Murcia-Albacete), France, Switzerland, and recently in Senegal. However, the causes of their aerial dispersal and their geographical distribution are not clear. During a diatom monitoring and dispersal study carried out in the Sant Llorenç del Munt i l'Obac Natural Park (Barcelona, Spain), we recorded the presence of *C. alvarniensis* frustules for the first time in Catalonia. Specifically, they were found in four different types of substrates: on running water biofilm, artificial pools or mesocosms, natural disconnected pools and rehydrated dry sediments. Given the forms of occurrence of *C. alvarniensis* in our samples and the absence of nearby diatomite deposits, we discuss the possibility that it is also an extant species in freshwater diatom communities.

Keywords. Diatom, diatomite, fossil, Sant Llorenç del Munt i l'Obac Natural Park.

Resumen. *Cyclotella alvarniensis* es considerada una especie fósil de diatomea del Mioceno Superior. La presencia de esta especie suele estar asociada a su proximidad a zonas de explotación de diatomita. Se han encontrado frústulas en algunas regiones de España (Murcia-Albacete), Francia, Suiza y recientemente en Senegal. Sin embargo, las causas de su dispersión aérea y su distribución geográfica no están claras. Durante un estudio de seguimiento y dispersión de diatomeas realizado en el Parque Natural de Sant Llorenç del Munt i l'Obac (Barcelona, España), registramos la presencia de *C. alvarniensis* por primera vez en Cataluña. Concretamente, aparecieron en cuatro tipos distintos de sustratos: sobre biopelículas de agua corriente, pozas artificiales o mesocosmos, pozas naturales desconectadas y sedimento rehidratado. Dadas las formas de aparición de *C. alvarniensis* en nuestras muestras y a la ausencia de depósitos de diatomita cercanos, discutimos la posibilidad de que también sea una especie actual de las comunidades de diatomeas de agua dulce.

Palabras clave. Diatomea, diatomita, fósil, Parque Natural de Sant Llorenç del Munt i l'Obac.

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Cyclotella alvarniensis (Wuthrich) Straub & Aboal is considered a fossil species of the centric order with a very characteristic triangular shape with rounded poles and an irregular central space (Fig. 1). The first record of *C. alvarniensis* was from samples collected in the “Tourbière du Cachot” (Switzerland), where several fossil species were found (Wuthrich 1979). It was initially named as *Fragilaria leptostauron* var. *alvarniensis* Wuthrich, a former synonym of *C. alvarniensis*. To verify the origin of this diatom, they placed aerial traps on the peat bog and concluded that *C. alvarniensis* frustules, along with other fossil species, came from nearby dumpsites. According to their hypothesis, some residues with diatomite, such as electrical appliances, were responsible for releasing fossil diatoms

into the atmosphere. For this reason, the appearance of *C. alvarniensis* frustules in other parts of Europe has been attributed to air transport in its fossil form. For example, *C. alvarniensis* in the French Pyrenees was attributed to air transport from areas of southern Spain (Bertrand & al. 2022). This is because large numbers of this triangular fossil species have been found in many Miocene diatomite spots from Murcia and Elche de la Sierra (Straub & Aboal 1992; Foucault & al. 1987; Servant-Vildary 1986). However, the causes of its aerial dispersal and its geographical distribution are not clear (Bertrand & al. 2022). Frustules of *C. alvarniensis* also appeared in a recent study of sub-fossil microflora in Thiaroye, Senegal (Sow 2004). This is considered the first record of this species in Africa. Al-

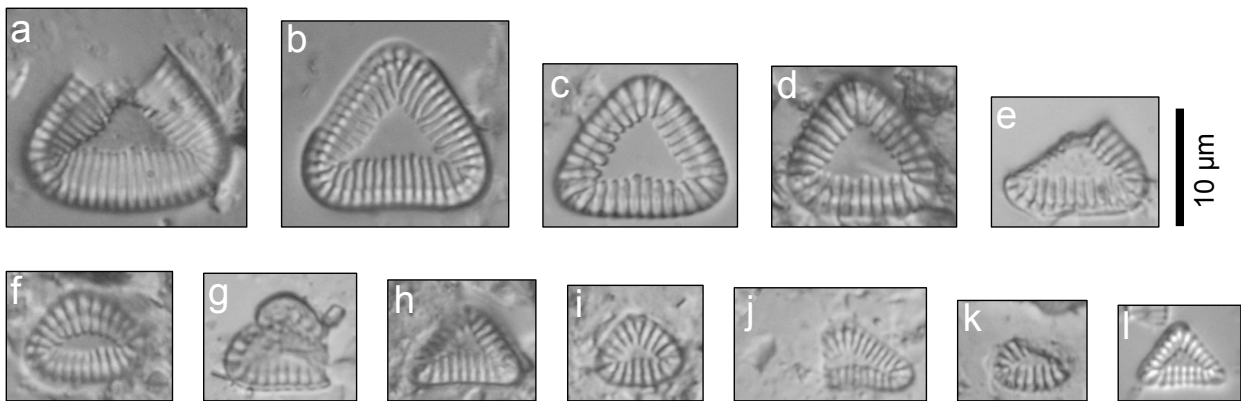


Fig. 1. Images of *Cyclotella alvarniensis* under the optical microscope: **a, c, d, f, g, h, i, j, k**, frustules from artificial pools samples (mesocosms); **b**, frustule from rehydrated sediment samples; **e**, frustule from biofilm samples in natural disconnected pools; **l**, frustule from biofilm growing in running waters.

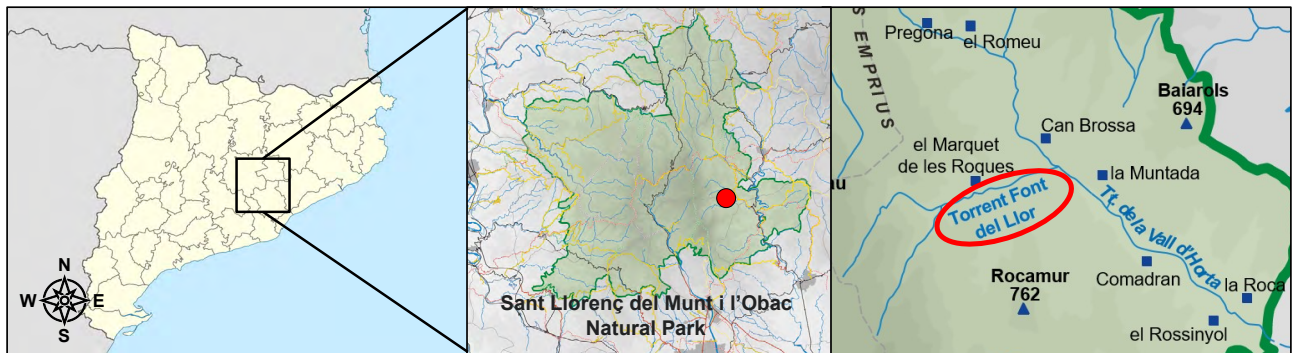


Fig. 2. Location of the Torrent de la Font del Llor in the Sant Llorenç del Munt i l'Obac Natural Park, Catalonia (Spain).

though its presence could be explained by wind transport and/or birds, it raised doubts about its geological origin. As the authors comment, even accepting the detrital origin of the species, its dating requires further investigation since the Miocene outcrops in the study area are mainly composed of volcanic rocks.

Our samples were collected in the Torrent de la Font del Llor (Sant Llorenç del Munt i l'Obac Natural Park, Barcelona, Catalonia) (Fig. 2). The first frustule recorded was from biofilm growing in running waters in 2019 spring (Fig. 1l). Lately from early September to early October of 2021 eleven frustules of *Cyclotella alvarniensis* were identified. In this period, this temporary stream was constituted by dry riverbeds alternated with disconnected pools. *Cyclotella alvarniensis* was found in three different type of samples: one frustule was found in biofilm samples from natural disconnected pools (Fig. 1e), another one in rehydrated sediment samples from the dry riverbed (Fig. 1b), and nine more from four artificial pools (mesocosms) placed on the dry riverbed sections and filled with bottled water (from an experiment which aimed to study organisms dispersion and colonization in temporary rivers) (Figs. 1a, c, f–k). No living individuals were found, nevertheless low abundant species are highly difficult to find in raw samples.

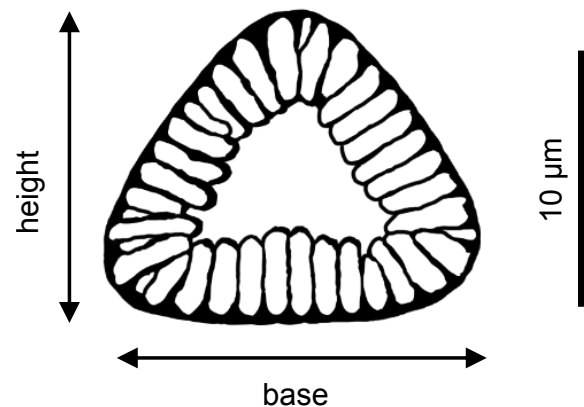


Fig. 3. Schematic drawing of *Cyclotella alvarniensis*. [Drawing by the authors].

In relation to the measurements of our specimens (Fig. 1), the number of striae was 10–16 for 10 µm and a base length of 6–16 µm (Fig. 3). These values were slightly different from those initially established for the species, with 10–12 striations for 10 µm and a base length of 10–18 µm (Wuthrich 1979). However, Estrada (1972) also recorded a wider range of measurements in diatomite sam-

ples from Murcia (Spain), suggesting that more studies are needed to better characterize this species.

The appearance of *Cyclotella alvarniensis* in our samples raises questions about whether it is an exclusive fossil species. Firstly, frustules of this species were found in four different types of substrates sampled (running waters biofilm, natural disconnected pools, rehydrated dry sediments and artificial pools). Secondly, they were found to be part of the current communities of freshwater diatoms. Thirdly, no frustules of *C. alvarniensis* or any other fossil species have appeared in any other tributary or river in the Natural Park, formerly intensively sampled. Finally, although we cannot rule out the wind as a passive dispersal mechanism, this would be a process difficult to explain. Besides there are not known nearby dumpsites that could have released diatomite into the atmosphere, the closest diatomite deposit in Catalonia is located more than 120 kilometers away (in Santa Eugènia de Nerella, la Cerdanya). If this were its origin, it would be highly likely that the wind would have spread *C. alvarniensis* also in other basins closer to the area of exploitation. On the other hand, the great Murcia deposit—more than 600 kilometers away—has been proposed as an important area for the emission of aerial fossil individuals (Aboal 1989). By the same token, no frustules of this diatom have appeared between Catalonia and Murcia despite this area have been intensely sampled for diatoms (Cambra & Ortiz-Lerín 2005; Flor-Arnau & al. 2008; Durán & Ormad 2012; Alvarez & Rojo García-Morato 2020). Precisely, the only record of *C. alvarniensis* until 2003 in the entire Iberian Peninsula was in Murcia (Aboal & al. 2003). No more recent bibliographic citations of this species are found in Catalonia or the rest of the Iberian Peninsula.

For all the exposed reasons, in our opinion there are modern and successful populations of *Cyclotella alvarniensis* thriving both in Catalonia and in other regions of Europe. Since its discovery, the few records of *C. alvarniensis* have automatically assumed its fossil form, not contemplating other modern forms. As diatoms samples are usually treated to their taxonomical identification, living samples are rarely observed, thus losing the opportunity to verify the current presence of living individuals. We encourage researchers to look at their untreated samples when recording *C. alvarniensis* in their samples.

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