

S2. Re-evaluation of the dinocyst biozonation (Chateauneuf and Gruas-Cavagnetto, 1978; revisited in this study).

CORRELATION OF THE PARIS BASIN AND NORTH-WEST GERMANY **WETZELIELLACEAE ZONATIONS**

For a long time now, the Wetzeliellaceae, a family of Dinoflagellate cysts (or dinocysts), has proved to be a major biostratigraphic tool in Palaeogene correlations. The usefulness of the seven genera and the several species of these dinocysts is due to their large geographic distribution, their sudden appearance in the late Palaeocene, followed by a rapid evolution and diversification during the early Eocene. In Western Europe, the coastal and deltaic sedimentation prevailing in the Eocene seem to fit well with their development.

The first charts of distribution were published in 1966 from North Sea wells (1) and 1976 from England on shore sections (2). In the Paris Basin, the first chart of the Wetzeliellaceae range chart was established by Chateauneuf and Gruas-Cavagnetto in 1978 (3). The same authors took part in the No. 124 North-West European Tertiary basins program, which carried through with the publication of a comprehensive Dinocyst chart for European basins (4). An attempt to correlate the Paris Basin Dinocyst chart with the D zones of NW Germany was carried out by Cavalier and Chateauneuf in 1992 (5).

Since then, the calibration of all these zonations has been largely improved by magnetostratigraphic data and nannofossil charts, particularly in NW Germany onshore basins where Wetzeliellaceae are appreciated as markers in the early and Middle Eocene (6).

The goal of the present contribution is to update the correlations of the Paris Basin Wetzeliellaceae chart and NW Germany Dinocyst Chart with regards to the NP zones erected in both areas. The 2012 standard zonation of Köthe (7) seems to be the most suitable for this purpose, as other North Sea zonations are based, on the one hand, mainly on well cutting data, and are therefore less precise and on the other hand, on sediments that are often scarce in Wetzeliellaceae.

In the Paris Basin, the first occurrence of Apectodinium homomorphum is in the upper part of the Bracheux Sands Formation, 10 m beneath the Apectodinium acme. The former W1 zone (3) can be divided into two zones:

- *W1a, ranging from the FO (first occurrence) of W. homomorphum to the first acme of Apectodinium plexus;*
- *W1b, from the first Apectodinium acme to the FO of the Wetzeliella astra.*

The base of W1b corresponds to the base of D5a in Germany. It is also the base of the French local Sparnacian substage where the Palaeocene-Eocene boundary and the CIE isotopic event are located.

Köthe's A. augustum zone (D5a) cannot be distinguished in the Paris Basin due to the rare occurrence of this form in the Sparnacian sediments.

The Wetzeliella astra zone (W2), for which the FO is located at the sharp base of the Laon Sands Formation, is equivalent to the German subzone D6a.

The Wetzeliella meckelfeldensis zone (W3) corresponds to the FO of W. meckelfeldensis associated with the FO of an additional marker, Charlesdowniea crassoramosa, as is the case for the base of the German D6b subzone. Adnatospheridium vittatum, the top marker of D6b, has not been recorded as of yet in the Paris Basin where the W3 top is characterized by the FO of Dracodinium similis. This last species is not qualified by Köthe as a key species for the base of the D7a zone, although its range starts at this level (8). Considering that the further Dracodinium varielongitudum (W5 and D7b) are coeval in both areas, we equate the W3 and D6b zones as well as the W4 and D7a zones.

The Dracodinium varielongitudum zone (W5) is defined in the Paris Basin by the FO of D. Varielongitudum and the FO of Charlesdowniea Coleothrypta (W5). The German equivalent, D7b, has the same base but the top is marked by the FO of Dracodinium politum, which is unknown in the Paris Basin, whereas the FO of Ch. Coleothrypta is located at the base of D8b. If we assume the synchronism of the FO of this last species in both regions, the W5 of the Paris Basin is equivalent to the D7b-D8a zones of NW Germany.

The above-mentioned W6 zone, which spans from the Argile de Laon (late Cuisian NP13) to the early Lutetian (NP 13 or 14) in the Paris Basin, is characterized by the FO of Ch. Coleothrypta and the FO of Ch. Coleothrypta subsp. rotundata.

From the base of D8b (NP12) to the onset of D9b2 (Middle Lutetian), the German zonation is no longer based on Wetzeliellaceae and the other Dinocysts used are unfortunately rare or absent in the Paris Basin. Thus, Areospheridium diktyoplokum occurs much higher in the Lutetian whereas Eatonicysta ursulae is scarcely present in the Bartonian. The thick limestone shelf deposits during the Lutetian seem to be less favourable to the development of Wetzeliellaceae and the consequence is a marked decrease in the species diversification.