



Fig. 62. Frida-1, reference well for the Freja Member. Black bar shows cored section.

ber in the Inez-1 well (shown as unnamed sandstones in Fig. 2); these sandstones may be contemporaneous or even contiguous with those of the Freja Member. However, confident correlation on the basis of log and seismic data is not possible at present.

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References

- Ahmadi, Z.M., Sawyers, M., Kenyon-Roberts, S., Stanworth, C.W., Kugler, K.A., Kristensen, J. & Fugelli, E.M.G. 2003: Paleocene. In: Evans, D. *et al.* (eds): *The millennium atlas: petroleum geology of the central and northern North Sea*, 235–259. London: Geological Society.
- Armentrout, J.M., Malecek, S.J., Fearn, L.B., Sheppard, C.E., Nayler, P.H., Miles, A.W., Desmarais, R.J & Dunay, R.E. 1993: Log-motif analysis of Paleogene depositional systems tracts, central and northern North Sea: defined by sequence stratigraphic analysis. In: Parker, J.R. (ed.): *Petroleum geology of Northwest Europe: proceedings of the 4th conference*, 45–57. London: Geological Society.
- Aubry, M.-P. *et al.* 2002: Proposal: Global Standard Stratotype-section and Point (GSSP) at the Dababiya section (Egypt) for the base of the Eocene Series, 58 pp. Unpublished report, International Sub-commission on Paleogene Stratigraphy.
- Aubry, M.-P. *et al.* 2003: Chronostratigraphic terminology at the Paleocene/Eocene boundary. *Geological Society of America, Special Paper* **369**, 551–566.
- Berggren, W.A. & Aubert, J. 1975: Paleocene benthonic foraminiferal biostratigraphy, paleobiogeography and paleoecology of Atlantic–Tethyan regions; Midway-type fauna. *Palaeogeography, Palaeoclimatology, Palaeoecology* **18**, 73–192.

- Berggren, W.A. & Aubry, M.-P. 1996: A Late Paleocene – Early Eocene NW European and North Sea magnetobiochronological correlation network. In: Knox, R.W.O'B., Corfield, R.M. & Dunay, R.E. (eds): Correlation of the Early Paleogene in Northwest Europe. Geological Society Special Publication (London) **101**, 309–352.
- Berggren, W.A. & Miller, K.G. 1988: Paleogene tropical planktonic foraminiferal biostratigraphy and magnetobiochronology. *Micropaleontology* **34**, 362–380.
- Berggren, W.A., Kent, D.V. & van Couvering, J.A. 1985a: Neogene geochronology and chronostratigraphy. In: Snelling, N.J. (ed.): The chronology of the geological record. Geological Society Memoir (London) **10**, 211–260.
- Berggren, W.A., Kent, D.V. & Flynn, J.J. 1985b: Paleogene geochronology and chronostratigraphy. In: Snelling, N.J. (ed.): The chronology of the geological record. Geological Society Memoir (London) **10**, 141–195.
- Berggren, W.A., Kent, D.V., Swisher III, C.C. & Aubry, M.-P. 1995: A revised Cenozoic geochronology and chronostratigraphy. In: Berggren, W.A. *et al.* (eds): Geochronology, time scale and global stratigraphic correlation. Society for Sedimentary Geology (SEPM) Special Publication **54**, 129–212.
- Bøggild, O.B. 1918: Den vulkanske Aske i Moleret samt en Oversigt over Danmarks ældre Tertiærbjergarter. Danmarks Geologiske Undersøgelse II. Række **33**, 159 pp.
- Bonde, N. 1966: The fishes of the Mo-clay Formation (Lower Eocene). Bulletin of the Geological Society of Denmark **16**, 198–202.
- Bonde, N. 1974: Palaeoenvironment as indicated by the 'Mo-clay formation' (lowermost Eocene of Denmark). *Tertiary Times* **2**, 29–36.
- Bonde, N. 1979: Palaeoenvironment in the 'North Sea' as indicated by the fish bearing Mo-clay deposit (Paleocene/Eocene), Denmark. Meddelingen Werkgroup Tertiær en Kwartair Geologie **16**, 3–16.
- Bonde, N. 1987: Moler – its origin and its fossils, especially fishes, 53 pp. Nykøbing Mors: Skamol.
- Bonde, N. 2003: Moleret – en guldgrube af fortidens livsformer. *Geografisk Orientering* **3**, 90–96.
- Bottjer, D.J. & Droser, M.L. 1992: Palaeoenvironmental patterns of biogenic sedimentary structures. In: Maples, C.G. & West, R.R. (eds): Trace fossils. Paleontological Society, Short courses in Paleontology **5**, 130–144.
- Brinkhuis, H. & Biffi, U. 1993: Dinoflagellate cyst stratigraphy of the Eocene/Oligocene transition in central Italy. *Marine Micropaleontology* **22**, 131–183.
- Brinkhuis, H. & Visscher, H. 1995: The upper boundary of the Eocene Series: a reappraisal based on dinoflagellate cyst biostratigraphy and sequence stratigraphy. In: Berggren, W.A. *et al.* (eds): Geochronology, time scale and global stratigraphic correlation. Society for Sedimentary Geology (SEPM) Special Publication **54**, 295–304.
- Brinkhuis, H., Powell, A. J. & Zevenboom, D. 1992: High-resolution dinoflagellate cyst stratigraphy of the Oligocene/Miocene transition interval in northwest and central Italy. In: Head, M.J. & Wrenn, J.H. (eds): Neogene and Quaternary dinoflagellate cysts and acritarchs, 219–258. Dallas: American Association of Stratigraphic Palynologists Foundation.
- Christensen, L. & Ulleberg, K. 1973: Sedimentology and micropalaeontology of the Middle Oligocene sequence at Sofienlund, Denmark. *Bulletin of the Geological Society of Denmark* **22**, 283–305.
- Clemmensen, A. & Thomsen, E. 2005: Palaeoenvironmental changes across the Danian–Selandian boundary in the North Sea Basin. *Palaeogeography, Palaeoclimatology, Palaeoecology* **219**, 351–394.
- Costa, L.I. & Manum, S. 1988: The description of the interregional zonation of the Paleogene (D1–D15) and the Miocene (D16–D20). *Geologisches Jahrbuch, Reihe A* **100**, 321–330.
- Crouch, E., Heilmann-Clausen, C., Brinkhuis, H., Morgans, H.E.G., Rogers, K.M., Egger, H. & Schmitz, B. 2001: Global dinoflagellate event associated with the Paleocene–Eocene thermal maximum. *Geology* **29**, 315–318.
- Danielsen, M. & Thomsen, E. 1997: Paleocene/Eocene diatomite in wells in the eastern North Sea. In: Thomsen, E. & Pedersen, S.A.S. (eds): Geology and palaeontology of the Mo-clay. Aarhus Geoscience **6**, 19–24.
- Danielsen, M., Michelsen, O. & Clausen, O.R. 1997: Oligocene sequence stratigraphy and basin development in the Danish sector of the North Sea based on log interpretations. *Marine and Petroleum Geology* **14**, 931–950.
- de Verteuil, L. & Norris, G. 1996: Part I, Dinoflagellate cyst zonation and allostratigraphy of the Chesapeake Group. *Micropaleontology* **42**, supplement, 1–82.
- Deegan, C.E. & Scull, B.J. (compilers) 1977: A standard lithostratigraphic nomenclature for the central and northern North Sea. Institute of Geological Sciences Report **77/25**, 36 pp. London: Her Majesty's Stationery Office.
- Dybkjær, K. 2004: Dinocyst stratigraphy and palynofacies studies used for refining a sequence stratigraphic model – uppermost Oligocene to lower Miocene, Jylland, Denmark. *Review of Palaeobotany and Palynology* **131**, 201–249.
- Dybkjær, K. & Rasmussen, E.S. 2000: Palynological dating of the Oligocene–Miocene successions in the Lille Bælt area, Denmark. *Bulletin of the Geological Society of Denmark* **47**, 87–103.
- Fyfe, J.A., Gregersen, U., Jordt, H., Rundberg, Y., Eidvin, T., Evans, D., Steward, D., Hovland, M. & Andresen, P. 2003: Oligocene to Holocene. In: Evans, D. *et al.* (eds): The millenium atlas: petroleum geology of the central and northern North Sea, 279–287. London: Geological Society.
- Gradstein, F.M. & Bäckström, S. 1996: Cainozoic biostratigraphy and palaeobathymetry, northern North Sea and Haltenbanken. *Norsk Geologisk Tidsskrift* **76**, 3–32.
- Gradstein, F.M. & Ogg, J.G. (compilers) 2002: International Union of Geological Sciences, International Commission on Stratigraphy (ICS), Consolidated Annual Report for 2002, 157 pp. Available on: <<http://www.stratigraphy.org/report02.pdf>>.
- Gradstein, F.M., Kaminski, M.A., Berggren, W.A., Kristiansen, I.L. & D'Iorio, M.A. 1994: Cenozoic biostratigraphy of the North Sea and Labrador shelf. *Micropaleontology* **40**, supplement, 1–152.
- Haaland, H.J., Furnes, H. & Martinsen, O.J. 2000: Paleogene tuffaceous intervals, Grane Field (Block 25/11), Norwegian North Sea: their depositional, petrographical, geochemical character and regional implications. *Marine and Petroleum Geology* **17**, 101–118.

- Håkansson, E. & Sjørring, S. 1982: En molerprofil i kystklinten ved Salger Høj, Mors. Dansk Geologisk Forening, Årsskrift **1981**, 131–134.
- Hamberg, L., Dam, G., Wilhelmson, C. & Ottesen, T.G. 2005: Paleocene deep-marine sandstone plays in the Siri Canyon, offshore Denmark – southern Norway. In: Doré, A.G. & Vining, B.A. (eds): Petroleum geology: North-West Europe and global perspectives. Proceedings of the 6th petroleum geology conference, 1185–1198. London: Geological Society.
- Hansen, J.M. 1979: Age of the Mo-Clay Formation. Bulletin of the Geological Society of Denmark **27**, 89–91.
- Haq, B.U., Hardenbol, J. & Vail, P.R. 1987: Chronology of fluctuating sea-levels since the Triassic. Science **235**, 1156–1167.
- Hardenbol, J., Thierry, J., Farley, M.B., Jacquin, T., de Graciansky, P.-C. & Vail, P. 1998: Mesozoic and Cenozoic sequence chronostratigraphic framework of European basins. In: de Graciansky, P.-C. *et al.* (eds): Mesozoic and Cenozoic sequence stratigraphy of European basins. Society for Sedimentary Geology (SEPM) Special Publication **60**, 3–13.
- Hardt, T., Holtar, E., Isaksen, D., Kyllingstad, G., Lervik, K.S., Lycke, A.S. & Tonstad, K. 1989: Revised Tertiary lithostratigraphic nomenclature for the Norwegian North Sea. In: Isaksen, D. & Tonstad, K. (eds): A revised Cretaceous and Tertiary lithostratigraphic nomenclature for the Norwegian North Sea. Norwegian Petroleum Directorate (NPD) Bulletin **5**, 35–55.
- Heilmann-Clausen, C. 1982: The Paleocene–Eocene boundary in Denmark. Newsletters on Stratigraphy **11**, 55–63.
- Heilmann-Clausen, C. 1985: Dinoflagellate stratigraphy of the uppermost Danian to Ypresian in the Viborg-1 borehole, central Jylland, Denmark. Danmarks Geologiske Undersøgelse Serie A **7**, 69 pp.
- Heilmann-Clausen, C. 1995: Palæogene aflejringer over Danskekalcken. In: Nielsen, O.B. (ed.): Danmarks geologi fra Kridt til i dag. Aarhus Geokompender **1**, 69–114.
- Heilmann-Clausen, C. & Schmitz, B. 2000: The late Paleocene thermal maximum $\delta^{13}\text{C}$ excursion in Denmark. In: Schmitz, B., Sundquist, B. & Andreasson, F.P. (eds): Early Paleogene warm climates and biosphere dynamics, short papers and extended abstracts from an international meeting in Göteborg, Sweden, June 9–13, 1999. GFF **122**, 70 only. Stockholm: Geological Society of Sweden.
- Heilmann-Clausen, C., Nielsen, O.B. & Gersner, F. 1985: Lithostratigraphy and depositional environments in the upper Paleocene and Eocene of Denmark. Bulletin of the Geological Society of Denmark **33**, 287–323.
- Huuse, M. & Clausen, O.R. 2001: Morphology and origin of major Cenozoic sequence boundaries in the eastern North Sea basin: top Eocene, near-top Oligocene and the mid-Miocene unconformity. Basin Research **13**, 17–41.
- Isaksen, D. & Tonstad, K. 1989 (eds): A revised Cretaceous and Tertiary lithostratigraphic nomenclature for the Norwegian North Sea. Norwegian Petroleum Directorate (NPD) Bulletin **5**, 59 pp.
- Jones, E., Jones, R., Ebdon, C., Ewen, D., Milner, P., Plunkett, J., Hudson, G. & Slater, P. 2003: Eocene. In: Evans, D. *et al.* (eds): The millennium atlas: petroleum geology of the central and northern North Sea, 261–277. London: Geological Society.
- Jones, R.W. 1999: Forties Field (North Sea) revisited: a demonstration of the value of historical micropalaeontological data. In: Jones, R.W. & Simmons, M.D. (eds): Biostratigraphy in production and development geology. Geological Society Special Publication (London) **152**, 185–200.
- Joy, A.M. 1996: Controls on Eocene sedimentation in the central North Sea Basin: results of a basinwide correlation study. In: Knox, R.W.O'B., Corfield, R.M. & Dunay, R.E. (eds): Correlation of the Early Paleogene in Northwest Europe. Geological Society Special Publication (London) **101**, 79–90.
- King, C. 1983: Cainozoic micropaleontological biostratigraphy of the North Sea. Institute of Geological Sciences Report **82/7**, 40 pp.
- King, C. 1989: Cenozoic of the North Sea. In: Jenkins, D.G. & Murray, J.W. (eds): Stratigraphic atlas of fossil foraminifera, 2nd edition, 418–489. Chichester: Ellis Horwood Ltd.
- Knox, R.W.O'B. 1996: Correlation of the Early Paleogene in Northwest Europe: an overview. In: Knox, R.W.O'B., Corfield, R.M. & Dunay, R.E. (eds): Correlation of the Early Paleogene in Northwest Europe. Geological Society Special Publication (London) **101**, 1–11.
- Knox, R.W.O'B. 1997: The late Paleocene to early Eocene ash layers of the Danish Mo-Clay (Fur Formation): stratigraphic and tectonic significance. In: Thomsen, E. & Pedersen, S.A.S. (eds): Geology and palaeontology of the Mo-clay. Aarhus Geoscience **6**, 7–11.
- Knox, R.W.O'B. & Holloway, S. 1992: 1. Paleogene of the central and northern North Sea. In: Knox, R.W.O'B. & Cordey, W.G. (eds): Lithostratigraphic nomenclature of the UK North Sea, 133 pp. Nottingham: British Geological Survey.
- Knox, R.W.O'B., Morton, A.C. & Harland, R. 1981: Stratigraphical relationships of Paleocene sands in the UK sector of the central North Sea. In: Illing, L.V. & Hobson, G.D. (eds): Petroleum geology of the continental shelf of North-West Europe: proceedings of the 2nd conference, 267–281. London: Heyden & Son Ltd.
- Kristoffersen, A.V. 2001: An Early Paleogene trogon (Aves: Trogoniformes) from the Fur Formation, Denmark. Journal of Vertebrate Paleontology **22**, 661–666.
- Kristoffersen, F.N. & Bang, I. 1982: Cenozoic excl. Danian Limestone. In: Michelsen, O. (ed.): Geology of the Danish Central Graben. Danmarks Geologiske Undersøgelse Serie B **8**, 62–71.
- Köthe, A. 1990: Paleogene dinoflagellates from Northwest Germany. Geologische Jahrbuch, Reihe A **118**, 111 pp.
- Köthe, A. 2003: Dinozysten-Zonierung im Tertiär Norddeutschlands. Revue Paleobiologie **22**, 895–923.
- Larsen, G. & Dinesen, A. 1959: Vejle Fjord Formationen ved Brejning. Sedimenterne og foraminiferfaunaen (Oligocæn–Miocæn). Danmarks Geologiske Undersøgelse II. Række **82**, 114 pp.
- Martini, E. 1971: Standard Tertiary and Quaternary calcareous nannoplankton zonation. In: Farinacci, A. (ed.): Proceedings of the second planktonic conference Roma 1970. Edizioni Tecnoscienza Roma **2**, 739–785.
- Michelsen, O. 1993: Stratigraphic correlation of the Danish onshore and offshore Tertiary successions based on sequence stratigraphy. Bulletin of the Geological Society of Denmark **41**, 145–161.
- Michelsen, O., Danielsen, M., Heilmann-Clausen, C., Jordt, H., Laursen, G. & Thomsen, E. 1992: Cenozoic sequence stratigraphy

- in the eastern North Sea. Final report of the CENOS-project, 51 pp. Geological Institute, University of Aarhus, Denmark.
- Michelsen, O., Danielsen, M., Heilmann-Clausen, C., Jordt, H., Laursen, G. & Thomsen, E. 1995: Occurrence of major sequence stratigraphic boundaries in relation to basin development in Cenozoic deposits of the southeastern North Sea. In: Steel, R.J. *et al.* (eds): Sequence stratigraphy on the Northwest European margin. Norwegian Petroleum Society (NPF) Special Publication **5**, 415–427.
- Michelsen, O., Thomsen, E., Danielsen, M., Heilmann-Clausen, C., Jordt, H. & Laursen, G. 1998: Cenozoic sequence stratigraphy in the eastern North Sea. In: de Graciansky, P.-C. *et al.* (eds): Mesozoic and Cenozoic sequence stratigraphy of European basins. Society for Sedimentary Geology (SEPM) Special Publication **60**, 91–118.
- Mitlehner, A.G. 1996: Palaeoenvironments in the North Sea basin around the Paleocene–Eocene boundary: evidence from diatoms and other siliceous microfossils. In: Knox, R.W.O'B., Corfield, R.M. & Dunay, R.E. (eds): Correlation of the Early Paleogene in Northwest Europe. Geological Society Special Publication (London) **101**, 255–273.
- Mudge, D.C. & Bujak, J.P. 1994: Eocene stratigraphy of the North Sea Basin. *Marine and Petroleum Geology* **11**, 166–181.
- Mudge, D.C. & Bujak, J.P. 1996a: Paleocene biostratigraphy and sequence stratigraphy of the UK central North Sea. *Marine and Petroleum Geology* **13**, 295–312.
- Mudge, D.C. & Bujak, J.P. 1996b: An integrated stratigraphy for the Paleocene and Eocene of the North Sea. In: Knox, R.W.O'B., Corfield, R.M. & Dunay, R.E. (eds): Correlation of the Early Paleogene in Northwest Europe. Geological Society Special Publication (London) **101**, 91–113.
- Mudge, D.C. & Bujak, J.P. 2001: Biostratigraphic evidence for evolving palaeoenvironments in the Lower Paleogene of the Faeroe–Shetland Basin. *Marine and Petroleum Geology* **18**, 577–590.
- Mudge, D.C. & Copestake, P. 1992a: Revised Lower Palaeogene lithostratigraphy for the Outer Moray Firth, North Sea. *Marine and Petroleum Geology* **9**, 53–69.
- Mudge, D.C. & Copestake, P. 1992b: Lower Palaeogene stratigraphy of the northern North Sea. *Marine and Petroleum Geology* **9**, 287–301.
- Munsterman, D.K & Brinkhuis, H. 2004: A southern North Sea Miocene dinoflagellate cyst zonation. *Netherlands Journal of Geosciences / Geologie en Mijnbouw* **83**, 267–285.
- Neal, J.E., Stein, J.A. & Gamber, J.H. 1994: Graphic correlation and sequence stratigraphy in the Palaeogene of NW Europe. *Journal of Micropalaeontology* **13**, 55–80.
- Nielsen, O.B., Baumann, J., Deyu, Z., Heilmann-Clausen, C. & Larsen, G. 1986: The Tertiary section of borehole D.G.I. 83101, Østerrenden, Storebælt, Denmark. In: Møller, T.J. (ed.): Twenty-five years of geology in Aarhus. *Geoskrifter* **25**, 235–253.
- O'Connor, S.J. & Walker, D. 1993: Paleocene reservoirs of the Everest trend. In: Parker, R.J. (ed.): Petroleum geology of Northwest Europe: proceedings of the 4th conference, 145–160. London: Geological Society.
- Pedersen, G.K. 1981: Anoxic events during sedimentation of a Paleogene diatomite in Denmark. *Sedimentology* **28**, 487–504.
- Pedersen, G.K. & Surlyk, F. 1983: The Fur Formation, a Late Paleocene ash-bearing diatomite from northern Denmark. *Bulletin of the Geological Society of Denmark* **32**, 43–65.
- Perch-Nielsen, K. 1976: New silicoflagellates and silicoflagellate zonation in north European Paleocene and Eocene diatomites. *Bulletin of the Geological Society of Denmark* **25**, 27–40.
- Piasecki, S. 2005: Dinoflagellate cysts of the Middle–Upper Miocene Gram Formation, Denmark. *Palaeontos* **7**, 29–45.
- Powell, A.J. 1986: Latest Palaeogene and earliest Neogene dinoflagellate cysts from the Lemme section, northwest Italy. American Association of Stratigraphic Palynologists Foundation, Contribution Series **17**, 83–104.
- Premoli Silva, I. 2005: Annual report 2004 of the Rupelian/Chattian Boundary Stratotype Working Group. Available on International Subcommission on Palaeogene Stratigraphy: <<http://wzar.unizar.es/isps/chattian2004.htm>>.
- Premoli Silva, I. & Jenkins, D.G. 1993: Decision on the Eocene–Oligocene boundary stratotype. *Episodes* **16**, 379–382.
- Rasmussen, E.S. 2004a: Stratigraphy and depositional evolution of the uppermost Oligocene–Miocene succession in western Denmark. *Bulletin of the Geological Society of Denmark* **51**, 89–109.
- Rasmussen, E.S. 2004b: The interplay between true eustatic sea-level changes, tectonics, and climate changes: What is the dominating factor in sequence formation of the Upper Oligocene – Miocene succession in the eastern North Sea Basin, Denmark? *Global and Planetary Change* **41**, 15–30.
- Rasmussen, L.B. 1961: De miocæne formationer i Danmark. *Danmarks Geologiske Undersøgelse IV. Række* **5**, 45 pp.
- Ravn, J.P.J. 1906: Om det saakaldte plastiske Lers Alder. *Meddelelser fra Dansk Geologisk Forening* **2**, 23–28.
- Rhys, G.H. 1974: A proposed standard lithostratigraphic nomenclature for the southern North Sea and an outline structural nomenclature for the whole of the (UK) North Sea. *British Geological Survey Report* **74/8**, 14 pp.
- Rønnevik, H.C., van den Bosch, W. & Bandlien, E.H. 1975: A proposed nomenclature for the main structural features in the Norwegian North Sea. In: Finstad, K.G. & Selley, R.C. (coordinators): Jurassic Northern North Sea Symposium, Stavanger, 28–30 September 1975. Norwegian Petroleum Society (NPF) Proceedings **JNNS/18**, 1–16.
- Salvador, A. (ed.) 1994: International stratigraphic guide: a guide to stratigraphic classification, terminology and procedure, 214 pp. Boulder: The International Union of Geological Sciences, IUGS Secretariat, Trondheim and the Geological Society of America, Inc.
- Schiøler, P. 2005: Dinoflagellate cysts and acritarchs from the Oligocene – Lower Miocene interval of the Alma-IX well, Danish North Sea. *Journal of Micropalaeontology* **24**, 1–37.
- Schiøler, P., Andsbjerg, J., Clausen, O.R., Dam, G., Dybkjær, K., Hamberg, L., Heilmann-Clausen, C., Kristensen, L.E., Prince, I. & Rasmussen, J.A. 2005: A revised lithostratigraphy for the Palaeogene – lower Neogene of the Danish North Sea. *Geological Survey of Denmark and Greenland Bulletin* **7**, 21–24.
- Schmitz, B., Heilmann-Clausen, C., King, C., Steurbaut, E., Andreasson, F.P., Corfield, R.M. & Cartledge, J.E. 1996: Stable isotope and biotic evolution in the North Sea during the Early Eocene: the Al-

- bæk Hoved section, Denmark. In: Knox, R.W.O'B., Corfield, R.M. & Dunay, R.E. (eds): Correlation of the Early Paleogene in North-west Europe. Geological Society Special Publication (London) **101**, 276–306.
- Sorgenfrei, T. 1958: Molluscan assemblages from the marine middle Miocene of South Jutland and their environments. Danmarks Geologiske Undersøgelse II. Række **79**, 503 pp.
- Steininger, F.F. *et al.* 1997: The global stratotype section and point (GSSP) for the base of the Neogene. Episodes **20**, 23–28.
- Stow, D.A.V. & Johansson, M. 2000: Deep-water massive sands: nature, origin and hydrocarbon implications. Marine and Petroleum Geology **17**, 145–174.
- Thomsen, E. 1994: Calcareous nannofossil stratigraphy across the Danian–Selandian boundary in Denmark. GFF **116**, 65–67. Stockholm: Geological Society of Sweden.
- Thomsen, E. & Danielsen, M. 1995: Transitional Paleocene/Eocene ash-bearing diatomite in the eastern North Sea. Tertiary Research **15**, 111–120.
- van Simaëys, S., de Man, E., Vandenberghe, N., Brinkhuis, H. & Steurbaut, E. 2004: Stratigraphic and palaeoenvironmental analysis of the Rupelian–Chattian transition in the type region: evidence from dinoflagellate cysts, foraminifera and calcareous nannofossils. Palaeogeography, Palaeoclimatology, Palaeoecology **208**, 31–58.
- Williams, G.L., Brinkhuis, H., Pearce, M.A., Fensome, R.A. & Weegink, J.W. 2004: Southern Ocean and global dinoflagellate cyst events compared: index events for the Late Cretaceous – Neogene. In: Exxon, N.F., Kennett, J.P. & Malone, M.J. (eds): Proceedings of the Ocean Drilling Program, Scientific Results **189**, 1–98. Available on: <http://www-odp.tamu.edu/publications/189_sr/volume/chapters/107.pdf>.
- Willumsen, P.S. 2004: Palynology of the Lower Eocene deposits of north-west Jutland, Denmark. Bulletin of the Geological Society of Denmark **52**, 141–157.
- Zevenboom, D. 1995: Dinoflagellate cysts from the Mediterranean Late Oligocene and Miocene, 221 pp. Unpublished Ph.D. thesis, University of Utrecht, The Netherlands.
- Zevenboom, D. 1996: Late Oligocene – early Miocene dinoflagellate cysts from the Lemme-Carrosio section (NW Italy); biostratigraphy and palaeoenvironmental interpretation. Giornale di Geologia, Ser. 3a **58**, 81–93.
- Ziegler, P.A. 1981: Evolution of sedimentary basins in North-West Europe. In: Illing, L.V. & Hobson, G.D. (eds): Petroleum geology of the continental shelf of North-West Europe: proceedings of the 2nd conference, 3–39. London: Heyden & Son Ltd.