

Ammonites in the Elly-3 well

A contribution to The Jurassic Petroleum System in
the Danish Central Graben - The PETSYS Project

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Ammonite stratigraphy in the Elly-3 well

Finds of ammonites in a cored interval (depths: 3957–3982m / 12983'00"-13064'02") are studied with the purpose of adding data to the biostratigraphy of the Elly-3 well (Fig. 1). 27 levels with ammonites were recorded within the interval (Table 1).

The Oxfordian was a time of pronounced faunal provincialism and separate zonations exist for different areas (Fig. 2). The zonation used in the Submediterranean (including e.g. Portugal, Spain, France, southern Germany and Poland) is considered the primary standard. A second zonation represents the Subboreal Province which is smaller and includes e.g. northernmost France, southern England, northern Germany i.e. getting close the Elly-3 well site. The Boreal ammonite zonation represents the most northerly province including e.g. Scotland, Greenland, Spitsbergen, Barents Shelf (Sykes & Callomon 1979). The ammonites in the studied interval of the Elly-3 well, are dominated by species of the genus *Amoeboceras* which is a characteristic Boreal form (Figs. 3–21; Table 1). The lowermost ammonite recorded may represent the *A. glosense* Zone (c. 3982m) and the ammonites in the overlying succession (3979.8–3972m, perhaps up to 3959.6m) demonstrate the presence of the *A. serratum* Zone and the *A. rosenkrantzi* Zone. The studied interval thus belongs to the upper Middle – Upper Oxfordian



Figure 1. Position of the Elly-3 well.

Correlation is possible through most of the Lower Oxfordian, but becomes problematic higher in the Oxfordian (Zeiss 2003). Tie points in correlation is provided by occasional occurrences of *Amoeboceras* in the Subboreal succession (Wright 1996) and the Submediterranean succession (Atrops et al. 1993).

		Submediterranean			Subboreal	Boreal			
		France, Spain	Switzerland	S. Germany	England	Greenland, Scotland, Svalbard			
Oxfordian	Upper	Planula (Grandiplex)	Galar (Gigantoplex, Grandiplex)	Galar	Galar	?	?	(? Bayi)	
			Praecursor	Planula	Praecursor	Baylei	Bauhini	Bauhini	
			Tonnerense		Planula				Planula
		Bimammatum	Hauffianum	Bimammatum	Bauhini	Densicostata	Ravni	Rosenkrantzi	
			Bimammatum		Hauffian.	Evoluta			
			Berrense		Bimammatum	Pseudocordata			
	Middle	Bifurcatus	Grossouvrei	Grossouvrei	Bifurcatus	Caledonica	Regulare		
			Stenocycloides	Stenocycloides		Variocostatum	Serratum	Serratum Koldewayense	
		Transversarium	Rotoides	Schilli	Schilli	Cautisnigrae	Glosense (Alternoides)	Glosense	
			Schilli						Transversarium
			Luciaeformis (Wartae)	Parandieri	Parandieri	Parandieri			Blakei
		Plicatilis	Antecedens	Antecedens	Antecedens	Antecedens	Tenuiserratum	Tenuiserratum	
	Vertebrale		Densiplicatum	Vertebrale	Vertebrale	Densiplicatum	Maltonense Vertebrale		
	Lower	Cordatum	Cordatum	Cordatum	Cordatum	Cordatum	Cordatum	Cordatum	
			Costicardia	Costicardia	Costicardia	Costicardia		Costicardia	
		Mariae	Praecordatum	Praecordatum	Praecordatum	Praecordatum	Praecordatum	Praecordatum	
			Scarburgense	Scarburgense	Scarburgense	Scarburgense	Scarburgense	Scarburgense	

Figure 2. Ammonite correlation chart. Thick lines indicate intervals where correlation is difficult due to faunal provincialism (Zeiss 2003)

GEUS sample no.	depth (in m.)	depth (in feet/inch)	Description	chrono-stratigraphy
474044	3957.22	12983'00"	fragment from medium-large specimen showing a few	
474043	3957.98	12985'06"	poorly preserved, indeterminate specimen	
474042	3958.64	12987'08"	poorly preserved, indeterminate specimen	
474041	3959.05	12989'00"	Imprint of large mostly smooth specimen. ? <i>A. rosenkrantzi</i>	(<i>A. rosenkrantzi</i> Zone?)
474040	3959.58	12990'09"	poorly preserved fragment	
474039	3959.96	12992'00"	small fragment of juvenile	
474038	3960.49	12993'09"	indeterminate fragment	
474037	3964.31	13006'03"	small fragment of the venter, poorly preserved but show prolonged forward curving ribs on the ventral shoulder and a serrated keel. <i>A. marstonense</i> ?	
474036	3967.75	13017'07"	poorly preserved indeterminate fragment	
474035	3969.45	13023'02"	fragment with dense strong ribbing, rectiradiate primaries, somewhat weakening at level of furcation, less strong secondaries that are forward projected, and extremely prolonged on the ventral shoulder/lower keel. Serrated outer keel. ? <i>A. marstonense</i>	(<i>A. rosenkrantzi</i> Zone?)
474034	3969.95	13024'09"	relatively large fragmented specimen with narrow umbilicus where dense fine ribbing is visible in the innermost whorls, part of the outer whorl is preserved showing flanks almost smooth except for faint growth lines weak ribbing in the upper flank/shoulder transition; resembles specimen of <i>A. rosenkrantzi</i> figured in Sykes & Callomon 1979 pl. 120, fig. 2. Another fragment (reverse side of slab) is from a relatively open-whorled form with dense, blunt slightly sinuous ribs resembling the earliest Kimmeridgian <i>A. bayi</i> Birkelund & Callomon, which though appear to be out of place (to young occurring together with <i>A. rosenkrantzi</i>)	(<i>A. rosenkrantzi</i> Zone?)
474033	3970.15	13025'05"	<i>Amoeboceras</i>	
474032	3970.37	13026'02"	small fragment with dense, low blunt ribs, one bifurcating, in a gently forward curve. Resembles <i>A. ilovaiskii</i> or <i>A. glosense</i> both of which are much too old considering the ammonite identification from deeper levels. Hence unidentified.	
474031	3970.63	13027'00"	small, indeterminate <i>Amoeboceras</i>	
474030	3971.00	13028'03"	fragment of smooth shell, ?bodychamber of large sized ammonite, indeterminate	
474029	3971.24	13029'00"	fragmented large (probably more than 120 mm in diameter) specimen showing the transition between septate part and bodychamber (last septum); the specimen appears to be fully smooth except for the serrated keel (which indicate <i>Amoeboceras</i>), some growth lines are visible. Could be a smooth variety of <i>A. rosenkrantzi</i> , i.e. here with hesitation called <i>A. cf. rosenkrantzi</i>	(<i>A. rosenkrantzi</i> Zone?)
474028	3971.85	13031'00"	indeterminate fragment	
474027	3972.81	13034'02"	one specimen (474027 c) has quite strong sharp ribbing, almost developing tubercles just before dividing high on flank into low, moderately projected secondaries on ventral shoulder. Actually resembles most closely the (much) older <i>A. glosense</i> , which would - however - conflict with the ammonite finds deeper in the well unless if the succession is disturbed (Compare with Sykes & Callomon 1979 pl. 115 fig. 9). However, the sample contains many other fragmented specimens, one fragment (not figured) being septate at a large diameter, and showing almost smooth flanks and the development of strong ventrolateral ribs that curves forward at the shoulder. Resembles <i>A. rosenkrantzi</i> as in Sykes & Callomon 1979 pl. 120 fig. 2a	<i>A. rosenkrantzi</i> Zone
474026	3973.91	13037'09"	fragmented poorly preserved <i>Amoeboceras</i>	(<i>A. rosenkrantzi</i> Zone?)
474025	3976.57	13046'06"	small fragmented imprint, ribs relatively well-defined on the umbilical margin, weakening and becoming almost smooth on flat flanks, dense secondaries near ventral margin. Resembles <i>A. rosenkrantzi</i> as figures in Sykes & Callomon 1979, pl. 120 fig. 4 but differs in having the almost smooth flanks at a much smaller diameter <i>Amoeboceras</i> sp. (or <i>A. aff. rosenkrantzi</i>). Compare also with the small specimen found in the sample 474024 together with <i>A. rosenkrantzi</i>	
474024	3978.08	13051'05"	fragment of middle to large sized specimen with loose ribbing showing fairly strong primaries that are asymmetric in section i.e. steep on the front and relatively gently sloping on the back side. The ribs faint, almost become smooth high on flank before dividing into two forward curving secondaries. Resembles <i>A. rosenkrantzi</i> as figured in Sykes & Callomon 1979, pl. 120 fig. 2a.	<i>A. rosenkrantzi</i> Zone
474023	3978.65	13053'04"	poorly preserved, ribs become strong towards the ventral shoulder	<i>Amoeboceras</i> sp.
474022	3978.86	13054'00"	fragmented specimen showing relatively close, involute umbilicus and densely and finely ribbed inner whorls, fragmented outer whorl where ribbing has become loose and ribs develop tubercles on the middle of the ribs/ middle of flank with lirae in between. The specimen may belong to <i>A. rosenkrantzi</i>	<i>A. rosenkrantzi</i> Zone
474021	3979.22	13055'02"	Slabbed core piece of 6 cm thickness; slender slab has two nicely preserved <i>Amoeboceras</i> ammonites, medium sized. The bigger slab has two levels with ammonites, one small to medium sized, another with two small juveniles, all <i>Amoeboceras</i> . The two largest specimens are likely the best for age-assessment. One has strong robust ribs that are slightly sinuous, umbilicus is relatively close and involute, only primary whorls are visible in previous whorls, on the last whorl primaries divide/bifurcate high on the side, close to the ventral shoulder except for a few dividing lower on the middle of the flank, the secondaries become stronger and raised, tending to become tuberculate, keeled but not clearly serrated - close to <i>Amoeboceras serratum</i> (Sowerby). Another specimen has a somewhat later growth-stage preserved where the ribbing first changes to somewhat stronger almost bullate primaries, weakening at the furcation level then becoming relatively strong again in the secondaries followed by marked change into almost smooth whorl side with only densely spaced slightly curved lirae. Keel more clearly serrated. <i>A. serratum</i>	<i>A. serratum</i> Zone
474020	3979.80	13057'01"	Fragment showing late stage of large, almost smooth amoeboceras with ornament only represented by lirae and very weak ribs that gain some strength near the ventral shoulder, where they also curve forwards, high keel with only weak fine serrated ribs. Close to specimen in Sykes & Callomon (1979) pl.118 fig. 2 <i>A. koldeweyensis</i>	<i>A. koldeweyensis</i> Subzone of the <i>A. serratum</i> Zone
474019	3979.90	13057'05"	half a whorl of a small specimen preserved. Relatively low whorls, characterized by rather strong thick ribs that produce bullae or longitudinal tubercles on the midflank immediately followed by branching into secondaries. These are curving forwards/projected on the lateral shoulder. Keel smooth at its base, serrated in the extreme. <i>Amoeboceras</i> sp.	<i>Amoeboceras</i> sp.
474018	3981.97	13064'02"	fragment of <i>Amoeboceras</i> with primary ribs that develops bullae before dividing into low, forward leaning secondaries. Resembles forms of the <i>A. ilovaiskii</i> group.	possibly <i>A. glosense</i> Zone.

Table 1. List of samples with depths, fossil content, descriptions and biostratigraphy



Figur 3. *Amoeboceras* sp., (# 474019, depth: 3979.90m / 13057'05")



Figure 4. *Amoeboceras koldeweyense*, (# 474020, depth: 3979.80m / 13057'01")



Figure 5. *Amoeboceras* sp., (# 474021, depth: 3979.22m / 13055'02"). See Figs 6, 7 for more specimens from this core piece.

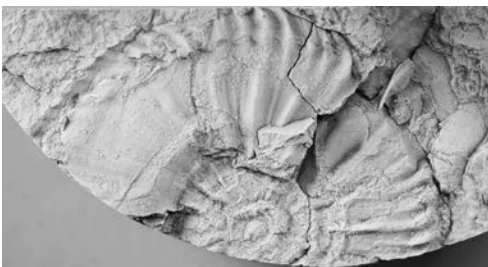


Figure 6. *Amoeboceras serratum*, another specimen from the same sample piece as Fig. 5 above and Fig. 7C below (#474021, depth: 3979.22m / 13055'02")



Figure 7. *Amoeboceras serratum*, another specimen from the same sample piece as Figs 5, 6 above (#474021, depth: 3979.22m / 13055'02")



Figure 8. *Amoeboceras cf. rosenkrantzi*
(# 474022, depth: 3978.86m /
13054'00")



Figure 9. *Amoeboceras* sp. (# 474023, depth:
3978.65m / 13053'04")

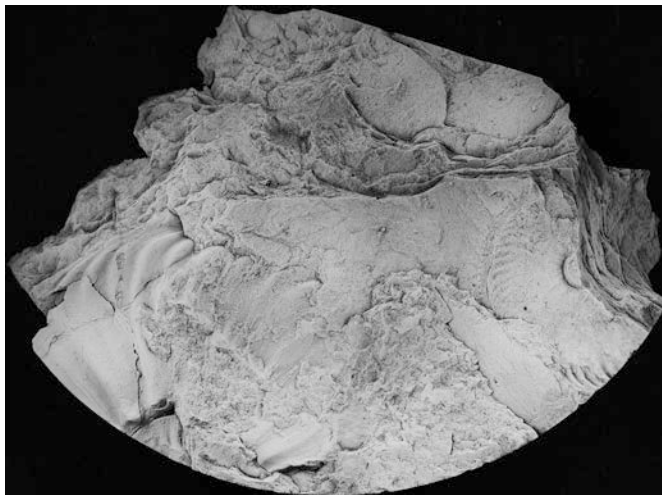


Figure 10. *Amoeboceras rosenkrantzi* (#
474024, depth: 3978.08m /
13051'05")



Figure 11. *Amoeboceras aff. rosenkrantzi*
(# 474025, depth: 3976.57m / 13046'06")

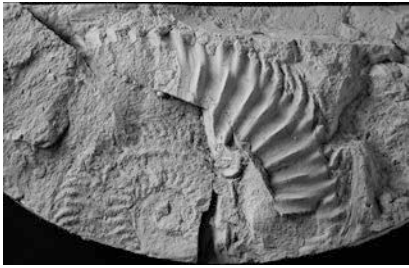


Figure 13. *Amoeboceras* cf. *rosenkrantzi*
(# 474027, depth: 3972.81m /
13034'02")



Figure 12. . *Amoeboceras* sp. Specimens from same
core piece as above in Fig. 12 (# 474027, depth:
3972.81m / 13034'02")

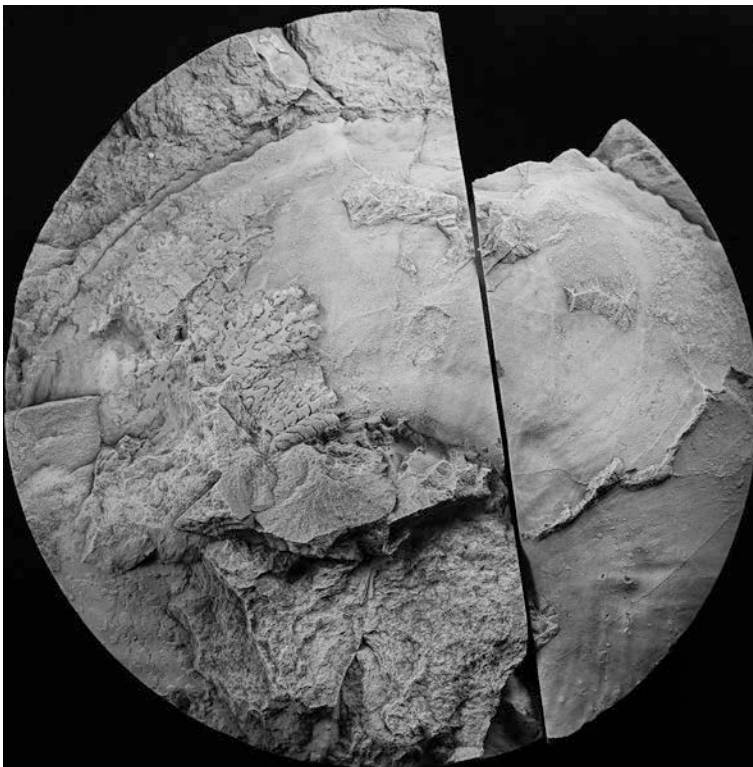


Figure 14. *Amoeboceras serratum*,
large specimen showing transition
between phragmocone (septate part)
and bodychamber. (# 474029, depth:
3971.24m / 13029'00")



Figure 15. Un-identified specimen (#474032, depth: 3970.37m / 13026'02")

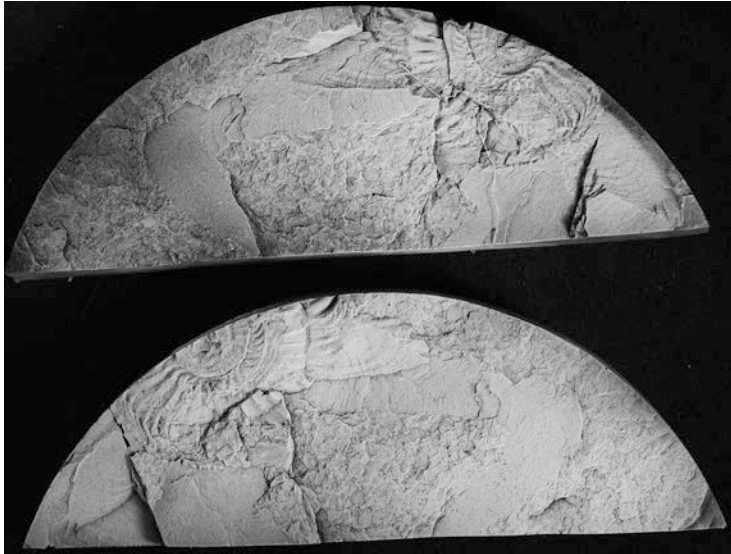


Figure 16. *Amoeboceras* (#474033, depth: 3970.15m / 13025'05")

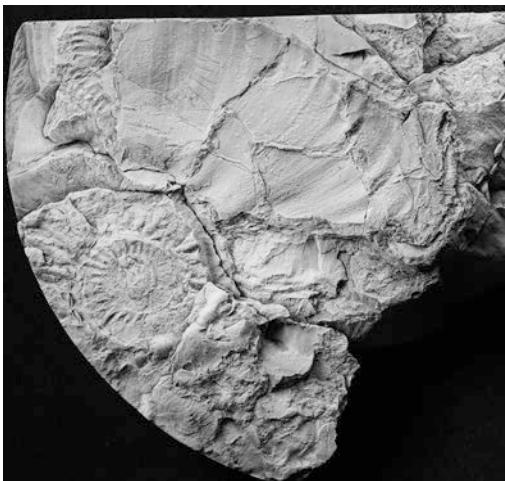


Figure 17. *A. rosenkrantzi* (#474034, depth: 3969.95 m / 13024'09")



Figure 18. *Amoeboceras* sp. (#474034, depth: 3969.95 m / 13024'09")

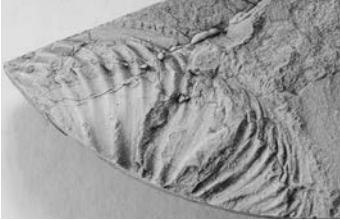


Figure 19. *Amoeboceras marstonense*?
(#474035, depth: 3969.45 m /
13023'02'')



Figure 20. *Amoeboceras rosenkrantzi* ?
(#474041, depth: 3959.05m / 12989'00'')

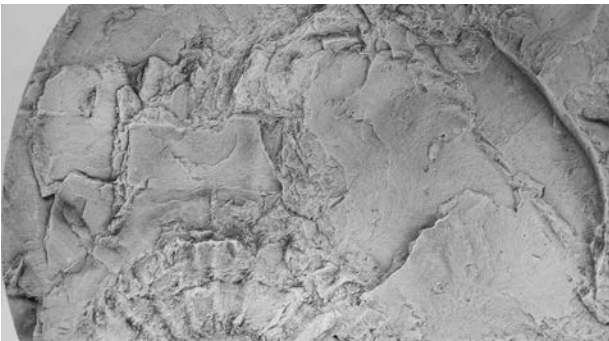


Figure 21. *Amoeboceras rosenkrantzi*?
(#474041, depth: 3959.05m /
12989'00'')

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