

33 IGC excursion No 9, August 15 – 18, 2008



33 IGC, The Nordic Countries

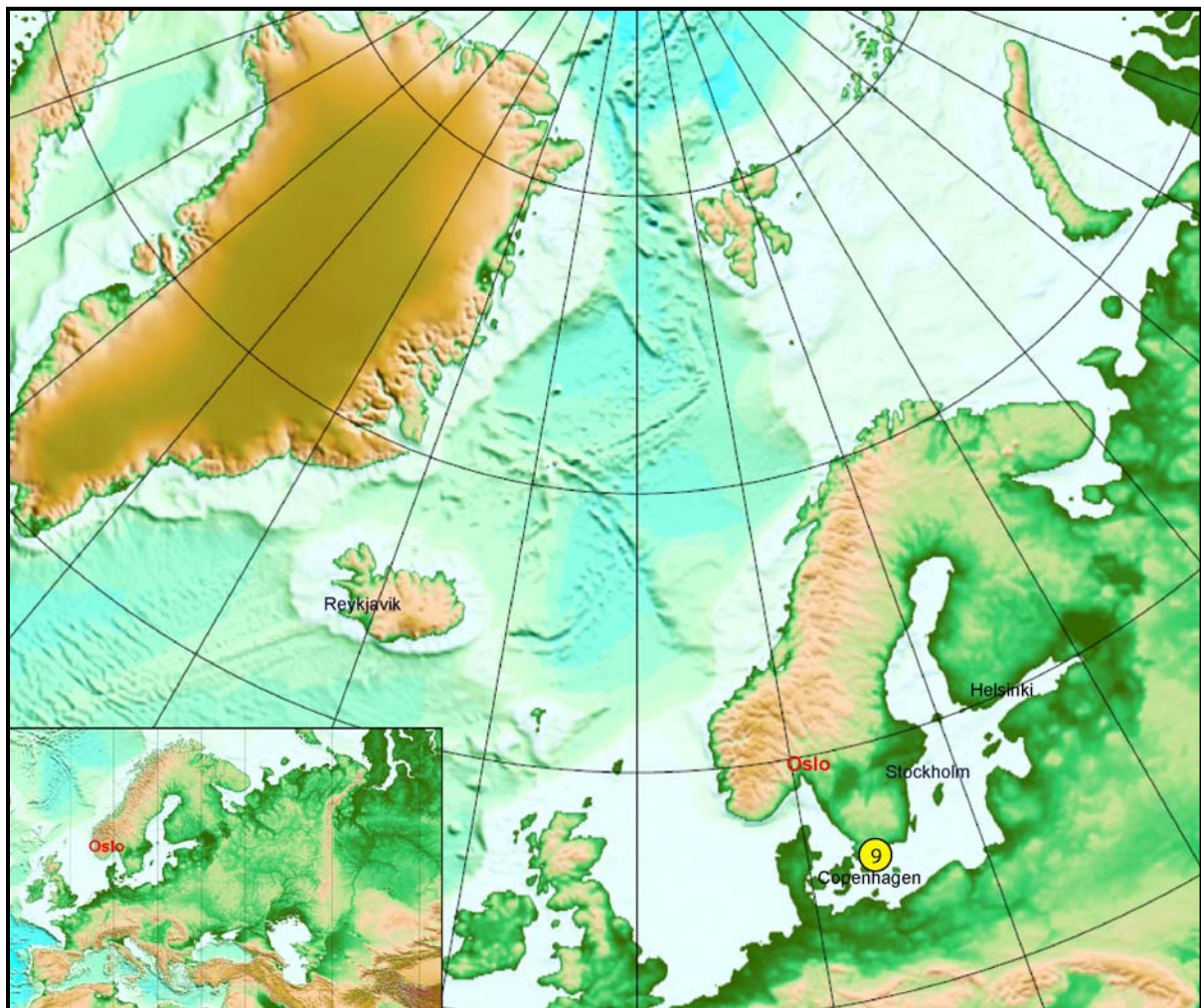


Mesozoic of Southern Scandinavia

Organizers:

Vivi Vajda, Lund University, Sweden

Peter Gravesen, Geological Survey of Denmark and Greenland, Copenhagen, Denmark



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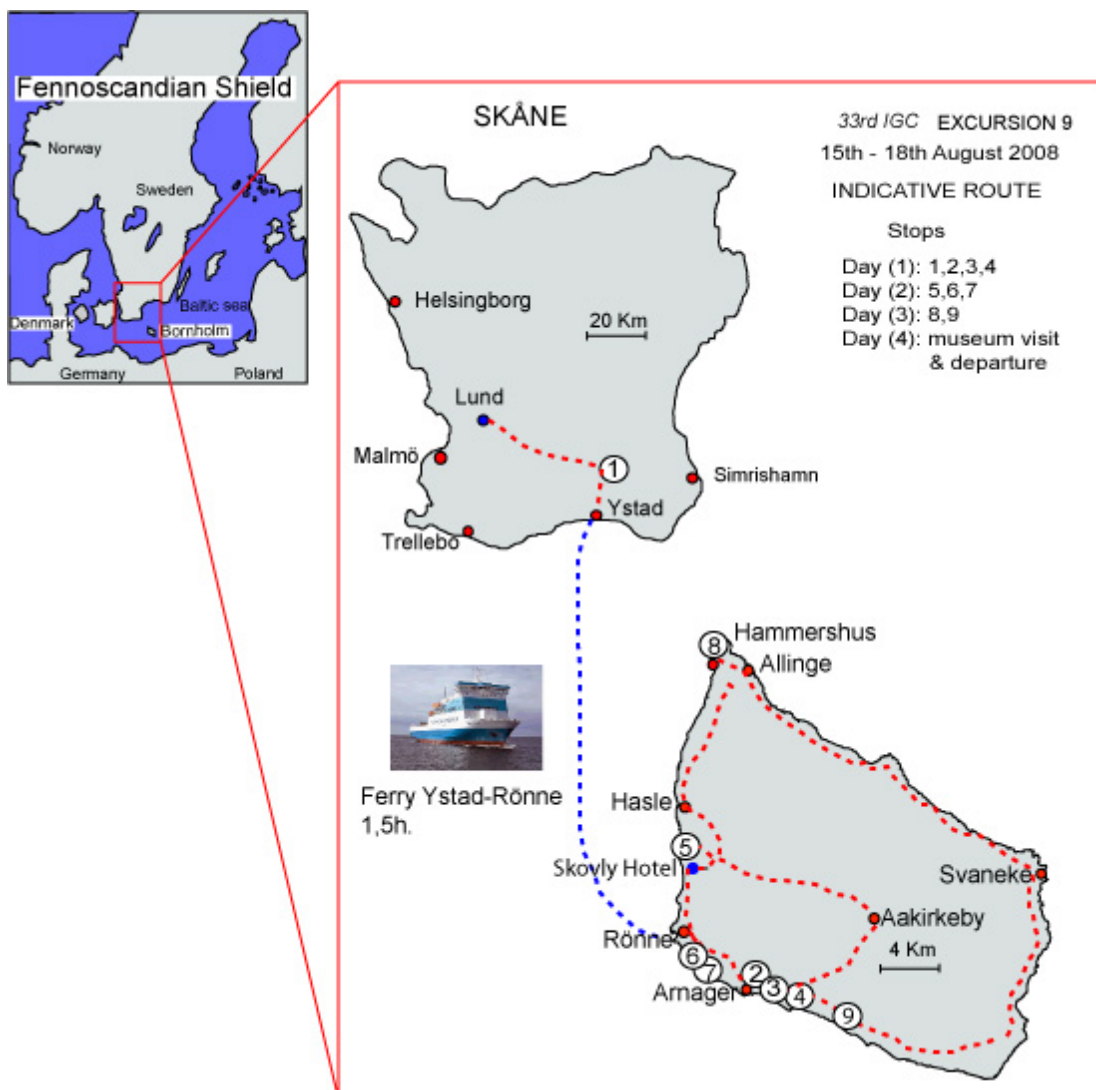
Under the Patronage of UNESCO

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Timing and Logistics

Dates and location

Timing: 2008-08-15 – 2008-08-18

Start location: Lund University, Sweden

End location: Lund University, Sweden/ Copenhagen Denmark

Travel arrangements

The fieldtrip starts on the 15 August 2008, 09.00 hrs, GeoBiosphere Science Centre, Lund University. Arrival in the morning or day before by plane or train from Oslo. The fieldtrip will be run with minibuses with 8 passengers per bus. Fieldtrip ends on the 18th of August in the afternoon on the island of Bornholm where participants either can take ferry direct to Copenhagen or back to Lund/ Sturup Airport. Organizers will make sure that the fieldtrip schedule will be accommodated to suite the international flights.

Excursion fee 600 Euros includes:

Hired bus. Lund-Bornholm return

Ferry tickets (return)

Accommodation (single or double room with breakfast) for 3 nights

Meals (lunch/dinner) for 3 days

Excursion leaders (3 for 3 days)

Accommodation

Hotel Skovly is a charming family hotel located ca. 10 km north of the island's "capital" Rønne. The hotel, with its typically Danish touch, is attractively situated in a protected forest, only 150 metres from the sandy beach on the west coast of Bornholm. Every room is situated on the ground floor and has its own entrance and terrace. Each room has also its own bathroom with shower, radio and SAT-TV. Breakfast buffet is enjoyed in the spacious and light dining room with view over the garden.



Field logistics

Transport will take place in minibuses. There will be plenty of stops along the route and no stretch is longer than 1,5 h. A ferry will take us from Ystad to Rønne. This ferry trip takes around 1h 30 min and the sea is normally nice and calm during this time of the year. The fieldtrip includes several kilometres of walking, usually along sandy beaches but sometimes also stony beaches where caution should be taken. Further the excursion includes some steep downhill walking to beach sections. Good walking boots are recommended.

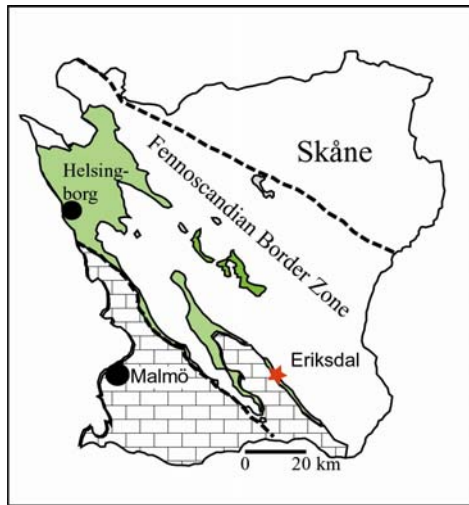
General Introduction

The aim of this fieldtrip is to give geoscientists from the international scientific community the possibility to visit the Triassic to Cretaceous exposures of Southernmost Scandinavia in the field, including Southernmost Sweden and the island of Bornholm, Denmark. The excursion will cover a range of palaeoenvironments; from arid terrestrial late Triassic sandstones to coals formed in a warm and humid environment. Further, there will be time to visit Late Cretaceous marine limestone deposits. Most of these sediments contain interesting sedimentological structures and well preserved fossil flora and fauna.

Regional Geology

The Danish Basin & Vomb trough with focus on the Mesozoic

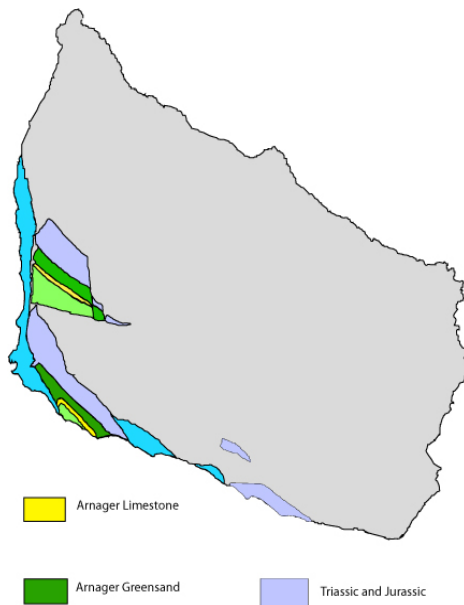
In Sweden, Jurassic sedimentary rocks are restricted to the southernmost province, Skåne. Exposures of Lower Jurassic strata are found mainly in the north-western part of the province and at the eastern margin of the Vomb trough in the central parts,



Geological map of Skåne, with Jurassic exposures marked with green. Eriksdal marked with red star.

and at the eastern margin of the Vomb trough in the central parts, where they rest on Lower Palaeozoic deposits. Exposures of Middle and Upper Jurassic sediments are known, as a result of mining activities, from one locality only, Eriksdal, located within the Vomb Basin. The Vomb Basin is a narrow, elongated graben with a length of c. 80 km and a maximum width of 11 km. During the Mesozoic, this area was tectonically active and the basin was severely affected by faulting leading to the formation of minor troughs within the basin. The eastern margin of the Vomb Basin is defined by a major fault forming the western boundary of an early Paleozoic plateau. The sedimentary deposits in the Vomb basin are mainly constituted by Late Cretaceous marine sediments; however a narrow rim of Upper Triassic and Jurassic strata are exposed, mainly composed of argillaceous sandstones and clays. The sediments were formed in

deltaic, freshwater environment during warm and humid climatic conditions but also some marine deposits prevail.



Geological map of Bornholm, with Mesozoic exposures color-coded

Bornholm is a Danish island situated almost in the centre of the Baltic Sea at 15 degrees east and 55 degrees north. The island is 40 km across and has a 141 kilometre-long coastline. Bornholm is located within the Fenno Scandian Border Zone and displays a block-faulted mosaic exposing a wide variety of rocks ranging from Precambrian gneisses and granites to Lower Palaeozoic and Mesozoic strata.

The Mesozoic sequence occurs in narrow fault blocks along the south and west coasts and offshore in the Rønne Graben west of Bornholm covering around 2500 metres of sediments spanning a period from Late Triassic to Late Cretaceous. The Lower and Middle Jurassic sediments are particularly well exposed and form a general transgressive or deepening sequence. This sequence initiates with deposition of Hettangian lacustrine and fluvial clay, and coal of the Munkerup and Sose Bugt Members of the Rønne Formation, overlain by Sinemurian tidal flat and channel mud and sand deposits of the Galgelokken Member of the Rønne Formation

		BORNHOLM	SE SKÅNE
		Formation	Formation
CRETACEOUS	Late	BAVNODDE GREENSAND	
		ARNAGER LIMESTONE ②	
		ARNAGER GREENSAND ②	
	Early	JYDEGÅRD Fm ③	Vitabäck Clay
		ROBBEDALE Fm ④	
RABEKKE Fm. ④		Nytorp Sand ANNERO Fm	
JURASSIC	Late		Fyledalen Clay ①
			Fortuna Marl ①
	Middle	BAGÅ Fm ⑤ ⑥	Glass Sand MARIEDAL Fm ① Fuglunda Mbr
		HASLE Fm	
	Early	RÖNNE Fm ⑦	
TRIASSIC	Late		
	Middle	KÅGERÖD Fm ⑨	KÅGERÖD Fm

Stratigraphic log over the Mesozoic of Bornholm (Denmark) and SE Skåne (Sweden). Numbers are indicating the stratigraphic positions of the different excursion localities (stops).

The Lower Cretaceous, Berriasian - Valanginian sand and clay sediments of the Rabekke, Robbedale and Jydegård Formations are mainly deposited in the shallow marine are as, on back-barriers and in lagoons, channels and lakes.

The Upper Cretaceous deposits consist of the Cenomanian Arnager Greensand Formation, the Coniacian Arnager Limestone Formation and the Cenomanian Bavnodde Greensand Formations. The three marine formations consist of marine glauconitic sands, marls, clays and limestones and conglomerates with a lot of marine fossils and trace fossils.

Day 1. Departure from Lund University at 9:00 am.



Stop 1. Eriksdal, Mid- to Late Jurassic sandstones and coal seams.

Eriksdal is situated 20 km north of Ystad in the Vomb basin. The Jurassic strata are exposed in the quarry run by Fyleverken. The strata is vertically tilted, slightly overthrust. The oldest sediments include the Earliest Jurassic (Liassic) ferruginous sandstones followed by the so called Eriksdals beds of Bajonian age, Glass sand of Bathonian age (stratigraphic chart).

This is followed by the green, plastic Fyledalen Clay of Kimmeridgian-Portlandian age. Plant fossils have been encountered in these sediments.

In the afternoon we drive to Ystad, from where we take the ferry to Rønne, “capital” of Bornholm. This ferry trip takes around 1h 30 min and the sea is normally nice and calm during this time of the year.

BORNHOLM

Stop 2. Arnager Town. Upper Cretaceous Cenomanian Arnager Greensand Fm and Coniacian Arnager Limestone Fm.

Near the town of Arnager on the south coast of Bornholm, the Upper Cretaceous deposits are exposed in a small cliff. The Arnager Greensand consists of fine-grained glauconitic quartz sand which is strongly bioturbated. The overlying Arnager Limestone is an uniform marl, silica-rich grey and white chalk deposited on a system of complex mounds on the sea floor. The lowermost layer is a 20 cm thick conglomerate composed of composite glauconized and phosphatized pebbles of chalk, and greensand.



Stop 3 and 4. Jydegård, Robbedale and Rabekke Formations at Arnager Bay.

The Lower Cretaceous deposits on Bornholm belong to the Nyker Group of Berriasian to Valanginian age. The Nyker Group comprises three formations; the Rabekke, Robbedale and Jydegård Formations. We will make the first stop at Arnager Bay where the three formations are exposed in a coastal setting.

The age of the lower Jydegård Formation is Late Berriasian- Valanginian corresponding to the German ‘Wealden’ and is equivalent to the Upper Purbeck, as well as to the lower Ashdown Fm., which is the base of the Hasting Beds of the type Wealden in Britain. The quartz sands and clays of the Jydegård Formation interfingers with the underlying Robbedale Fm.

The Robbedale Formation is composed by cross-bedded and massive quartz sand with a vast number of trace fossils (e.g. *Sholithos*) of which some are interpreted as feeding traces of rays. The sediments belonging to the formation were deposited in a shallow marine environment. The entire formation is of Berriasian age and is correlated with the lower part of the German ‘Wealden’.

The sediments of the underlying Rabekke Formation are composed of fluviatile and lacustrine to marginal marine green and black clays and sand of an supposedly Berriasian age. The deposits yield plant fossils and ostracods.

Arrival and check in at Hotel Skovly

Day 2 (August 16th)

We depart from Hotel Skovly at 8.30 to spend the day at the coastal sections at the western and southern shore of Bornholm. This will be a long day walking at the beach sections. Lots of drinking water recommended. Bring sunhat, long sleeves, swim wear etc.

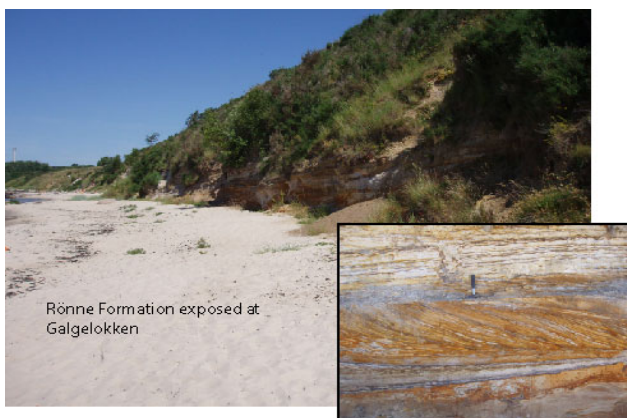


Stop 5-6. Hasle Clay pit/ Korsodde

The principal exposures of the Bagå Formation occur at the Hasle brick-factory clay pit and in the coastal cliff section in the vicinity of Korsodde. The Formation reaches a thickness of c. 400 m and encompasses the late Pliensbachian to Bathonian. Today most of these sediments are inundated but sediments at the edge of the clay pit and in blocks around it. The Bagå beds are also exposed along the coast south of the Clay pit.

The Bagå beds consist of interbedded sand, clay, and coal beds with rootlets below and the dominant facies is a laminated, grey to dark grey clay with occasional silt and sand lamina. Plant fragments including small logs, stems and leaves are common in the clay. Plant macrofossils are common in the formation and were

described in the late 1800. The depositional environment of these sediments was those of paralic, lacustrine and alluvial settings. No marine macrofossils have been encountered but dinoflagellates have been indentified from the basal beds



Stop 7. Galgeløkken

Sinemurian sandstones intercalated with clay layers are exposed at this coastal locality stretching for 400 m along the beach. The sediments are part of the so called Galgeløkken Member and makes up the upper part of the Rønne Formation. The layers, which comprise a total thickness of up to 210 meters, are slightly dipping and becoming older towards the south.

The lithology consists of thin sand and clay beds interpreted to have been deposited in a tidal, delta environment. This locality is known by its interesting sedimentary structures.

Barbeque at Hotel Skovly

Day 3 (August 17th)



Stop 8. Hammershus Castle ruin.

We leave our hotel at 8.30, driving north to Hammershus Castle ruin, a historically interesting site. We continue our tour around the island stopping at historical villages and scenic spots. On our way back along the south coast time will be given to visit a few more geological/archaeological sites, depending on time. The sun will be up until 10 pm so there is plenty of time for fieldwork.....

Stop 9. Risebæk, Late Triassic (Carnian)

The Risebæk member, which is part of the Kågerød Formation, reaches a thickness of 70 metres, exposed along the southern coast of the island. The exposed sediments consist of multicolored (red-greenish) plastic clays of a Late Triassic, Carnian age. Within the clays, white, calcrete nodules are encountered formed as caliche in the Late Triassic arid climate. These clays were formed on a coastal plain with meandering rivers depositing channel-sand. Triassic deposits are un-conformably overlain by the Early Jurassic Rønne Fm.



Day 4. (August 18th).

Check out from Hotel Skovly

Visit to Rønne Geological Museum. End of fieldtrip, participants can either take ferry to Copenhagen, Sweden or Poland.

Literature

- Bonde N., Christiansen P. 2003: New dinosaurs from Denmark. *Palevol* 2, 13–26.
- Bundgaard Koppelhus, E., Nielsen, L.H. 1994: Palynostratigraphy and Palaeoenvironments of the Lower to Middle Jurassic Bagå Formation of Bornholm, Denmark. *Palynology* 18, 139-194.
- Gravesen, P., Rolle, F. & Surlyk, F. 1984: Lithostratigraphy and sedimentary evolution of the Triassic, Jurassic and Lower Cretaceous of Bornholm, Denmark. *Danm. Geol. Unders. Ser B*, 7. pp. 51.
- Gry, H., Flemming R. 1977: Geologi på Bornholm VARV ekskursionsföreläsning nr. 1. 55-84
- Guy-Ohlson, D. 1982. Biostratigraphy of the Lower Jurassic-Cretaceous unconformity at Kullemölla southern Sweden. SGU serie, pp 82.
- Guy-Ohlson, D., Norling, E. 1994: Jurassic sequences in Sweden. *GEOBIOS* 17, 275-286.
- Noe-Nygaard N, Surlyk, F. 1988: Washover fan and brackish bay sedimentation in the Berriasian -Valanginian of Bornholm, Denmark. *Sedimentology* 35, 197-217.
- Norling, E., Ahlberg A., Erlström M., & Sivhed U. 1993. Guide to the upper Triassic and Jurassic geology of Sweden. SGU serie, pp 82.
- Sivhed U. 1980: Lower Jurassic ostracods and stratigraphy of western Skåne, southern Sweden. *Sveriges Geologiske Undersökelse Serie Ca* 50, 84 pgs.
- Sivhed U., 1984 Litho- and biostratigraphy of the Upper Triassic-Middle Jurassic in Scania, Southern Sweden. *Sveriges Geologiske Undersökelse Serie C* 806, 31 pgs.
- Surlyk, F., Noe-Nygaard N., 1986: Hummocky cross-stratification from the Lower Jurassic Hasle Formation of Bornholm, Denmark. *Sedimentary geology* 46, 259-273.