

ISOS-14 Field Guide

The Ordovician of Estonia

Edited by Olle Hints and Ursula Toom

14th International Symposium on the Ordovician System, Estonia, July 19-21, 2023

Pre-conference Field Excursion: The Ordovician of Estonia, July 15-18, 2023



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The conference and field excursion are supported by:
IGCP Project “Rocks and the Rise of Ordovician Life”
University of Tartu
Tallinn University of Technology
Geological Survey of Estonia
Estonian Museum of Natural History



Recommended reference to this publication:

Ainsaar, L. 2023. Stop 11: Aru-Lõuna (Kunda-Aru) quarry. In: Hints, O. and Toom, U. (eds). *ISOS-14 Field Guide: The Ordovician of Estonia*. TalTech Department of Geology, Tallinn, p. 65–68.

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Electronic copy available at: <https://geologia.info/reference/47491>

Printed by Alfapress OÜ

ISBN 978-9916-80-008-9 (printed)

ISBN 978-9916-80-009-6 (pdf)

Tallinn, 2023

Stop 12: Männamaa drill core, western Estonia

Marko Kabel

Location: Latitude 58.83816°N, longitude 22.62839°E; Hiiumaa Island, western Estonia.

Stratigraphy: Complete Ordovician succession from the Tremadocian to Hirnantian.

Status: Reference section, drilled for geological mapping in 1988.

More information: <https://geoloogia.info/en/locality/498>

The Männamaa (F-367) borehole was drilled in the central part of Hiiumaa Island, western Estonia, with the aim of 1:200000 deep geological mapping (Pöldvere 2008). The borehole is 358.3 m deep. The Ordovician strata in the Männamaa core are covered by the 29 m thick Quaternary cover and ca 17 m of Silurian limestones. Ordovician strata start from a depth of 46 m and continue until 183 m. Being near to the Kärddla impact crater (Sandbian in age), the succession is weakly influenced by its

ejecta in the Tatruse Formation, Haljala Regional Stage. During different periods, the core has been sampled for microfossils (chitinozoans, acritarchs, ostracods etc), geophysics and geochemistry (e.g., Grahn et al. 1996; Hints et al. 2010; Kiipli et al. 2008; Meidla and Ainsaar 2008; Meidla and Tinn 2008; Nölvak 2008; Pöldvere et al. 2008; Shogenova and Shogenov 2008; Truuver et al. 2021; Suuroja et al. 2008; Uutela 2008).



Fig. 12.1. Männamaa F-367 core box No 34, showing a series of Sandbian K-bentonites with the Kahula Formation, including the infamous Kinnekulle Bed, which marks the base of the Keila Regional Stage. Photo from the Estonian Land Board database.

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Lithological log legend:

	Limestone		Argillaceous limestone		Sandstone
	Skeletal limestone (grains 10-25%)		Biohermal limestone		Bioclast-rich sandstone
	Skeletal limestone (grains 25-50%)		Dolomitic limestone		Argillaceous siltstone
	Fine bioclasts (left), coarse bioclasts (right)		Dolostone		K-bentonite
	Crypto- and microcrystalline limestone		Marlstone		
	Sandy limestone		Argillaceous marlstone		

Männamaa (F-367) core interval 37-190 m

Series	Stage	Fm.	Depth 1:200	Lithology	Description/notes
O3-S1 Upper Ordovician-Liandovery	Juuru	Varbola	38.0		37,0-46,0 m – Limestone (grains 10-40%) with marlstone films and interbeds (10-20%), light-grey, texture: indistinctly medium- to thin-bedded and nodular.
			40.0		Some interlayers (thickness up to 20 cm) contain carbonate clasts (mainly 1-3 cm across). Rounded stromatoporoids reach 5 cm in size.
			42.0		Discontinuity surfaces are pyritized.
			44.0		
			46.0		46,0-46,5 m – Cryptocrystalline limestone (Koigi Mb.; grains <10%, in some layers <50%) with marlstone films and interbeds (<5%), light yellowish-grey to grey, in some layers pyritized, texture: indistinctly medium- to thin-bedded.
			48.0		46,5-49,1 m – Biohermal limestone (Tõrevere Mb.; grains often >50%; boundstone), in some layers dolomitized, light-grey, texture: indistinctly wavy-bedded to massive.
	Porkuni	Ärina	49,1-49,3 m – Limestone (Siuge Mb.; grains <25%), brownish-grey with calcitic marlstone interbeds (5%).		
			50.0		49,3-50,4 m – Limestone (Vohilaiu Mb.; grains 10-50%), light brownish-grey, in some layers dolomitized and argillaceous.
			52.0		50,4-52,2 m – Dolostone (Rõa Mb.; grains <25%), light brownish- to greenish-grey with dolomitized bioclast-rich and argillaceous limestone layers, texture: massive. The discontinuity surface is pyritized.
			54.0		52,2-68,2 m – Limestone (grains 10-25%, in some layers <10% or >50%) with argillaceous limestone and marlstone (bioclasts up to 20%) interbeds (5-20%),
			56.0		light-grey, the upper 2,5 m light yellowish- to brownish-grey, uppermost part dolomitized, in places greenish-grey and pyritized, texture: indistinctly thin- and medium-bedded with nodular intervals.
			58.0		Carbonate clasts (0,5-3,0 cm across) containing intervals are up to 20 cm thick. At 54,1 m the pentamerid brachiopod Holorhynchus giganteus is found.
Pirgu	Adlia	60.0		Discontinuity surfaces are pyritized.	
		62.0			
		64.0			
		66.0			
		68.0		68,2-87,0 m – Limestone (grains 10-30%, in some layers <10% and >50%) with marlstone interbeds (<5%), light brownish-grey, texture: thick-bedded, in places nodular or indistinctly thin- to medium-bedded intervals.	
		70.0		Carbonate clasts (0,5-4 cm across) are observed in up to 10 cm thick intervals.	
		72.0		Fragments of calcareous algae Palaeoporella (Dasyporella) are found.	
		74.0		Discontinuity surfaces are pyritized.	
		76.0			
		78.0			
Moe	Moe	80.0			
		82.0			
		84.0			
		86.0			

Fig. 12.2. Ordovician succession in the Männamaa F-367 drill core, Hiiumaa Island, western Estonia.

O3 Upper Ordovician	Vormsi	Kõrgesseare	88.0	87,0-92,4 m – Limestone (grains 10-30%), light grey, slightly argillaceous with interbeds of highly argillaceous limestone and marlstone (bioclasts up to 30%), texture: thin- and medium-bedded, rarely thick-bedded and nodular.
			90.0	The discontinuity surface is pyritized.
			92.0	
			94.0	92,4-98,0 m – Calcareous marlstone (bioclasts in some layers up to 50%), dark greenish-grey, intercalation with greenish-grey, medium to highly argillaceous limestone (grains 10-25%), texture: thin- and medium-bedded, in places nodular.
			96.0	Phosphatized discontinuity surfaces lie on the lower boundary.
			98.0	
			100.0	98,0-104,0 m – Limestone (grains 10-25%, in some layers <10%, often pyritized), light grey and yellowish-grey, with marlstone (bioclasts up to 30%) interbeds (5-10%), texture: thin- and medium bedded, in places nodular.
			102.0	
			104.0	A phosphatized and pyritized discontinuity surface lies on the lower boundary.
			106.0	104,0-108,0 m – Limestone (grains <10%, in some layers <25%), beigish light-grey, with rare calcitic marlstone interbeds (1-2%), texture: indistinctly thin- and medium-bedded. Calcite-filled primary and secondary veins are found.
	Nabala	Saunja	108.0	108,0-113,2 m – Limestone (grains 25-50%), light greenish-grey, slightly argillaceous with marlstone (bioclasts up to 50%) interbeds (5-20%), texture: thin- and medium-bedded, rarely indistinctly nodular.
			110.0	At 108,5-109,1 m lies a beigish-grey, burrowed micro- to cryptocrystalline limestone interbed.
			112.0	Discontinuity surfaces are pyritized.
		Päekna	114.0	113,2-117,4 m – Limestone (grains 10-25%), light-grey, with marlstone (bioclasts up to 10%) interbeds (<5%), texture: indistinctly thin- and medium-bedded.
			116.0	Discontinuity surfaces are pyritized.
			118.0	117,4-126,4 m – Limestone (Tudu Mb.; grains 10-25%), light beigish-grey, with rare marlstone interbeds (<5%), texture: thin- and medium-bedded, very rarely thick-bedded.
	Rakvere	Rägavere	120.0	The uppermost 0,5 m contains kerogenous interlayers, at 117,45 and 117,7 m lie dark brown distinct kukersite oil shale interbeds (thickness 1 cm and 5 cm, respectively). Discontinuity surfaces are pyritized.
			122.0	
			124.0	
			126.0	126,4-138,2 m – Limestone (Piilse Mb.; grains <10%, in some layers 30%), light-grey, with rare marlstone interbeds (<5%), with small pyrite mottles (especially at 128,0-133,0 m), in places with beige shade, texture: thin- and medium-bedded. Calcite-filled veins occur.
			128.0	
			130.0	
			132.0	
			134.0	
			136.0	138,2-138,8 m – Limestone (Tõremäe Mb., grains 10-25%, rarely <40%), light grey, slightly argillaceous with rare marlstone interbeds (5%), texture: indistinctly medium- and thin-bedded. Discontinuity surfaces are pyritized.
			138.0	
	Oandu	Hirmuse	140.0	138,8-141,0 m – Calcareous marlstone (bioclasts in some layers up to 40%), dark greenish-grey, intercalation with light greenish-grey, in some layers dolomitized, slightly to highly argillaceous limestone (grains 10-30%). Clay content increases downwards.
			142.0	141,0-157,3 m – Argillaceous limestone with calcareous marlstone intercalations.
Kella	Kahula	144.0	Limestone (grains 25-60%) is light grey or greenish-grey, mainly medium to highly argillaceous. Grain content increases upwards, in some layers bioclasts are accumulated in up to 5 cm high conic bodies with distinct edges. At 144,0-146,0; 148,0-148,8 and 154,0-155,0 m interlayers of slightly argillaceous, often microcrystalline limestone are common.	
		146.0	Marlstone (bioclasts in some layers up to 40%) prevails in the intervals 141,0-142,6; 146,2-147,4; 149,0-152,6 and 155,0-156,9 m, where calcite and clay content changes in thin layers and patches. Texture: indistinctly nodular or thick- to medium-bedded, with micro- to thin-bedded intervals (thickness up to 10 cm).	
		148.0		
		150.0		
		152.0		
		154.0	At 156,44 m and on the stage boundary lie greenish-grey K-bentonite beds (thickness 1 cm and 40 cm (Kinnekulle), respectively).	
		156.0	157,3-158,6 m limestone (Jõhvi Substage; grains 25-50%), light greenish-grey, with rare marlstone interbeds (<5%), texture: medium- and thick-bedded. At 157,7 m lies 2 cm K-bentonite bed.	

Fig. 12.2 (continued). Ordovician succession in the Männamaa F-367 drill core, Hiiumaa Island, western Estonia.

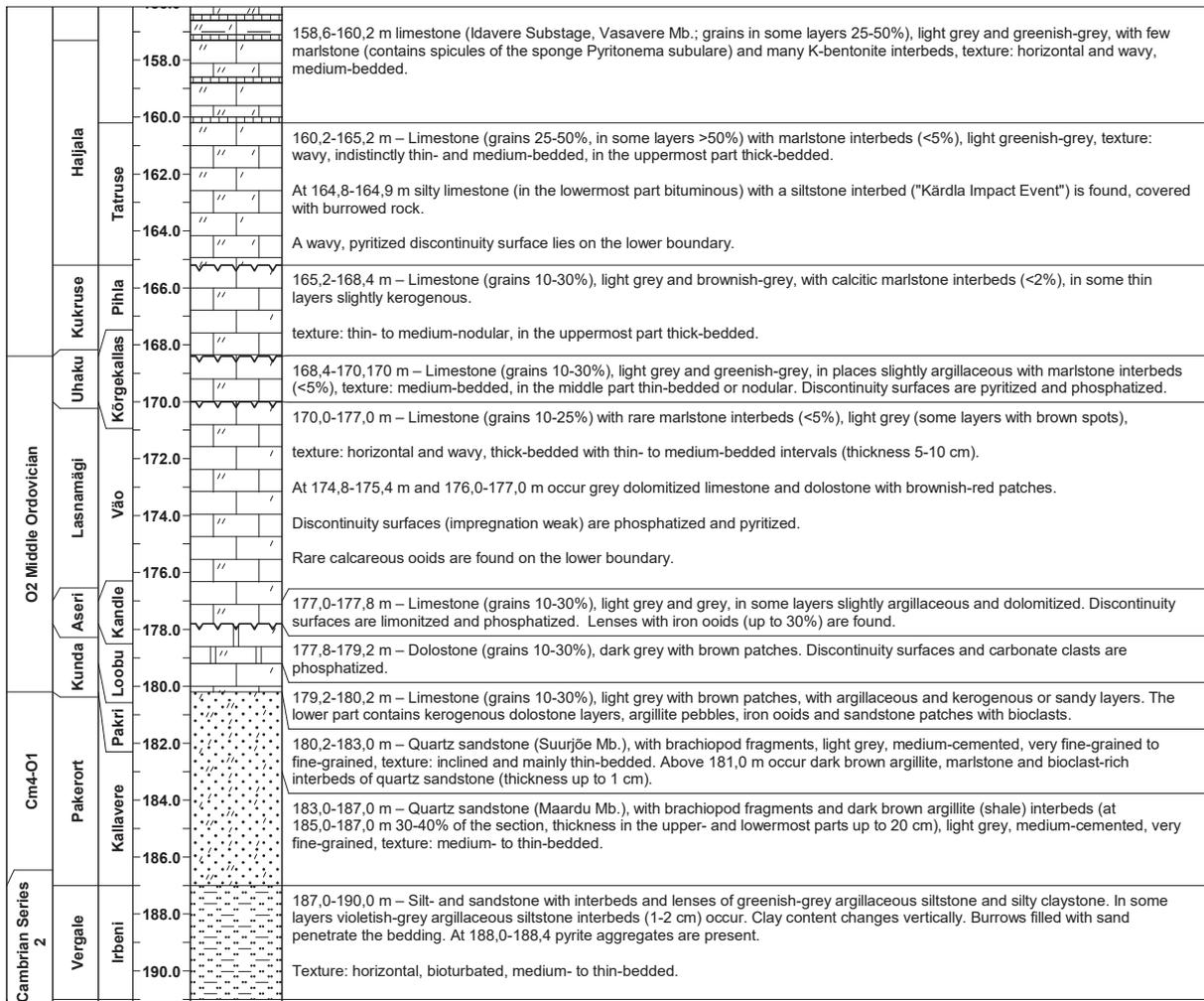


Fig. 12.2 (continued). Ordovician succession in the Männamaa F-367 drill core, Hiiumaa Island, western Estonia.