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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Stop 14: Ruhnu drill core, SW Estonia

Marko Kabel

Location: Latitude 57.80316°N, longitude 23.24135°E; Ruhnu Island, SW Estonia. Stratigraphy: Complete Ordovician succession from the Tremadocian to Hirnantian. Status: Reference section, drilled for oil and gas prospecting in 1972. More information: https://geoloogia.info/en/locality/972

The Ruhnu (500) core was drilled in 1972 on Ruhnu Island (Põldvere 2003). It is one of the deepest boreholes in Estonia, with a total length of 787.4 m. The primary purpose of the drilling was prospecting for oil and natural gas. This attempt failed, and only Cl-Ca-Na type mineral groundwater (salinity 17 g/l) was found in the lower and middle Cambrian sediments. The Quaternary cover in the area is about 8 m. Below that, the Eifelian Narva Formation occurs. The thickness of the Devonian is 138.3 m, and the Silurian strata are about 454.9 m thick, reaching a depth of 601 m. The boundary between the Ordovician and Silurian systems most likely correlates with a level within the Õhne Formation. Thus, the Ordovician successsion is ca 106 m thick. The Ordovician succession in this

References

Põldvere, A. (ed). 2003. Ruhnu (500) drill core. Estonian Geological Sections Bulletin 5. Geological Survey of Estonia, Tallinn. https://fond.egt.ee/fond/egf/9313 area corresponds to the relatively deeper-water environments, which are characteristic of South Estonia, Latvia and Sweden.

The Ordovician succession in Ruhnu drillcore has been heavily sampled and analysed for palaeontology, geochemistry and geophysics. Many tens of research papers have been published using the data from the Ruhnu core and making it one of the key Ordovician–Silurian sections in Baltoscandia.

The section is well characterised palaeontologically, and numerous brachiopods, conodonts, chitinozoans, graptolites, agnathan and fish microremains, ostracods and other fossils have been collected.

Ruhnu (500) core interval 588-720 m

Series	Stage	Fm.	Depth 1:200	Lithology	Description/notes			
3-S1 Upper Ordovician-Llandovery	Juuru		-588.0-		588, 1-598,5 m – Calcareous maristone, grevish-green and violetish-bro	wn, with interbeds and nodules of slightly argillaceous		
		õhne			limestone (grains <10%),			
					texture: wavy, irregularly medium- to thin-bedded and medium- to thin-nodular.			
			-592.0-					
			- 594.0-					
			-596.0-					
			-598.0-					
0					598,5-600,6 m – Cryptocrystalline limestone (grains <10%), light grey, sl (20-40%), texture: wavy, irregularly nodular.	ightly argillaceous with calcareous maristone interbeds		
			- 600.0-		600,6-601,0 m – Limestone, greyish-green, slightly to highly argillaceous,	dolomitized. The wavy discontinuity surface is pyritized.		
601.0-603.0 m – Limestone (grains 10-50%, in some layers >50%), light grey, containing ooids, san thin-bedded. Content and diameter (mostly up to 1 mm) of carbonate ooids increases upwards. We				grey, containing ooids, sandy, texture: cross- and micro- to ids increases upwards. Well rounded quartz sand interbeds				
	Porkuni			(thickness 0,5-2 cm) are present. 0 - - - - - - - - - -				
		ldiga			texture: wavy, medium- to thin-bedded or thick- to thin-nodular.			
			-606.0-	506.0		more numerous in the upper part) contain carbonate clasts		
			-608.0-		or pellets and quartz sand.			
				<u> - -</u>				
					609,5-617,1 m – Limestone (grains 10-25%), greenish-grey, slightly argillaceous, interbedded with calcareous maristone (bioclasts			
		Ku	-612.0-		texture: wavy, irregularly thin- to thick-bedded.			
			-614.0-		The clay content increases upwards.			
				- - -				
			-616.0- 					
			-618.0-		617,1-618,9 m – Calcareous martstone, light greenish-grey, with nodules and clasts of highly argillaceous limestone (grains 10-25% and in some layers 25-50%), texture: massive, sometimes nodular. In the lower part skeletal fragments concentrate in layers. Burrows are filled with brown martstone and rust-coloured iron compound.			
	Pirgu		-620.0-		619,1-621,6 m – Limestone (grains 10-25%), brownish-red, at some levels dark yellow, with calcitic marlstone interbeds (10-20%). The marl content changes vertically. Crinoids are dominating. Discontinuity surfaces are goethitized or not impregnated.			
		orp	-622.0-		621,6-631,1 m – Limestone (grains 10-25%), argillaceous, brownish-red, with calcitic marlstone (bioclasts 10-25%) interbeds (40-50%, upper part 20%),			
			-624.0-	/	texture: wavy, thin-nodular, lower 0,6 m medium-bedded or medium-nodular.			
		Jons	- 626.0- 		The clay content decreses upwards.			
03 Upper Ordovician		Saunja Fjäcka			Fig. 1	L4.1. Ordovician succession in the 10 million to 10 million and 10		
			-628.0-					
			-630.0-		Flat iron ooids occur on the lower boundary.			
	>		632.0		631,1-631,8 m – Limestone (grains <10%), greenish-grey and light-grey interlavers (35%).	with limonitized spots, argillaceous, with shale-like marlstone		
	Nabala				631,8-632,7 m – Limestone (grains 10-25% and 25-50%), in some layer	s cryptocrystalline, yellowish-grey.		
			-634.0-		632,7-638,0 m – Limestone (grains 10-25%, in the lower part 25-50%), light greenish-grey (upper 0,5 m violet spots), with calcareous maristone interbeds (5-7%),			
	e	õntu	-636.0-		texture: irregularly thin- to medium-bedded, some layers are thick-bedde	d.		
	takve	ź	- 638.0-		Discontinuity surfaces are rust-coloured (limonitized?)	nich grov with coloitic modetono (40% bioclasts 10.25%)		
	2				interbeds, texture: irregularly nodular. Discontinuity surfaces are pyritized	d.		
	Dandu	Ę	-640.0-		638,8-640,50 m – Calcareous maristone (bioclasts 10-25%), greenish-grey, with rare nodules of argillaceous limestone (20-30%; grains <10%), texture: massive and in some layers nodular.			
	Keila	Blidene Mosse	-642.0-		640,5-645,7 m – Calcareous marlstone (bioclasts 10-25%), dark greenis	h-grey, dolomitized, in the lower part argillaceous,		
					texture: wavy, indistinctly bedded, in some layers thin-hodular.			
			-646.0-		645,7-647,1 m – Calcareous marlstone (bioclasts 10-25%), dark greenish-grey, dolomitized, with rare limestone nodules, texture: wavy, indisctinctly bedded or nodular. Basal 0,5 m is greenish-grey, highly argillaceous limestone with calcareous marlstone interbeds.			
			-648.0-	- <u> </u>	647,1-650,1 m – Limestone (unsorted grains 10-25%, in some layers >5 calcareous maristone interbeds (30%) and greenish-vellow to light grey	0%), light grey and greenish-grey, argillaceous, with microbedded K-bentonite claystone (20 cm) on the lower		
			-650.0-		boundary. Texture: wavy, thin- to medium-bedded or irregularly nodular.			
650,1-652,4 m – Limestone (grains 10-25%), light greenish-grey, ar				' - '' -	650,1-652,4 m – Limestone (grains 10-25%), light greenish-grey, argillad calcareous maristone (30-40%), texture: wavy, thin- to medium-bedded	ceous, in some layers microcrystalline with interbeds of or irregularly nodular.		
			-652.0-		ron oolds are tound.			

	Haljala	Adze			652,4-653,5 m – Limestone (in some layers grains 25-50%), slightly argillaceous with marlstone interbeds (20-30%).		
			-654.0-		653,5-659,7 m – Limestone (grains 25-50%), light grey, in some l	layers microcrystalline, slightly to medium argillaceous,	
				- ' <i>''</i> -	texture: wavy, irregularly thin- to medium-bedded.		
			-656.0-		Interhade containing iron coids (diameter 0.5 mm) are valley, and	l vielet	
				"		violet.	
			-658.0-	- ''' -			
		Dreimani					
			-660.0-		659,7-666,8 m - Limestone (grains 10-25% and 25-50%), light bi	rownish- or yellowish-grey, in some layers slightly argillaceous, in	
	Kukruse				some layers microcrystalline, with calcareous maristone interbeds	s (<5%),	
			-662.0-	// /	texture: wavy: irregularly nodular and medium-bedded.		
				<i>"''''</i>			
			-664.0-				
	haku	Taurupe	-668.0-		666,8-677,2 m – Limestone (grains 10-50% and >50%), light gree intervals 2-8 cm) and microcrystalline, with calcitic marlstone inter	enish-grey, in some layers slightly argillaceous, crypto- (thickness of rbeds (<5%),	
				1 1 1 1	texture: wavy indistinctly thin- to medium-bedded		
			-670.0-		Villes and server the server because the		
					Yellow and brown spots surround Iron colds.		
			-672.0-				
			-674.0-				
			-676.0-				
					677,2-678,1 m – Limestone (grains 25-50%; goethitized and rour	nded), light grey, crypto- and microcrystalline with marlstone	
	gi	as	-678.0-		Interbeds (1-2%), texture: medium-bedded. Some layers contain	Iron oolitins.	
	amä	Stirn	- 0.089-		to medium-bedded. Some layers contain iron ooids. Discontinuity	v surfaces are wavy, phosphatized (at 679,55 m) and limonitized.	
	-asn			" /	680 5-687 9 m – Limestone (grains 25-50 and >50%) light brown	to brownish-red with rare gray spots in some layers argillaceous	
	-		-682.0-	- '-"-	in some layers microcrystalline, with marlstone interbeds (10-20%	(b),	
	Aseri	Segerstad			texture: wavy, thin- to medium-nodular.		
ian			-684.0-		Carbonate clasts (diameter up to 0,5 cm) are found.		
O2 Middle Ordovic				_ ///			
			-686.0-				
				" <u> </u>			
			-688.0-	· / " "	687,9-697,5 m - Limestone (grains 10-50%), greyish-red with bro	ownish-grey and grey interlayers (thickness 5-20 cm), dolomitized,	
					with marlstone interbeds (<5%),		
	Kunda	Baldone	-690.0-		texture: wavy, irregularly thin- to medium-bedded or thin-nodular.		
			-692.0-				
			-694.0-				
			-696.0-				
		a			/		
		akyn	-698.0-		697,5-698,5 m – Dolostone (grains >50%), yellowish-grey with gr texture: wavy, medium-bedded.	een shade, calcareous, with dolomitic marlstone interbeds (1-2 %),	
		»،			698,5-700,6 m – Limestone (grains <25%; >50%), brown, grey or	r yellow mottled and violetish-red (lower 1 m), in some layers	
	Volkhov		-700.0-		argillaceous, with rare marlstone interbeds (1-2%), texture: thin-t Wavy discontinuity surfaces are limonitized.	o medium-bedded. In the middle violet-brown calcareous dolostone.	
		tai			700,6-705,9 m – Dolostone (grains 25-50% and >50%), violetish-	brown, calcareous, slightly argillaceous, with dolomitic marlstone	
		Criuk	-702.0-		interbeds (5-10%),	- · · · -	
		_	-704 0-		texture: wavy, thin- to medium-bedded or irregularly thin-noular.		
					Wavy or flat discontinuity surfaces are limonitized and hematized		
-	8	Jre	-706.0-	$\sim \sim $	705,9-706,65 m – Dolostone (Lower Ordovician, Hunneberg-Billingen Stages), violetish-brown mottled, pinkish-white and		
Ó	±	Zet			greenisn-grey, sandy, argillaceous, texture: medium-bedded. Well rounded glauconite grains (10-30%, in the lower part rare). Wavy discontinuity surfaces are limonitized.		
		Leetse	-708.0-		706,65-706,8 m - Quartz sandstone, glauconitic, greenish-grey, f	fine- to coarse-grained, medium-cemented (by dolomite).	
					The lower strongly cemented 10 cm contains inarticulate brachiop	oods, glauconite and well rounded quartz grains.	
			-710.0-				
			-712.0-		706,8-724,2 m - Quartz sandstone, yellowish-grey and pinkish-w	hite, very fine-grained to fine-grained, weakly cemented. Grains are	
L L			744.0		weii rounaea.		
ingia	Deimena	Ruhnu	-/14.0-				
m3 Mialoi			-716 0-			Fig. 14.1 (continued) Ordovician	
						succession in the Ruhnu 500 drill core.	
Ū			-718.0-			SW Estonia.	
					l		
			-720.0-				