

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



ISOS-14 Field Guide: The Ordovician of Estonia

Edited by Olle Hints and Ursula Toom

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

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

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.

© 2023 Authors. This publication is distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<http://creativecommons.org/licenses/by/4.0>), if not indicated otherwise.

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

Printed by Alfapress OÜ

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

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

Tallinn, 2023

Stop 16: Jägala waterfall

Oive Tinn

Location: Latitude 59.45006°N, longitude 25.17861°E; Harju County, North Estonia.

Stratigraphy: Tremadocian to Darriwilian, from the Pakerort to Aseri regional stages.

Status: Outcrop is under nature protection – no hammering.

More information: <https://geoloogia.info/en/locality/10087>

The Jägala waterfall (Fig. 16.1, 16.2) is located at the lower reaches of the Jägala River, about 25 km east of Tallinn. The ca 50 m wide and 8 m high Jägala waterfall is the highest natural waterfall in Estonia. (The Valaste waterfall at the North Estonian Klint with its up to 30 m is higher, but that is an artificial waterfall that was formed thanks to the drainage trench directed to the Klint escarpment.) The upstream receding waterfall has created an about 300 m long and 10–14 m high shadowy canyon. It has been estimated (Miidel 1997) that, on average, the klint edge retreats about 16–17 cm per year, and thus the age of the waterfall may be around 3000 years. However, the retreat of the waterfall is not uniform but depends on the strength and crumbling of the topmost limestone unit (Meidla 2008).

The outcrop behind and next to the waterfall exposes the Lower and Middle Ordovician sequence (Fig. 16.1). The base of the outcrop consists of organic-rich black shale (graptolite argillite) of the Türisalu Formation (Tremadocian). Although a large part of this formation lies below the water line, shale pieces broken open by the falling water are abundant in the river canyon and around the waterfall. The Türisalu Formation is covered by the grey glauconitic mudstone of the Varangu Formation (accord-

ing to Nõlvak et al. 2019, it may be the lower part of the Leetse Formation and Hunneberg Regional Stage). On top of this unit lies the glauconitic sandstones of the Leetse Formation (Tremadocian/Floian; Fig. 16.3). These are overlain by variably dolomitised glauconitic limestones of the Toila Formation (Dapingian, Volkhov Regional Stage). The boundary interval of the Volkhov and Kunda regional stages is marked by a distinctive thin brownish-grey unit of argillaceous limestone with Fe-ooids, the Sillaoru Formation. On top of the Sillaoru Formation lies an about 10 cm thick bed of the Pakri Formation (Darriwilian), which consists of yellowish-grey dolomitised limestone with quartz grains. The uppermost part of the outcrop comprises hard nautiloid-rich limestone beds of the Loobu Formation (Darriwilian, Kunda Regional Stage). In the canyon wall, the Loobu Formation is topped by about 0.6 m thick bed of marly limestones of the Aseri Regional Stage (Darriwilian; Orviku 1940), although this part of the section is mainly covered by vegetation.

The outcrop of the Jägala waterfall is the stratotype of the Jägala Member (Kunda Stage, Pakri Formation), which is represented by quartz-rich limestone. Besides, the Jägala outcrop also comprises the stratotype of the

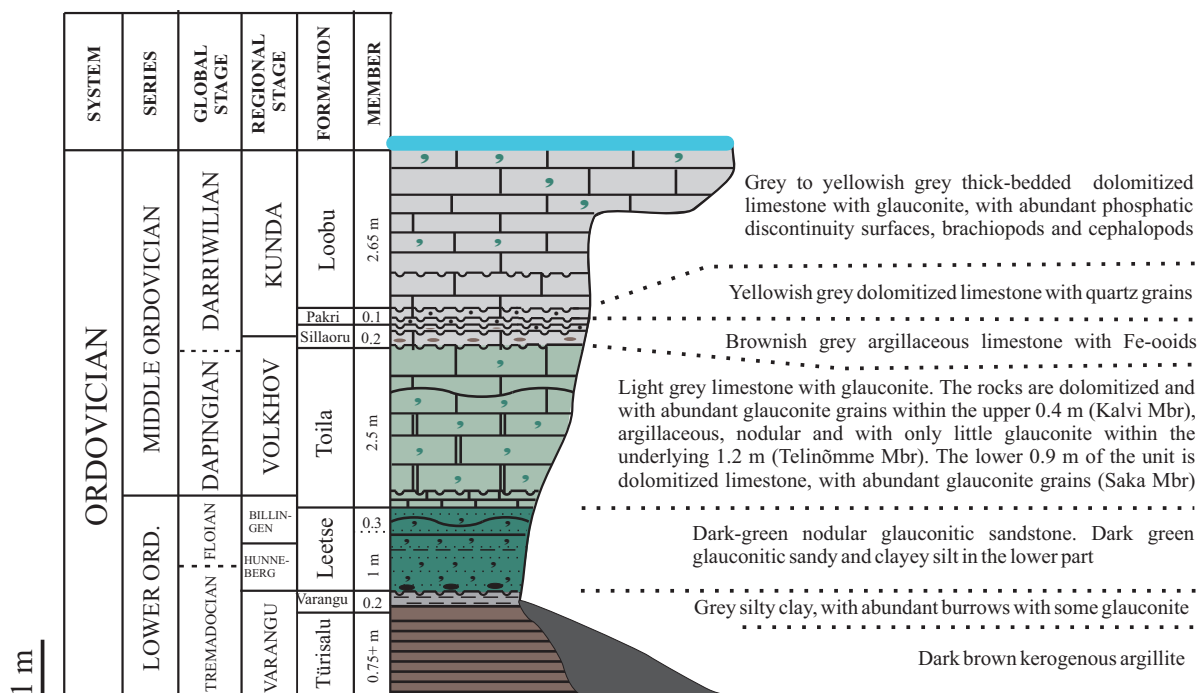


Fig. 16.1. Jägala waterfall section (modified after Meidla 2008 and <https://sisu.ut.ee/stratotuup/o-jägala-joaastang>).



Fig. 16.2. Jägala waterfall, where Tremadocian to Darriwilian succession is exposed. Photo: Gennadi Baranov, 2022.

Joa Member (Leetse Formation, Tremadocian, Floian).

The Jägala waterfall and canyon sections are rich in fossils (Fig. 16.4). Among these are trilobites from the Kunda Regional Stage (*Asaphus expansus*, *Illaeus wahlenbergi*, *Metopolichas verrucosus*, *Pseudoasaphus*

globifrons); cephalopods *Proterovaginoceras*, *Estonioceras*, *Tragoceras*, *Ormoceras*, *Eichwaldoceras*; brachiopods from genera *Gonambonites*, *Orthambonites*, *Lycophoria* from the Kunda Stage; *Antigonambonites*, *Raunites*, *Porambonites*, *Nothorthis*, *Productorthis* from



Fig. 16.3. Lower part of the Jägala waterfall section, showing the glauconitic sandstone of the Leetse Formation, Tremadocian-Floian. Hammer points to the boundary between the Varangu and Leetse formations (according to an alternative interpretation by Nõlvak et al. (2019), the Varangu Formation is missing in the section). Photo: Olle Hints, 2012.

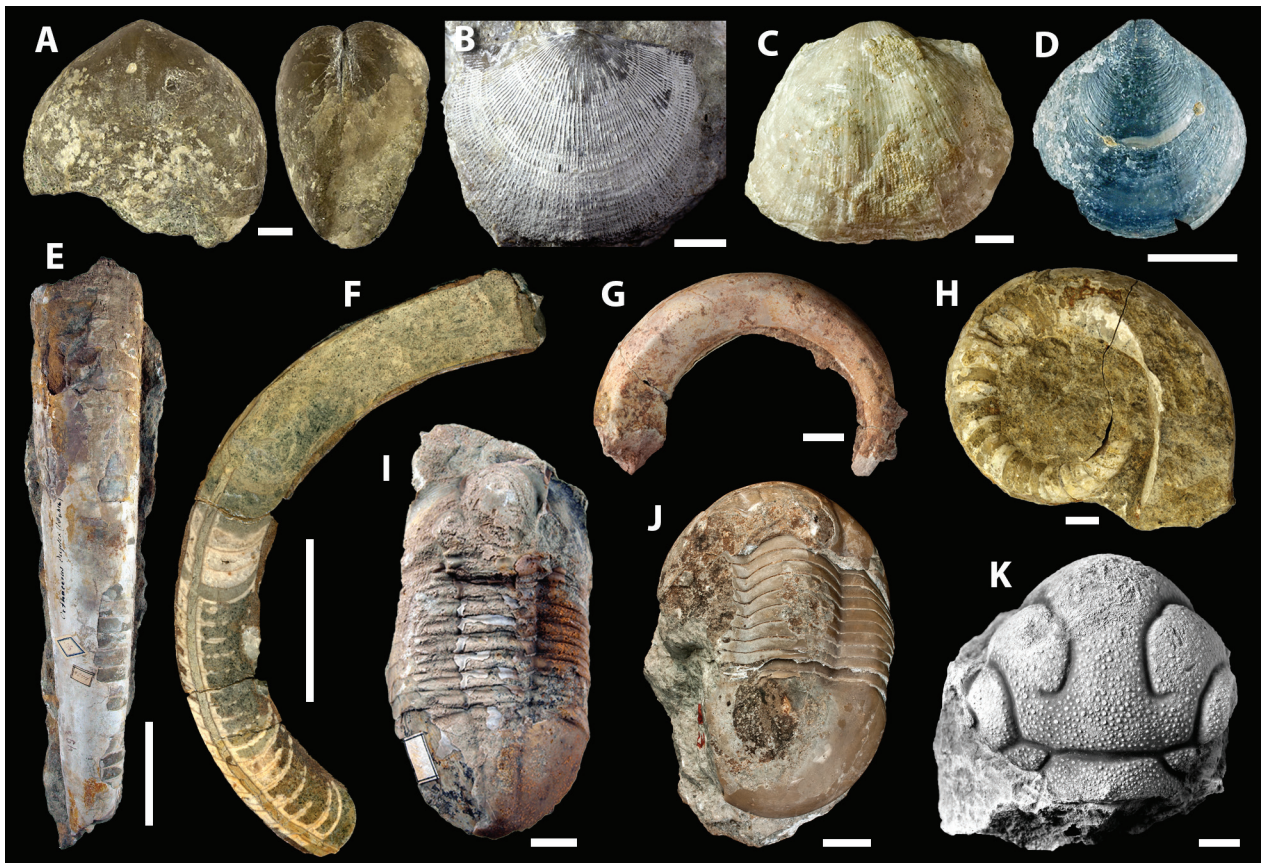


Fig. 16.4. Selected fossils collected from the Jägala Waterfall and nearby sections. Scale bars: E, F – 5 cm; H, I, J – 1cm; A, B, C, D, G, K – 5 mm. Institutional abbreviations: GIT – Department of Geology, Tallinn University of Technology; TAM – Estonian Museum of Natural History; TUG – Natural History Museum, University of Tartu. **A** – pentamerid brachiopod *Eoporambronites latus* TUG 2-869, Volkhov Stage; **B** – billingsellid brachiopod *Clitambonites adscendens* GIT 543-357, Aseri Stage; **C** – billingsellid brachiopod *Gonambronites inflexus* GIT 129-10, Kunda Stage; **D** – lingulid brachiopod *Ungula ingraca* TUG 1619-161, Tremadocian; **E** – endoceratid cephalopod *Proterovaginoceras incognitum* TUG 860-1651, Kunda Stage; **F** – tarphyceratid cephalopod *Tragoceras falcatus* GIT 426-126, Kunda Stage; **G** – eogastropod *Ecculiomphalus* TAM G433:1118; **H** – tarphyceratid cephalopod *Estonioceras perforatum* TUG 2-128, Kunda Stage; **I** – asaphid trilobite *Pseudoasaphinus tecticaudatus* TUG 860-1281, Aseri Stage; **J** – illaenid trilobite *Illaenus wahlenbergi* TAM G439:1254, Kunda Stage; **K** – lichid trilobite *Metopolichas verrucocus* TUG 1085-51, Kunda Stage.

the Volkhov Stage and *Panderina*, *Ingria*, *Siphonotreta* from the Billingen Stage. Also, gastropods *Lesueurilla*,

Pararaphistoma and *Ecculiomphalus* are common in the Kunda Stage.

References

- <https://sisu.ut.ee/stratotuup/o-jägala-joaastang> (retrieved May 1st, 2023)
- Meidla, T. 2008. Stop B1: Jägala Waterfall section. In: O. Hints, L. Ainsaar, P. Männik, and T. Meidla (eds), The Seventh Baltic Stratigraphical Conference. Abstracts and Field Guide, pp. 98–100.
- Miidel, A. 1997. Escarpments and waterfalls. In: A. Raukas and A. Teedumäe (eds), Geology and Mineral resources of Estonia. Estonian Academy Publishers. Tallinn. 391-395.
- Nõlvak, J., Liang, Y. and Hints, O. 2019. Early diversification of Ordovician chitinozoans on Baltica: New data from the Jägala waterfall section, northern Estonia. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 525, 14–24.
- Orviku, K. 1940. Lithologie der Tallinna-serie (Ordovizium, Estland). *Acta et commentationes Universitatis Tartuensis* A36: 1–216.
- Suuroja, K. 2006. Baltic Klint in North Estonia. A Symbol of Estonian Nature. Ministry of Environment, 224 pp.