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 10: Valaste waterfall and Baltic Klint

Oive Tinn

Location: Latitude 59.44411°N, longitude 27.33510°E; Ida-Viru County, NE Estonia.
Stratigraphy: Cambrian Series 2 to Darriwilian.
Status: Geological sightseeing spot of the Baltic Klint.
More information: https://geoloogia.info/en/locality/13283

The Baltic Klint is one of the most extensive outcrops of Lower Palaeozoic rocks in the world. The total length of the Baltic Klint is nearly 1200 km; the height reaches 56 meters (Fig. 10.1; Suuroja 2006). The Klint emerges at the western side of the Öland Island in Sweden, follows along the southern coast of the Gulf of Finland and reaches up to the Ladoga Lake in Northwest Russia. The nearly 300 km long North Estonian Klint is part of this large structure. Geologists value the Baltic Klint mostly because of the extraordinary preservation of the Lower Palaeozoic rocks that have not been subject to metamorphism and folding.

The section between Valaste and Saka is the highest and most spectacular, offering impressive views to the outcrop, as well as an uninterrupted panoramic view to the Baltic sea. The artificial Valaste waterfall, falling from the 54 m high North Estonian Klint, is the highest waterfall in Estonia. Its height is usually between 26 and 28 m, but after exceptionally heavy rainfalls the strong flow may erode a deep pit in the sandstone on the foot of the Klint, and the total height of the waterfall can be up to 30 meters. Downwards, the waterfall continues as a 10–15 m high rapid, flowing into the sea. In fact, the waterfall at Valaste is man-made. Due to the slight southward dip (3–4 m per 1 km) of the limestone layers and the absence of water outlet, the fields in the Klint area were suffering from excessive water during rainy seasons. At the beginning of the 19th century, a 7 km long and up to 2 m deep drain was made to aid water run off the manor's fields nearby. As a result, the water flow has cleaned and eroded the cliff face, exposing the Lower Cambrian to the Middle Ordovician sedimentary sequence. A platform has been constructed in front of the waterfall in order to make observing the site safer and more attractive.

The section (Fig. 10.2, 10.3) is stratigraphically similar to the Ontika Klint, 3 km west of Valaste (Mägi, 1990).

At its lowermost part, near the sea level, a shallow bank exposes the **Cambrian** "Blue Clay" of the Terreneuvian age (Lontova Formation). This formation contains pyritic trace fossils, occasional shells *Aldanella kunda* which belong to the purported small shelly fossils, and shells of *Platysolenites* (Hints 2014). It is noteworthy that regardless of the age, this lower Cambrian sediment has still

Fig. 10.1. Map showing the extent of the Baltic Klint - a 1200-km-long escarpment exposing Cambrian and Ordovician rocks.

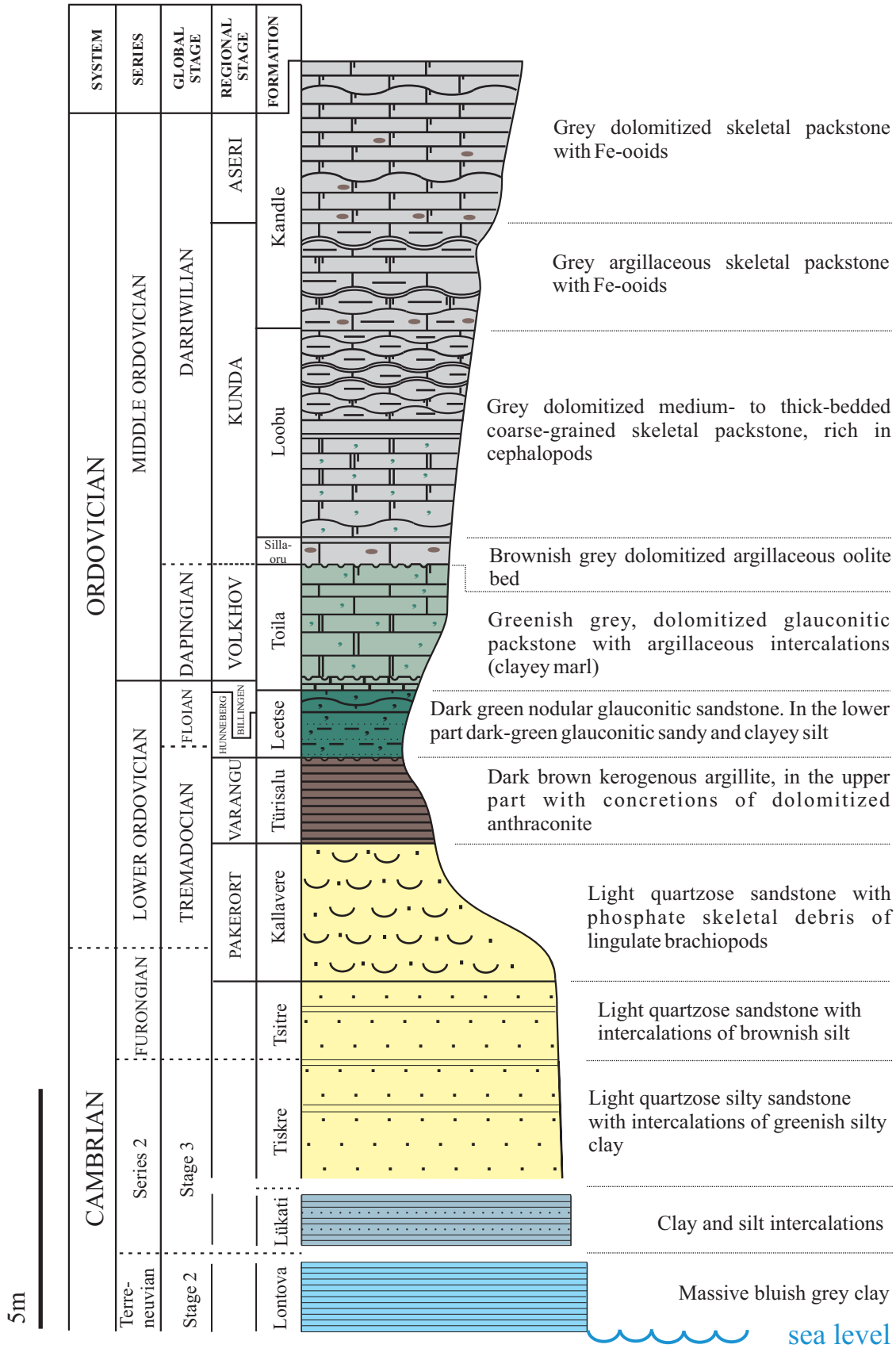

Fig. 10.2. Valaste waterfall section after Tinn 2004.

Fig. 10.3. Baltic Klint at Valaste, showing the succession of Cambrian Series 2 siliciclastics to Middle Ordovician carbonate rocks. Photo: Olle Hints.

retained its plasticity, which is explainable with the low burial depth and lack of thermal overprinting (Hints 2014). On the slope upwards, occasional partly buried banks of intercalated clay and silt of the Lükati Formation (Cambrian Series 2) can be spotted. A more continuous section starts with the light-coloured sandstones of the Tiskre, Tsitre and Kallavere formations. The latter of these yields lingulate shell fragments, as well as conodont *Cordylodus lindstroemi* (Heinsalu et al. 1991), which marks the Cambrian–Ordovician boundary within the lower part of the Kallavere Formation.

The Lower Ordovician is represented by the dark brown argillite of the Türisalu Formation (Tremadocian). At Valaste, this formation, and also the overlying dark green glauconitic sandstone of the Leetse Formation, are considerably thinner than in the western part of the North Estonian Klint on the Pakri Peninsula. However, the data on conodonts (Viira et al., 2006) indicate that stratigraphically the Valaste section is more complete than similar sections in the western part of the Klint escarpment. The Tremadocian–Floian boundary lies within the Leetse Formation.

The Middle Ordovician is represented by greenish-grey limestones of the Toila Formation (Volkhov Stage, Dapingian) and variable Darriwilian limestones of the Sillaoru, Loobu, Napa (Kunda Stage) and Kandle (Aseri Stage) formations. The base of the Darriwilian is tentatively drawn between the Volkhov and Kunda regional stages. The Darriwilian limestones are rich in fossils, including cephalopods, trilobites, brachiopods etc (Fig. 10.4).

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Fig. 10.4. Cephalopod limestone of the Kunda Regional Stage, lower Darriwilian is a typical rock type of the Baltic Klint successions. Sample from the Päite Cliff, NE Estonia. Photo: Avo Miidel, 2002.