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Two hundred years of geology education in Estonia

In 2020 we celebrate 200 years since the beginning of geology education in Estonia. The very first lectures in mineralogy were given at the University of Tartu by Gottfried Albrecht Germann, Professor of Botany, already in 1802, but systematic teaching in geology started in 1820 when the Chair of Natural Sciences and Mineralogy as well as the Mineralogy Cabinet were established. The lectures in Mineralogy and the Earth Structure were held already in the autumn semester of the very same year by the first appointed Professor of Mineralogy Otto Moritz Ludwig von Engelhardt. He remained at this position for the next 22 years, building the foundation for teaching geological disciplines at the University of Tartu (Isakar 2005a; Pani 2005). The first curricula were centred on courses in mineralogy, crystallography, applied mineralogy and general geology. However, they also included the first palaeontology course held in the universities of the whole of the Russian Empire by Private Docent Karl Eduard Eichwald in 1822 and petrography by Johannes Ernst Hoffmann in 1833 (Pani 2005; Laane 2006). The first master's degree in geology was awarded at the University of Tartu to Alexander Schrenk in 1852 and the first degree of Doctor of Science in Geology was awarded to Caspar Andreas Constantin Grewingk in 1859, who was the Professor of Mineralogy at the university in 1854–1887. Constantin Grewingk can be regarded as one of the most influential geology professors of the 19th century in the Baltic region, but he is also known as the founder of archaeological research in the Baltics and northwestern Russia.

Overall, the geology education at the university level in Estonia can be broadly divided into five periods. The first period falls into the 19th century and was shaped by Baltic-German professors who themselves or their students were at the birth of systematic geology research in the Russian Empire, e.g. Otto Herman Abich, Georg von Helmersen and Carl Friedrich Schmidt.

The second period started at the end of the 19th century and lasted until the end of World War I. It was dominated by Russian professors including Fjodor Loewinson-Lessing, Nikolai Andrussov, Vassili Tarassenko and Georgi Mihhailovski, who continued geology teaching and introduced new disciplines like Historical Geology and Dynamic Geology (Pani 2005).

The third period began with the birth of the Estonian Republic in 1918. Hendrik Bekker, the first Estonian elected to the geology professor position in 1924, started lecturing on Estonian Geology already in 1922. One of his most significant achievements was the foundation of the geological terminology in Estonian – many of his terms are still in use. Following the early-deceased Professor Bekker, the teaching and growing research in geology between two World Wars was led by Professor Armin Öpik, a world-renowned palaeontologist.

The fourth period after World War II in the Soviet Era was characterized by a significant expansion in geology education in Estonia. While in earlier periods only few students specializing in geology graduated from the university (17 students between 1918 and 1945; Isakar 2005b), in 1945 already eight students started the geology curriculum. The beginning of this period is marked by Professor Artur Luha and Professor Karl Orviku, who started the university teacher career already in the 1920s–1930s before World War II, and Docent Evald Möls. They were the first heads of the chairs of Palaeontology and Stratigraphy, Geology and Geomorphology, and Mineralogy and Petrography established in 1945. In 1958 only the Chair of Geology remained at the University of Tartu and was headed from 1960 until the end of the 1980s by Professor Arvo Rõõmusoks.

The fifth and ongoing period started after the restoration of independence in 1990 when the Chair of Geology was reorganized as the Institute of Geology of the University of Tartu in 1992. Geology education was given at all levels of higher education with three chairs: Geology and Mineralogy, Palaeontology and Stratigraphy, and Applied Geology led by professors Aadu Loog, Madis Rubel and Volli Kalm (until 2017). The Chair of Palaeontology and Stratigraphy was established as a joint chair with the Institute of Geology of the Estonian Academy of Sciences and has been run by Professor Tõnu Meidla since 2000. The Chair of Geology and Mineralogy was led by Professor Väino Puura in 1997–2001 and is presently headed by Professor Kalle Kirsimäe (from 2002). In 2008 the Institute of Geology was again reorganized into the Department of Geology that belongs to the Institute of Ecology and Earth Sciences of the University of Tartu.

The fifth period is also significant for advancing the geology education in Estonia by the establishment of the Applied Geology Chair at the Department of Mining of Tallinn University of Technology in 1992. The geology disciplines (general geology, engineering geology, hydrogeology, etc.) were lectured at the university already before World War II, but this was the first time when the specialization in geology was initiated. The first Professor

of Applied Geology at Tallinn University of Technology was Enn-Avo Pirrus (until 2002), followed by Mait Mets (until 2006). In 1997 the Institute of Geology of the Estonian Academy of Sciences joined Tallinn University of Technology. In 2006 doctoral training started in physical geology, followed by MSc studies in Earth Sciences including specialization in geology in 2007 and BSc level in 2011. In 2016 the Department of Mining merged with the Institute of Geology. Alvar Soesoo was the Professor of Physical Geology at Tallinn University of Technology in 2003–2018 and Rein Vaikmäe was the Professor of Earth Sciences in 2004–2014. Olle Hints and Siim Veski became Professor in Bedrock Geology and Palaeontology and Professor in Earth Sciences, respectively, in 2015.

During these two centuries the focus in geology education has been, and still is, on training highly qualified professionals with the aim of increasing the overall competence in geology. Over this time, and regardless of political regimes and social trends, geology has remained a capital science both in terms of fundamental knowledge of the development of the Earth and increasingly important applied aspects of georesources management. This tightly intertwined dualism between the fundamental and applied sides is reflected in the geology education that is targeted, on the one hand, at training young scientists, which is an important factor of sustainability of the University of Tartu and the general geological knowledge, but on the other hand, at educating specialists working in applied fields of geology. These aims are, in fact, not that different because the technologically advancing society needs an increasing number of specialists at the highest educational level with doctoral degree being engaged in the industry, business and public sector, which is required for the implementation of innovative research and development applications outside the universities. Another objective of the modern geological education is a consistent development of its interdisciplinarity. For a long time geology has not been just only mineralogy or palaeontology. It is interacting with a large number of other fields of science, e.g. climatology, ecology, archaeology, energetics, environmental technology, medicine, experimental physics and materials science. In many cases we do not know any more where one discipline ends and the other starts. Geology as a field of science is in constant evolution and it is our task to keep pace with this development by providing the best possible education and expertise in geology in Estonia.

This special volume of the *Estonian Journal of Earth Sciences* is dedicated to the 200th anniversary of geology education in Estonia. It gives a versatile yet inevitably incomplete overview of the current geological research in Estonia and neighbouring areas with the topics spanning from geophysical modelling to isotope geochemistry, palaeontology and Holocene stratigraphy. The geophysical research in this volume is represented by the gravity inversion modelling to determine the depth of the structurally important Mohorovičić discontinuity in Latvia by Viesturs Zandersons and Jānis Karušs, and the geophysical modelling of the magnetic anomaly of the Jõhvi iron ore in northwestern Estonia by Jüri Plado and co-authors. The geology of the Baltoscandian Palaeobasin is discussed in papers by Kalle Kirsimäe and co-authors dealing with the diagenetic history of the unique unconsolidated Cambrian clays and by Leho Ainsaar and co-authors who present new data from ten sections across the Baltoscandian Palaeobasin on the global Middle Darriwilian isotopic carbon excursion. Different aspects of palaeontology in the Baltic Palaeobasin are discussed in contributions by Oive Tinn and co-authors, who reveal the affinity of an enigmatic Ordovician fossil *Martsaphyton moxi*, Tõnu Meidla and co-authors, who study ostracod biostratigraphy across the Ordovician–Silurian transition, and Ervins Lukševics, who reports on conulariids from the Upper Devonian of Latvia. The palaeontology contributions are complemented by Girts Stinkulis and co-authors discussing the sedimentological context of the distribution of vertebrate fossils in the Frasnian Ogre Formation in eastern Latvia. Enn Karro and co-authors present the hydrogeological research and an overview of natural sources of high iron concentrations in the Middle Devonian aquifer system in Estonia. Tiit Hang and co-authors finalize the volume with the updated stratigraphical scheme of the Holocene in Estonia.

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