Estonian Journal of Earth Sciences, 2009, **58**, 4, 217–218

The International Year of Planet Earth is finishing – some results and developments in Estonia

Human impact on the environment has grown considerably in the last years. We have admitted that in the recent decade the mankind has become the main factor reorganizing the environment, including the ground on the planet Earth. Every year humans move about 30–35 billion tonnes of earth sediments or rocks in house and road construction, mineral production, and elsewhere. This has created a new situation on the Earth with new questions to be answered on the level of governments, society groups, and every individual. Growing importance of geosciences in society is also exemplified by the initiation of the International Year of Planet Earth (IYPE), 2007–09, aimed at advocating the geosciences and their role in supporting the sustainable development. Various events have been organized in Estonia in connection with the IYPE, particularly targeting a wider audience and increasing general visibility and publicity of Earth sciences. These activities are listed at the national IYPE website at www.planeetmaa.org. With respect to the scientific aims of the IYPE, several international conferences have been held between 2007 and 2009. Moreover, the main research targets in Earth sciences cover some highlighted topics of the IYPE: (1) Groundwater – reservoir for a thirsty planet; (2) Climate – the ‘stone tape’; (3) Resource issues – towards sustainable use; (4) Soil – Earth’s living skin; and (5) Life – origins of diversity. The aim of this special issue of the *Estonian Journal of Earth Sciences* is to give a glimpse of the geological research in Estonia related to these topics, but also to other issues relevant to the development of geosciences, particularly in Estonia.

After Estonia regained independence in 1991, and joined EU in 2004, many new perspectives have opened for geosciences. Most of the research in this field is carried out at two universities: University of Tartu and Tallinn University of Technology. Geological mapping and other applied branches of geology are well covered at the Geological Survey of Estonia.

The Institute of Ecology and Earth Sciences (www.lote.ut.ee/om), established at the University of Tartu in 2007, incorporates former institutes of Geology, Geography, Botany and Ecology, and Zoology and Hydrobiology. The Institute and the Department of Geology have achieved a significant infrastructural development by the establishment of new joint laboratory facilities and relocation into the Maarjamõisa Science Campus of the University of Tartu.

The Institute of Geology at Tallinn University of Technology (www.gi.ee), formerly an institute of the Estonian Academy of Sciences, joined the university in 1997. In 2006 the institute moved to a new building and renovated rooms at the campus. During the last four years more than two million euros has been invested into the institute’s laboratory renovations. A closer integration with the university enabled launching teaching on the comprehensive Earth sciences curriculum, which incorporates geological, oceanographic, and meteorological sciences at the doctoral level since 2006 and master’s level since 2007.

The research scope of Estonian geoscientists covers a wide range of topics defined as important by the IYPE programme, but also includes fundamental research on stratigraphy and palaeontology, mineralogy and petrology, geochemistry, modelling of geological processes, etc. In this issue, twelve research papers covering crystalline basement stratigraphy, magma segregation modelling, terrestrial gravity data unification, seismic correlation of Palaeozoic rocks across the Baltic, the Baltic basin structure, quartz mineralogy, calcareous tubeworms, thelodont phylogeny, chitinozoan diversity, late glacial Baltic basin evolution, palaeolimnology and chemical peculiarities of the Silurian–Ordovician and Cambrian–Vendian aquifers are published. However, these articles represent only a fraction of geological topics and results obtained in the last decade. Some of the results of Estonian geoscience studies are summarized below.

The Palaeozoic succession of the Baltic area is world-famous for its fossil content and long study history. During the last few decades the palaeontological studies in Estonia have been dealing with corals, stromatoporoids, brachiopods, trilobites, ostracods, conodonts, chitinozoans, scolecodonts, acritarchs, agnathans, early fishes and tetrapods, and various other groups of organisms. Many of the new data have been incorporated into global analysis of palaeobiogeography and palaeobiodiversity, and some have provided new insights into major evolutionary traits, such as the development of vertebrate limbs, thus fostering our knowledge of the evolution and biodiversity on Earth in general. Studies on biostratigraphy, the main application of palaeontology, have also significantly advanced in recent decades, particularly thanks to micropalaeontology. The newly emerged or enhanced biozonations of Ordovician and Silurian chitinozoans and conodonts deserve special attention as the collections used and the research conducted in Estonia have utility beyond the country and the Baltica palaeocontinent.

As one of the modern approaches to Palaeozoic strata, stable isotope geochemistry was introduced in Estonia in the 1990s. The records of carbon and oxygen isotopes extracted from carbonate rocks not only tell about the past climate and environments, but also enhance the temporal background for various other studies. In particular, the carbon isotope curves from the Baltic Ordovician and Silurian have turned into *de facto* standards against which other continents and successions are compared. Oxygen and carbon isotopes of groundwater and ice cores have been extensively used in palaeoclimate studies as well as water quality assessments. These research targets include Spitzbergen and Antarctica.

Volcanic ash-beds, the bentonites, which are common in the early Palaeozoic succession of the Baltic area, provide chronostratigraphic precision unattainable by other means. New methods developed for mineralogical and geochemical fingerprinting of these marker horizons have provided new possibilities of independent time-correlations and, coupled with high-resolution biostratigraphy, enable palaeobasin modelling and influence stratigraphy globally.

The results of tectono-thermal development studies of the Baltica palaeobasin suggest that despite the relatively low tectonic activity of the basin since the Precambrian, the sedimentary complex has been significantly influenced by the Caledonian, Hercynian, and Uralian orogeneses, leading to fault reactivation and low-temperature hydrothermal processes.

Recent multidisciplinary Holocene palaeolimnological studies conducted in Estonia have shown great potential of lake deposits for reconstructing palaeoenvironments, palaeogeography, early human impact, and palaeoclimate. Combined geochemical, palynological, and diatom studies enable assessment of the reference conditions and ecological status of lakes which, in turn, has implications for the EU Water Framework Directive. Palaeogeographic reconstructions of freshwater lakes during the Fennoscandian ice recession demonstrate that the Baltic Ice lake initially had the same water level as glacial lakes Peipsi and Võrtsjärv.

Meteorite impact crater studies have proposed a generalized model for mineralogical and geochemical changes in the cooling crater. The model is able to describe the cooling of small- to medium-sized craters without significant melting.

Numerical and analogue modelling of magma segregation has revealed a self-organized criticality phenomenon of the partial melting system. Petrological, geochemical, and geochronological studies of the Estonian Precambrian basement have resulted in a detailed evolutionary model of the basement and established a new melting event within granulites.

Geological mapping and a number of applied geological investigations have been conducted at the Geological Survey of Estonia (www.egk.ee). For example, a new geological discovery of this period – the Neugrund Meteorite Crater in the NW Estonian coastal sea – was made during geological mapping. Geological maps of the Estonian crystalline basement, sedimentary bedrock, Quaternary deposits, mineral resources, hydrogeology, and groundwater vulnerability at a scale of 1 : 400 000 have been compiled. A map of radon risk of Estonia has been compiled at a scale of 1 : 500 000 and a geochemical atlas of soils has been published at a scale of 1 : 1 200 000. Until early 2009, thematic layers of 25 map sheets of the digital Geological Base Map of Estonia at a scale of 1 : 50 000 have been compiled at the Geological Survey. Besides, several monographs and issues of the series *Estonian Geological Sections* (1998–2008) have been published.

Collections of rocks, minerals, fossils, and drill cores are an integral part of geological research. In Estonia the geological collections are stored mainly at the Institute of Geology at Tallinn University of Technology, Museum of Geology of the University of Tartu, Geological Survey/Estonian Land Board, and Estonian Museum of Natural History. A national programme devoted to scientific collections fostered collaboration between these institutions and a 'national geological collection' was established. Recent and ongoing efforts in building a common electronic database (www.geokogud.info) deserve special attention as geology has been leading the way in joining international data networks, such as BioCASe and GBIF, and in opening the collections to researchers and the public.

Publication of this special issue was financially supported by the Institute of Geology at Tallinn University of Technology; the Department of Geology, Institute of Ecology and Earth Sciences, University of Tartu; and the Geological Survey of Estonia.

Alvar Soesoo
Guest Editor