

Estonian georesources in the European context

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Estonia is situated on the southern buried slope of the Baltic Shield where the sedimentary bedrock (sedimentary cover) overlies the Precambrian crystalline basement. The bedrock ranges in thickness from 100 m near the coast of the Gulf of Finland to 800 m in southern Estonia. It is composed of Vendian, Cambrian, Ordovician, Silurian, and Devonian strata. The Vendian, Cambrian, and Devonian complexes consist of terrigenous rocks – sands, sandstones, and clays. The Ordovician and Silurian are represented by different limestones, dolostones, and marls. The bedrock is covered by Quaternary sediments that have formed in the glacial and postglacial periods.

The Cambrian section contains famous “blue clay”, Lower Ordovician section – phosphate *Obolus* sandstone (shelly phosphorite), and Upper Ordovician – oil shale (kukersite). Deposits of the most important mineral resources – oil shale, phosphorite, and carbonate rocks – are located in the northern and northeastern part of Estonia. Peat, sand, and gravel resources are distributed almost evenly all over the country.

According to the Earth’s Crust Act of Estonia, mineral resources are clay, crystalline building stone, dolostone, gravel, lacustrine lime, lake and sea muds, limestone, oil shale, peat, phosphate rock (phosphorite), and sand. The bedding conditions and characteristics of a body for registration as mineral reserve in a mineral deposit have been established by the Ministry of the Environment. The Mineral Resource Classification System developed in Estonia (by the Estonian Commission on Mineral Resources) is based on internationally accepted principles.

Estonia is not very rich in minerals, but we have some georesources remarkable in the European context:

1. **Oil shale.** The Estonia deposit is the largest commercially exploited and best-studied oil shale deposit in the world.
2. **Phosphorite.** The Rakvere deposit (well-studied but not exploited) is the largest phosphorite deposit in Europe.
3. **Peat.** Estonia is considered as a country richest in peatlands in North Europe. The total area occupied by 9836 mires is one million hectares (about 22% of the Estonian territory). Among these mires 1626 are peat deposits of commercial interest.

Unfortunately for more than 80 years oil shale and phosphorite have been mined and industrially used in environmentally hazardous ways, devastating large regions in northern and northeastern Estonia. In 1991, considering the environmental impact and exhaustion of mineable phosphorite reserves at the Maardu deposit, phosphorite mining and enrichment of phosphorite were terminated. Phosphorite reserves were excluded from the list of mineable mineral reserves in the middle of the 1990s.

Several problems are connected with the mining and use of georesources:

1. Technological and technical problems
 - high losses related to oil shale mining – to support the roofs of mining shafts, about 25–30% of mineable oil shale is left as pillars;
 - formation of water-filled depressions on the ground (could cause collapses of oil shale mining shaft roofs).

2. Environmental problems

- pollution of surface and groundwater by polluted mine drainage waters;
- lowering of groundwater level and formation of large depression cones;
- changes in soil properties and overall landscape;
- formation of waste dumps (where the residual organic matter is prone to self-ignition);
- huge amounts of gaseous emissions (SO₂, NO_x, etc.) contaminating ambient air, caused by utilization of oil shale and phosphorite.

3. Economic problems

- the concentrates from Estonian phosphorite will not pay off;
- competition between the landusers and mining companies;
- rational use of mineral resources: as complete and complex mining as possible and the most

effective utilization of explored resources (for example, peat in the overburden of oil shale; oil shale in the overburden of the phosphorite layer);

- insufficiency of natural building resources (limestone, dolostone, sand, gravel, etc.), caused mainly by different environmental and social problems of mining.

4. Social problems

- one part of the population is affected by mining activities;
- the greatest part of the Estonian population is against the mining at all.

The Estonian Government has decided to find a complex solution to different problems related to mining and utilization of georesources. In the future special strategies will be built and established for the use of georesources (oil shale, natural building resources, and peat).