NORWAY

Geography

Norway is situated in northern Europe and borders Sweden, Finland and the Russian Federation. It also has maritime borders with the North Sea and the North Atlantic Ocean. The country has a length of ~1800 km.

Norway is one of the most northerly countries and is situated on the western part of the Scandinavian Peninsula. The country is characterized by the Scandinavian Mountains which run from the northern tip to the south in a series of high plateaus (fjells) and dissected by numerous fjords on its western shore, some of which penetrate deep into the interior of the country. The mountains attain their highest elevation of 2470 m north of Oslo. This area covers one of the largest glaciers in Europe. The fjords and numerous valleys are the result of erosion by ice. Many islands are scattered off the coast in the North Atlantic Ocean, e.g., Lofoten Islands.

During the Ice Age, Norway was completely covered by a thick ice sheet. After melting of the ice the country experienced isostatic rebound, an upwards movement after the release of the weight of the overlying ice sheet. Many features of the present-day topography were formed throughout and after the Ice Age. The relatively flat terrain occurring towards the east is countered by very rough topography, with steep cliffs, to the west.

Depending on latitude and elevation, agricultural use of the land differs widely. In the southern lowlands and valleys, crops may be grown, whereas further north, the amount of arable land gradually decreases while the proportion of mountain pasture increases. Only ~8% of the country's surface is arable and nearly 50% consists of mountainous terrain.

Considering the northern latitude of the country, the climate is relatively mild owing to the influence of the Gulf Stream. At the coast, the winters are milder than in the mountains or in the north. Average winter temperatures in the milder areas may be just below 0°C, whereas in the northern polar areas the temperature may reach -40°C. Similarly, the summer temperatures in the Oslo area may average 15–17°C and only 5–10°C in the northern areas. Large differences in precipitation are observed, with the coastal areas having much higher rainfall (up to 3000 mm/year in some areas) than inland areas, some of which have as little as 300 mm/year [17.1].

Geology

Norway is part of the Fennoscandian Shield, which includes Norway, Sweden, Finland and the north-western part of the Russian Federation (Figure 1). In the east and SE, the Precambrian basement forms part of the Fennoscandian Shield, whereas in the west and north, metasedimentary rocks and metavolcanic rocks are of Cambrian–Silurian age. In addition, Carboniferous–Permian rocks are found in the Oslo area. The Precambrian contains Archaean gneisses, migmatites and schists in northern Norway (Kola block). Lower Proterozoic rocks are found in Finmark, on the Lofoten Islands and near Narvik. Middle Proterozoic rocks occurring in southern Norway are highly deformed and were metamorphosed around 1000 Ma. The post-metamorphic period is characterized by granitic intrusions which are overlain by alternately reduced and oxidized sandstones and intercalated with basalts (Trysil Series).

The Fennoscandian Shield was consolidated in the Upper Proterozoic and this episode has been dated at 800 Ma. The Lower Palaeozoic strata start with Cambrian sandstone and shale, followed by Ordovician limestone and shale. During this period, the Caledonian Orogeny (~400 Ma) deformed part of the Precambrian basement and the Cambrian–Ordovician sedimentary rocks. Sedimentary rocks of Devonian, Permian and Mesozoic age are less widespread.

Ore deposits are found in the Precambrian, Caledonides and Permian rocks. In northern Norway, banded iron ore deposits, massive sulphide deposits and iron–titanium deposits occur in Precambrian rocks. In the Ordovician greywacke–greenstone sequence, massive sulphide deposits were formed, such as the Kongsberg deposit (silver), and lead–zinc and porphyry molybdenum deposits.

Rocks and sequences favourable for the formation of uranium deposits include the Trysil Series (with similarities to unconformity-related deposits). Cambrian black shales may be enriched in uranium. The magmatic rocks of the Oslo province are enriched in thorium [2–5].

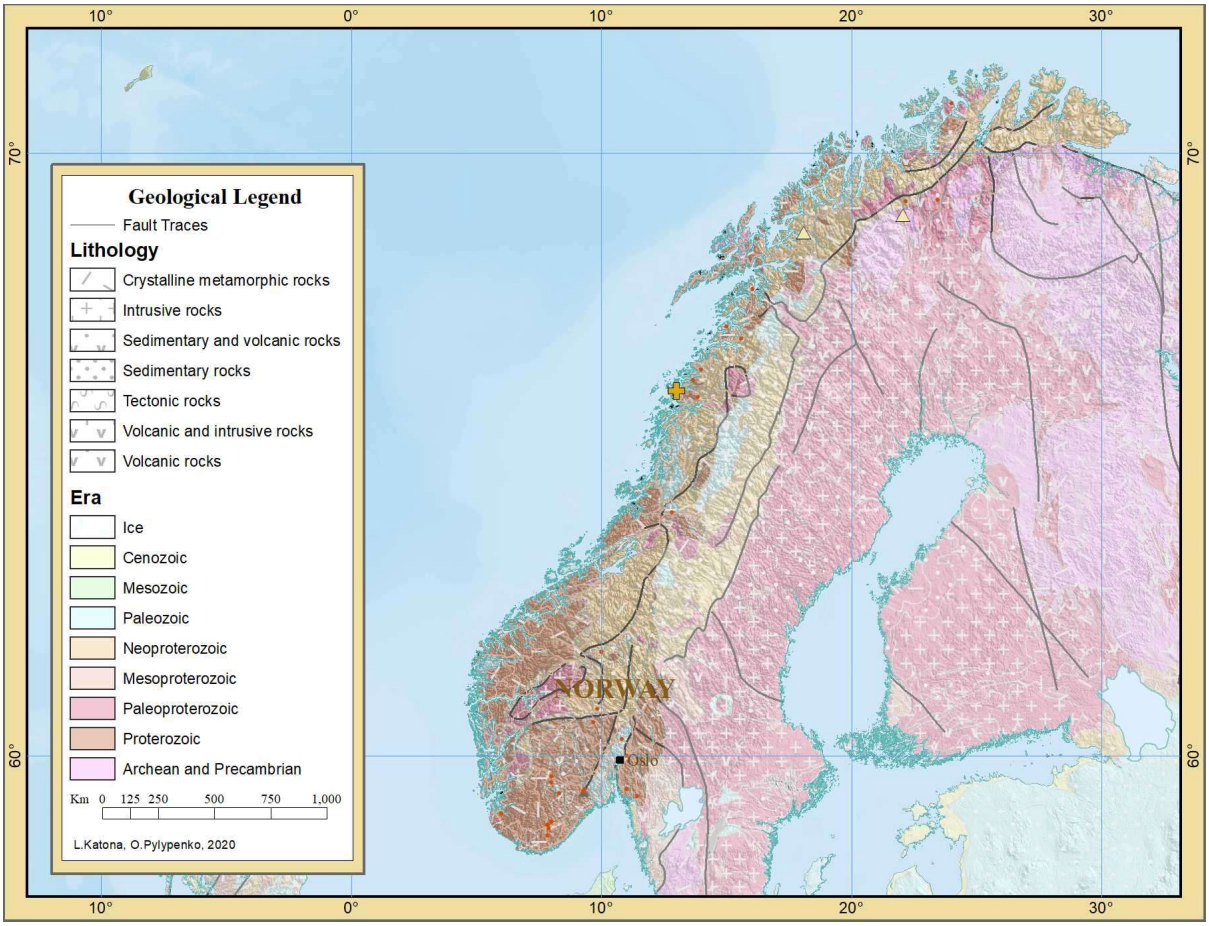

FIG. 1. Regional geological setting of Norway showing the distribution of selected occurrences. For the general uranium deposit and occurrence legend see World Uranium Geology, Exploration, Resources and Production, IAEA, 2020. A general global geological legend is shown although not all geological units necessarily occur on this particular map.

Uranium exploration

With the exception of the occurrence of small amounts of uranium in pegmatites, which was used for colouring glass in the 19th century, no systematic exploration was conducted before 1945. After 1945, exploration was carried out by several organizations targeting the Cambrian black shales, pegmatites and other previously known showings. The black shales, similar to those occurring in Sweden, are in some locations found to contain up to 300 ppm U.

During the 1950s and 1960s, systematic exploration, including car-borne and air-borne methods, was conducted over ~30% of the country. After 1975, a 10-year programme was started by the Geological Survey of Norway using car-borne, air-borne and geochemical exploration, as well as stream sediment and bedrock sampling. A limited drilling programme was carried out on promising anomalies.

However, detailed follow-up was not undertaken and no resources were delineated. In 1997, no uranium exploration activities were reported to the Red Book [3–8].

Surface drilling in 1977 comprised two holes totalling 400 m and in 1978 six holes and 600 m. No drilling was undertaken after 1978. Exploration expenses in 1976–1983 amounted to US $3.18 million.

Uranium resources

No uranium resources have been well-documented.

Potential for new discoveries

The IUREP missions reported a list of known uranium occurrences and these data were combined with information from the mission experts on potential areas [4, 5]. This has provided a reasonably complete assessment of the uranium potential of Norway.

Known occurrences, none of which at the time of compilation were of economic interest, include several hydrothermal type mineralized occurrences and pegmatites located in Precambrian rocks. Some of the occurrences are associated with other metals (e.g., Cu, Ag, Mo and Fe).

In addition to Precambrian strata, alum shales were also investigated, but discouraging results and ecological considerations precluded further work being undertaken.

Areas of potential were classified in both IUREP reports [4, 5], but likely exploration targets were not identified. Some potential may exist in ancient placers of Lower Proterozoic age, as these bear similarities to uranium mineralization found in Finland. Quartz pebble conglomerates are poorly developed. Some hydrothermal type mineralization occurrences are considered to have good potential but as these lie in protected areas that lack ready access, their potential for further investigation is limited. In general, the lack of detailed exploration limits assessment of the uranium potential. Further details are provided in Ref. [4].

Speculative resources are estimated at 9000–58 000 tU, excluding the 10 000–50 000 tU of speculative resources hosted in alum shale.

Comments

Norway has never produced uranium and there is no nuclear power industry. Norway's most recent report to the Red Book was in 1998.

References

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