

## ITALY

### Geography

Italy extends into the Mediterranean Sea and includes the major islands of Sicily and Sardinia, as well as a number of smaller islands. It has land borders with France, Switzerland, Austria and Slovenia.

The Italian peninsula, with its famous 'boot-like' shape, has a length of ~1000 km and a width of 130–250 km. Sicily is situated at the southern tip of the peninsula. In general, the country is very mountainous, with ~75% covered by mountainous and hilly terrain. Mont Blanc, with an elevation of 4807 m, is the highest mountain massif in the Alps and straddles the border with France. From a morphological and physiographic point of view, from north to south, Italy consists of the Alpine mountainous region, which extends from the north-western part and forms the northern border with Switzerland and Austria, and entering Slovenia in the east. The highest mountains are permanently snow-capped. A number of deep, north–south trending valleys extend south from the Alps and host large lakes, as exemplified by Lake Maggiore, Lake Como and Lake Garda.

South of the Alps, the Po River's wedge shaped plain extends west–east. South of the Po River, the Apennine Mountains run NW–SE through the central part of Italy. Small coastal plains are found in the centre and in the south.

The country has several volcanoes, including Mount Vesuvius, near Naples, and the active Mount Etna, in Sicily. The Aeolian Islands, north of Sicily, are also volcanic, and include the active volcanoes Mount Stromboli and Vulcano.

The island of Sicily is characterized by a mountain chain, with Mount Etna located at its eastern end. On Sardinia, low-range mountains are distributed throughout the island, intersected by several river valleys.

The climate varies according to the geographical location. The northern alpine area has cold winters with abundant snow and temperate summers. In the valleys south of the Alps, the climate is milder. The lowlands generally have mild climatic conditions influenced by the Mediterranean. In the Apennines, the winters can be cold and the summers are temperate to warm. To the south the climate is warmer. In general, winters tend to be mild and summers hot.

Roughly 35% of the country is arable and roughly one quarter is covered by forest and woodland. Depending on the climate and the fertility of the soil, rice and corn are grown. Citrus fruit and grapes are also intensively cultivated in some areas.

Natural resources include marble, building stone, mercury and potash, as well as some natural gas and crude oil. The mountainous terrain poses risk from natural hazards, such as landslides and winter avalanches. Italy is seismically active, and volcanic eruptions and earthquakes pose another natural hazard [1, 2].

### Geology

Italy's geology (Figure 1) is very diverse and therefore in this report only the geology of potentially favourable uranium-bearing areas will be described. For further details refer to Refs [3–7].

Structural settings are mainly the result of activity throughout the Miocene period which was related to the latest phase of the Alpine Orogeny that resulted from the collision between the northerly moving African Plate and the Eurasian Plate. In the mountain chains, older strata are preserved and these may be of importance as regards ore genesis. The oldest complexes are probably of early Palaeozoic age, deformed by the Caledonian and Hercynian orogenies. Acidic intrusions of both

orogenic phases provide pre-concentrations of uranium. In the Alps, throughout the Late Carboniferous and more importantly throughout the Permian period, continental basin-like areas formed which contain the debris of older rocks. The sediments are arenitic, deposited in lagoons in littoral and deltaic environments. Intercalations of Lower Permian intermediate to acid volcanic rocks are common. These strata are favourable for the formation of uranium deposits in the Southern Alps.

In Calabria, Hercynian massifs hosting intrusions of granitic composition have been found to be favourable for uranium ore formation. In the Latium region (west central Italy), basins with continental sediments of Quaternary age and alkaline volcanic rocks are enriched in uranium and have been subjected to detailed exploration. In Sardinia, Hercynian granites, together with volcanic rocks of alkaline composition and of Permian and Tertiary age, were found to be prospective.

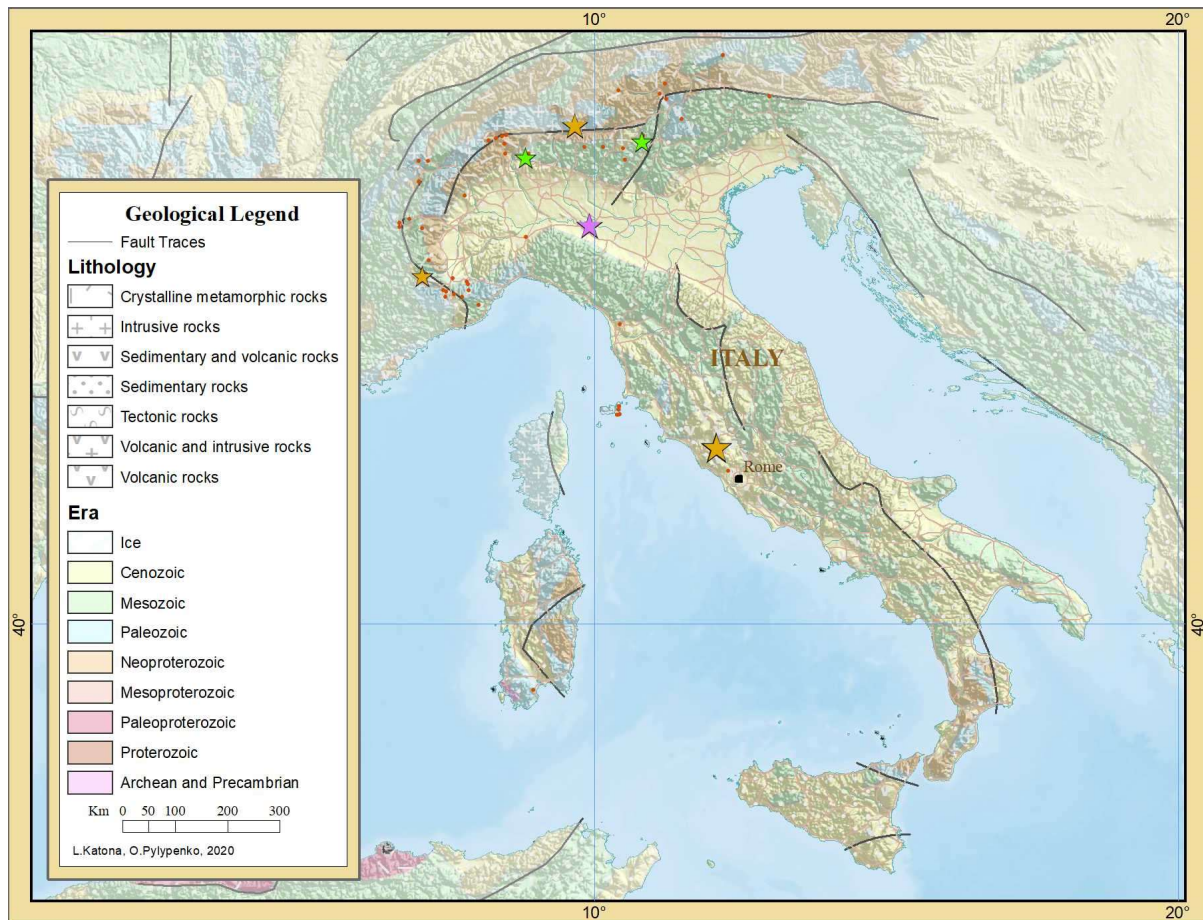


FIG. 1. Regional geological setting of Italy showing the distribution of selected uranium deposits and occurrences. For the general uranium deposit and uranium occurrence legend see *World Uranium Geology, Exploration, Resources and Production*, IAEA, 2020. A general global geological legend is shown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

## Uranium exploration

Uranium exploration began in Italy in the 1950s with a reconnaissance survey of all favourable areas. This led to the finding of the Novazza deposit between 1954 and 1962. This deposit, located in the Bergamasc Alps, west of Bolzano, consists of volcanic-hosted mineralization of Permian age. A similar deposit was found throughout exploration at Valvedello, near Novazza, in 1975–1983. The Novazza mineralization occurs in a Permian ignimbrite host, which has been subjected to sodic metasomatism. Pitchblende and sphalerite exist in microfractures and were formed at temperatures of between 80° and 100°C. Total exploration expenditures of USD \$ 75 million (including 178 973 metres of drilling) were incurred (Fig. 2).

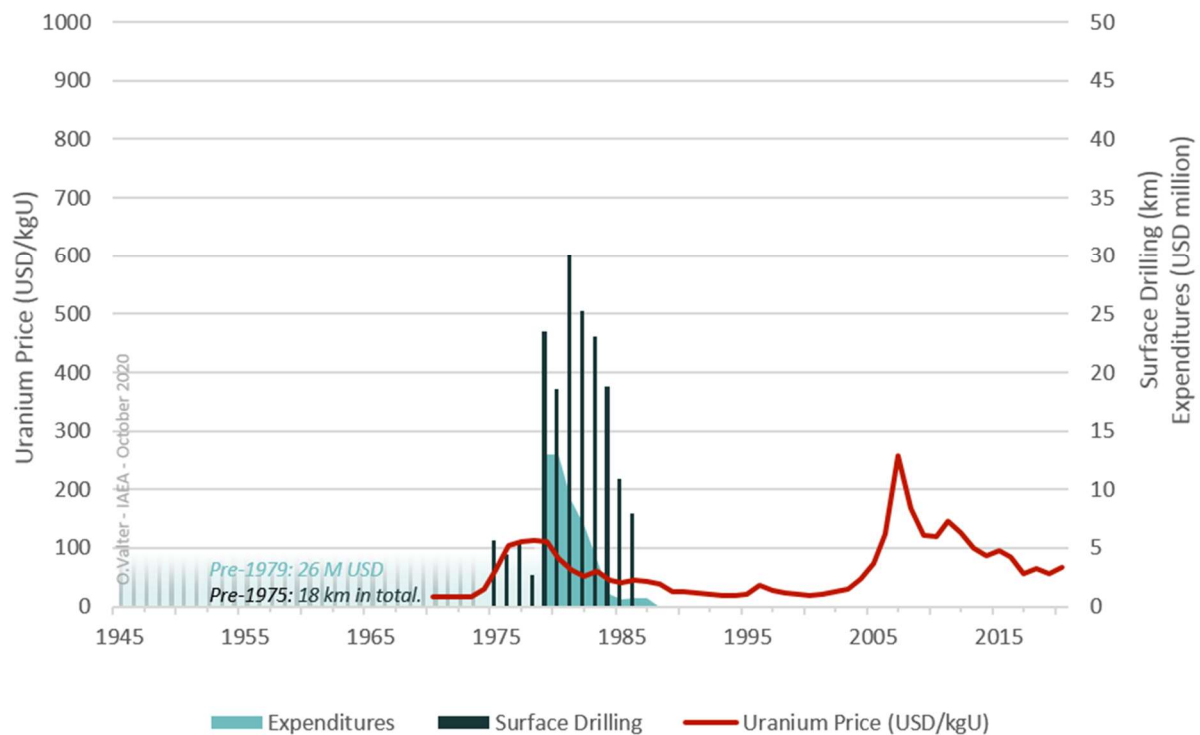


FIG. 2. Domestic uranium exploration data for Italy. Comparison of exploration expenditures, drilling and uranium market price (US\$ current).

Other mineralization of interest has been found at several places in the Permian of the Southern Alps. The most promising are in the Val Rendena and Val Daone areas in the Trento region of northern Italy. Pitchblende and pyrite occur with organic material in coarse-grained grey sandstone located below red sandstones. Other occurrences of limited interest include veinlets hosting pitchblende and sulphides in Hercynian granites of the Mount Blanc Massif, and small-scale mineralization in the contact metamorphics and granites of southern Sardinia and Calabria [8, 9].

## Uranium resources

Resource estimates made in 1987 were reported in the 1991 Red Book [9]. No more recent updates are available. The 1987 estimates are:

- (a) Reasonably assured resources at <US \$80/kgU: 4800 tU;
- (b) Estimated additional resources (EAR-1) at US \$80–130/kgU: 1300 tU;
- (c) Speculative resources at <US \$130/kgU: 10 000 tU.

According to UDEPO and the Red Book, the reasonably assured resources and EAR-1 occur in the volcanic type Novazza and Valvedello deposits. Both projects are currently dormant. UDEPO reports Novazza's resources as 1000–2500 tU at grades of 0.05–0.1% U and Valvedello's resources as 2500–5000 tU at grades of 0.05–0.1% U.

IUREP reports reasonably assured resources for Novazza as 1200 tU at a grade of 0.09% U, and EAR-1 and inferred resources at 1000 tU [8].

## Uranium production

Italy does not produce uranium. The Valvenova production centre, with a yearly output capacity of 260 tU, was built to process ores from underground mines at the Novazza and Valvedello deposits. The plant never operated.

## Potential for new discoveries

The potential for new discoveries is believed to lie within the continental series of Permian strata, which are located in the Alps. However, most Alpine areas are in environmentally sensitive zones, such as national parks and tourist destinations or have restrictions as regards mining. The same restrictions would apply to those areas where granitic intrusions have potential, such as in the Alps, as well as in other parts of the country.

## References

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