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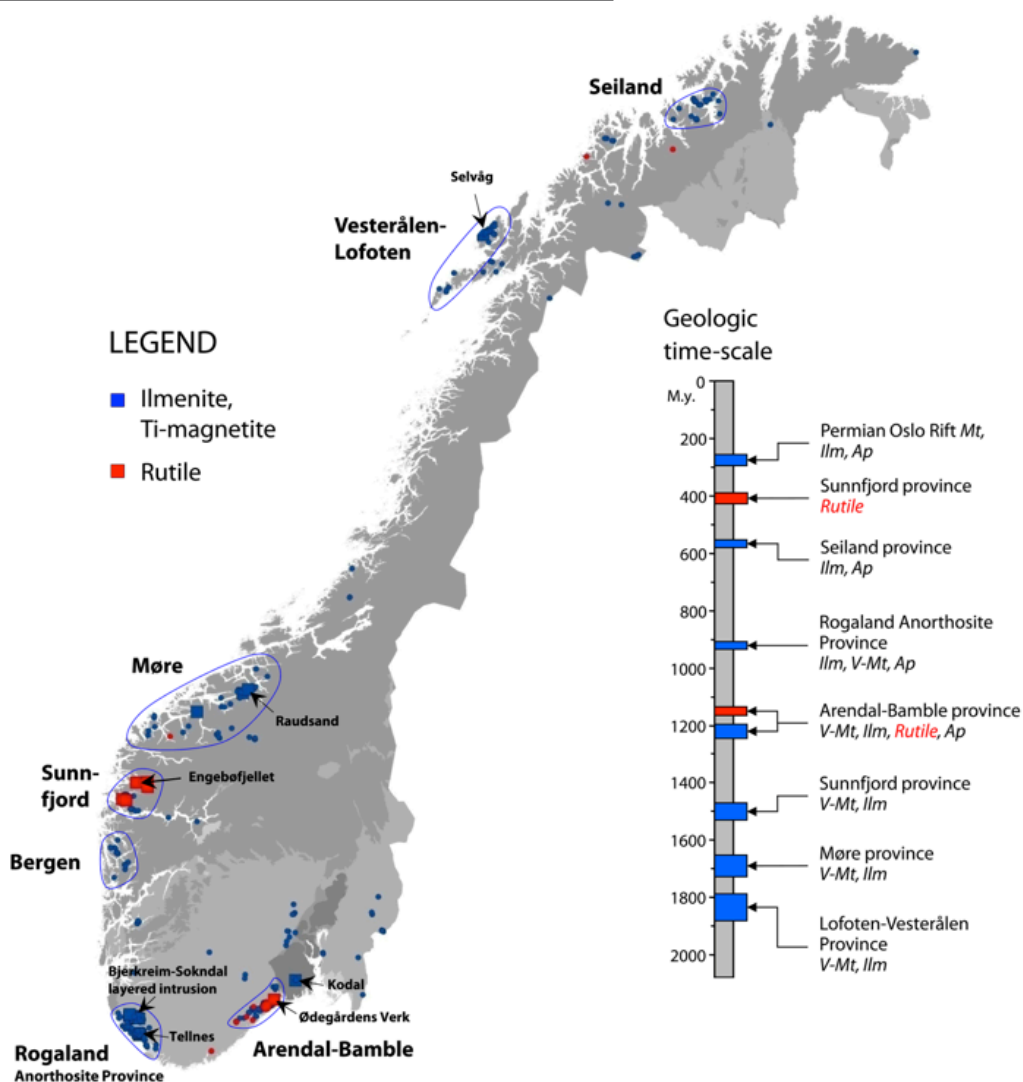
Engerbøfjellet rutile/eclogite deposit, Naustdal, Sogn og Fjordane

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## TITANIUM AND IRON-TITANIUM DEPOSITS IN NORWAY

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Approximately 300 titanium and iron-titanium mineral occurrences and deposits are known. The most significant deposits are (1) the Tellnes ilmenite deposit (in operation) and (2) combined apatite, ilmenite and vanadium-rich titanomagnetite, both in the Rogaland Anorthosite province in southernmost Norway, and (3) the Engerbøfjellet rutile/eclogite deposit in the Sunnfjord region of western Norway.



| Province/region    | Type of deposit | c. age      | Major deposit | % TiO <sub>2</sub>             | Mineral resource (Mt ore) |                     |                   | Comments   |
|--------------------|-----------------|-------------|---------------|--------------------------------|---------------------------|---------------------|-------------------|--|
|                    |                 |             |               |                                | Reserve                   | Identified resource | Possible resource |  |
| Arendal            | Ilm-Mt (V)      | igneous     | 1250          | 5-20                           |                           |                     |                   | 0.8-1.2 % V <sub>2</sub> O <sub>3</sub> in Mt                |
| -Bamble            | Rutile          | metasomatic | 1180          | Ødegården <sup>1</sup>         | 2-4                       |                     | > 50              | > 30 ppm U in rutile   |
| Rogaland           | Ilm             | igneous     | 925           | Tellnes <sup>2</sup>           | 28                        | 180                 | > 100             |  |
| Anorthosite        | Ilm             | igneous     | 930           | Storgangen                     | 17                        | 60                  |                   |  |
| Province           | Ap, Ilm, V-Mt   | igneous     | 930           | Bjerkreim-Sokndal <sup>3</sup> | 4-10                      |                     | > 600             | c. 30 % Ap+Ilm+Mt (0.4-0.8 % V <sub>2</sub> O <sub>3</sub> ) |
| Bergen             | Ilm-Mt          | igneous     | 950           |                                |                           |                     |                   |  |
|                    | Rutile          | metamorphic | 400           | Husebø <sup>4</sup>            | 3-6                       |                     | > 50              |  |
| Sunnfjord          | Ilm-Mt          | igneous     | 1200          |                                | 5-10                      |                     |                   | < 1.5 % MgO in ilm.  |
|                    | Rutile          | metamorphic | 400           | Engebøfjellet <sup>5</sup>     | 3-4                       | 31                  | > 123             | < 1 ppm U in rutile  |
| Møre               | Mt(V), ilm      | igneous     | 1700          | Raudsand <sup>6</sup>          | 4                         | 11                  | > 100             | 25-30 % Mt (0.7 % V <sub>2</sub> O <sub>3</sub> )            |
| Lofoten-Vesterålen | Mt(V), ilm      | igneous     | 1900          | Selvåg <sup>7</sup>            | 4                         |                     | 44                | c. 30 % Mt (0.6 % V <sub>2</sub> O <sub>3</sub> )            |
| Other              | P, Mt, Ilm      | igneous     | 270           | Kodal <sup>8</sup>             | 3-7                       | 15                  | 34                |  |

1 Rutile-bearing scapolitized metagabbro.

2 Mine in operation since 1960, operated by Titania AS (Kronos Worldwide Inc.). The yearly mine production is about 850.000 t ilmenite concentrate with 44-45 % TiO<sub>2</sub>.

3 In the Bjerkreim-Sokndal layered intrusion horizons in the magmatic sequence are distinctly enriched in apatite, ilmenite and titanomagnetite. Approximately 2 km<sup>2</sup> are regarded as potential ore with 30-35 % apatite + ilmenite + titanomagnetite (0.7-1.2 % V<sub>2</sub>O<sub>3</sub>).

4 The Husebø rutile-bearing eclogite deposit consists of variably eclogitised jotunite affected by retrograde alteration, with 3-5 % TiO<sub>2</sub> outcropping more than 100.000 m<sup>2</sup>.

5 Two types of Ti deposit occur in the Sunnfjord region: magmatic ilmenite-titanomagnetite deposits associated with Palaeoproterozoic mafic intrusions, and rutile-bearing Caledonian eclogitic rocks. The ilmenite deposits in the region are of minor economic interest, while the rutile-bearing eclogites represent a major mineral resource, particularly the Engebøfjellet deposit.

6 The Rødsand deposit (in operation from 1899 to 1981) is disseminated to semi-massive Fe-Ti oxides within amphibolite. The crude ore produced contained 25-30 % magnetite, 3.5-4 % ilmenite and 0.15-0.20 % V. The magnetite concentrate contained 64% Fe, 2 % TiO<sub>2</sub> and 0.7 % V<sub>2</sub>O<sub>3</sub>, and was the raw material for production of pig iron and ferrovanadium.

7 Massive and disseminated Fe-Ti deposits occur in gabbros and anorthosites. Selvåg is the only deposit considered to be of potential economic interest, with 44 Mt probable ore with 20-30 % titanomagnetite (0.6 % V<sub>2</sub>O<sub>3</sub>) and minor ilmenite.

8 The larvikite-lardalite complex in the southernmost parts of the Permian Oslo Rift host a number of titanomagnetite-ilmenite-apatite concentration, of which the Kodal deposit was investigated for apatite in the 1970's and 80's, and the deposit has recently been evaluated by Kodal Minerals. The mineral resource is c. 50 Mt with c. 5 % P<sub>2</sub>O<sub>5</sub> (12 % apatite), 25-40 % titanomagnetite and 5-10 % ilmenite.

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