



INVEST IN FINLAND

## **World-class Finnish nickel mine project – an overview**

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# World-class finnish nickel mine project – an overview

## Introduction

Finland's history in nickel mining is legendary. Nickel mining began back in the late 1930's in Makola and significant deposits were then found at Kaulatunturi in the early 1940's. Smelting and refining also started up in the 1940's at Kolosjoki and now the Fennoscandian smelting and refining capacity amounts to about 20% of global production. Up to now, Finland has mined about 50 million tonnes of nickel ore but, despite this impressive history, it appears that the 'golden' age for nickel mining still lies ahead. Deficits in raw materials are predicted by smelters worldwide, and it appears that Finland will be able to contribute substantially to meeting the considerable level of demand. Several medium-sized nickel exploration projects are underway but they are all put in the shade by the massive Talvivaara project in north-eastern Finland. Its 340 million tonnes of resources represent the largest known nickel sulphide deposit in Europe and will satisfy about 3% of the global demand for primary nickel when it comes onstream in 2009.

This overview of the Talvivaara nickel project begins by focusing on what makes Talvivaara so significant and how the project will be realised, then goes on to introduce the main organisations instrumental in supporting not only the Talvivaara project but also Finnish nickel mining in general, now and in the near future. These organisations are the Finnish Ministry of Trade and Industry (KTM), the Geological Survey of Finland (GTK), Finnish Industry Investment Ltd and Invest in Finland.

## Advantages of the Finnish mining industry as an investment target

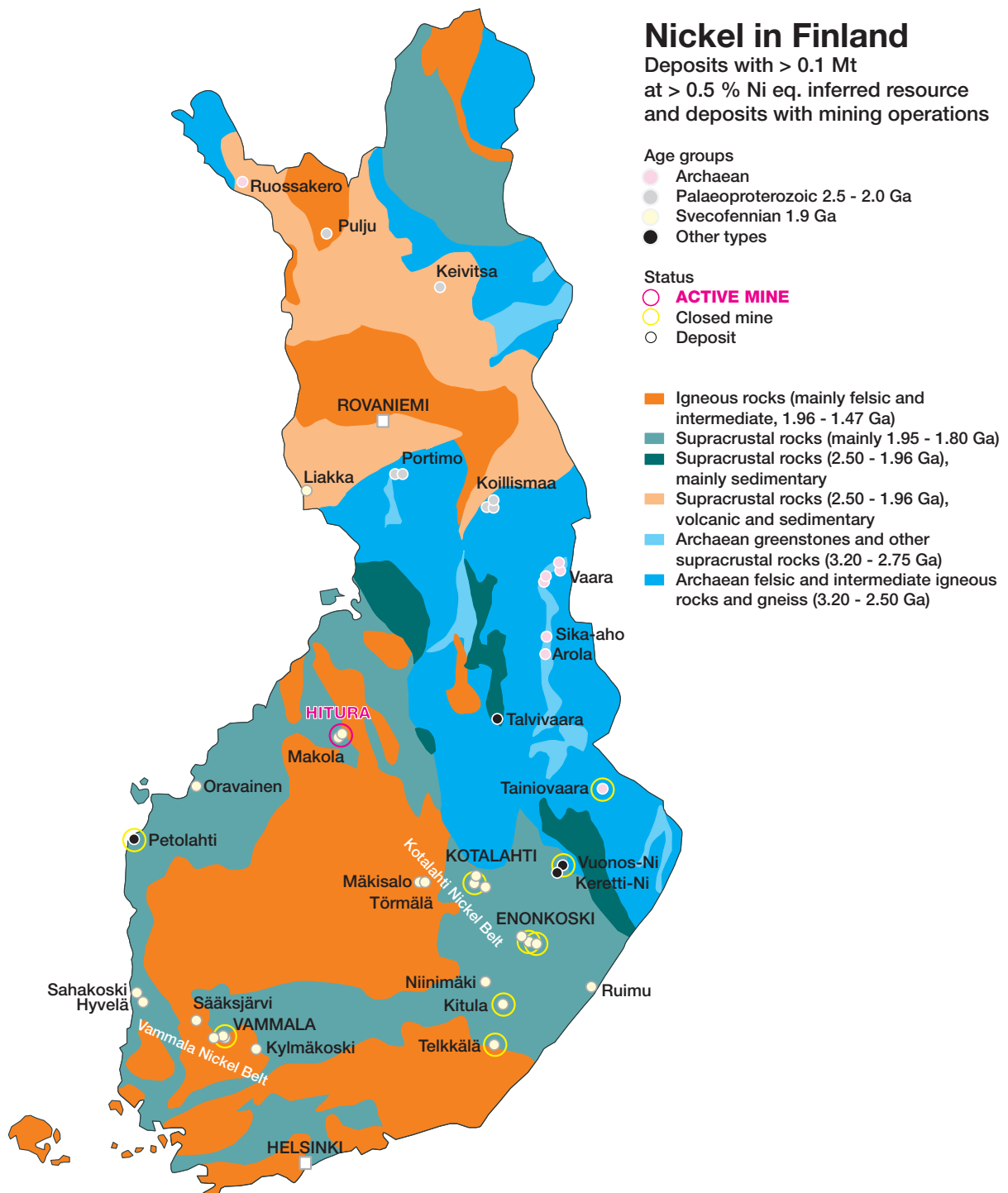
Finland is a large country, at 337,000 km<sup>2</sup> the eighth largest in Europe, but, with a sparse population of just 5.2 million, much of the country is still uninhabited and unexplored, allowing significant potential for new discoveries. A combination of hard work by bodies such as KTM and GTK and Finland's unrivalled hi-tech base means that there is excellent geodata available.

Finland is a mining-friendly country, where interest from local authorities and residents is high, and public opinion surveys show that a majority of people are in favour of mining projects, partly because of the country's long and proud traditions in the industry. National and local government organs are highly committed to developing the sector, and advanced mining legislation and a stable and secure economic and political environment ensure that investors can invest with confidence. Bureaucracy is low compared with many European countries and there is virtually no corruption in business.

An excellent education system (nominated by PISA (Programme for International Student Assessment) as the world's best) ensures that a highly qualified and able work force is available, and a high level of public investment means that infrastructure is excellent allowing fast, efficient transport and communications and substantial cost savings, one of the reasons why it is profitable to mine even low-grade deposits in Finland.

## Nickel in Finland

Deposits with > 0.1 Mt  
at > 0.5 % Ni eq. inferred resource  
and deposits with mining operations



### The Talvivaara Project

The Talvivaara project is located near Sotkamo about 560 km north of Helsinki in a largely uninhabited part of the Kainuu region. The mining licences for the deposits there are held by the company Talvivaara Project Ltd, the operational subsidiary of the holding company, Talvivaara Mining Co. Ltd. For mining operations, the location is ideal, close by a ready work force, road and rail connections and blessed with abundant supplies of energy and water. No areas of conservation exist in the immediate vicinity.

The deposits comprise two different polymetallic orebodies, Kuusilampi and Kolmisoppi. The Australian Joint Ore Reserves Committee (JORC) has classified the resources as amounting to 340 million tonnes of ore, containing 0.27% nickel, 0.56% zinc, 0.14% copper and 0.02% cobalt.

The Talvivaara deposits have been attracting interest since the 1970's, when GTK carried out extensive exploration in the area. Finnish mining and minerals giant, Outokumpu plc, was then granted mining licences and continued work in the area throughout the 1980's and early 1990's. The resource, although large, was however found to be relatively low-grade, and, with the current technologies available at the time, not an economically viable proposition. Outokumpu therefore never exploited the resource and, for a while, after the turn of the millennium, when the company made a strategic decision to withdraw from mining activities, it seemed as if perhaps exploitation would never be carried out.

The birth of the Talvivaara Mining Co. Ltd, however, soon changed all that as company CEO, Pekka Perä explains: 'Our history goes back to 2003, when we bought Europe's largest nickel deposits from Outokumpu. Since then, utilising new technology, we've been developing those deposits. Currently things are looking so promising that I think that we will be able to make a major investment decision by the end of this year (2006) and begin construction'.

According to Mr Perä, the company is currently directly employing 35 people, but once full-scale production starts up in 2009, that figure will shoot up to more than 400. It is estimated that indirect employment effects will increase the total number of new jobs in the Kainuu region to more than one thousand. The annual production capacity of the mine will be 30,000 tonnes of nickel, 60,000 tonnes of zinc, 10,000 tonnes of copper and 1,500 tonnes of cobalt. This will place it amongst the top five nickel mines in the world. Annual mined resources in Finland amount to about 20 million tonnes and this is what is planned for Talvivaara alone. It is anticipated that large-scale production will last for at least 25 years.

Talvivaara is situated in the southern part of the Kainuu schist zone, and consists mainly of metasediment quartzites, black schists and mica schists. The Talvivaara deposits at Kuusilampi and Kolmisoppi are hosted by black schists, which were originally organic-rich muds, intensively folded during Svecofennian deformation. Three mineralogical ore types are distinguishable in these orebodies – fine-grained dissemination, coarse-grained breccias and skarn ore. The common sulphide mineral contents are between 20 wt% and 25 wt% and the main sulphides are pyrrhotite, pyrite, chalcopyrite, sphalerite and pentlandite. Graphite content is also high, both at Kuusilampi and Kolmisoppi.

#### **Talvivaara Mining Co. Ltd, its investors and financing**

The company operates through a highly networked business concept, working in close co-operation with a specially selected group of leading partners in business and development, which includes Algol Oy/Kaitos (construction technology), the Finnish Road Enterprise (responsibility for earthworks), Grundfos (pump solutions), Metso Minerals, Sandvik Tamrock (heavy mining equipment), Bioshale Consortium (biotechnology for exploring black shale ores), Boliden (mining and smelting), GTK, Gridpoint Finland (rock engineering consulting and research), Helsinki University of Technology, Lapland Water Research Ltd, OMG (producer of metal-based materials), Outokumpu, Tampere University of Technology (bioheapleaching trials), the Finnish Funding Agency for Technology and Innovation (TEKES) (finance for bioheapleaching trials) and the Kainuu Employment and Economic Development Centre.

As well as being a partner, Outokumpu retains an option to become a minority shareholder in the company once certain development milestones are reached.

Towards the end of 2005, it was announced that Talvivaara Mining Co. Ltd was forming a co-operation and financing consortium with OMG Finland Oy, Metso Minerals Oy and the Varma Mutual Pension Insurance Company 'to ensure the financial and technical resources required to take the Talvivaara Mine Project through its bankable feasibility study and relevant research and development to an investment decision'. As a result of this move, the company currently has €8-10 million, for expenditure on R&D and feasibility studies during 2006. The company said it hoped that the consortium would bring world-leading technological know-how and financial strength to the project, and also offer exceptionally advanced R&D resources such as in hydrometallurgy and bulk materials handling.

According to Mr Perä, these three companies are each putting several million euros into the project, in addition to Outokumpu and GTK, which have spent about €40 million on it. The ultimate equity requirement for the project is about €140 million and the intention is to collect that amount by listing on the London Stock Exchange.

## A need for the latest technologies

As has been already mentioned, the low grade of the Talvivaara deposits meant that the use of conventional technologies would not have made the project economically viable. In the 1990's, when Outokumpu was deciding not to exploit the deposits, the technology of bioleaching, although very suitable for sub-arctic climatic conditions like Finland, was considered to be rather too new and unproven, therefore too risky for large-scale operation. By the turn of the millennium, however, attitudes were changing.

Pekka Perä explains: 'The deposits are fairly low-grade, and we found that bioheapleaching was very suitable and cost-effective for deposits where the nickel part is low. First we drill and blast, then we crush the material to a size of 8mm, agglomerate it with sulphuric acid to consolidate the finer and coarser particles, then stack it in huge heaps irrigated with an acidic bacterial solution through a network of plastic pipes. As this solution goes through the heap, it leaches out the valuable materials and we then collect them from the solution and pump them to the metals recovery plant. After the metals are removed, the solution is further purified and returned to irrigate the heaps again. This method has traditionally been very common with copper and gold, but in recent years it's become a proven technology for nickel too, although we believe that ours is the first commercial application for nickel'.

The bacteria used in bioheapleaching at Talvivaara has been collected and nurtured from composite water samples from the area of the orebody, so it is endemic to the area and therefore well-adjusted to the prevailing environmental conditions.

Together with OMG, the company is developing sophisticated technology for the precipitation of metals from the solution. The technology is also seen as being relatively environmentally-friendly in comparison to traditional methods, as it bypasses the smelting stage, the stage at which the majority of carbon dioxide and sulphur are produced. As back-up alternatives, other leaching techniques such as pressure acid leaching (PAL) are being evaluated. Processes are being tested in a 50,000 tonne-onsite demonstration trial during 2005 and 2006. The deposits will be mined as open pits, with a very favourable waste to ore ratio, at a scale of 15 million tonnes per annum.

## Nickel mining in Finland

Thanks to a large extent to voracious demand from the European stainless steel industry, demand for nickel is significant and growing, so development in the Finnish nickel industry is coming along just at the right time, especially as other Nordic countries have no new mines or even advanced exploratory projects in the pipeline.

Finland, however, is rife with them. Another major deposit exists at Keivitsa near Sodankylä in Lapland, which is being exploited by Scandinavian Minerals Ltd. This contains measured and indicated resources of some 100 million tonnes of nickel and other multi-metal deposits. The project is nearing the completion of its pre-feasibility study based on open-pit mining of 3.5 million tonnes of ore per annum.

Then at Kylylahti in the Outokumpu region of eastern Finland is a project owned and managed by Vulcan Resources Ltd of Australia. This site is concentrating more on copper deposits estimated to be 74,000 tonnes, but it is also expected to yield about 15,000 tonnes of nickel, and even 143,000 ounces of gold.

At Suhanko in Lapland is the Arctic Platinum Project owned and operated by Gold Fields Ltd. This is again a multi-metal site on which more than €40 million has been spent on exploration and feasibility studies. The ore type is palladium-dominated, but the 0.09% grade of nickel is expected to yield about 80,000 tonnes of nickel.

Companies such as Finn Nickel Ltd are busy exploring deposits in several locations. Before Talvivaara begins operations, Finn Nickel is aiming to get open-pit production up-and-running at smaller deposits at Särkiniemi, Mäntymäki, Niinimäki and Hyvelä and underground production at Sahakoski, Hautalampi, Valkeisenranta and Riihilähti.

According to sources at Finland's Ministry of Trade and Industry, the current general situation in Finnish nickel mining is and will continue to be very promising. There are a great many nickel deposits in Finland and good potential for more. Historically, however, the deposits that have been mined have almost all been very low-grade, normally between 0.5% and 1% nickel. Such is the case with the one currently operational nickel mine in Finland at Hitura. This, however, is what has made Finland very good at making its mining operations as efficient and cost-effective as possible. Exploring, mining and processing low-grade nickel ores is traditionally one of Finland's specialities, and the country is now getting credit for its good work in the form of international interest and investment. It is an accepted fact that many of the deposits that have been mined in Finland could not have been in any other country'.

## Important players in mining

### *Ministry of Trade and Industry*

Finland has no specific Ministry of Mining so Finland's Ministry for Trade and Industry, [www.ktm.fi](http://www.ktm.fi), handles such duties. The ministry contains a small technology department in charge of handling applications within the sphere of the Mining Act, granting reservations for claims, claims and mining concessions. In co-operation with GTK, the department also produces annual statistics on mining exploration. A further role is to participate in the promotion of exploration and available mining capacity. It handles applications for State support for new mines and liaises with the media. The Ministry is in charge of drafting new legislation and improving that which already exists, but is not involved with environmental permits required for mining operations, for which the Ministry of the Environment is responsible.

### *GTK (Geological Survey of Finland)*

Established in 1885, the Geological Survey of Finland, [www.gtk.fi](http://www.gtk.fi), is a national geological research centre of some 700 employees, operating under the auspices of the Ministry of Trade and Industry.

One of its main duties is to promote mineral exploration and mining in Finland. It is responsible for the acquisition and management of geoscience information in Finland, with a particular emphasis on providing the exploration and mining sectors with high-quality data. Through a comprehensive mapping and research programme, GTK also identifies and documents areas with mineral potential, in order to encourage follow-up exploration and exploitation by the private sector, with the aim of supporting sustainable use of both bedrock resources and surficial deposits. All GTK discoveries are offered to the private sector through an open tendering process arranged by the Ministry of Trade and Industry. Neither the Finnish Government nor GTK have any role in the downstream development of mineral deposits.

GTK offers the minerals industry expertise in Fennoscandian economic geology, as well as confidential, client-tailored exploration services, including geophysical surveys and modern chemical, mineralogical and mineral processing laboratory services, both within Finland and worldwide.

Of nickel mining in Finland, GTK says that, since the 1940's, about 50 million tonnes of nickel ore have been mined yielding 300,000 tonnes of actual nickel. The most rewarding of the exploration targets have been the Palaeoproterozoic orogenic deposits (Svecofennian), nine of which have produced the lion's share of production so far at 42 million tonnes of ore at average grades of 0.67% nickel. The only currently operational mine at Hitura has produced 13.6 million tonnes at a grade of 0.60%, and existing reserves are estimated to be in the region of 5 million tonnes at 0.70%. Finland's highest grades can be found in the Kotalahti and Vammala nickel belts in central and southern Finland, where dozens of potential deposits exist with grades as high as 2%.

The highest potential for new discoveries lies in the Archaean komatiites in eastern and northern Finland, and the Palaeoproterozoic komatiites (is this really a correct spelling? for komatiites) in northern Finland, which have only been actively explored since the 1990's. Deposits here are numerous but quite small, the largest being the Ruossakero in north-western Lapland with resources of 4.2 million tonnes at a grade of 0.52%. A possibility exists to find as yet undiscovered Pechenga-type deposits in this region.

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### *Finnish Industry Investment Ltd*

Finnish Industry Investment Ltd (FII), [www.industryinvestment.com](http://www.industryinvestment.com), is a government-owned investment fund, which invests the proceeds accrued from the privatisation of State-owned companies to promote the growth and internationalisation of Finnish business. The fund invests mainly in private equity and venture capital funds, but also directly in companies. Targets come from all sectors, and are particularly early- and growth-stage businesses that would otherwise not receive sufficient private capital.

Capital investments are needed for the recipient companies' seed phase and for financing growth, spin-off projects, change-of-generation arrangements, major industrial investments and restructuring. FII acts as a co-investor, investing at most one-half of the capital and limiting its ownership to 50%. So far, the fund's investments and investment commitments have amounted to some €330 million.

According to Tuomo Mäkelä, Senior Adviser at FII, a recent initiative by the fund to pool institutional investments in the mining and minerals sector in a new private equity fund in 2005 came to nothing as insufficient interest was shown by Nordic institutions. ‘The board therefore resolved to start a mining sector investment programme inside the existing structure’, says Mr Mäkelä. ‘This is a programme targeted at Finnish-based mining ventures, making use of our own funds and based on our balance sheet. In principle, it’s similar to other target equity initiatives, based on the co-investment principle, where our co-investor is an expert in that particular sector and a comparable amount of money must come from them’.

This programme was allocated funding of €20 million, and launched in spring 2006. The first investment was in June 2006, a sum of €1.5 million in Vulcan Resources Ltd, a company listed on the Australian Stock Exchange, which, as previously mentioned, owns and manages the Kylylahti copper-cobalt-nickel-gold project in north Carelia, but is also prospecting in Kuhmo, Pudasjärvi and Tornio.

Then in September 2006, FII invested €1.25 million in the Canadian ore exploration company, Belvedere Resources Ltd, whose shares are quoted on the Toronto Stock Exchange. All Belvedere’s research sites are in Finland and FII’s input represents 36% of the total initial financing round. The capital will be used by Belvedere to finance its acquisition of a 45% equity stake in Finn Nickel Ltd, which was agreed in spring 2006, and to speed up further development of its Finnish projects.

The driving force behind this new mining investment programme is foreign investors’ interest in Finland’s ore reserves, whilst larger domestic players have focused on refining rather than mining. ‘These targets have been different to our previous investments in the sense that they are companies already listed outside Scandinavia’, continues Mr Mäkelä. ‘This is a typical characteristic of the mining industry that venture capital funding is raised on listed markets. Most other industrial ventures are privately financed. There will, however, in future also be investment from us in private companies in the mining sector’.

‘Business in all natural resources is booming and in mining and metals in particular’, says Mr Mäkelä. ‘This is a super-cycle, stronger, longer and more dynamic than most typical boom-and-bust cycles. This is largely because of the huge demand from China and other emerging economies. Supply can’t cope with demand. Finland has really benefited from this and, as far as minerals development is concerned, has been the most active in Europe in terms of investment in recent years’.

### *Invest in Finland*

Invest in Finland (IIF) is an expert organisation whose primary goal is to help you in the process of setting up a business in Finland and to serve you once you have established a presence in the country. This covers all aspects of the investment process from choosing the right partners and location through to comprehensive information and advice on the business environment and investment conditions. In order to ensure that these services are of the highest quality, IIF works closely with KTM, GTK, FII and other experts in the field of mining. IIF serves you through a vast domestic network and international partners in over 50 countries worldwide. The services are free of charge. Invest in Finland is funded by Finland’s Ministry of Trade and Industry.

If you have any questions regarding establishing a mining business in Finland, please contact Tuomo Airaksinen, tel. +358 10 773 0302, tuomo.airaksinen@investinfinland.fi (we can be your first point of contact).



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