A world class deposit in the Skaergaard intrusion

The classic Skaergaard intrusion hosts a large tonnage PGE-Au-Ti-V-Fe deposit. The inferred tonnage is 1,500 million tonnes. The precious metals are hosted in a series of stratiform sulphide-bearing levels in ilmenite and magnetite rich, layered gabbro. The mineralisation formed at magmatic temperatures in the upper part of the intrusion in strongly fractionated basaltic magma. The mineralisation was little affected by later remobilisation and the dominant precious metals are skaergaardite (PdCu) and tetraauricupride (AuCu).

The Skaergaard intrusion

The 54.5 Ma old Skaergaard intrusion is located at 68°N in the volcanic rifted margin along the coast of East Greenland. The intrusion was emplaced during the build up of the regional flood basalts and the initial stages of continental rifting and seafloor spreading in the North Atlantic. The intrusion is currently modelled as a box-like magma chamber app. 11 by 7.5 km in surface area with an original stratigraphy of c. 3.8 km. The original volume was ca. 300 km^3.

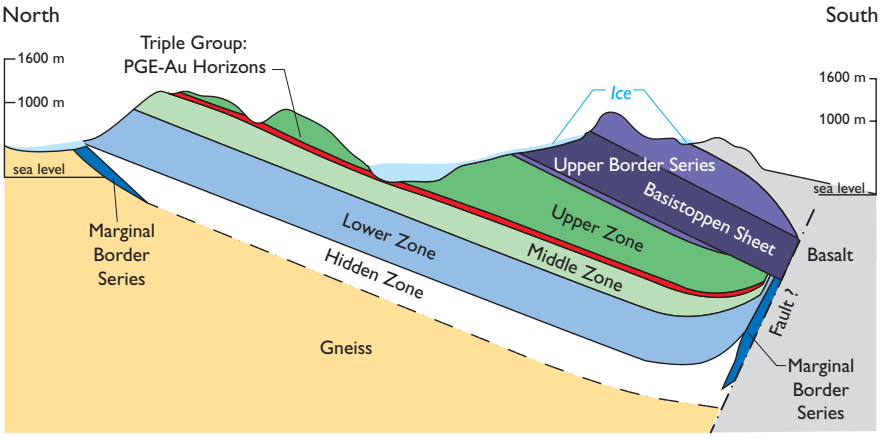
Crystallisation up from the floor, along the walls and down from the roof resulted in three main formations:

(1) The Upper Border Series under the roof (UBS, c. 50 km^3).
(2) The Marginal Border Series along the walls (MBS, c. 50 km^3).
(3) The Layered Series (LS, c. 200 km^3) accumulated up from the floor of the intrusion.

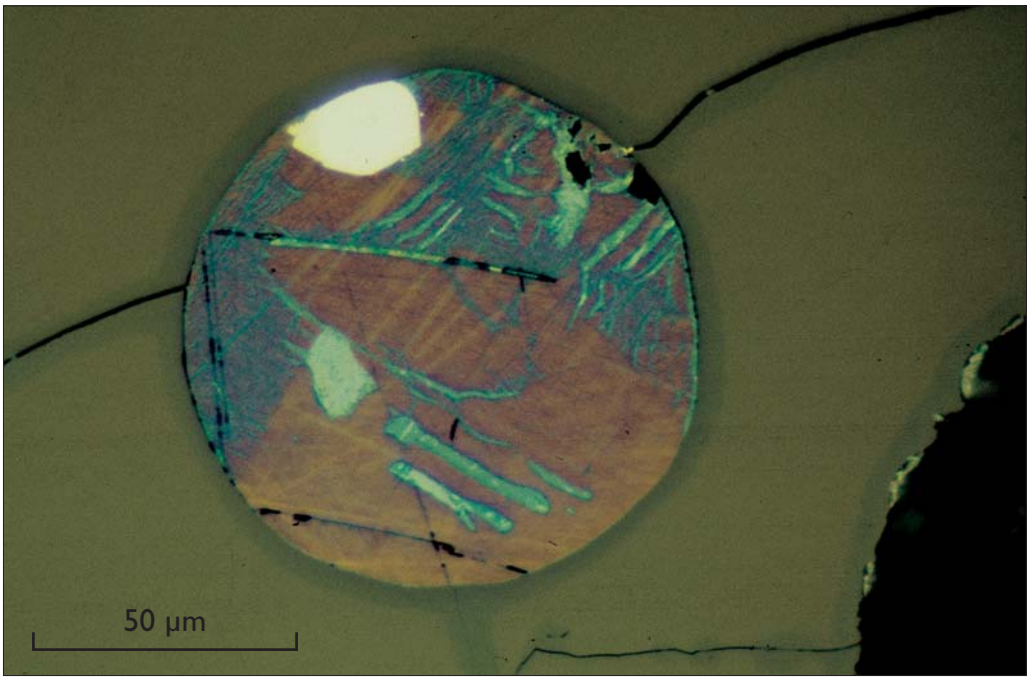
The last rock unit to crystallise is the Sandwich Horizon (SH) at the interface between LS and UBS, c. 600 m below the roof. The intrusion is rotated c. 15° to the south and most of the stratigraphy is exposed due to erosion of the northern parts.

The three leuco layers of the Triple Group near the top of Wagertoppen (background) and in the Pukugatryggen (foreground right).

The magma solidified in concentric zones toward the centre of the intrusion. Phase layering, i.e., liquidus parageneses, and cryptic variation in liquidus minerals allow a subdivision of the intrusion. The cryptic variation in minerals is significant. Olivine evolves from c. Fo_{70} to



N-S section through the Skaergaard intrusion. Mineralisation in the upper 100 metres of Middle Zone.



Precious metal phase in syn-magmatic sulphide droplet hosted in liquidus magnetite.

Fo_1, and plagioclase from c. An_{70} to An_{10}. The deepest gabbros in LS are not exposed and referred to as the Hidden Zone (HZ). The exposed rocks of LS are divided in Lower Zone (LZ), Middle Zone (MZ), and Upper Zone (UZ).

The mineralisation

The mineralisation is hosted in the Triple Group in the upper part of MZ after the crystallisation of c. 70 % of the parental ferrobasalt magma. The Triple Group is the name of a c. 100 m stratigraphy characterised by three, distinct, leucogabbro layers. The mineralisation is located in the stratigraphic section from the base of the lower leucogabbro layer and to just above the second leucogabbro layer. The mineralisation is composed of five main levels and in total ten well-defined levels of enrichment in PGE (Pd-levels). The stratigraphic separation between main Pd-levels is c. 10 m. All Pd-levels are perfectly parallel to the well-developed saucer-shaped magmatic layering in the host gabbros.

The number of developed Pd-levels decreases systematically toward the margins of the intrusion, where only one Pd-level (Pd_5) is developed. Gold is always concentrated in or just above the top of the locally developed Pd-levels irrespective of the number of developed Pd-levels. The stratigraphic separation between the base of Pd_5 level and the top of the Au-rich zones increases from c. 5 m at the margin to c. 60 m in the centre of the mineralistion.

The mineralisation has a low suphide content (<0.5 vol% bornite and chalcosite). The precious metal grains occur in sulphide droplets in liquidus minerals or groundmass or as free precious metal droplets in the groundmass of the Ti-,V- and Fe-rich host rock. The dominant PGE mineral is skaergaardite (PdCu) in the centre of the intrusion, and zviagintsevite (Pd_3Pb) at the eastern margin. The gold mineralogy is more complex, but dominated by tetraauricupride (AuCu).

Inferred resource

The Skaergaard deposit is a PGE-Au-Ti-V-Fe multi element mineralisation. The host rocks of the mineralisation are rich in titanium, vanadium and iron. A 44-m profile across the mineralisations indicates average contents of 6.6% TiO_2, 1.3 kg/t V_2O_5 and 19% Fe_2O_3 in the host rock of the precious metal mineralisation. The lowest Pd-level (Pd_5) is the main source of PGE and estimated to contain 104 million tonnes with of 0.11 g/t Au, 1.91 g/t Pd and 0.16 g/t Pt. The combined gold zone is estimated to contain 107 million tonnes with 1.68 g/t Au, 0.59 g/t Pd and 0.05 g/t Pt.

Key references

Nielsen T.F.D. (2004). The shape and volume of the Skaergaard intrusion: implications for mass balances and bulk composition. Journal of Petrology 45, 507–530.

Nielsen, T.F.D., Andersen, J.C.Ø. & Brooks, C.K. (2005). The Platinova Reef of the Skaergaard intrusion. Mineralogical Association of Canada Short Course 35, 431–455.

Wager, L. R. & Brown, G. M. (1968). Layered Igneous Rocks. Edinburgh and London: Oliver & Boyd.

Bureau of Minerals and Petroleum
(BMP)
Government of Greenland
P.O. Box 930
DK-3900 Nuuk
Greenland

Tel: (+299) 34 68 00
Fax.: (+299) 32 43 02
E-mail: bmp@gh.gl
Internet: www.bmp.gl

GEUS

Geological Survey of Denmark
and Greenland (GEUS)
Øster Voldgade 10
DK-1350 Copenhagen K
Denmark

Tel: (+45) 38 14 20 00
Fax.: (+45) 38 14 20 50
E-mail: geus@geus.dk
Internet: www.geus.dk

Author:
T.F.D. Nielsen
Editor: K.Secher
Layout: C.E. Thuesen, GEUS

ISSN: 1602-8171