Uranium potential in Greenland

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Greenland

- Greenland is part of the Kingdom of Denmark
- Largest island in the world, >2 mio. km²
- ~80% covered by an ice sheet
- 56,000 inhabitants
- 18 towns and 60 settlements
Uranium in Greenland

- Known uranium deposits (Keulen et al. 2014)
- Exploration and research in South and East Greenland in the 1950’s to the 1980’s
- Intrusion
- Vein
- Sandstone
- Metasomatic
- Volcanic
- Qz-pebble conglomerate
South Greenland has the highest background radiation in Greenland, but the Nuuk region also has relatively high background radiation.
Airborne radiometric survey

Uranium Syduran

Armour-Brown et al. (1982)
Uranium in Greenland

- The potential for uranium deposits is good (Keulen et al. 2014)

- Several areas with favorable geological environment for uranium deposits, fx. the Thule region (sandstone and unconformity-related deposit types).
South Greenland

Radioactivity related to:
1) The Julianehåb batholith (pink)
2) Gardar intrusions (red-brown)
The Ilímaussaq Complex

Agpaitic Nepheline Syenites
Highly-evolved, highly-enriched in incompatible elements
(Zr, Nb, Ta, Be, REE, U, Th etc)

>220 minerals
34 discovered here
16 unique

- Kakortokites
- Lujavrites
- Naujaite
- Sodalite Foyaite
- Pulaskite, Foyaite
- Augite Syenite
- Quartz Syenite
Ilímaussaq Intrusion

Upper Lujavrites (at Kvanefjeld)
- Final crystallized melt
- U concentrated in steenstrupine
- Also enriched in REE, Th, Zn and Be

Kakortokites (at Kringlerne)
- Floor cumulates
- Eudialyte rich layers – red kakortokite
- Eudialyte enriched in REE, Zr, Ta, Nb and Hf
- No U

From Rønsbo, 2008 modified after Andersen et al., 1981
Ilímaussaq Instrusion

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Steenstrupine
$\text{Na}_{14}\text{REE}_6(\text{Mn},\text{Fe})_3(\text{Th},\text{U},\text{Zr})(\text{Si}_6\text{O}_{18})_2(\text{PO}_4)_7\cdot3\text{H}_2\text{O}$

Eudialyte
$\text{Na}_{15}\text{Ca}_6(\text{Fe},\text{Mn})_3\text{Zr}_3\text{SiO}(\text{O},\text{OH, H}_2\text{O})_3(\text{Si}_3\text{O}_9)_2(\text{Si}_9\text{O}_{27})_2(\text{OH,Cl})_2$
The history of Kvanefjeld

- 1955, Danish government initiates uranium prospecting program
- GGU recommends targeting the Ilímaussaq Complex
- A primitive geiger counter survey was carried out by military personnel.
- 1956, the Kvanefjeld deposit was discovered.
Start up

- 1957, first attempts were made to develop a method to extract uranium from ore
- 1958, the first drilling program was carried out – 36 holes, 3728m
- 1962, 1400 m were drilled

1957, Niels Bohr became an honorary citizen in Narsaq
Progress

• In 1977, 27 holes, 5100 m drilled
• A one kilometre long adit in 1979-80
• Approximately 4.500 tonnes of ore were transported to Denmark in 1980 for further testing and processing.
• Finally in 1982, an efficient extraction method was developed for uranium from Steenstrupine.
Resistance

- Late 1970’s resistance against nuclear power rose in Greenland and Denmark.
- In 1985, Danish Parliament formally decided not to have nuclear power facilities in Denmark.
- A "zero tolerance" policy was introduced.
- The ban was lifted October 24, 2013
GME has invested over $75M in exploration and research over the past 6 years

Source: GME
Kvanefjeld Multi-Element Project

- The Kvanefjeld project: Kvanefjeld, Sørensen (Zone 2) Zone 3
- One of the largest REE deposits in the world
- Open pit mining highest grades near surface

Project overall resource inventory:
956 Mt of ore containing: 10.33 Mt TREO (TREO includes: 0.37 Mt heavy REO, 0.84 Mt yttrium oxide), 2.25 Mt zinc, 575 Mlbs $U_3O_8$ indicated and inferred (JORC-compliant), at a 150ppm cut off

Source: GME
Total of 575 Mlbs $U_3O_8$ (260,800 ton $U_3O_8$)
indicated and inferred, JORC-compliant, at a 150 ppm $U_3O_8$ cut-off

Source: GME

Olympic Dam’s resources are 5,404 Mlbs

Source: BCC, Company Filings and websites as at January 27, 2012
Conclusions

• The uranium potential in Greenland is very good
• Kvanefjeld is the first advanced uranium project in Greenland
• Application for exploration licence expected in 2015.