New geomodels to explore deeper for High-Technology critical raw materials in Alkaline rocks and Carbonatites

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Call: GROWING A LOW CARBON, RESOURCE EFFICIENT ECONOMY WITH A SUSTAINABLE SUPPLY OF RAW MATERIALS
New sustainable exploration technologies and geomodels. SC5-11d-2015

Title of Proposal: **HiTech AlkCarb**

New geomodels to explore deeper
for High-Technology critical raw materials in Alkaline rocks and Carbonatites

Participant No		Participant organisation name	Country
1 (Coordinator)	UNEXE	University of Exeter (Camborne School of Mines)	UK
2	GEOAF	GeoAfrica	Namibia*
3	NERC	Natural Environment Research Council (British Geological Survey)	UK
4	TERRA	Terratec Geophysical Services	Germany
5	EKUT	University of Tübingen	Germany
6	MENDELU	Mendel University in Brno	Czech Rep
7	USTAN	University of St Andrews	UK
8	UdA	University G. d'Annunzio	Italy
9	LANC	Lancaster Exploration Ltd	UK
10	NHM	Natural History Museum	UK
11	ASEC	A. Speiser Environmental Consultants	Namibia*
12	GEUS	Geological Survey of Denmark and Greenland	Denmark

1.1 Objectives

The objectives of the project are to:

1. Develop new geomodels to explore for 'hi-tech' raw materials (critical and related elements – REE, Sc, Nb, Ta, Zr, Hf, fluorspar) associated with alkaline rocks and carbonatites. The aim is to distinguish exploration indicators that suggest mineralisation at depths to 1 km.
2. Improve and develop interpretation of geophysical and downhole data to be able to make better interpretations down to 1 km in alkaline rocks and carbonatites.
3. Transfer into Europe expertise gained in African exploration to improve the chance of more 'hi-tech' element deposits being found within European countries.
4. Give Europe world-leading expertise so that European consultancy businesses can expand, in Europe and worldwide.

1.2 Relation to the work programme

This proposal relates to the Topic of 'New sustainable exploration technologies and geomodels. SC5-11d-2015'. It addresses both areas of interest mentioned in the scope of the call, namely improving the **geomodels** available for alkaline rocks and carbonatites and **new sustainable exploration methods**.

The focus is on one particular and rather rare type of geology, the alkaline igneous - carbonatite association, (0.5% of the world's rocks) which is particularly important in supplying the world's 'high technology' metals. The proposal tackles three of the Challenges outlined in the grant call.

1. - The Challenge that the majority of new deposits will be found at greater depths. This is certainly the case for alkaline rocks and carbonatites in Europe, where there are promising surface expressions that indicate the likelihood of deposits below. The main aim of this project is to be able to explore at greater depths for mineral deposits associated with these rocks.
2. - The Challenge of geological and, especially mineralogical, uncertainty of deposits is a very important factor that hinders exploration of alkaline rocks and carbonatites. This project will help to constrain uncertainties in order to cut the risks and costs of exploration.
3. - The Challenge of mining in densely populated areas is a potential issue if Europe is to secure its supply of 'hi-tech metals'. Work package six considers environmental and social impact and brings lessons in mining from deposits in Africa to Europe. The test drilling case study area has a nature reserve and vineyards and thus serves as a good example of potentially conflicting uses of land.

1.3 Concept and approach

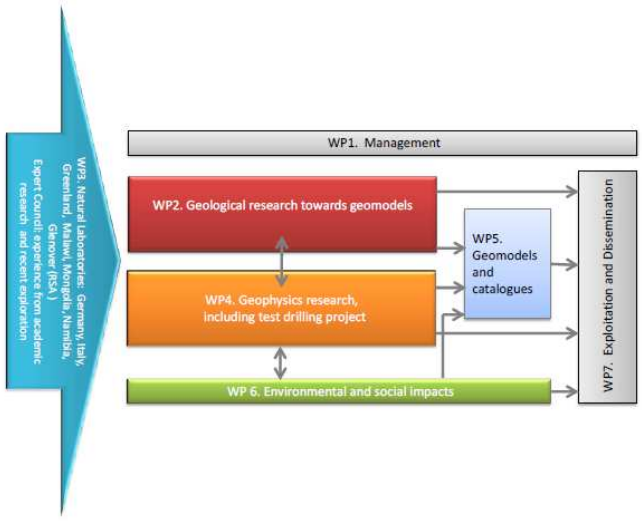


Figure 1 Project diagram showing work packages and work flow. HiTech AlkCarb will harness expertise and experience from key natural laboratories, and also from an Expert Council of external experts (WP3) to carry out geological research (WP2) making use of improved and more effective and cost efficient geophysical techniques (WP4) , all aiming to develop new geomodels (WP5) that will provide a framework for exploring deeper in alkaline and carbonatite complexes in Europe. Environmental and social impacts will be considered (WP6) and a substantive programme of dissemination activities and exploitation partners will ensure effective use of the results (WP7).

The need for 'hi-tech' and critical metals and minerals

Rapid technological developments are a feature of modern life, and are dependent on a supply of a growing number of different raw materials. The European Union has recognised twenty of these raw materials as **critical** (European Commission, 2014), because of their economic importance to the EU combined with risks to supply. Of the critical materials, five are associated with alkaline rocks and carbonatites, mainly heavy and light rare earth elements (REE), niobium, fluorspar and phosphate.

The **REE** have been the headline of the critical metals agenda because of their risks to supply, in particular the heavy rare earth elements HREE, and because of their use in a very wide range of consumer products. One of the most important and growing uses is in permanent magnets, particularly Nd-Fe-B magnets, which are widely used in applications such as hard disks, speakers, wind turbine motors and electric cars. Nd is the most important of the REE for magnets, but Dy, Tb and Sm are also used. The REE are also used in significant volumes in catalysts, phosphors, glass, polishing, ceramics, batteries and metal alloys, and are critical in a number of defence and medical applications.

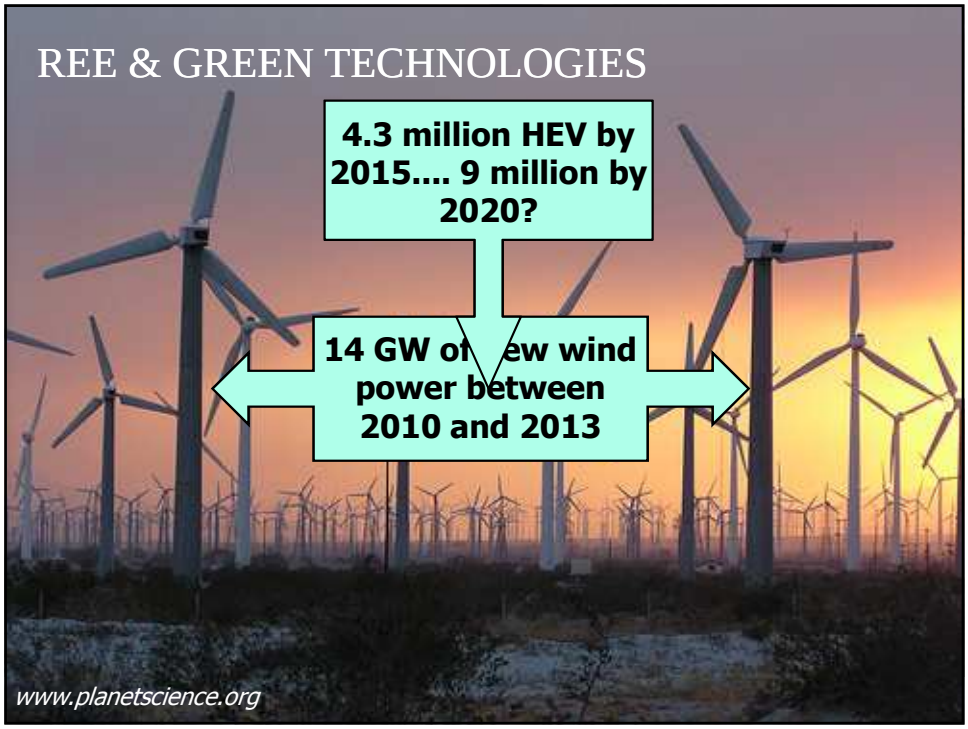
Why Carbonatites and AR?

– Scientific value and source of critical metals!

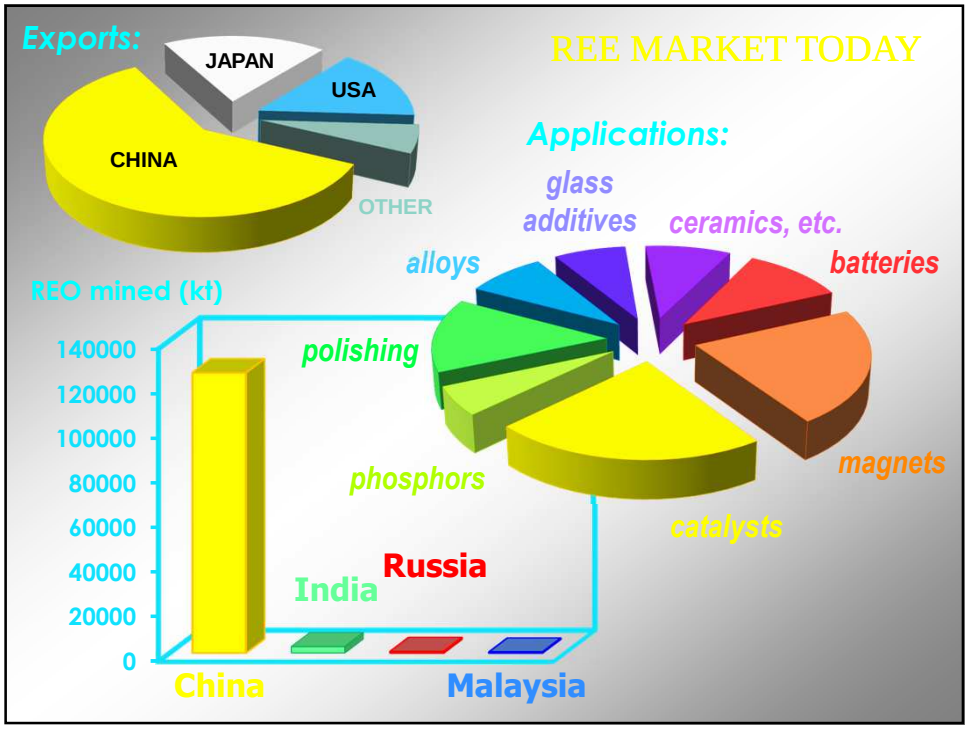
- **Source of Nb (*pyrochlore*):**
  - Araxá & Catalão, Brazil (478 Mt in reserves at 1-3% Nb_2O_5)
  - Niobec, Québec (~24 Mt in reserves at 0.7% Nb_2O_5, ~50 M$/yr in sales)

- **Source of REE (*fluorocarbonates and monazite*):**
  - Bayan Obo, Inner Mongolia, China (leading producer, 1985-now, 48-135 Mt at 3.5-6 % REE2O3)
  - Maoniuping (1978-2007; 1.45 Mt at 8.17% REE2O3)
  - Mountain Pass, California (1965-1985; 16.7 Mt at 8% REE_2O_3)
  - Bear Lodge , Wyoming (~7.5 Mt at 3.8% REE_2O_3)

www.cambior.com
USGS Minerals Yearbook
www.rareelementresources.com
www.questrareminerals.com




REE & DEFENSE
F-15E releasing a GBU
Northrop Grumman ALMDS fact-sheet


Exports:
JAPAN
USA
CHINA
OTHER
REE MARKET TODAY
Applications:
glass additives
ceramics, etc.
alloys
batteries
polishing
magnets
phosphors
catalysts
REO mined (kt)
140000
120000
100000
80000
60000
40000
20000
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China
India
Russia
Malaysia

Realistic in EU?

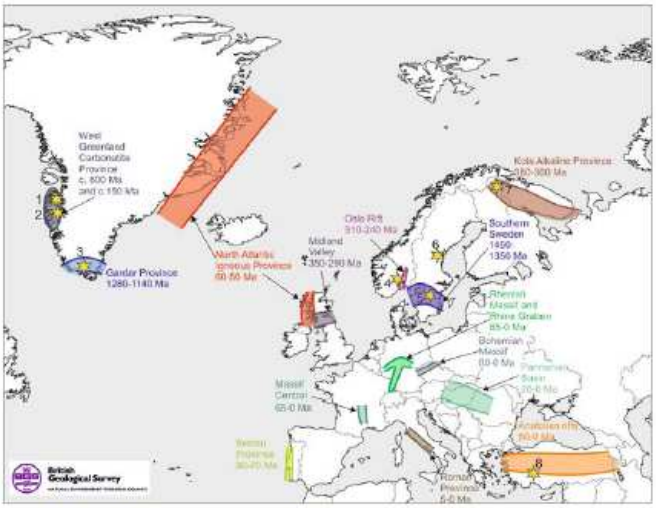

Figure 4 Some of the key alkaline provinces in Europe, showing the approximate age in Ma (millions of years). Map prepared as part of the EURARE project. Numbers refer to active REE exploration projects and mines. Europe has many smaller occurrences of alkaline igneous rocks that are not shown.

Conclusions, recommendations and insights

- Strong and realistic topic
- Strong = hardworking partners
- Strong support of home institution
- Strong = interesting preliminary results

- For more info see also:
- http://criticalmetalsmeeting.com/

WARMPEACE OUTDOOR ADVENTURE

MONGOLSKO

VE SLUŽBÁCH VĚDY

Text a foto Jindřich Kynický

Vše začalo již před pěti lety, kdy se na Masarykově univerzitě v Brně zrodil první studentský geologický expediční projekt. Důležitou událostí pro uskutečnění a budoucí pokračování záměru bylo zahájení spolupráce s Technickou univerzitou v Ulaanbaataru a zahájení spolupráce s tuzemskou firmou Geotest Brno v rámci jejího projektu pomoci rozvojovým zemím při vyhledávání zásob průmyslových a vodních zdrojů v pouštním a polopouštním prostředí.

Při první expedici procestovali mladí výzkumníci téměř 2/3 mongolského území, přičemž dohledávali i objevovali veškeré lokality výskytů zájmových hornin, minerálů, geologických útvarů i paleontologických nálezů důležitých pro výzkum v následujících letech. Další výpravy se soustředily na podrobný průzkum dosud neprozkoumaných lokalit na jihu a západě Mongolska. Vznikla tak další témata diplomových prací, tentokrát i pro studenty Lesnické a dřevařské fakulty Mendelovy zemědělské a lesnické univerzity v Brně. Tato expedice, jako dosud nejrozsáhlejší, byla na rozdíl od předchozích výprav diametrálně odlišná. Hlavní rozdíly tkvěly v tom, že jsme jeli vlastním autem – Gazelkou, nato-vým Gazem 4x4, a v tom, že jsme zajistili kargo na převoz studijního materiálu do ČR.

Z našich cílů jsme po vyčerpávajících měsících nakonec dosáhli téměř všeho, co bylo původně v plánu. Těmi nejdůležitějšími pro nás byly výzkumy skarnových ložisek, planetárních živců a největších ložisek mědi. Hned na druhém místě jsme nejvíce času věnovali průzkumu uhelných a fluoritových ložisek. Problematika vzniku a mineralizace mezozoických alkalických žul, ložisek zlata a karbonatitů již byla značně rozpracována z předchozích let, a tak šlo všechno „jak po másle".

Gobi

Mnoho lidí ví, že Gobi představuje jednu z největších, nejchladnějších a nejstarších pouští na světě. V zimě teploty klesají i pod -50 °C (dokonce i v Ulaanbaataru bylo před třemi roky naměřeno -72 °C). V létě se teploty pohybují v maximálním intervalu -10 °C v noci až +55 °C ve dne na jihozápadě. Představa Gobi jako písečné pouště je zcela mylná – písek zabírá z celé rozlohy necelá

Thank you for your attention and have a good luck in all you do with respect to nature!