developing a sustainable exploitation scheme for Europe’s REE deposits

• Over 20 partners, Europe-wide, research & industry
• 5-year EC-funded project from 1 January 2013
• Characterising European REE resources and developing new ore beneficiation technologies
• Aims to safeguard EU supply of REE raw materials
Work packages of EU Rare sustainable exploitation

Geology
- WP1: Assessment of European REE Resources and REE demand

Mining & Beneficiation
- WP2: Beneficiation technologies for European REE deposits

Metallurgy
- WP3: Extraction and separation of REE from ore concentrates and industrial by-products
- WP4: Industrial REE metals and alloys production

WP5: Field Demonstration of novel technologies

WP6: Techno-Economical and EHS Assessment

IT & Dissemination Support
- WP7: Dissemination and exploitation of project results
Work package 1: Assessment of European REE resources and REE demand

Task 1.1 Compiling current knowledge on REE resources and REE demand within Europe

Task 1.2 Developing a knowledge base of potential deposits and occurrences, including new research on poorly-known occurrences

Task 1.3 Development of an integrated knowledge management system

WP1 lead; Denmark & Greenland resources

Finland resources

IKMS lead; France resources

UK & non-partner country resources

Norway resources

Market survey

Sweden resources

Greece resources
Task 1.1

- Table produced showing all known REE deposits and significant occurrences in Europe. > 100 individual deposits/occurrences
- Based on geological experts critically assessing all knowledge on REE in their country – specifically done for EURARE
- Range in size from large economic deposits (e.g. Kvanefjeld, Norra Kärr) to small and currently of academic interest only. Few formal resource/reserve estimates
- Information about key countries and deposits is disseminated via the website www.eurare.eu (over 20,000 visitors in 2014)
- REE market survey in progress (d’Appolonia)
Map of European REE occurrences

www.eurare.eu
Types of European REE resources

Range of tectonic settings
- c. 100 total occurrences assessed: includes <10 deposits with formal resource estimates, many smaller occurrences
- Europe here = EU countries & candidate countries, Norway, Greenland
Anatomy of a magmatic rift system

Primary deposits in southern Europe are likely at depth below surface
Task 1.2: European REE research

Within the context of the EURARE project, the surveys are engaged in research at a number of localities:

- Finland – Sokli carbonatite, Iivaara alkaline complex
- Greece – bauxites and placers
- Greenland – Ilimaussaq and Motzfeldt syenite complexes
- Norway – Gloserheia pegmatite and Biggejavri albitites
- Romania – Ditrau alkaline complex
- Sweden – Bergslagen district, Alnö carbonatite, pegmatites
- Turkey – Aksu diamas placer and bauxites

Review paper in preparation – collaboration with ASTER

Every deposit is different! Type, mineralogy, size, REE ratios..
Task 1.3 - IKMS

Best practice « production/diffusion » architecture schema

INSPIRE compliant
Mineral Resource code lists agreed
EURARE database structure prepared
National databases being loaded
Major challenges for European REE industry

• Work in WP1 shows that Europe has many REE resources
• However, every REE deposit is different in mineralogy, grain size, texture, U and Th content....
• Beneficiation and extraction of REE is a major challenge
• Has to be environmentally friendly and economically worthwhile
• Addressed in EURARE by WPs 2-5
WP2 – Ore beneficiation

Progress on beneficiation & production of concentrates for:
- Kvanefjeld (Greenland)
- Kringlerne (Greenland)
- Norra Kärr (Sweden)
- Olserum (Sweden)
- Fen (Norway)

Pilot plant stage now reached: Kvanefjeld ore
WP3: REE extraction technologies

- Successful leaching of low grade concentrate with low mineral acid consumption, under atmospheric conditions
- Leaching REEs in water-free Ionic Liquid (IL) systems - *successful first results*
- Selective leaching of REE from red mud using Ionic Liquids - *successful first results*
WP3: Innovative REE separation technologies

- Innovative water-free IL liquid-liquid REE separation systems – successful first results
- Innovative separation through the use of surface modified Magnetic Nano Particles - successful first results
- Investigation of state-of-the-art solvent extraction (S-X) systems - successful first results
WP4: Innovative / optimized REE metal production technologies

- Investigation for optimization of state-of-the-art molten salt electrolysis cell (Chinese technology)
- Successful La electrodeposition at atmospheric conditions in water-free Ionic Liquid system
Summary

- The EURARE project aims to set the basis for an European REE industry, and is half-way through 5 years of funding
- The project has assessed European REE resources and is carrying out research on those resources
- Beneficiation, extraction, and separation techniques are all under development
- Regulation and environmental aspects are also studied
- www.eurare.eu