Lithium opportunities Portugal

Empresa de Desenvolvimento Mineiro, SA
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Nacional Lithium Stategy

Potentialities

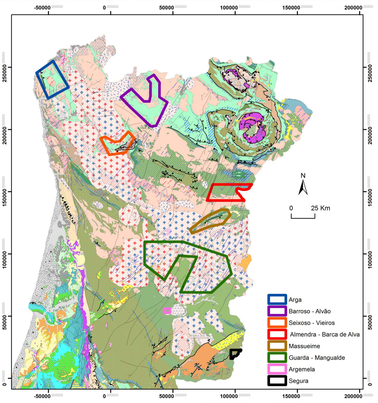
- Portugal has strong mineral potential to host extensive lithiniferous thick aplito-pegmatite dikes and veins swarms or greisen systems;
- The resources have been exploited together with the feldspars for the ceramic and paints industries;
- The acceleration of electrical mobility and communications technologies and the search for more efficient energy storage mechanisms can enhance their use for other applications.

Integrated strategy involving the entire range

- The existence of user industries in Portugal enhances the opportunity to create a new industrial sector from extractive activity to the production of batteries, due to the proximity economies it may provide;
- There is a consolidated research on the technological processing in the beneficiation of lithium minerals in their main types of occurrences: lepidolite, spodumene and ambligonite;
- It is essential to stimulate the "cooperation" of companies in order to evaluate and install technological units to increase the added value of these products;
- Promote the integration of environmental concerns and efficient use of mineral resources, aiming at "zero waste" in the lithium recovery process;
- Promote the principles of circular economy by encouraging the recycling of lithium from used batteries .

More competitive and more transparent acess to the activity

- Portugal has a stable legal framework, adequate institutional support, excellent infrastructures and high scientific and technological know-how that confers advantages on investment in the lithium sector;
- Granting of exploration areas through open public tenders that promote the interest of multinational players with demonstrated technical and financial capacities.



Geological mapping 1/500 000 (LNEG)

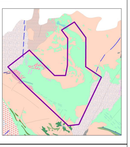
Li Potential Areas

Serra de Arga Aplitic-Pegmatitic Field

- Area: 409 km^2
- Exo-granitic aplite-pegmatites
- LCT type
- Pegmatites with petalite and/or spodumene and aplites with disseminated ambligonite-montebrasite
- Petalite (ceramics) > 22 000 ton @ max. 1.3% Li_2O (Formigoso)
- Spodumene (Probable resources) > 2 500 ton @ max. 1.9% Li_2O (Afife)

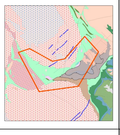
Barroso-Alvão Aplitic-Pegmatitic Field

- Area: 647 km^2
- Rare elements pegmatites; LCT complex- type, spodumene, petalite and lepidolite sub-types
- Spodumene aplite-pegmatites: 0.78% Li_2O
- Petalite aplite-pegmatites: 1.30% Li_2O
- Lepidolite aplite-pegmatites: 0.77% Li_2O
- Inferred Resources: 14 millions tons @ 1% Li_2O (average grade)



Seixoso—Vieiros region

- Area: 256 km^2
- Rare elements pegmatites, LCT complex-type, petalite sub-type
- Seixoso aplite-pegmatites: ambligonite-montebrasite, petalite
- Vieiros aplite-pegmatites: spodumene, petalite (ambligonite-montebrasite)
- Resources estimation: not available



Almendra—Barca de Alva region

- Area: 343 km^2
- Rare elements pegmatites; LCT complex- type, lepidolite sub-type
- Lithiniferous pegmatites: 0.42—0.52% Li and 0.05%Sn (Barca de Alva mine); 0.5% Li and 0.07% Sn (Feli mine)
- Aplitic-pegmatitic veins: 0.16% Li and 0.05% Sn (Pombal)

Massueime region

- Area: 258 km^2
- Pegmatitic dykes: ambligonite and lepidolite
- Granulitic or pegmatitic veins: ambligonite rare
- Massueime deposit: <150 tons Li_2O; <1500 tons Sn and ambligonite > 500kg

Guarda—Mangualde Aplitic-Pegmatitic Fields

- Area: 1725 km^2
- LCT complex-type pegmatite, lepidolite and petalite sub-type
- Measured Mineral Resources : 1 400 000 tons @ 0.42% Li_2O (Seixo Amarelo—Gonçalo)

Argemela region

- Area: 15 km^2
- Ambligonite-montebrasite: hydrothermal deposits related with granites (Mina da Argemela)
- Lepidolite and Ambligonite-montebrasite: microgranite modified by pegmatoids fluids (Cabeço da Argemela)
- Inferred Mineral Resource: 20.1 million tons @ 0.4% Li_2O

Segura region

- Area: 34 km^2
- LCT complex-type with rare metals, lepidolite sub-type
- Exo-granitic aplite-pegmatite veins

Technical feasibility for the production of Concentrates of Li-Minerals in Portugal

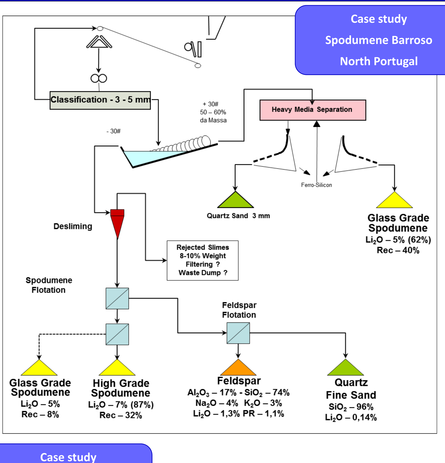
TECHNOLOGICAL PROCESSING is needed for beneficiation of Li Minerals

Techniques that take advantage of the contrast of properties exhibited by different Li minerals and by the associate gangue minerals, such as ***specific gravity***, "***floatability***" and ***optical properties*** can be applied to upgrade Li concentrates:

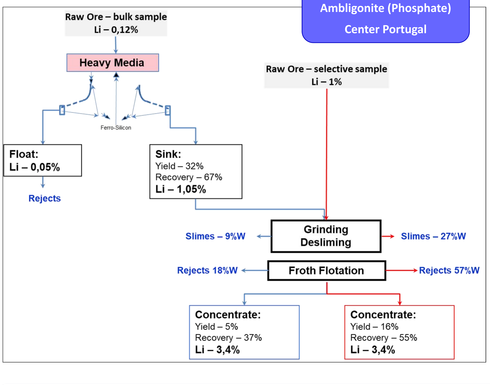
- Heavy Media Separation and Optical Sorting can be used in roughing stages, in order to produce "pre-concentrates"
- Froth Flotation – is referred to as the processing technology that is capable of producing **High Purity Li Minerals Concentrates**

The Portuguese main Li Ores (lepidolite, spodumene, ambligonite) have been investigated for years in order to study the application of those mineral processing techniques.

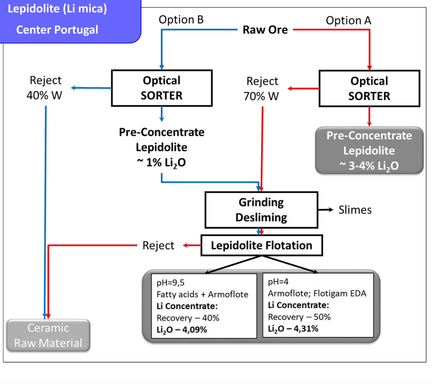
Case study
Spodumene Barroso
North Portugal



Case study
Ambligonite (Phosphate)
Center Portugal



Case study
Lepidolite (Li mica)
Center Portugal



Tender

Deadline: 1st semester 2018

Conditions: www.edm.pt

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ECONOMIA

Portugal Energia
SECRETARIA DE ESTADO DA ENERGIA

Direção Geral de Energia e Geologia

LNEG