



**Valorização de Pegmatitos Litiníferos - IBEROEKA**

# **New processing concepts for improving Lithium mineral resources efficiency**

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*[www.anzaplan.com](http://www.anzaplan.com)*

Lisboa, May 26<sup>th</sup>, 2011

# About ANZAPLAN

The Service Company in Strategic Minerals

**ANZAPLAN** - a full service specialist in high-value industrial and strategic minerals based on long term experience.

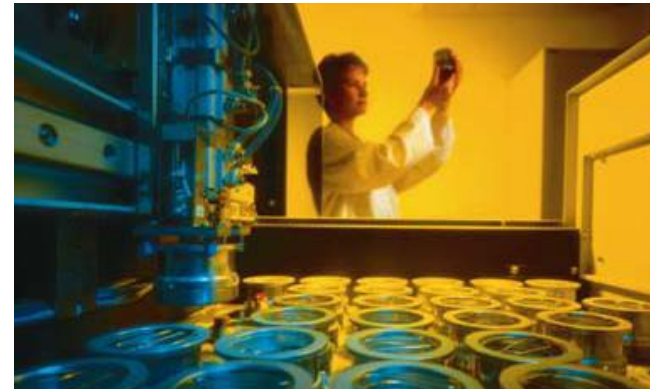
1 H																	2 He
3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
55 Cs	56 Ba	57 La	58 Hf	59 Ta	60 W	61 Re	62 Os	63 Ir	64 Pt	65 Au	66 Hg	67 Tl	68 Pb	69 Bi	70 Po	71 At	72 Rn
87 Fr	88 Ra	89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr	

# Analytics

## Quality at the highest level

Anzaplan analytical services department covers three main topics:

- **Raw material analysis**
- **Product analysis**
- **Environmental analysis**



*Dorfner Anzaplan and its laboratory are assigned by the DACH-accreditation chamber, a signatory of the **International Laboratory Accreditation Cooperation (ILAC)**. Therefore analyses and testing by Anzaplan are internationally accepted.*

*Services by Dorfner Anzaplan are certified and approved by **ISO 9001 and ISO 14001** for chemical and physical analyses, process engineering, research and development, for basic materials, industrial mineral products and systems, and environmental technology*

# Process Engineering

## Commitment to process engineering

Anzaplan is globally active in the development of innovative, high-tech solutions for the core areas:

- Valuation of mineral deposits,
- Feasibility studies,
- Process development,
- and Engineering

**... within the segments of:**

Quartz - Diatomite - **Lithium** - REE – Clay Minerals - Feldspar and Mica



## Project Development

Anzaplan one stop shopping

- Exploration and sampling program (Resources)
- Basic analysis, process design and technology (Reserves)
- Market Potential Analysis
- Sample Production and application tests
- Basic engineering and quality control
- Project Valuation

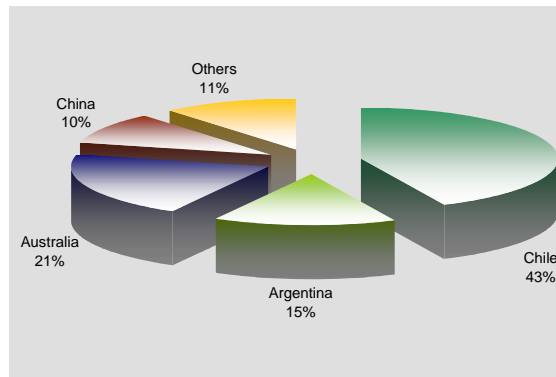


# Motivation

## Regional Distribution of Lithium Supply and Demand

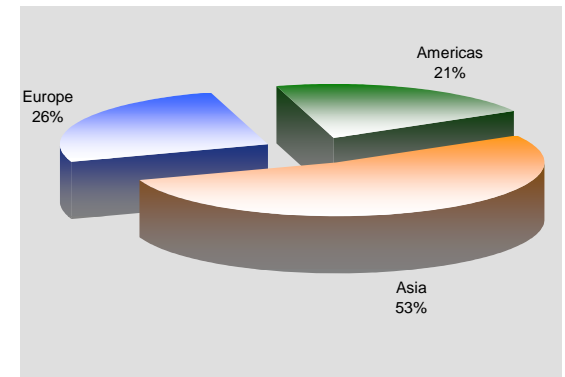
### Supply

About 59% of the global Lithium reserves are found in South America



### Demand

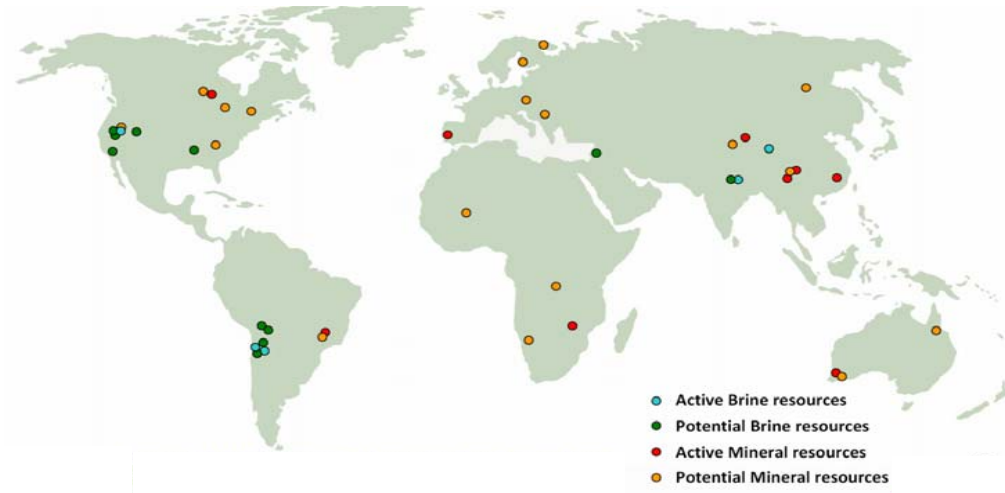
Europe and Asia: No resources but high demand



# Regional Availability

## Regional Distribution of Hard Rock Deposits

Mineral Deposits are widespread while Brine Resources are locally concentrated due to their very specific genesis.



Sources: SQM, An Abundance of Lithium (Evans), Talison Minerals, Minerals Reserve Committee of China, Qinghai Salt Lake Research Institute, Admiralty Resources, Orocobre, Roskill I.S. and others

## Li-Carbonate Production Process

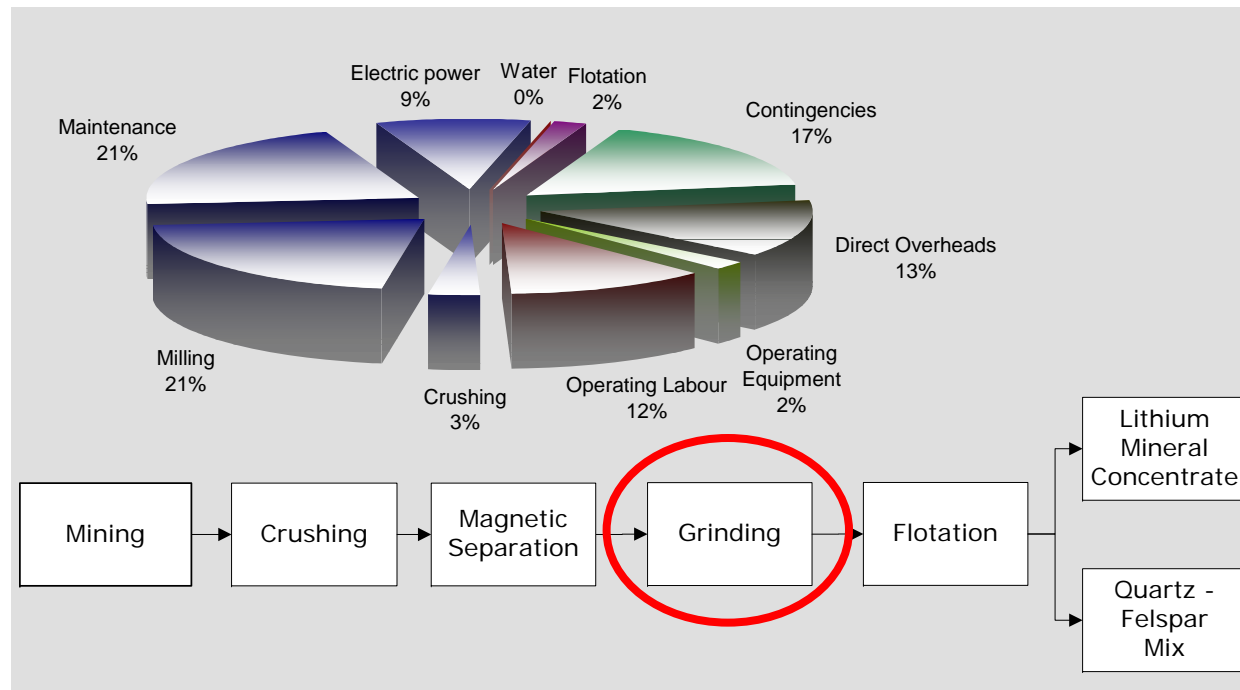
- Comparison of Ore and Brine Processing Technology
- Cost barrier for lithium minerals due to today's processes

Item	Brine	Ore
Deposit	Lithium Brine	Spodumene Ore
Process	Pumping – lithium extraction by solar evaporation – lithium chloride finishing process or lithium carbonate conversion	Crushing – grinding – flotation – separation – calcination – leaching – filtration – lithium carbonate conversion

# Standard Processing of Li-Mineral Concentrates

## Cost structure

- The major cost driver is the crushing and grinding process.
- It also triggers the major utility cost component (electricity) and maintenance.



IM (2009): The Lithium Industry

## Processing of Li-Mineral Concentrates: New Concept

### Main weakness of the conventional process

- higher costs compared to the brines' processing
- unspecific grinding with no regard to pegmatite properties

### Approach of a new concept

- Consideration of specific pegmatite properties
- Introduction of innovative comminution and separation techniques
- Design a more specific process for mineral concentration
- Improving cost base by avoiding overgrinding
- New advantages for value-added by-products

## Characteristics of Lithium-Pegmatite

Essential properties of pegmatites are:

- coarse crystal size
- differences in color
- difference in morphology

In this example:

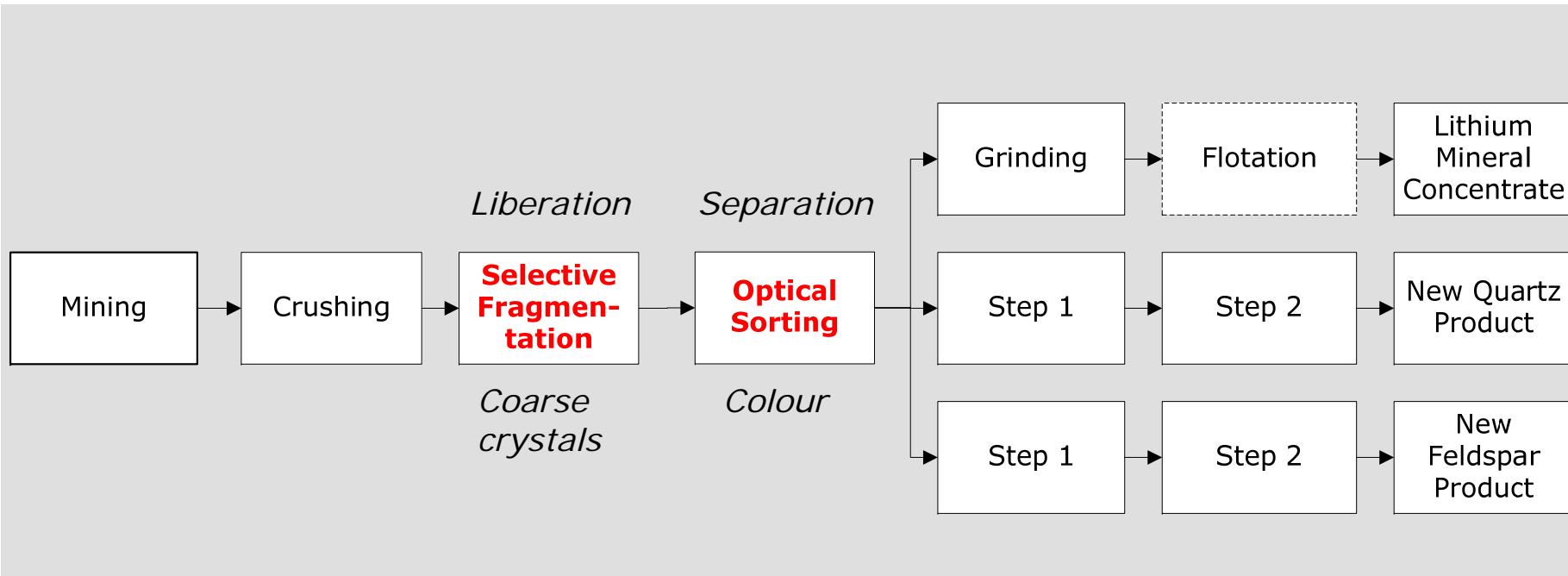
- spodumene exhibits as green, elongated particles,
- whereas quartz is clear and
- feldspars are typically milky or slightly reddish in color.



*Polished section of a lithium pegmatite*

# Selective Benefication Improves Economics

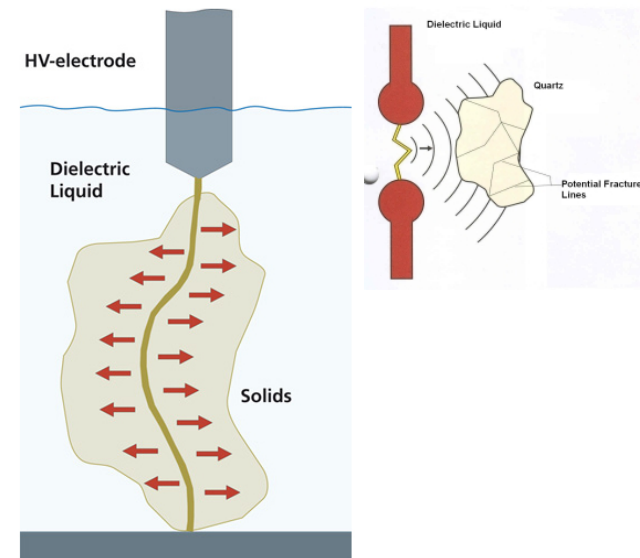
## New Concept



# Mineral Liberation: Electrodynamic Fragmentation

## Working principle

- Hard rock material is exposed to high voltage pulses (ns/kV) in a dielectric liquid.
- The electrical discharge forms a plasma channel and generates strongest internal shockwaves.
- Consequently, composite materials are fragmented along grain boundaries with a high degree of selectivity.



# Mineral Liberation: Electrodynamic Fragmentation

## Test Results

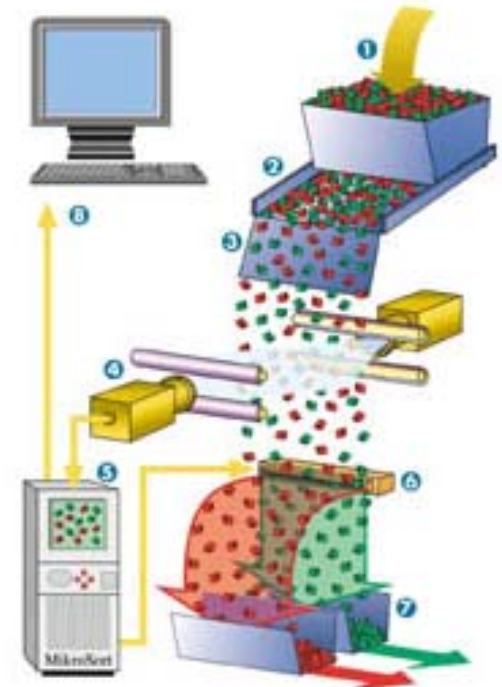
- Electrodynamic fragmentation provides selective liberation of main pegmatite minerals.
- A narrow grain size distribution is achieved supporting the optical sorting efficiency.



# Mineral Separation: Optical Sorting

## Working principle

- Individual particles (in sizes 3–250 mm) are scanned by high resolution color line cameras.
- Within a few milliseconds, the scanned images are evaluated by a computer for the detection of particles to be removed.
- The detected rejects are separated by compressed air pulses.



# Mineral Separation: Optical Sorting

## Test Results and Mineral Applications

- Spodumene concentrates are being used in glass and ceramics manufacturing as well as LCE conversion. Typical concentrates contain 4,8-7% of  $\text{Li}_2\text{O}$ .
- The global demand in glass and ceramics production is likely to grow from 28.900 MT (LCE/2011 to 44.400 MT in 2020 (IM 1-2011).



*Theoretical  $\text{Li}_2\text{O}$  content:*

<i>Spodumene <math>\text{LiAl}[\text{Si}_2\text{O}_6]</math></i>	<i>8,0%</i>
<i>Petalite <math>\text{LiAl}[\text{Si}_4\text{O}_{10}]</math></i>	<i>4,9%</i>
<i>Li-Carbonate <math>\text{Li}_2\text{CO}_3</math></i>	<i>40,4%</i>

## Test results: Quartz and Feldspar

Chemical analysis of by-products after selective fragmentation and optical sorting

Oxide [wt.-%]	Quartz	K-feldspar
SiO <sub>2</sub>	99.3	67.1
Al <sub>2</sub> O <sub>3</sub>	0.46	18.8
Na <sub>2</sub> O	0.13	1.17
K <sub>2</sub> O	0.04	12.6
CaO	0.01	< 0.01
Fe <sub>2</sub> O <sub>3</sub>	0.01	0.02
TiO <sub>2</sub>	<0.01	< 0.01

# Quartz Concentrate

## Applications

- Quartz seems to be a general commodity being used in many different applications.
- However, high purity quartz is a specialty mineral with highest value in the lamp tubing, semiconductor, optics and microelectronics industry.
- The global demand for high purity quartz is heavily impacted by the photovoltaics industry either as strategic feedstock or for quartz glass crucibles in the solar silicon production.



*Courtesy to OSRAM and Covalent Materials Co.*

# Feldspar Concentrates

## Applications

- Feldspar concentrates are widely used in glass and ceramics manufacturing, offering the opportunity of cross sales together with spodumene and quartz.



## European Developments

### The Länttä Spodumene Deposit (Keliber Oy)

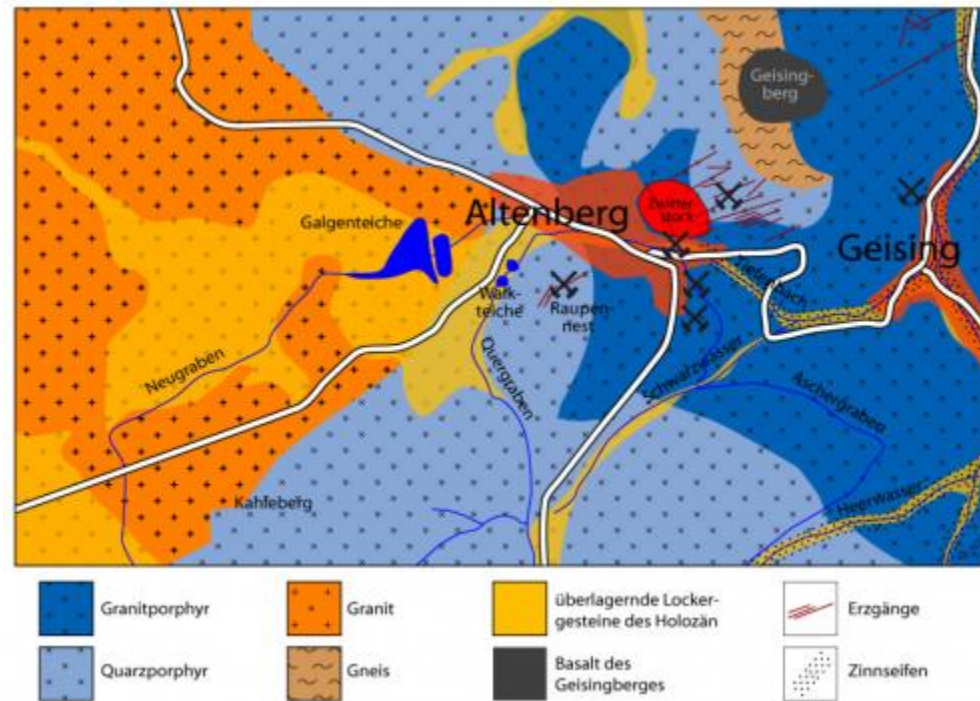
- In 2010, Keliber has executed further drilling program with the purpose is to identify additional mineral resources adjacent to Keliber's other activity.
- The exploration work has improved the quality and classification of the deposits at Länttä and Outovesi.
- Approximately 1.26 million tons of ore have now been classified in the ore reserve category (proven and probable).



# European Developments

## Germany

- The German solar technology group and worldwide leader in crystalline solar power technology SolarWorld will investigate the Altenberg-Zinnwald deposits in Saxonia since the company is expecting an increasing demand for lithium.
- The Saxony deposits are among the ten largest lithium deposits worldwide and probably the largest in Europe.



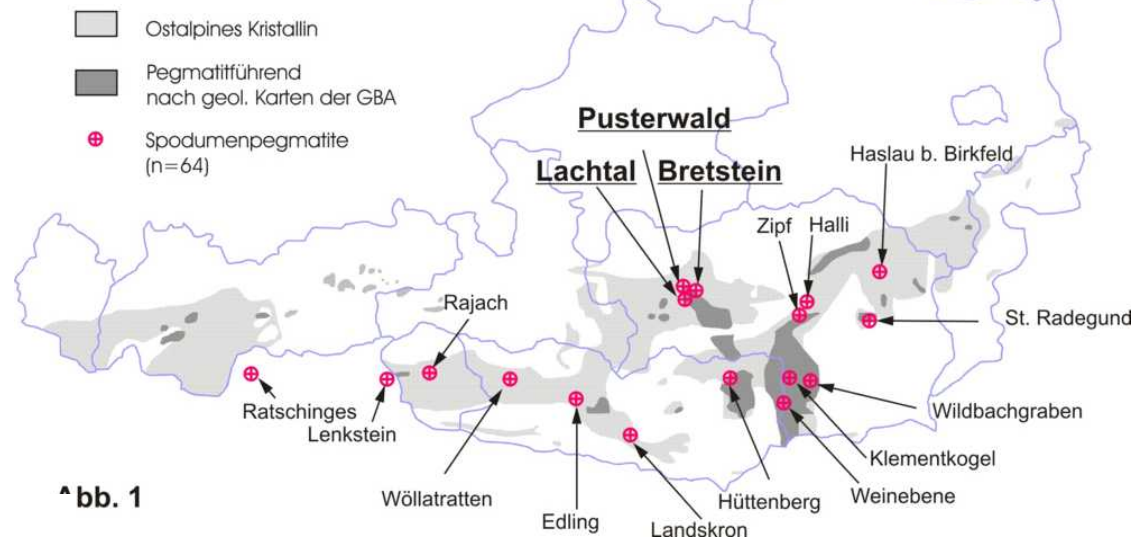
## European Developments

### The Weinebene in Austria, sold to ECM Australia for 10 Mio EUR

- The Austrian Lithium Project is considered to be of strategic importance to European manufacturers.
- It is Pegmatite hosted with a JORC Resource (inferred) of 18 million tonnes grading 1.6% Lithium Oxide.
- In addition, the Project also contains an additional exploration target of 8 to 12 million tonnes with a grade of 1.5% to 2%  $\text{Li}_2\text{O}$ .

### Pegmatite in den Ostalpen

(modifiziert nach Gassner 2001, Senzenberger 2001)



## European Developments

Bild ?

### Rio Tinto mulls opening of Jadarite mine in Serbia

- Rio Tinto, a global mining and resources group, is likely to exploit Jadarite in Serbia.
- Jadarite is a lithium-boron mineral used for the production of lithium carbonate, boron hydroxide and sodium sulphate.
- Resources are estimated at 100 million tonnes of exploitable reserves.



## Conclusion

### Selective Beneficiation Improves Economics, Efficiency and Sustainability in Lithium Minerals Processing

- New Approach offers the erosion of lithium minerals processing cost barrier supports a widespread lithium availability.
- Replacement of the cost intensive milling stage by selective fragmentation technology offers less energy consumption
- Therefore, optical sorting creates the opportunity to produce highly valuable, even strategic by-product concentrates
- ... and 80-90% of sales product is another major contribution for the sustainability of the new process for both – economics and environment.

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