Tantalum and Niobium production
State of the art

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Araxá Mine in Minas Gerais, Brazil – CMBB (Companhia Brasileira de Metalurgia e Mineração)

- ~ 85% of global production
- Open pit mine
- ~ 460 Mt at 2.5% Nb₂O

Mining

• Mostly open pit mining
  ▫ Primary Ores: Blasting and Crushing
  ▫ Secondary Ores: Excavation

Nearly all mines in carbonatites and other steeply-dipping intrusive rock structures are open pit mines.

• Very few underground mines, mainly in pegmatitic ores
• Artisanal small-scale mines (Central Africa)
Ta : refractory nature, low natural abundance, extensive solid solution, few known deposits, sporadic supply and difficult metallurgy → Ta is a complex, critical and high tech metal of the future.

Nb being by and large associated with Ta at the mineralogical level, improvements in processing technology that apply to Ta will also benefit production of Nb.

To a large extent, improvements in processing that are deemed beneficial to Ta concentration are not specific to Ta-bearing ores: Current trends in mineral processing that target lower grade polymetallic ores are directly relevant to Ta and Nb processing.
Basic production route: Mineral processing ➔ extractive metallurgy ➔ solvent extraction of Ta ➔ Typical recovery using modern process techniques: 90% (Tanco Mine, Manitoba, Canada)

Mineral processing: Notwithstanding artisanal mining from placer deposits in Central Africa (hand-picking and concentration via rudimentary gravity separation), industrial beneficiation of tantalite-bearing ores at the industrial scale relies upon the combination of:

- **Crushing** (jaw, cone or impact crusher) to say < 15-20 mm
- **Grinding** (ball or rod milling) and **classification** (screens and hydrocyclones) in closed circuit to <1 mm: Complexity as great variety of mineralisation between orebodies.
- Conventional (jig, shaking table), centrifugal (spiral) and **enhanced gravity separation** (MGS, Falcon concentrator), depending on the size of the liberated particles. The gravity separation takes advantage of the high density of the Ta-bearing phases, with specific density in the range 6 to 8.
- **Selective reverse flotation** to concentrate the finest material
- Low and high intensity **magnetic separation** to remove companion magnetic phases.
- **Thickening** circuit to recycle the process water.
Processing

Known processing issues:

• **Production of unrecoverable Ta ultrafines with finer mineralisation**
  ➔ Tailoring the comminution-classification step to the ore mineralisation
  ➔ Size classification is critical in closed grinding circuits.
  ➔ Presence of Th/U: health and safety issues with fines (Class 7 type material, shipping from mines to processing facilities by sea)

• **High consumption of flotation additives** (pH regulation, collectors) is a significant cost factor for the flotation processing of Ta-Nb fines, as well as an environmental issue.

• **Gravity separation for concentration of dilute fine suspensions** (4-7wt% solids) flotation streams requires efficient gravity concentration ➔ enhanced gravity separation ➔ Demonstration of the value of Falcon separators; **Source:** Deveau and Young, 2005.
Natural Ta-Nb bearing ores exhibit specific properties that promote the production of **fines and ultrafines**, which is a source of metal loss.

<table>
<thead>
<tr>
<th>Ore property</th>
<th>Relevant beneficiation processes</th>
<th>Innovation keywords</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brittleness: propensity to produce fines under mechanical stress</td>
<td>Comminution</td>
<td>Selective liberation (Texture-driven processing, texture characterisation)</td>
</tr>
<tr>
<td>High specific gravity</td>
<td>Gravity separation</td>
<td></td>
</tr>
<tr>
<td>Complex mineralogy: Ta is highly intergrown with sulfide and other oxide minerals</td>
<td>Flotation</td>
<td>Fines and ultrafines processing</td>
</tr>
<tr>
<td></td>
<td>Dewatering / Process water management</td>
<td>Process intensification</td>
</tr>
</tbody>
</table>
Selective liberation and mineral texture

Electron-microphotograph of a tantalum ore concentrate from Rwanda consisting of around 30% coltan minerals (Source: BGR: German Geological Survey)

Advanced mineralogical and (spatial) texture analysers: QEMSCAN, MLA

Possible pathways for innovation:
- Texture modelling/analysis and ore processability: 3D texture analysis (reconstruction), "mechanical texture" analysis
- Embrittlement for selective liberation (pretreatments: μwaves, electrical pulses, cryogenic fragmentation,...)
- Advanced sorting technologies
- On-line texture analysis for process control
Processing

Fines and ultrafines processing

Improved technology

Example: 2” cyclones, MGS and cross-belt separators are replaced with enhanced gravity Falcon separators for a higher recovery of Ta-fines. Source: Deveau & Young, 2005

Mainstream advanced modelling and simulation tools (CFD, DEM, process simulation)

Process Intensification

Improvement of the interface between processing and extraction

Artisanal processing
- Low-cost efficient unit operations
- Human safety
- Environmental impact

Possible pathways for innovation are technology improvements for fine particle processing:
- Comminution (prevention)
- Size classification, gravity separation, advanced flotation, dewatering
- In-line control
- Advanced sorting technologies
- Process intensification (coupled comminution and extraction)
General chart for Niobium production

Niobium scrap

Unoxidized pure scrap
- Acid leaching
  - Oxidized coated scrap
    - Columbite, tantalite concentrates
  - Oxidized scrap
    - HF digestion
    - Filtration
    - Solvent extraction
      - Ta solution
    - Nb solution
      - Ammonia precipitation
      - Calcination
      - Ore concentrates
        - Nb₂O₅
          - Carburation
          - Alumino-thermic reduction
          - Carbo-thermic reduction
          - Nb carbide
          - Nb alloys (NbFe etc.)
          - Nb metal

Electro-thermic reduction with carbon
- Ferro-alloy Nb(Ta)
  - Oxidation
  - Nb(Ta) synthetic concentrate
    - Distillation
      - TaCl₂
      - NbCl₅
      - Chlorination or carbo-chlorination
      - H₂ or Mg reduction
      - Vacuum distillation

Oxidized resin-free scrap
- Pyrochlore concentrate
- Tinslag
Extractive Hydrometallurgy of Ta and Nb

- Nb and Ta have **similar chemical properties** and occur together in minerals.
- Depending on applications, they need to be separated from each other.
  - Nb/Ta separation ways:
    - Physical properties: solubility of various salts (fractional crystallization), boiling point of chlorides (chlorination process).
    - Chemical properties: affinity towards organic extractants (solvent extraction), reduction potential of chlorides.
- Marignac process based on fractional crystallization nowadays abandoned.
- **All commercial solvent extraction** is performed in the presence of fluorides after digestion with HF (+ H$_2$SO$_4$) - CBMM process.
- A large number of **extractants** and their extraction mechanisms have been studied on laboratory scale.
- Industrially only few extractants are used.
  - MIBK is the most common extractant.
  - Tri-butylphosphate (TBP), 2-octanol and cyclohexanone are sometimes used.
Solvent extraction with MIBK

MIBK extractant  - advantages: cheap, low density and viscosity  
- drawbacks: high water solubility, volatility and low flash point  
  → reagent losses and potential explosion risk

Key extraction parameter:  
solution acidity affecting metal speciation

Example of flowsheet
Solvent extraction with other extractants

- **Cyclohexanone (CHO)**
  - Similar to MIBK but much higher water solubility and lower stability

- **TBP extractant**
  - Advantages: very high flash point, low water solubility
  - Drawbacks: not stable in HF acid, hydrolized byproducts impair extraction efficiency, higher cost
  - Extraction usually performed in HF and binary HF/H$_2$SO$_4$ acid media
  - Separation of Nb from impurities is more efficient than with MIBK
  - Nb - Ta separation can be effected at low acid concentration

- **2-Octanol**
  - Advantages: low cost, low water solubility, high flash point
  - Considered to be the optimal extractant, currently used in China
  - Extraction performed in binary HF/H$_2$SO$_4$ acid media
Alkali fusion

- Process used in the 1930’s for high grade concentrates of columbite-tantalite
- Alkali fusion using either NaOH+Na$_2$CO$_3$ or KOH followed by acid leaching
- After acid leaching, resulting oxides were purified by the Marignac process
Processing of secondary sources

- **Tin slags**
  - High-grade slags (>10% Nb+Ta) are processed directly by hydrometallurgy
  - Low grade slags are generally upgraded by a pyrometallurgical process, involving the production of ferroalloy (block metal)
  - The block metal is further upgraded by a simple acid leaching or by a combination of oxidative smelting followed by acid leaching
  - Hydrometallurgical processing of low grade is not practised in the industry, but numerous processes have been investigated

- **Various metallic scrap**
  - Well-classified metal scrap can be reused directly in the fabrication plant after short chemical treatment
  - Not classified or contaminated material needs more complex processes
  - Oxidized scrap is processed via hydrometallurgy (leaching) or chlorination
  - Non-oxidized scrap is directly hydrogenated leading NbH$_5$
Innovation potential in the hydrometallurgical recovery of Ta and Nb from various resources

- Nb and Ta have similar chemical properties and are often found together
- Most processes developed for Nb can be equally employed for Ta

- Barriers in current processing:
  - Non-selective leaching (large amounts of impurities are also dissolved)
  - Current extractants used in SX processes are not optimized
  - Environmental and safety issues associated with the use of HF
  - Generation of substantial solid wastes

- Innovative potential:
  - Selective processing and leaching techniques -> increasing the Nb/Ta concentrations
  - Leaching and solvent extraction processes avoiding the use of HF and fluorides
  - More robust extractants with higher efficiency in non-fluoride media
  - Increased recycling of effluents to reduce liquid and solid waste
  - Development of combined, well adapted hydro-pyrometallurgic processes
Extractive Pyrometallurgy of Nb/Ta from Primary sources

Brussels, 9th of March 2017

Jean-Marie LAMBERT- ERAMET Research
Introduction

Niobium and Tantalum are sisters elements, that co-occurs in the same type of mineral deposits and that have very similar chemical properties. That is why both of these elements have similar extraction techniques in pyrometallurgy.
Extractive Pyrometallurgy of Niobium/Tantalum at the industrial scale

- Aluminothermic reduction
- Carbothermic reduction
- Carbochlorination
Aluminothermic Reduction

- **Source:** from Pyrochlore concentrates
- **Plants:**
  - NIOBEC- Canada, CBMM & CATALAO-Brazil
- **Product:**
  - FeNb alloy
- **Chemical reactions:**
  - \[10 \text{Al}^0 + 3\text{Nb}_2\text{O}_5 = 6 \text{Nb} + 5 \text{Al}_2\text{O}_3 - \Delta H^{\circ}_{298K} \approx -265 \text{ kJ/mol of Al}\]
  - \[\text{Fe}_2\text{O}_3 + 2\text{Al}^0 = 2 \text{Fe} + \text{Al}_2\text{O}_3 - \Delta H^{\circ}_{298K} \approx -430 \text{ kJ/mol of Al}\]
- **Thermochemistry**
  - Reaction highly exothermic but needs energy addition to have good slag-metal separation
- **Technologies:**
  - Converter (with hematite additions)
  - Smelting arc furnace
- **Other process steps before:**
  - P,S, Pb, H2O removal by various techniques(leaching, roasting, smelting)
Carbothermic Reduction

- **Source:** from Columbite Tantalite
- **Products:** Niobium Carbide
- **Chemical reactions:**
  - \( \text{Nb}_2\text{O}_5 + 7 \text{ C} = 2 \text{ NbC} + \text{ CO(g)} - \Delta H^\circ_{298K} \approx 1067 \text{ kJ/mol of Nb}_2\text{O}_5 \)
  - \( \text{Nb}_2\text{O}_5 + 5 \text{ C} = 2 \text{ Nb} + \text{ CO(g)} - \Delta H^\circ_{298K} \approx 1345 \text{ kJ/mol of Nb}_2\text{O}_5 \)
- **Thermochemistry**
  - Reactions highly endothermic
- **Technology:**
  - Smelting arc furnace
- **Further trearments**
  - HF digestion
  - Chlorination
Chlorination

• Sources: by product from carbothermic reduction & loparite minerals

• Products:
  ▫ chlorides: NbCl$_5$ and TaCl$_5$ recovered by fractionnal distillation
  ▫ Tvap NbCl$_5$= 248.2°C- Tvap TaCl$_5$ = 239.4°C

• Chemical reactions:
  ▫ $\frac{1}{5}$ Nb$_2$O$_5$ + Cl$_2$(g) + C = $\frac{2}{5}$ NbCl$_5$(g)+ CO(g)
  ▫ $\frac{1}{5}$ Ta$_2$O$_5$ + Cl$_2$(g) + C = $\frac{2}{5}$ TaCl$_5$(g)+ CO(g)

• Thermochemistry
  ▫ Above 500°C,

• Technologies
  ▫ Fluidized bed types of reactor
  ▫ Static Bed with agglomeration step with carbon
Thanks!
Chlorination (2/2)

- Industrial experience for Recovery from Loparite mineral
Aluminothermic Reduction

- Main industrial experiences in aluminothermic reduction from pyrochlore concentrates:

<table>
<thead>
<tr>
<th>Company</th>
<th>NIOBEC</th>
<th>CBMM→1976</th>
<th>CBMM→1994</th>
<th>CBMM 2000→present</th>
<th>CATALAO I</th>
<th>CATALAO II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production zone</td>
<td>Canada</td>
<td>Brazil</td>
<td>Brazil</td>
<td>Brazil</td>
<td>Brazil</td>
<td>Brazil</td>
</tr>
<tr>
<td>Nb2O5 grade in concentrate</td>
<td>51.50%</td>
<td>55-60%</td>
<td></td>
<td></td>
<td>?</td>
<td></td>
</tr>
<tr>
<td>Leaching</td>
<td>HCl</td>
<td>Soda</td>
<td>HCl</td>
<td>None</td>
<td>HCl</td>
<td>Caustic Soda</td>
</tr>
<tr>
<td></td>
<td>P</td>
<td>P, Ca, S</td>
<td>P, Ca, S</td>
<td></td>
<td>P, Ca, S</td>
<td></td>
</tr>
<tr>
<td>Drying - Roasting</td>
<td>counter current</td>
<td>rotary kiln at 200°C</td>
<td>rotary kiln at 850°C</td>
<td>agglomeration</td>
<td>Rotary kiln</td>
<td>Rotary kiln</td>
</tr>
<tr>
<td></td>
<td>H2O</td>
<td>H2O</td>
<td>H2O, Pb</td>
<td>S, H2O</td>
<td>H2O</td>
<td>H2O</td>
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<tr>
<td>Dephosphorization</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>EAF</td>
<td>-</td>
</tr>
<tr>
<td>Aluminothermic reduction</td>
<td>Converter</td>
<td>Converter</td>
<td>EAF</td>
<td>Converter</td>
<td>Converter</td>
<td>Converter</td>
</tr>
</tbody>
</table>

- Flowsheets evolved in order to eliminate Pb, P, S and H2O
Carbothermic Reduction (2/2)

• Main industrial experiences in carbothermic reduction are for Colombite-Tantalite treatment:

• The treatment of the product can be followed then by many routes:
  ▫ HF digestion-Solvent extraction
  ▫ Chlorination
BACK-UP SLIDES
• Complex and variable ore mineralogy: **more than 70 different chemical compositions** identified.

<table>
<thead>
<tr>
<th>Mineral</th>
<th>Chemical Composition</th>
<th>Ta_2O_5 Content</th>
<th>Nb_2O_5 Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tantalite</td>
<td>((\text{Fe, Mn})(\text{Ta, Nb})_2\text{O}_6)</td>
<td>40-80%</td>
<td>2-30%</td>
</tr>
<tr>
<td>Wodginite</td>
<td>((\text{Ta, Nb, Sn, Mn, Fe, Ti})<em>{16}\text{O}</em>{32})</td>
<td>45-75%</td>
<td>1-15%</td>
</tr>
<tr>
<td>Microlite</td>
<td>((\text{Ca, Na})_2(\text{Ta, Nb})_2(\text{O, OH, F})_7)</td>
<td>50-79%</td>
<td>1-10%</td>
</tr>
<tr>
<td>Columbite</td>
<td>((\text{Fe, Mn})(\text{Ta, Nb})_2\text{O}_6)</td>
<td>1-40%</td>
<td>30-75%</td>
</tr>
<tr>
<td>Stueverite</td>
<td>((\text{Fe, Mn})(\text{Ta, Nb, Ti})_2\text{O}_6)</td>
<td>5-26%</td>
<td>7-17%</td>
</tr>
<tr>
<td>Euxenite</td>
<td>((\text{Y, Ca, Ce, U, Th})(\text{Ta, Nb, Ti})_2\text{O}_6)</td>
<td>2-12%</td>
<td>22-30%</td>
</tr>
<tr>
<td>Samarskite</td>
<td>((\text{Fe, Ca, U, Y, Ce})_2(\text{Ta, Nb})_2\text{O}_6)</td>
<td>15-30%</td>
<td>40-55%</td>
</tr>
</tbody>
</table>

Source: Zhu and Cheng, 2011

• **The natural co-occurrence of Ta and Nb** explains their co-production from primary resources.

• **Columbite – Tantalite (Coltan)** is the primary mineral for industrial production of Ta.

• Nb can be found with low or no Ta in the **pyrochlore mineral** group (Pyrochlore – Microlite): \((\text{Na, Ca})_2\text{Nb}_2\text{O}_6(\text{OH, F})-(\text{Na, Ca})_2\text{Ta}_2\text{O}_6(\text{OH, F})\)

• **A variety of Ta-Nb bearing geological deposits**: Carbonatites, Alkaline to peralkaline granites and syenites, Pegmatites and associated placers (altered primary ores).
<table>
<thead>
<tr>
<th>Deposit Name</th>
<th>Company</th>
<th>Country</th>
<th>Status</th>
<th>Type of Ore</th>
<th>Mining method</th>
<th>Commodity</th>
<th>Reserves Mt</th>
<th>% Nb₂O₅</th>
<th>% Ta₂O₅</th>
</tr>
</thead>
<tbody>
<tr>
<td>Araxá</td>
<td>CBMM</td>
<td>Brazil</td>
<td>Operation</td>
<td>Weathered Carbonatite</td>
<td>Open pit</td>
<td>Nb</td>
<td>462</td>
<td>2.48</td>
<td></td>
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<tr>
<td>Catalao - Boa Vista</td>
<td>China Molybdenum Co. Ltd.*</td>
<td>Brazil</td>
<td>Operation</td>
<td>Weathered Carbonatite</td>
<td>Open pit</td>
<td>Nb</td>
<td>42</td>
<td>1.2</td>
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<td>Niobec mine</td>
<td>Magris Resources Inc.</td>
<td>Canada</td>
<td>Operation</td>
<td>Mineralized Carbonatite</td>
<td>Underground</td>
<td>Nb</td>
<td>630</td>
<td>0.42</td>
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<tr>
<td>Aley</td>
<td>Taseko Mines Ltd. Corp.</td>
<td>Canada</td>
<td>EIA process</td>
<td>Mineralized Carbonatite</td>
<td>Open pit</td>
<td>Nb</td>
<td>84</td>
<td>0.5</td>
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<tr>
<td>Greenbushes mine</td>
<td>Global Advanced Metals</td>
<td>Australia</td>
<td>Operation</td>
<td>Pegmatite</td>
<td>Open pit + Underground</td>
<td>Ta ± Nb, Sn</td>
<td>68</td>
<td>0.023</td>
<td>0.026</td>
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<tr>
<td>Wodgina mine</td>
<td>Global Advanced Metals</td>
<td>Australia</td>
<td>Operation</td>
<td>Pegmatite</td>
<td>Open pit</td>
<td>Ta ± Be, Sn</td>
<td>28</td>
<td>0.042</td>
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<tr>
<td>Mibra / Volta Grande mine</td>
<td>Advanced Metallurgical Group</td>
<td>Brazil</td>
<td>Operation</td>
<td>Pegmatite</td>
<td>Open pit</td>
<td>Ta, Nb, Sn Li</td>
<td>6</td>
<td>0.009</td>
<td>0.038</td>
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<td>Mt Cattlin</td>
<td>Galaxy Resources Ltd.</td>
<td>Australia</td>
<td>Operation</td>
<td>Pegmatite</td>
<td>Open pit</td>
<td>Li, Ta</td>
<td>10</td>
<td>0.015</td>
<td></td>
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<tr>
<td>Tanco</td>
<td>Cabot Corporation</td>
<td>Canada</td>
<td>Operation</td>
<td>Pegmatite</td>
<td>Underground</td>
<td>Ta, Cs, Li</td>
<td>2</td>
<td>0.22</td>
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<tr>
<td>Toongi / Dubbo Zirconia</td>
<td>Alkane Resources Ltd.</td>
<td>Australia</td>
<td>Development</td>
<td>Trachyte</td>
<td>Open pit</td>
<td>Zr, Hf, Nb, Y, Ta, REE</td>
<td>73</td>
<td>0.46</td>
<td>0.03</td>
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<tr>
<td>Pitinga Mine</td>
<td>Minsur / Mineração Taboca</td>
<td>Brazil</td>
<td>Operation</td>
<td>Peralkaline granite</td>
<td>Open pit</td>
<td>Sn, Nb, Ta</td>
<td>267</td>
<td>0.22</td>
<td>0.027</td>
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<tr>
<td>Kenticha mine</td>
<td>Elenilto Mining</td>
<td>Ethiopia</td>
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<td>Pegmatite</td>
<td>Open pit</td>
<td>Ta, Nb</td>
<td>116</td>
<td>0.02</td>
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<td>Tabba Tabba</td>
<td>Pilabara Minerals Ltd.</td>
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<td>Pegmatite</td>
<td>Open pit</td>
<td>Ta</td>
<td>0.318</td>
<td>0.095</td>
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<tr>
<td>Kanyika</td>
<td>Globe Metals &amp; Mining Africa (Pty) Ltd.</td>
<td>Malawi</td>
<td>Operation</td>
<td>Nepheline Syenite</td>
<td>Open pit</td>
<td>Nb, Ta, U, Zr</td>
<td>21</td>
<td>0.33</td>
<td>0.015</td>
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<tr>
<td>Abu Dabbab</td>
<td>Gippsland Ltd.</td>
<td>Egypt</td>
<td>Operation</td>
<td>Bankable Feasibility</td>
<td>Open pit</td>
<td>Ta, Sn, Feldspar</td>
<td>32</td>
<td>0.027</td>
<td></td>
</tr>
<tr>
<td>Several artisanal small-scale mines</td>
<td>Central Africa</td>
<td>Operation</td>
<td>Weathered Pegmatites</td>
<td>Open pit</td>
<td>Ta, Nb</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
China Molybdenum has agreed to buy niobium and phosphate assets in Brazil from Anglo American for $1.5bn. Source: InfoMine, July 2016

Significant Ta mines around the world
(Source: Soto-Viruet et al., 2013. USGS, Open-File Report 13–1239)
<table>
<thead>
<tr>
<th>Deposit Name</th>
<th>Company</th>
<th>Country</th>
<th>Type of ore</th>
<th>Status</th>
<th>Reserves</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penouta mine</td>
<td>Strategic Minerals Spain</td>
<td>Spain</td>
<td>Alkaline granite</td>
<td>Exploration</td>
<td>95.6 Mt @ 0.0094% Ta$_2$O$_5$, 0.0090% Nb$_2$O$_5$, 0.044% Sn</td>
</tr>
<tr>
<td>Alberta II</td>
<td>Strategic Minerals Spain</td>
<td>Spain</td>
<td>Pegmatites</td>
<td>Exploration</td>
<td>12.3 Mt @ 0.0121% Ta$_2$O$_5$, 0.044% Sn, 0.204% Li</td>
</tr>
<tr>
<td>Motzfeldt</td>
<td>Regency Mines (Denmark)</td>
<td>Greenland</td>
<td>Syenite</td>
<td>Exploration</td>
<td>340 Mt @ 0.19% Nb$_2$O$_5$, 0.012% Ta$_2$O$_5$, 0.46 ZrO$_2$</td>
</tr>
<tr>
<td>Sokli</td>
<td>Yara International ASA</td>
<td>Finland</td>
<td>Carbonatite</td>
<td>Exploration stopped</td>
<td>110 Mt @ 0.1% Nb$_2$O$_5$, 16.5% P$_2$O$_5$</td>
</tr>
<tr>
<td>Echassières</td>
<td>Imerys</td>
<td>France</td>
<td>Cassiterite, granite</td>
<td></td>
<td>5 Mt Ta$_2$O$_5$ /yr</td>
</tr>
</tbody>
</table>

- Fast changing **supply chain**, at both ends.
- Figures show **significant discrepancies** between sources.
- EU produces 1% of the world's Ta production at the most.
- **Only one operating mine in the EU** at the present time.
- **Ta supply** is an important and critical issue for the European aeronautics industry (Source: Tantalum-Niobium International Study Center)