MINERAL RESOURCES/ RESERVES OF SERBIA RELATED TO UNFC – 2009

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1. Metallogenic position of the Republic of Serbia
2. Mineral potential
3. The interest in mineral raw materials of Serbia
   3a. The economic importance of mineral
4. Legislative
   4a. Classification system of Mineral Resources/Reserves of solid minerals
   4b. Map Conversion of Mineral Resources/Reserve
      (*New Rule book – in drafting*)
5. Mineral resources/Reserves in relation to UNFC-2009
6. Geological exploration of Uranium deposits
   6a. Mineral Resources/ Reserves of Uranium
      (*Previous Categories A,B,C,D /in situ*) related to Standards NEA/IAEA*)
   6b. Mineral resources/ Reserves of uranium
7. New legislative - In drafting/ Important
8. Conclusion
1. **Metallogenic Position of the Republic of Serbia**

The Tethyan – Eurasian metallogenic belt - The North-Eastern Mediterranean Sector

The Alpine–Balkan–Carpathian–Dinaride metallogenic and geodynamic province

Metallogenic units within Serbia are part of regional metallogenic units which extend beyond the political boundaries of the country.
2. MINERAL POTENTIAL OF SERBIA

FOSSIL RESOURCES
Coal: 13 bituminous coal basins
33 brown coal basins

Oil and Gas fields: > 90
Oil and Gas deposits: >250

Oil shale
Significant deposit: Aleksinac

ACTIVE – 2 Coal Mines (open pits)
1 Underwater Coal mine
7 Underground Coal Mines
70 Oil and Gas Fields

NON-METALLIC MINERAL RESOURCES
There are more than 2500 non-metallic mineral deposits (industrial minerals) and mineral occurrences.

ACTIVE – 150 Open pits (Building stone; Brick clay and Industrial Minerals).

METALLIC MINERAL RESOURCES
There are more than 2,000 metallic mineral deposits and mineral occurrences

ACTIVE: 8 Metallic mines

HYDRO-GEOTHERMAL RESOURCES
60 Convective hydro-geothermal systems deep up to 3 km
100 geothermal waters up to 3 km depth

Active 110 Geothermal wlls = 156 MW (Milojevic, 2001)
3. The interest in mineral raw materials of Serbia

Investments
- National Development
- Investments/Public interest
- Trading

Foreign investments
- Company interest
- Trading

Legislative
- Domestic - EU directive;
- Standards

International Standards

Reporting on Mineral Resources/ Reserves
- State Competent person - For State Balans

Competent person

UNFC - 2009
3A. The Economic Importance of Mineral Resources

1. Primary
   - Coal, Oil and gas
   - Cu (Au), Pb, Zn (Ag)
   - Hydro and Geothermal resources
   - Industrial minerals and building stone

2. Secondary
   - The first group: Ni, Co, Mo, Sb,
   - The second group: Fe, Cr, Mn, W, Sn, Hg and U.

3. Tertiary
   - Ti, rare elements etc.
4. LEGISLATIVE, ACTUAL SITUATION

- THE LAW ON MINING AND GEOLOGICAL EXPLORATION (2011)
- The Rule book on classification and categorization of solid mineral raw material resources and their record keeping (1979)
- The Rule book on classification and categorization of oil and gas and their record keeping (1987)
- The Rule book on classification and categorization of underground water and their record keeping (1987)

- THE LAW ON HEALTH AND SAFETY AT WORK (2005)
- THE LAW ON THE ENVIRONMENTAL PROTECTION (2005)
- THE LAW ON CULTURAL PROPERTY AND HERITAGE (2011)
- THE LAW ON IONIZING RADIATION PROTECTION AND NUCLEAR SAFETY (2012)
- TECHNICAL INSTRUCTIONS etc.
4.A. **Classification System of Mineral Resources/Reserves of Solid Minerals**

**MINERAL RESOURCES**
- Inferred
- Indicated
- Measured

**RESERVES**
- Probable
- Proved

**Elaborate (Study) on Mineral Resources and Reserves** (Pre-Feasibility study)

**Report of Competent person** (Geology + Mining engineer)

**Basic geological exploration**
- REPUBLIC GEOLOGY SURVEY

**Geological exploration**
- Annual Report
- Final Report

**Ministry of Mining and Energy**
- Or Secretary of Province

**Certificate on Reserves**
- (The base for Licence for Exploitation)

**Work Group for Verification**
### 4.B. Map Conversion of Mineral Resources (New Rule Book – in drafting)

#### New categorization and classification (2011)

<table>
<thead>
<tr>
<th>Results of Geology Exploration</th>
<th>Mineral Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inferred</td>
<td>Indicated</td>
</tr>
</tbody>
</table>

#### Rule Book of Categorization and classification ... for solid minerals (1979)

<table>
<thead>
<tr>
<th>Assumed Categories</th>
<th>Perspective/Potential Category</th>
<th>Geological reserves</th>
</tr>
</thead>
<tbody>
<tr>
<td>D₂ and D¹</td>
<td>C₂</td>
<td>Balanced + Off</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Category</th>
<th>Geological reserves</th>
</tr>
</thead>
<tbody>
<tr>
<td>C₁</td>
<td>(Error 50%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>D₁</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Assumed categories</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>D₂</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Assumed categories</td>
</tr>
</tbody>
</table>

#### UNFC-2009

<table>
<thead>
<tr>
<th>Mineral Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>334</td>
</tr>
<tr>
<td>223</td>
</tr>
<tr>
<td>222</td>
</tr>
</tbody>
</table>

(After: M. Ilić, R. Jelenković, R. Vukas, Č. Beljić; For Solid Mineral Raw Materials)

- A – Well-known and defined characteristic of the deposit and mineral ore (Explored ore reserves; allowed estimate error +/- 15%)
- B – Known and established characteristic of the deposit and mineral ore (Explored ore reserves; allowed estimate error +/- 30%)
- C₁ – Partly known and defined characteristic of the deposit and mineral ore (Explored ore reserves; allowed estimate error +/- 50%)
- C₂ – Partly tested deposit conditions and mostly determined by analogy with known parts of the deposit (Inferred/ Perspective)
- D₁ – Inferred based on geological conditions, detailed prospecting data, exploratory and mine workings also in unexplored parts of known properties
- D₂ – Inferred based on complex geological, geophysical, geochemical prospecting for the geological history and make up of the region of indicated mineral resources for which ore reserve are estimated by analysis of formations and use of statistical (probability theory) and analytical method.

### AS WELL AS THE BASIC RELATION OF MUTUAL, FRAMEWORK COMPARASION AND CORRELATION

\[
100\% : \text{BALANCE RESERVES (} B_{IIA+B+C1} \text{)} = 71\% : (Pr + Pb) \text{ ORE RESERVES (Vukas, 2009)}
\]
5. Mineral Resources/Reserves in Relation to UNFC-2009

- Measured (2011)
  - In situ
  - Off Balance and balanced reserves Categ.-B+A (1979)

- Indicated (2011)
  - In situ
  - Off Balanced and balanced reserves Categ.-C1 (1979)

- Inferred (2011)
  - In situ
  - Perspective reserves Categ.-C2 (1979)

Elaborate on Mineral Resources/Reserves

- Proved reserves (2011)
  - Balanced reserves Categ. A+B (1979)

- Probable reserves (2011)
  - Balanced reserves Categ. C1 (1979)

Elaborate on Mineral Resources/Reserves

- Final report on Geological Exploration

Sales Production

Socio-economic viability

The Mining Project

Elaborate on Mineral resources/Reserves

Licence for exploitation

Feasibility study

Project on geological exploration

Licence for geological exploration (3+2+2)

Final report ... Annual report

R. Vukas, 2015
6. GEOLOGICAL EXPLORATION OF URANIUM DEPOSITS

HISTORICAL DATA OF GEOLOGICAL EXPLORATION (from 1948 to 1990)

- No balanced reserves of uranium
- No mining activity

CURRENT SITUATION

- There are no Geological explorations of uranium deposits
### 6.a. Mineral Resources/Reserves of Uranium

(Previous Category A,B,C,D /in situ related to standards NEA/IAEA)

<table>
<thead>
<tr>
<th>Reasonably Assured Resources RAR</th>
<th>Estimated Additional Resources Category I- EAR-I</th>
<th>Estimated Additional Resources Category-II EAR-II</th>
<th>Speculative Resources SR</th>
</tr>
</thead>
<tbody>
<tr>
<td>A + B</td>
<td>C1</td>
<td>C2</td>
<td>D1 + D2 (Rule book, 1979)</td>
</tr>
<tr>
<td>Measured</td>
<td>Indicated</td>
<td>Inferred</td>
<td>EXPLORED RESULTS (Law, 2011)</td>
</tr>
<tr>
<td>- $80</td>
<td>- $80</td>
<td>- $80</td>
<td></td>
</tr>
<tr>
<td>$80 – $130 kg/U</td>
<td>$80 – $130 kg/U</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**In situ**, Categ. B + C₁ + C₂ + D₁ + D₂ = 13 537 779t (total Mineral Resources)
U₃O₈ – 450 g/t; total U₃O₈ – 6 055 t

*Roncovic G., 2001 y.*
*Add Vukas R., 2014 y.* (table; category of resources/reserves)
6.b. Mineral resources/ Reserves of uranium

(1) Ore field BUKULJA- BELANOVICA
   (2 250 t (ore) U₃O₈;)

(2) Ore field CER-IVERAK
   (300/200 t (ore) U₃O₈)

(3) Ore field STARA PLANINA-JANJA
    /KALNA)
   350 t (ore) U₃O₈.
   (after Putnik S., 1998.y; Rončević G.
   Popović R., 2005; IAEA)

(4) Field Kukavica
   ( (4) added R. Vukas, 2014.y.)

- Wein type/granitoid:
  - Bukulja -1
  - Janja - 2
  - Cer - 3
  - Slatinska reka - 4

- Sediment type/tabular:
  - Belanovica-1a
  - Dojkinci -2a
  - Iverak (Ribarice)....3a
  - Stolovac - 5a
  (after Jelenković R, 2008.y.)

(5a) added Vukas R., 2014.y.)
7. **New Legislative - In Drafting/ Important**

- New amendments – EU directive
- Law on Mining and Geology exploration
- New Rule book for classification of Oil and Gas – related to PRMS Guide,
- New Rule book for classification of hydro and geothermal resources - related to international standards.
8. CONCLUSION

1. Several millennia old mining tradition in Serbia
2. Very good geological and mining potential
3. Many foreign and domestic companies are included in geological exploration and mining activities in Serbia
4. More than 100 exploration prospects (metallic) and 250 exploitation field (solid minerals)
5. Friendly relation of International standards for reporting
6. Discovered new Li-mineral (Jadarite; Western Serbia), epithermal gold deposits and porphyry type Cu-deposits (Timok magmatic massive; Eastern Serbia)
7. Mining sector includes 1.5% GDP