A CONTRIBUTION TO THE NEW SERBIAN CLASSIFICATION OF MINERAL RESOURCES / RESERVES OF SOLID MINERALS HARMONYZED WITH INTERNATIONAL STANDARDS

Radoslav Vukas, Republic geological inspector
Ana Dajovic, Senior Advisor for geological exploration

radoslav.vukas@mre.gov.rs
ana.dajovic@mre.gov.rs

7th Meeting Expert Group Resources Classification
Geneva, UNECE, 2016, April, 26 – 29
1. Mineral wealth of Serbia
2. The economic and strategic importance of Mineral resources
3. Legislative
4. Categories of „Reserves“
5. Mineral resources/Reserves in relation to UNFC-2009
6. Conclusion
1. MINERAL WEALTH OF SERBIA

NON-METALLIC MINERAL RESOURCES

There are more than 2,500 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 wells = 156 MW (Milojevic, 2001)

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
2. THE ECONOMIC AND STRATEGIC IMPORTANCE
OF MINERAL RESOURCES

Mineral and other geological resources in natural resource owned by the Republic of Serbia and can be used in accordance with the law

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

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.
3. LEGISLATIVE

1. PRESENT SITUATION

- THE LAW ON MINING AND GEOLOGICAL EXPLORATION (2015)
  
a) The Book of Regulations on classification of solid mineral raw material resources and their record keeping (1979)
b) The Book of Regulations on classification of oil and gas and their record keeping (1987)
c) The Book of Regulations on classification of underground water and their record keeping (1987)

2. IN PROCEDURE

a) The New Book of Regulations on classification of solid mineral raw material resources and their record keeping (base on the PERC code)
b) The New Book of Regulations on classification of oil and gas and their record keeping (base on the PRMS and on Directive of EU)
c) The New Book of Regulations on classification of underground water and their record keeping (base on Directive of EU)
4. CATEGORIES OF „RESERVES“

An old term that comprising both Mineral resources and Reserves

- **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%)

- **C<sub>1</sub>** – Partly known and defined characteristic of the deposit and mineral ore (Explored ore reserves; allowed estimate error +/- 50%)

- **C<sub>2</sub>** – Partly tested deposit conditions and mostly determined by analogy with known parts of the deposit (Inferred/ Perspective)

- **D<sub>1</sub>** – Inferred based on geological conditions, detailed prospecting data, exploratory and mine workings also in unexplored parts of known properties

- **D<sub>2</sub>** – 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.

After Vukas, 2009
Main elements of the official Serbian classification of „Reserves“ (the term comprises both resources and reserves) of solid mineral raw materials: compiled from the 1979 Book of Regulations.

<table>
<thead>
<tr>
<th>Degree of Exploration</th>
<th>Classes/Categories of Reserves Obtained by Geological Exploration</th>
<th>Steps of Geological Exploration Process</th>
<th>Reporting to Governmental Authorities</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RESERVES OF SOLID MINERAL RAW MATERIALS</td>
<td>Basic exploration</td>
<td>Reports on results of geological exploration</td>
</tr>
<tr>
<td></td>
<td>Potential:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>D₂ Category</td>
<td>Geological analysis and analogy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>D₁ Category</td>
<td>Geological analysis and extrapolation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C₂ Category</td>
<td>Prospecting</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Established (Geological – in situ):</td>
<td>Detailed exploration</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Out-of-Balance</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C₁ Category</td>
<td>Preliminary (General) exploration</td>
<td>Reports on balance reserves (with technical-economic evaluation)</td>
</tr>
<tr>
<td></td>
<td>Balance</td>
<td>Detailed exploration</td>
<td></td>
</tr>
<tr>
<td></td>
<td>B Category</td>
<td>Exploration during exploitation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A Category</td>
<td>Technical-economic evaluation (analysis of geological, genetic, technical exploitation; technological, regional, market and social-economic factors)</td>
<td></td>
</tr>
</tbody>
</table>
**Main Elements of the Proposed New Serbian Classification of Resources/Reserves of Solid Minerals Intended for the New Serbian Book of Regulations, Based on, and Harmonized with the Classification Contained in the 2013 PERC Standard.**

<table>
<thead>
<tr>
<th>RESULTS OF GEOLOGICAL EXPLORATION AND SOLID MINERAL RESOURCES/RESERVES</th>
<th>SUCCEEDING STAGES OF GEOLOGICAL EXPLORATION AND THE PERTAINING STUDIES</th>
<th>REPORTING OF THE RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inferred</strong></td>
<td>Reconnaissance/Preliminary Estimation</td>
<td>Annual Reports, Final Report (to Governmental Authorities)</td>
</tr>
<tr>
<td><strong>Measured</strong></td>
<td>Prospecting/Opportunity (Scoping) Study</td>
<td>Annual Reports, Final Report (to Gov. Auth.)</td>
</tr>
<tr>
<td><strong>Indicated</strong></td>
<td>Preliminary (General) Exploration/Pre-Feasibility Study</td>
<td>Annual Reports, Final Report (to Gov. Auth.)</td>
</tr>
<tr>
<td><strong>Probable</strong></td>
<td>Detailed Exploration/Feasibility Study</td>
<td>Annual Reports, Final Report (to Gov. Auth.)</td>
</tr>
<tr>
<td><strong>Proved</strong></td>
<td>Exploration During Mining/Special Geological and/or Mining Studies</td>
<td>Annual Reports, Mining Report (to Gov. Auth.)</td>
</tr>
</tbody>
</table>

*Consideration of the „Modifying Factors“ (mining, processing, metallurgical, infrastructure, economic, marketing, legal, environmental, social, and governmental factors)*

After Ilich and Vukas, 2016
**Correlation and Conversion Map of Categories and Classes of Resources/Reserves of Solid Minerals from the Classifications Contained in the 2009 UNFC, in the 1979 Book of Regulations and in the Proposed New Serbian Book of Regulations (Based on Ilich et al., 2012, Supplemented by the Present Authors).**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Inferred</td>
<td>Indicated</td>
</tr>
<tr>
<td></td>
<td>D₂, D₁</td>
<td>C₂</td>
<td>C₁</td>
</tr>
<tr>
<td>UNFC (2009)</td>
<td>334</td>
<td>223</td>
<td>222</td>
</tr>
</tbody>
</table>

After Ilich and Vukas, 2016
5. MINERAL RESOURCES / RESERVES IN RELATION TO UNFC-2009

- **Proved reserves (2015)**
  - Balanced reserves Categ. A+B (1979)

- **Probable reserves (2015)**
  - Balanced reserves Categ. C1 (1979)

- **Measured (2015)**
  - In situ
  - Out-balanced and balanced reserves Categ.-B+A (1979)

- **Indicated (2015)**
  - In situ
  - Out-balanced and balanced reserves Categ.-C1 (1979)

- **Inferred (2015)**
  - In situ
  - Perspective reserves Categ. C2 (1979)

---

**Mineral Resources (2015)**

**Licence for geological exploration (3+3+2)**

**Final report ......Annual report**

(R.Vukas, 2016)
6. CONCLUSIONS

1. More than 100 exploration fields for solid minerals
2. More than 200 exploitation fields for solid minerals
3. Many foreign and domestic companies are included in geological exploration and mining activities in Serbia
4. Good understanding of International reporting standards
1. Ilich M., Vukas R.: On the harmonization of Serbian classification and accompanying regulations on resources/reserves of solid minerals with the PERC standard, EFG- Eurogeologist, June, 2016 (in print),


4. International Template for Reporting of Exploration Results, Mineral Resources and Mineral Reserves (The CRIRSCO Template), 2006,

5. Pan-European Standard for Reporting of Exploration Results, Mineral Resources and Reserves (PERC Standard), 2013,

6. Zakon o rudarstvu i geološkim istraživanjima (Law on Mining and Geological Exploration), Službeni glasnik Republike Srbije br. 101/2015,