

## **MAPPING THE MINERAL RESOURCES DATA OF WEST BALKAN REGION INTO EXISTING EUROPEAN DATA MODEL**

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### **ABSTRACT**

Primary and secondary mineral resources are of strategic importance for the EU. Most EU countries (including Slovenia) are already part of the pan-European Minerals Intelligence Network which provides consistent and organized data information on primary and secondary mineral resources on the European level. It was established in previous projects as EuroGeoSource, Minerals4EU, ProSUM, Mica and ORAMA. The Eastern and south Eastern European (ESEE) region represents a gap in this network, but at the same time is also identified as one of most important strategic regions for the EU with great potential for mineral supply. The large concerns are aiming to expand their business to the region, but access to relevant data interesting for the investors is still not available. There is a need for surveyed and unified mineral resources data.

In the framework of RESEERVE (EIT RM KAVA project, duration 1.4.2018-31.3.2021), national mineral resources data of six task partners from West Balkan countries (Albania, Bosnia and Herzegovina, Croatia, Serbia, Montenegro and Macedonia) were implemented and harmonized with INSPIRE directive (European directive for organizing spatial data). Since EU directives are mandatory for members only and West Balkan countries are not yet targeted (except Croatia), they are still interested in their implementation.

For that reason the main project goal is the creation of the West Balkan Mineral Register, provided by national data providers, which will represent a starting point to integrate the ESEE region into existing EU data platforms and bring it closer to common minerals market. Regional mineral data will become more accessible and relevant. The goal of the project is to anticipate the future supply and demand for minerals, particularly regarding critical minerals and therefore to contribute to the sustainable mineral supply in Europe.

Leading partner for RESEERVE project is Geological Survey of Slovenia (GeoZS), which has identified relevant data providers and examined data quantity, quality and format. GeoZS will synthesize primary and secondary raw material data into common West Balkan Mineral Register and test the harvesting of data in INSPIRE compliant European data model.

The scenarios drawn up in the project will be available through the European Geological Data Infrastructure (EGDI), which will offer easy access to existing mineral data. EGDI provides access to Pan-European and national geological



datasets and services from the Geological Survey Organizations of Europe. Through EGDI data from several European data harmonization projects are accessible. EGDI was launched in June 2016 in a Version 1 and has since then been extended to include more data sets, including mineral resources.

The article is mostly focused on workflow harmonizing the data and spreading IT knowledge of mapping the national primary and secondary minerals data to already existing European data model and developing national relational databases, that fit into European common database structure. Data harmonization was already performed through national training workshops to assist task partners in taking the first step toward INSPIRE directive implementation.

**Keywords:** *mineral resources, West Balkan, Geological Data Infrastructure (EGDI) Network, INSPIRE directive, data harmonization*

## INTRODUCTION

In order to meet the need for mineral resources, it is essential to know the location, area quantity and availability of mineral resources. Europe, as well as its industry, increasingly depends on imports of mineral raw materials, mainly metal and industrial mineral resources, which has led the European economy to considerable instability. The security of European resources can already be compromised in the near future, as Europe is becoming increasingly dependent on external suppliers. Recently, we could have seen a significant increase in the prices of mineral raw materials, especially metal, on a global scale. Data on reserves and resources of mineral resources exists within each country, but each country collects them in their own way. Data are at different levels, from local, regional to the data of individual economic corporations that remain commercial secrecy.

As we want to reduce the dependency on the supply of raw materials from "abroad", we need to standardize the data between the individual countries at EU level. That was done by Directive of the European Parliament and of the Council on the establishment of an infrastructure for spatial information in the European Community, called the INSPIRE (INfrastructure for SPatial Information in Europe) directive, valid from 15. May 2007. It regulates the baseline for the establishment of a European infrastructure for spatial and environmental data in the Member States. Such infrastructure enables the institutions and stakeholders to share information and knowledge, to find, view and acquire standardized and harmonized geo-referenced and related data, including data on mineral resources. It integrates the best available mineral expertise and information base on the geological knowledge, in support of public policy making, industry, society, communication and education purposes at international level. [4]

At the time of the present research in the considering ESEE region there was no effective information system to support sustainable management of mineral resources, which would follow the INSPIRE directive and provide enough good and argument decisions to:

- decision makers at local level (municipalities, local communities, mayors, city councils, professional departments at ministries etc.),

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- national decision makers (government, government departments, state chambers, ministries, inspectors, administrative units...),
- decision-makers at international level (Council of the EU, commissioners...).

Very important for all economics is also the knowledge of:

- the negative impacts of mining to the environment,
- recycling management and strategies,
- potential of mineral resources,
- the acquisition of trust and social consent to exploitation and
- availability of the commodities.

All these facts also apply to the countries of ESSE region; however, they have not yet had the data organized in systematic ways. Getting the good data is not easy. Even if you know where to find it, the data will probably be in a different format for each country, out-of-date and usually in non-digital form. National institutions have also their own ways of working, different dissemination, data formats and language. The RESEERVE project will bring the national minerals related geodata of the region into one virtual place through web portal, so the users can more easily get the information they need, directly onto their computer and free-of-charge. The elementary aim of the RESEERVE project is to obtain quality data and integrate it into already existing European platforms and present their data on the web portal. This will represent their starting point to follow the INSPIRE directive, obtain a strong decision-making tool for the management of mineral resources and environment protection. The expert public of the region will complement the fundamental knowledge of regional geology, mineralogy, stratigraphy, geochemistry, environmental geology, and nevertheless also of information systems. Such approach therefore will connect in an efficient way the area of organizing information systems and the geology.

### **METHODOLOGY, METHODS AND MATERIALS**

For reaching the final harmonization of data the following methodology have been used:

#### **Engineering of end users' requirements**

First step was the analysis of end user needs. The end users are different, and they have different requirements. We can divide the users ' target groups into:

- users of databases and data providers (geological surveys, faculties, ministries...),
- other web application users (e.g. mining inspectors, students, general public, mining experts, academic circles, equipment manufacturers...),
- potential users of data (stakeholders, environmental agencies, statistical offices, other ministries, investors, mining companies...).



### **Qualitative and quantitative research of data**

To reach this purpose, a summarized Excel table for the collection of national data on primary and secondary mineral raw materials, relevant for possible investors, was designed. The table with common attributes, using a top down approach (from general to detailed information) has been completed by all project partners. The table includes the attributers such as basic geographical and ownership information about each site, geometry, volume, technological data such status, mining methods and reserves, geological data such stratigraphy and lithology, mineral composition and rock types, stability, chemical composition, environmental impacts etc.

The recommendation, according to EU mineral demands and strategic tendencies, is to focus on metals and industrial minerals (special focus on CRM), addressed to active mines/open pits, abandoned and closed mines with reserve/resources and other potential sites, and mine/metallurgic waste sites. At the end relevant primary and secondary raw materials of the ESEE region were identified and key players from expert institutions. Quality, quantity and format of gathered data were also examined to obtain spatial data on mineral deposits and descriptive data as well.

### **Overview of existing EU data model and harmonizing the basic Excel table fields with INSPIRE database fields**

National data of individual countries have been harmonized with the INSPIRE data model and online services for data on mineral raw materials have been established. To accomplish this end, we examined INSPIRE directive in detail, identified the fields that coincide with the directive, and adapted them accordingly to the requirements. In the first phase, we focused only on mandatory fields from the INSPIRE directive and produced extended series of Excel tables in accordance with the INSPIRE data model. In the second phase, we expanded the number of entered deposits to the minimum of 50 and started by entering extended information by filling also voidable fields.

### **Mapping the basic Excel table to INSPIRE customized Excel tables/ harmonization of existing data to INSPIRE-compliant data**

At this stage, it was necessary to consider the specific rules required by the common data model. The data must be entered in an exact sequence, for this purpose the instructions for inserting data were also made. It is necessary to follow the provided INSPIRE code lists for interoperability with existing EGDI platform, use the specific record identifiers and correctly track the relationships between the data.

This stage of work has carried out a series of national workshops/training courses with technical support to help the partners on harmonization of existing data sets into INSPIRE compliant data and working with relational databases.

**Mapping INSPIRE customized Excel tables to the Access relational database**

This phase was relatively simple, since the pre-existing Excel tables have been organized in a same way as relational database and the data provider just copies the tables into it one by one. Access database is already a relational database and all the errors, made in Excel table appear, so it is also a good control of the entry itself. National workshops have also been carried out for this purpose.

At this point synthesis and creation of common primary and secondary raw materials dataset has already been established.

**Mapping Access database into PostgreSQL**

The following step was the migration of national Access databases to open source Solutions (PostgreSQL database, used by the project). This step was performed by GeoZS.

**Harvesting national databases to the common EU database**

In order to create a system with updated date, the project adopted a distributed architecture based on central harvesting database synchronized with a central database. Data harvesting is the process to automatically extract large amount of data from web services. GeoZS implemented a harvesting system to collect and validate INSPIRE compliant spatial European data of mineral resources. On a country level national provider distribute their data as A Web Feature Service (WFS), GeoZS harvesting system retrieves this data, performs data transformation and quality control and finally store validated data in the central database. [2]

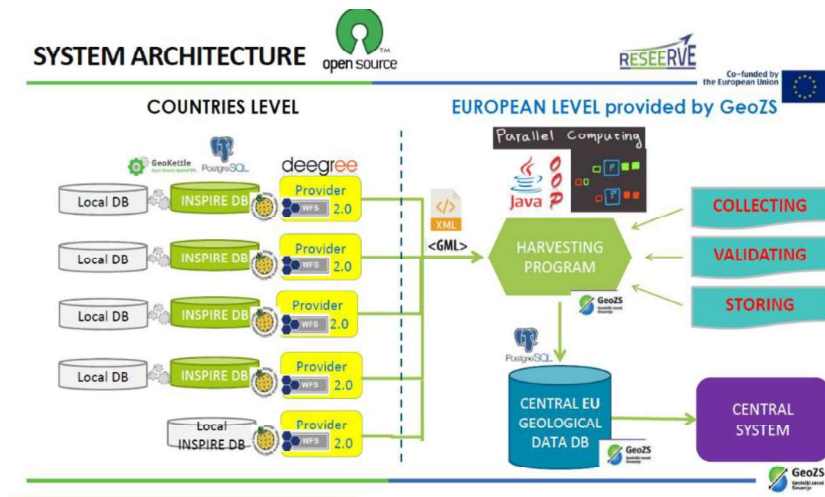


Figure 1: Architecture of harvesting system

**Presentation of data on the EGDI web portal**

In addition to map service displaying the mineral deposits and mines in West Balkan countries on EGDI portal, the portal also provides occurrence-specific documents related to mineral material, enabling users to make their own analyses



from a huge amount of data. It represents a new knowledge base of primary and secondary resources of the region that is interoperable with national databases. Based in this, industry can be encouraged to invest in West Balkan mineral sector. [3]

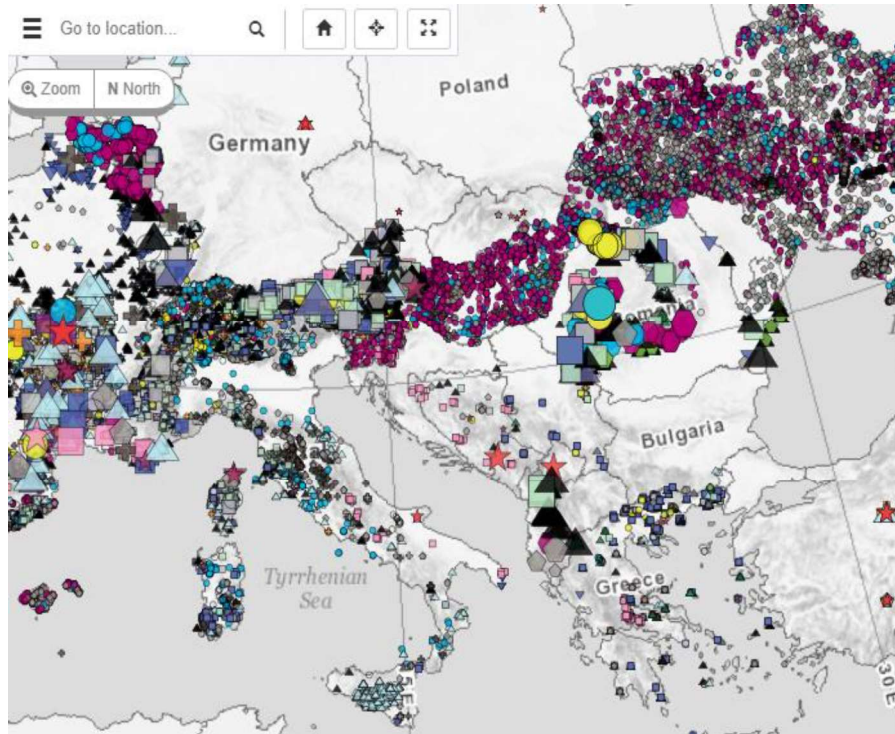


Figure 2: EGDI map viewer

## RESULTS

The main result is the creation of West Balkan Mineral Register for primary and secondary mineral resources. Statistics of data collected and harmonized in first two years of project duration is following: Albania 134 primary resources altogether (41 mines) and 15 secondary mineral sites, Serbia 55 primary (43 mines) and 28 secondary resources, Croatia 183 primary (all of them are mines) and 46 secondary resources, Montenegro 50 primary (35 mines) and 4 secondary resources, Bosnia and Herzegovina altogether 134 primary (81 in Federation and 53 in Republic of Srpska) and 15 secondary resources (11 in Federation and 4 in Republic of Srpska).

All the data are already a part of EGDI accessible through a web portal (<http://www.europe-geology.eu/map-viewer/>), It provides data, tools, services and expertise to enhance sustainable development of Europe in support of public policy making, industry, society, communication and education purposes at European and national level.

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Through the register existing data sources, assessment of data availability and quality has been delivered to achieve harmonization and standardization of EU mineral statistic.

The other outcomes of the project are [5]:

- investors will get the register for primary and secondary resources and list of national contacts,
- the task partners countries with increased capacity for national mineral management. Their market will become accessible,
- ensured enough flow of information on mineral resources for Europe's industry to expand their business and investments in the West Balkan Region,
- joint knowledge base from ESSE national geo-surveys, provided public data,
- increased mineral exploration activities and roadmap for the exploitation of mineral sector in the region for future implementation, updating and maintenance after the project.

## CONCLUSION

Data related to raw materials, either metallic ores, industrial minerals or construction materials, of primary origin from mining and from industrial wastes certainly are available in West Balkan countries. However, they are often scattered amongst variety of institutions, including governmental institutions, agencies, universities and industries. These data are often stored in databases with their own design/architecture and vocabulary, while their merging and compilation is difficult and time consuming. Issues regarding availability, quality, organization, accessibility and sharing of data are common to in all countries. Solving these problems requires access and use of interoperable data, which are now joined in West Balkan Mineral Register. The register allows to easily combine information related to primary and secondary mineral resources and to provide end-users with all the available information. Data platform represents a first step to the future effective and sustainable information system of the region. The technical solutions facilitate data update and maintenance and gives a full access to information related to the whole mineral resource's life cycle.

Joint knowledge and information from ESSE national data providers will provide publicly available data (regarding to national legislation) by generating comprehensive and useful register of primary and secondary mineral resources and increased capacity of West Balkan countries for management of mineral resources on national level. [1]

Especially the information of mine and metallurgic waste gathered throughout the project are of great importance for the region and whole Europe, because recently waste has become an important potential source of raw materials. So far waste sites have been relatively neglected due to massive primary mineral



extraction. SRM data is relatively poorly organized but created dataset of SRM contains important data for mineral extractive industry.

Extended data survey (especially regarding secondary resources) needs to be performed through follow-up projects, geographically outreaching to other ESSE countries (SVK, CZ, HUN, ROU and BGR). [5]

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