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Valorization of undeveloped industrial rock deposits in Poland

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ABSTRACT

Mineral deposit attributes are: renewability specific location controlled by geology, and the important role of meeting the needs of society. Their resources should be therefore rationally used. It requires in particular safeguarding access to deposits areas. The way to indicate the valuable deposits to protect them seems to be their valuation, using uniform criteria. The authors present a simple method of mineral deposits value ranking. It consists of deposits ranking value in four, separate domains: quality and size (resources) of deposit, as a main domain, mining conditions, environmental conditions, and land-use planning restrictions. Size of deposit and mineral (rock) quality parameters were defined for each kind of mineral commodity. Mining conditions were described by the degree of exploitation difficulties and the possibility to deliver the raw material to customers. Both environmental and land-use planning domains indicate some limits related to nature protection, housing and industrial building. Within each of four domains of evaluation 3 categories were distinguished, allowing for the specification of each deposit through a four letter symbol. The presented method was applied on yet undeveloped industrial mineral and rock deposits in Poland. These results are presented and discussed in the article.

1. Introduction

Mineral deposits are a specific element of the natural environment. Their exploitation is indispensable to the satisfaction of basic needs of contemporary societies because over 80–90% of materials and goods used in everyday life are made of raw mineral materials. Bearing in mind that mineral deposits are non-renewable, with a few exceptions (e.g. gravel deposits in river valleys), they deserve careful protection to ensure their availability in the future. Their protection and reasonable exploitation are indispensable requests, resulting from sustainable development principles, as well as fundamentals of the multigenerational justice concept. One of most important aspects of mineral deposit protection is allowing for their accessibility in current and future exploitation. This means that the land (area) where mineral deposits occur has to be safeguarded for mining activity. It raises several land-use conflicts: between mining- and housing, road infrastructure, nature protection, forestry, agriculture, as well as social expectations. Problems of this type occur in all countries and for their solution various methods are used (SMARA, 1975; Barnsley Metropolitan Borough Council, 2005; Badera, 2010; Beeby, 1998; Nieć and Myszka, 2000; Radwanek-Bąk, 2006, 2008; Nieć and Radwanek-Bąk 2010; Tiess, 2010, 2011; Weber, 2012; Wexler, 1996; Wringhton et al., 2014). All of them must take into account the principles of sustainable development and a need for compromise needed in the use of space (Shields and Šolar, 2004; Minerals Planning Policies and Supply Practices in Europe 2004; Baker et al. 2005; Villas Boas et al., 2005; Radwanek-Bąk, 2005; Wagner and Tiess, 2008; Improving framework conditions for extracting minerals for the EU. 2010; Solar and Shields, 2011; Nieć and Radwanek-Bąk, 2014). One of the ways to achieve this compromise between spatial land use planning and protection of mineral deposits is the valorization of mineral deposits, indispensible for safeguarding the most valuable ones against sterilization. It refers in particular to industrial minerals and rocks which, due to their open-pit exploitation, generate the most conflict. Such valorization is the aim of this study. The performed valorization is focused on explored deposits with identified (inferred or indicated) resources that till now were not designed for mining. Due to their real economic value not yet being defined, the proposed valorization is a kind of qualitative evaluation under which geological and mining attractiveness of deposits, as well as environmental and planning constraints for their usage, were considered. It is based on ranking deposits according to a selected set of criteria and was applied to a wide group of industrial minerals and rocks in Poland and was performed on a country-wide scale.

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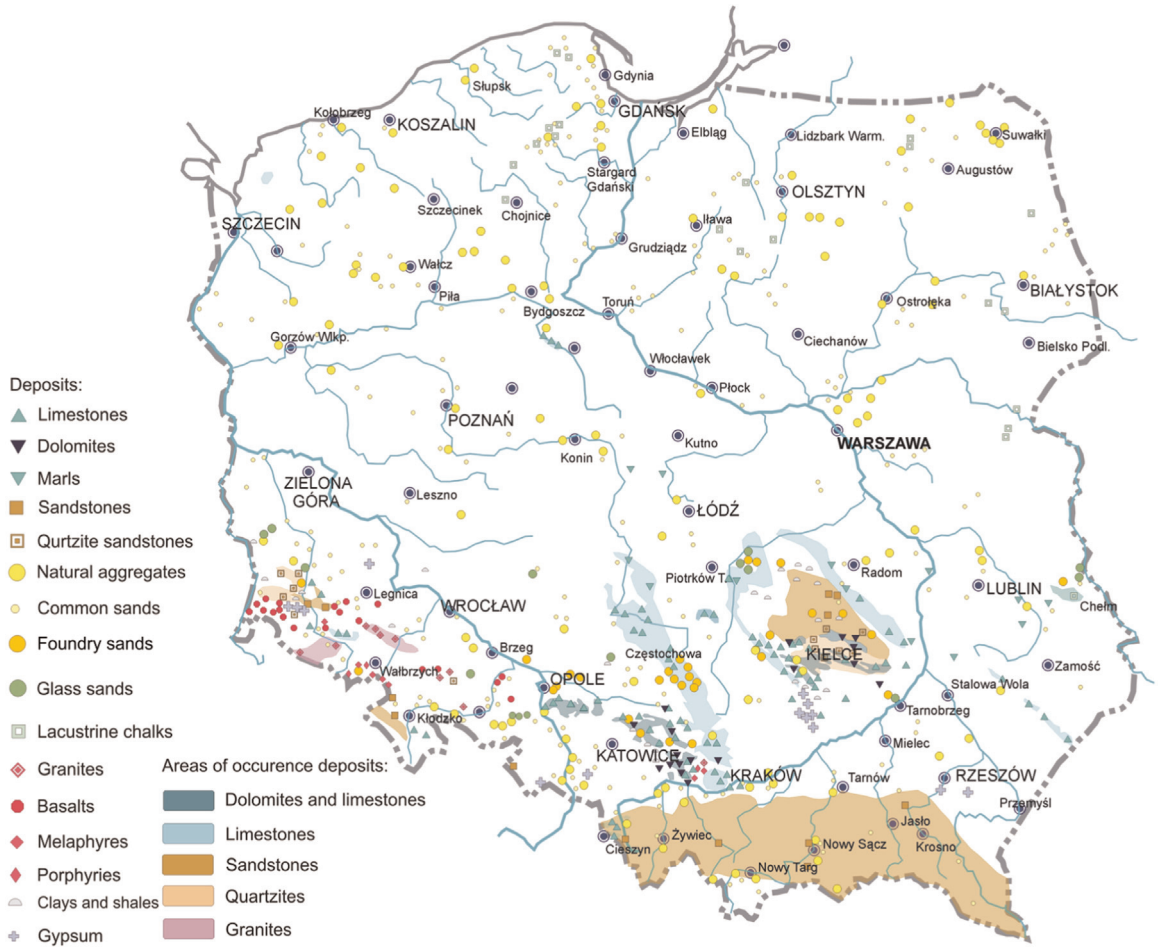

Fig. 1. Distribution of industrial rock deposits in Poland (generalized acc. E. Pietrzyk-Sokulska et al., in print);

2. Industrial mineral and rock deposits in Poland – an overview

Poland is a country with considerable and diversified industrial mineral and rock resources, with long mining traditions dating back to prehistoric times. The oldest evidence of using mineral resources is related to the making of stone tools, extraction of clay for ceramics production, use of natural pigments (e.g. hematite-based ones), and use of rock materials for construction and building.

At present, the Polish Mineral Resources Register lists about 12,000[1] identified deposits of minerals and various industrial rocks (natural aggregates, dimension and crushed stones, ceramic clays, silica sands, gypsum and anhydrite, industrial dolomites, limestone for lime and cement industry, and several others). Among them, 7378 are not yet exploited. These deposits are of varying size (both resources and the area of occurrence). Their resources vary from a few thousand to over one hundred million tons and the area of occurrence from a few to several hundred hectares (Register of mineral resources in Poland as of et al. December 2014).

Industrial minerals and rocks occur mainly in southern Poland (Fig. 1). The most important region where their presence is recorded is *Lower Silesia* (*Lower Silesian and Opole Districts-Voivodships*), situated in the south-western part of Poland where about 52% of dimension and crushed stones resources are located. Numerous deposits of basalt granites, melaphyres, porphyres and keratophyres, gabbros and syenite, as well as metamorphic rocks (amphibolites, gneisses, quarzites, hornfelses, serpentinite, marbl and schists deposits) occur here, as well as significant deposits of sedimentary rocks (limestones, sandstones, kaolin, ceramic and brick clays). In the Odra river basin numerous important natural gravel–sandy aggregate deposits occur.

The Upper Silesia (*Silesian District*), situated in the southern part of Poland, is a highly industrialized region of traditional intensive underground hard coal and zinc–lead mining activity. It is rich in several industrial rocks: dimension and crushed sandstones, dolomites, limestones, brick clays, natural aggregates, ordinary and foundry sand.

The Holy Cross Mts region (*Holy Cross District*), located in the southern part of middle Poland, was a cradle of Polish mining which dates back to prehistoric times. There, in Opatów village in the vicinity of Ostrowiec town (Kamienna river valley), the important Neolithic underground flint mines were located. Recently, this unique flint with a white and black ribbon design has become valuable jewellery. The region is rich in varied industrial rocks: limestone and marl for the lime and cement industry, dolomites, limestones, sandstones as dimension and crushed stones, gypsum, ceramic clays, and silica-glass sands have been found there and numerous deposits are demonstrated.

The *Carpathian Region* (Małopolskie and Podkarpackie Districts), in the south and south-eastern part of Poland, is rich in sandstone deposits as well as several good quality natural (gravel–sandy) aggregates located along many river valleys (the Vistula and almost all mountain river valleys). They are an important source of sand and gravel and have been intensively exploited for

[1] The number of registered deposits varies in time.