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HOME Revista ESPACIOS ÍNDICES / Index A LOS AUTORES / To the AUTORS

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Peloids as important resource for regional sustainable development: conceptual considerations

Peloides como recurso importante para el desarrollo sostenible regional: consideraciones conceptuales

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Contents

ABSTRACT:

Peloids are a kind of natural material that can be used for the purposes of healing, cosmetics, and the relevant recreation. The present paper conceptualizes the idea of peloid as a natural resource. This resource is renewable, and its geographical distribution is spot-like. The Russian South provides a clear example of regional-scale importance of this resource. Exploitation and conservation of peloids contribute to regional sustainable development via innovations, increase in regional attractiveness, and creation of new competitive advantage.
Keywords: Innovation , Renewable resources , Russian South , Therapeutic muds.

RESUMEN:

Los peloides son un tipo de material natural que se puede usar con fines de curación, cosméticos y recreación. El presente trabajo conceptualiza la idea de peloide como un recurso natural. Este recurso es renovable y su distribución geográfica es puntual. El sur de Rusia proporciona un claro ejemplo de la importancia a escala regional de este recurso. La explotación y conservación de los peloides contribuyen al desarrollo regional sostenible a través de innovaciones, el aumento del atractivo regional y la creación de nuevas ventajas competitivas.
Palabras clave: innovación, recursos renovables, sur de Rusia, lodos terapéuticos.

1. Introduction

Modern society remains dependent on natural resources, and demand for very specific natural resources increases together with socio-economic progress. Peloids, also known as therapeutic

muds, have been used by humans for centuries. However, expansion of recreation and acceleration in mud consumption for medical and cosmetic purposes have made their extraction and use true industry in the 20th century. Surprisingly, the number of studies of peloids remains limited. Most comprehensive and "fresh" syntheses of the knowledge can be found in the works of Veniale et al. (2007), Munteanu & Dumitrascu (2011), Gomes et al. (2013), and Glavaš et al. (2017). However, these works tend to focus on natural state of peloids, i.e., their physical and (bio)chemical properties, occurrence in the geological environment, and therapeutic potential. A significant research gap is linked to the understanding of peloids in socio-economic frame. An attempt to fill this gap is presented in this paper.

The main objective of the present study is conceptual characterization of peloids as a specific natural resource. Its usefulness for sustainable regional development is discussed. The authors' considerations are based on the both literature review and personal experience of studies of therapeutic muds in various environments of the Russian South.

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2. Key peculiarities of peloid resources

Peloids are natural muds (or muddy suspensions) consisting of clay and other minerals, various chemical compounds (often sulfidic), organic matter, water, gases, and microorganisms that can be used in medical (sensu stricto) practice directly or after artificial modification. This material is formed on some sea coasts and floodplains, in lakes (especially hypersaline) and bogs, or as a result of mud volcanism and hydrothermal activity. Visually, it looks commonly like a black dense mud, although its view may differ. Detailed descriptions of peloid properties and utility were provided by Veniale et al. (2007), Munteanu & Dumitrascu (2011), Gomes et al. (2013), and Glavaš et al. (2017). The results of the case studies of Karakaya et al. (2010), Carretero et al. (2014), and some others are also important to the understanding of this material. Modern classification of peloids was developed by Gomes et al. (2013), whereas Munteanu & Dumitrascu (2011) summarized earlier the knowledge of their importance for human health.

Peloids are economically-valuable natural resource because of several reasons. First, its occurrence and origin are natural, i.e., this material is formed because of geological, geochemical, and biological processes. Second, peloids are used on regular basis in many places of the world, and they create driver for development of recreational industry in some regions (e.g., in the Russian South). This means their use is economically profitable. Third, peloids are often extracted for distance use (e.g., in medical establishments). Fourth, the amount of peloids available globally is significant to be compared with some other natural (especially mineral) resources. For instance, the estimated resources of peloids in the relatively small-sized Big Tambukan Lake (area of ~2 km2, depth < 10 m – see Fig. 1) in the Russian South exceed 700000 m3.

Figure 1
General view of the Big Tambukan Lake in the Russian South

Source: Own image

Peloid resources have some evident peculiarities that are briefly characterized below. First, peloid utility differs. This material is used actively in medical practice (healing function) and cosmetic practice because of its unique physical and biochemical properties (Munteanu & Dumitrascu, 2011; Gomes et al., 2013). However, the well-known therapeutic effect of mud bathes attracts many visitors to sites of peloid occurrence. These visitors may and may not need healing or cosmetic procedures, but they test these procedures anyway because of beliefs in "health accumulation" or simple curiosity. Access to natural mud bathes is limited in some cases, but it is often uncontrolled. As a result, recreational zones grow around such sites with some infrastructure development (Fig. 2). Recreational zones also grow near official centers of peloid use for healing or cosmetic procedures.

Figure 2
Mud salsa lake of the *Gnilaya Gora* (Hephaestus) mud volcano (Taman Peninsula, Russian South); stairs is constructed for recreational purposes

Source: Own image

Second, peloid resources are limited, but renewable. If the local environment is not disturbed significantly, accumulation of muds and their maturation continue, and these processes are quite rapid. In the case of saline lakes, deposition of terrigenous matter from the surrounding land coupled with precipitation from chemical compounds dissolved in water and growth of microbial communities leads to formation of new amounts of therapeutic mud and its gradual maturation. In the case of mud volcanoes, new eruptions of mud mass from the interiors together with fluid outflow and gas emissions (Table 1) also increase the amount of peloids available on the surface or in salsa lakes and pools. If so, extraction of peloids can be balanced with their natural production.

Table 1

Methane emissions from the Gnilaya Gora (Hephaestus) mud volcano, Taman Peninsula, Russian South

Location	**Flux of methane in water, mg/m2*h**	**Methane in bottom sediments, mkg/g**
Sample point 1	103,43	2,26
Sample point 2	856,34	2,43
Sample point 3	266,42	2,54

Source: The authors' own measurements

Third, therapeutic muds can be used both in situ and ex situ. In the first case, natural mud bathes are used by visitors. Although a natural object (e.g., saline lake) does not loose significant amount of mud in this case, its environment can be anthropogenically disturbed and the object itself can be polluted. These will lead to quick impoverishment of peloid resources because of loss in their quality. In the second case, peloids are extracted to be transported to

medical establishments, spa centers, etc. The amount of the resource decreases "physically" if it is not balanced with the natural mud production and maturation.

Fourth, peloid resources are characterized by unusual distribution. On the one hand, these occur on restricted areas linked to water objects with specific conditions. Their distribution is, thus, spot-like as in the case of mineral deposits. On the other hand, the quality of peoloids is region-dependent. This means that it is determined by the physical-geographical and geological conditions on a given area. Moreover, environmental differentiation of large territories influences on the distribution of peloids with different properties like this occurs in the Russian South (see below).

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3. Peloids in regional perspective: evidence from the Russian South

The Russian South is a large region located between the Azov and Black seas in the west and the Caspian Sea in the east. The previous studies (Fedorov et al., 2004, 2015; Fedorov & Garkusha, 2017; Sallam et al., 2018) have shown that it possesses significant peloid resources that are exploited at some localities, from which the Big Tambukan Lake (Fig. 1) and the mud volcanoes of the Taman Peninsula (Fig. 2) are the most well-known. Therapeutic muds are used for three main purposes, namely medical and cosmetic (chiefly at resort establishments of the Caucasian Mineral Waters resort district), as well as recreational purposes. The both in situ use and extraction for ex situ use take place in the Russian South.

Peloids of the Russian South demonstrate significant diversity. As suggested by the results of the authors' studies, these can be subdivided into three major classes, namely A) sulfide therapeutic muds of intra-continental mineralized lakes and reservoirs, isolated basins of coastal zone, and marine embayments, B) mud-volcano therapeutic muds, and C) limnic mud-volcano therapeutic muds. The former class is the most widely distributed. Such muds are actively exploited in the Big Tambukan Lake. These are also linked to hydrological objects of the Rostov and Stavropol regions, as well as the coastal zones of the Azov and Black seas. Two latter classes are restricted to the Taman Peninsula. The mentioned peloids differ significantly by all parameters, including content of methane and hydrogen sulfide, pH, and Eh (Table 2) (for details see Fedorov et al., 2004, 2015; Fedorov & Garkusha, 2017). It should be noted that sulfide therapeutic muds are rich in different metal sulfides and organic matter; these also bear microbial communities. These muds accumulate on the bottom of hydrological objects where the muds are covered by highly-mineralized solution with significant concentration of chlorides and sulfates.

Table 2
Some basic hydrochemical parameters of mud-bearing water objects of the Russian South

Location	pH	Mineralization, mg/dm^3
Golubitskoe Lake	8,00	17932
Beysugskiy Liman coastal lake	7,80	11464
Plyoso-Krugloe Lake	8,38	6436
Sladkiy Liman coastal lake	7,70	5132
Big Tambukan Lake	7,36	22444
Solyenoe Lake	7,00	500
Proletarskoe Reservoir	7,13	65696

Pilenkino Lake	7,70	7547

Source: The authors' own measurements

The Russian South provides example of wide distribution of peloid occurrences on a large territory. In this case, it is possible to conclude about existence of abundant and diverse, multi-purpose, and regional-scale peloid resources. These are climate aridity, some geological peculiarities, and mud volcanism that determine the existence of these resources and their relevance to the entire Russian South.

4. Discussion

As it is shown above, peloids may constitute a regionally-important natural resource that can be exploited for different purposes. In contrast to some other resources linked to the geological environment, this one has a significant advantage – its exploitation contributes to sustainable development. It should be stressed that two-folded treatment of sustainability is employed for the purposes of this study. First, this is socio-economical sustainability (e.g., Kemp, 1994; Goodland, 1995; Turner II et al., 2007; Gupta, 2018; Tost et al., 2018), which means progressive regional development that is not interrupted by unbalance, distortion, turbulence, and long periods of stagnation. Second, this is environmental sustainability (i.e., sustainability sensu stricto – e.g., see Liu et al., 2012; Karppi et al., 2012; Iribarren et al., 2016; Starik et al., 2016; Gonzalez-Garcia et al., 2018), which means balanced development of society and nature without excessive anthropogenic pressure on the environment. Undoubtedly, the both types of sustainability are strongly interdependent.

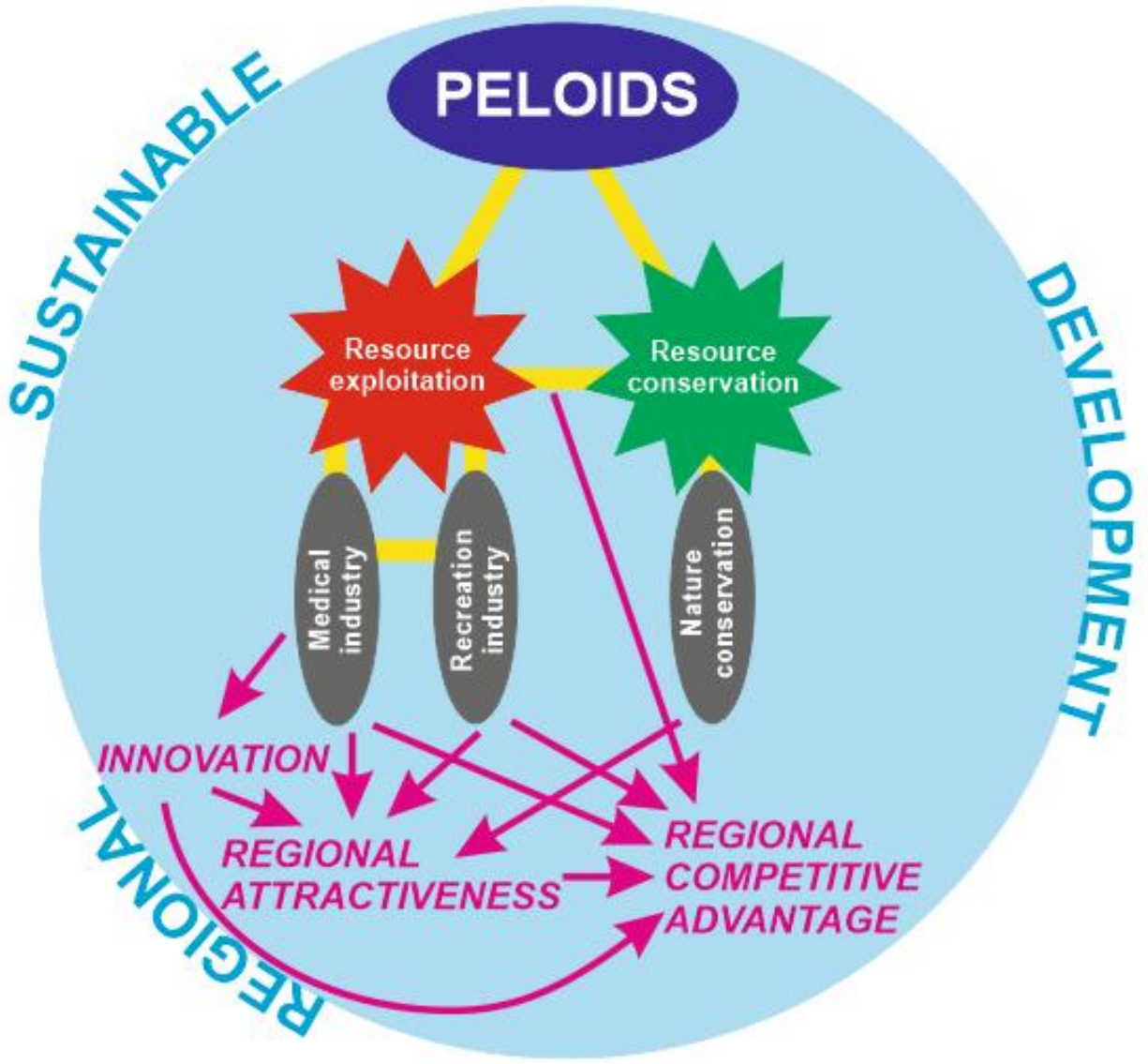
Peloids are economically valuable resource, which is exploited for the needs of medical and recreation industries (healing, cosmetics, and resort-related recreation). However, this resource also requires conservation because of two reasons. On the one hand, occurrences of therapeutic muds reflect very specific geological and environmental conditions (e.g., Sallam et al., 2018), which implies their uniqueness, i.e., natural heritage value. On the other hand, peloids are renewable resource, which means their rational use and protection from pollution and other kinds of anthropogenic stress permits their accumulation and maturation to continue. In such a case, efficient management of peloid exploitation and conservation are issues of environmental sustainability.

Medical industry based on the use of peloids for healing appears to be innovative by definition. This was well shown by Veniale et al. (2007) by example of thermal muds. Such innovations have two effects. First, these contribute to formation of positive image of a region, i.e., these increase regional attractiveness. The latter is a key factor of success in regard to the growth of entrepreneural environment and investment attraction. Second, each innovative industry should be considered as a serious competitive advantage of regional socio-economical system. Notably, significant attractiveness is also a kind of such a competitive advantage. Development of medical and recreation industries itself is a factor of the both regional attractiveness and regional competitive advantage. This is because it provides new opportunities for business, creates new profits for regional budget, and, finally, demonstrates human-centered and "green" directions of regional development. Peloid conservation, if efficient, demonstrates successful environmental practices (environmental sustainability) that is important for improvement in region's image. It should be added that joint exploitation and conservation of regional peloid resources is also a significant competitive advantage because this permits these resources to become really renewable. The latter extends the time frame of resource exploitation with the relevant socio-economic benefits.

All considerations present above imply that attention to regional peloid resources is important to regional sustainable development (Fig. 3). This is also the case when environmental sustainability becomes indivisible from socio-economical sustainability. A serious question is how to pay this attention. Uncontrolled, chaotic, unregulated exploitation of therapeutic mud

deposits leads quickly to their desiccation. Too strict regulation of their use in the interest of nature conservation diminishes socio-economical benefits. This means that regions rich in peloids should implement specific environmental policy aimed at finding balance between exploitation and conservation for the purposes of sustainable development. It is recommended that the relevant legal acts, official strategies, programs, and very decision-making should include several components. The latter have to deal with norms of extraction, recreational visit norms and permits, natural and, particularly, geological heritage protection, and investments. Similarly important is regional exploration of peloid resources and subsequent spatially-justified planning of their exploitation and conservation.

Figure 3
Importance of peloid resources for regional sustainable development



Source: Own construction

5. Conclusion

The present conceptual treatment of peloids permits making three general conclusions. First, peloids should be considered as a separate kind of natural resource with specific characteristcs (e.g., this is a renewable resource with spot-like geographical distribution). Second, the example of the Russian South demonstrates this resource can be of regional importance. Third, exploitation and conservation of therapeutic mud deposits can contribute to regional sustainable development (environmental and socio-economical sustainability coincide in this case), which requires careful development and implementation of specific direction of environmental policy.

Generally, this paper demonstrates that judgments of peloids in socio-economical frame are not only possible, but also useful (both theoretically and practically). Therefore, the relevant research should become more active in the future with emphasis on regions rich in peloid resources.

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[Index]

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