

THE EXTRACTION OF RAW MATERIALS FOR THE CEMENT INDUSTRY AND NATURE CONSERVATION

ZAGOTAVLJANJE PRIMERNIH MATERIALOV ZA CEMENTNO INDUSTRIJO S CILJEM OHRANJANJA NARAVE

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The basic raw material for the cement industry is a mixture of high carbonate and siliceous lithological components, mined, as a rule, from open pits and quarries. This activity is a permanent interference with the land, which is a basic component of the ecosystem. It would be possible to limit the use, or better, to continue the extraction of raw materials and ensure, in parallel, the positive interference of open-pit mining on the environment. The correct revival of open-pit areas and quarries would preserve the geological and ecological knowledge of the formation of mineral deposits and their surroundings. The correct preservation and valuation of acquired data would permit the industrial and technological development with respect to nature conservation and sustainable growth. The implementation of this model would change the use of abandoned open pits and quarry areas for schools to provide education about natural processes.

Key words: cement industry, raw materials, nature conservation, sustainable development

Povzetek

Surovina za cementno industrijo je zmes apnenca in silikatnih litoloških komponent, ki se po pravilu pridobivajo v odprtih kopih in kamnolomih. Ta dejavnost je stalna motnja v naravi, ki je podlaga ekosistema. Ali bi bilo mogoče omejiti uporabo, ali bolje, ohraniti pridobivanje surovin in doseči pozitivno interferenco med izkoriščanjem odprtih kopov in okoljem. Pravilna oživitvev področij odprtih kopov in kamnolomov bi ohranila geološko in ekološko znanje o nastanku ležišč mineralnih surovin in njihove okolice. Pravilna ohranitev in ocena podatkov pa bi omogočila industrijski in tehnološki razvoj pri spoštovanju narave in načel trajnostnega razvoja. Uporaba tega modela bi spremenila uporabo opuščenih odprtih kopov in kamnolomov v šole za poučevanje naravnih procesov.

Ključne besede: cementna industrija, surovine, ohranjanje narave, trajnostni razvoj

1 INTRODUCTION

Respect for fundamental ecological requirements is the basis for sustainable economic development and growth, and offers an acceptable alternative for future generations. The principles of sustainable development are accepted, generally, as a basis for economic growth and environmental preservation¹⁵. The bridging of the difference between sustainability and sustainable development is, in the long term, a difficult-to-achieve goal and, for this reason, sustainable development is a changeable process moving to defined goals that are equilibrating in given conditions the questions of development and nature conservation. The correlation between human economic development is a permanent survival contest for the acquirement of goods, especially in times of cultural and economic growth.

The difference in economic development between countries reflects the density of population and the level of life. The density of population, if related to a lower availability of natural sources, may promote a negative character of the contest for life goods. The evolution of trade is based on the equilibrium of the quality and the quantity of products, while the basis of economic growth is the quality and quantity of human and natural resources.

Human resources have a positive effect on economic development and economic growth and, with the given natural conditions, the growth rate is related to the quality of human capital. From the earliest times of human evolution two types of individuals are known:

1. Quantitative individuals, giving low weight to natural resources,
2. A smaller qualitative population that also considers the correct preservation of qualitative resources (an accent on sustainability) and strives for technological advance.

In the frame of the development of the extraction of raw materials, considering also the re-cultivation of the deposit site, several investigations were performed, e.g., a selective extraction with regard to the availability in the open pit and in correlation with the process of clinker manufacturing^{7,8,9,10}. The results of these investigations allowed a valuation of the mineral deposit, to optimise the raw-material exploitation and to find the best-suited method for the revitalisation of the surface damaged by the mining exploitation. The parallel use of qualitative and quantitative sources in the same area encompasses Darwin's theory of evolution, according to which the individual is forced into changes because of the limitation of resources. Short time changes also require a

change in the relation to known sources of survival and implies the Lamarck theory of evolution of a qualitative population. With such thinking the following question appears: to what level can the base resources be used and how can we ensure the exploitation of the remaining sources?

2 GEOLOGY

The open pits and quarries of the Salanit Anhovo company, situated on the left-hand side of the river Soča at the regional road Nova Gorica–Tolmin consist of the abandoned Deskle quarry, the Lastivnica and Perunk quarries and the Rodež quarry, which is the base of the reserves. The quarries are bordered to the east by the Banjščica plateau and to the west side by the Trnovo plateau. According to the geological structure the area belongs to the unity of the Trnovo nappe, and to a part of the more complex geotectonical unity, the Adriatic-Apulia plate⁵. A smaller part of the unity is pushed on the flysch of the Vipava synclinorium, which towards the south west passes over to the overturned anticlinal Sabotin-Skalnica, while it sinks to west to the flysch of Goriška Brda, Furlany and Slovenian Benečija. The area is interweaved with smaller local discontinuities⁷ and the regional fractured structures of the dinar direction northwest–southeast. The exploitation area, which the quarries are part of, is crossed by two regional faults: the Grgar separating the lower and upper paleocene flysch in Deskle, and the Voglar fault, with a clod of lower cretaceous limestone.

In the early cretaceous and in paleocene the area of Lower Posočje was the bottom of a sedimental basin. Between Morsko and Trieste three ridges of limestone forming under water shelves¹³ existed already in the period of flysch sedimentation. Similar structures are also found on the north and the south sides, and are considered to divide the sedimental basin between Kanal

on the north and Trieste on the south, in more or less separated sedimental depressions-intraplatform basins opened to the northwest and west. Because of the abrasion by the regression, the sea and also related to tectonic movements, at bluffs empilements, great quantities of carbonate material were formed, which slid in the form of an underwater landslip. In the slipping process a turbidit flow was created⁴ from which flysch sediments were formed. Such underwater gravitational flows in the surroundings of Anhovo on the east and southeast coasts eroded the older incompletely lytified sediments. The moving mass laid down in the boundary area of the depression with a relatively flat bottom and formed a fan. This explanation is confirmed by the presence of layers of marly calcareous breccias with great inserts of olistostromic breccias. Above this horizon, the coarse-grained limestone breccia was laid down, which passes gradually to a fine-grained breccia, calcirudite, calcarenite and marlstones. Limestone blocks of 100 m in length and 30 m in height were found². Above the marlstones the sedimentation is continued in the early paleocene with rapidly changing layers of siltstones, marlstones and siliceous and carbonate sandstone. On the north in the area of today's Austrian Alps, in the early cretaceous period a similar process of formation of carbonate mud at **rudist** ridges¹¹ occurred.

Slides and flows did carry to the Anhovo Area from the east and the southeast carbonate and siliceous material filling. In this way, the underwater valley between the early cretaceous limestone Jelenk and the underwater shelf Sabotin-Skalnica on the south side, was formed. The flow of carbonate material from the north gradually decreased⁶ and from west and northwest prevailed the distal sedimentation of turbidit flows.

The formation of carbonate material, the erosion, the transport and accumulation represent a dynamical equilibration between the sediment and the environmental physical forces. The accumulation of material at

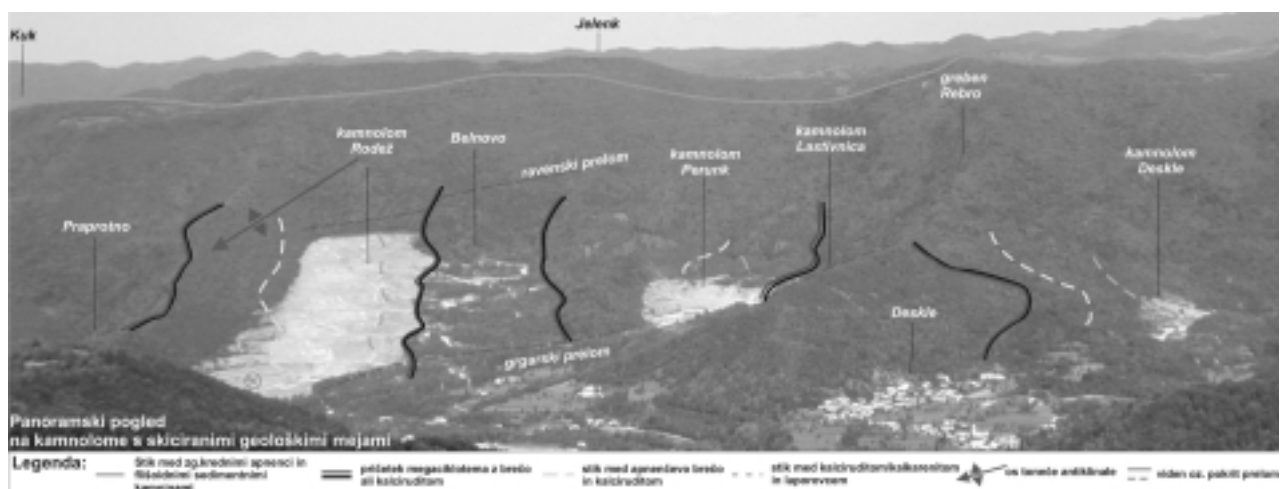


Figure 1: Idealised presentation of the intra-platform basin
Slika 1: Idealizirana predstavitev bazena med platformami

Globokomorski procesi, transport in sedimentacija vzorčevanih merjencev

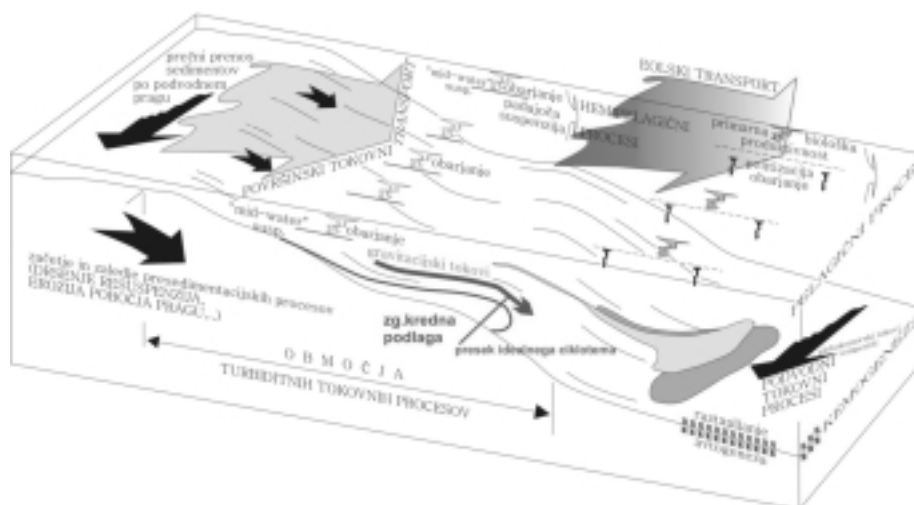


Figure 2: Deep-sea processes, transport and sedimentation
Slika 2: Globokomorski procesi, prenos in sedimentacija

the coast and at the underwater ridge depends on superposed factors. Summarising the sedimentation in some points, we can conclude that it depends on the depth of the water and the distance between the sedimentation place and the underwater ridge. It is linearly dependent on the level of kinetic energy in the sedimental environment and the quantity of plankton as well as r and K organisms.

The energy of the flow consists of the initial potential energy and the frictional energy, both changing in the movement to viscous and potential energy. It is possible from the facial data to draw a conclusion on the paleo-gradient, which is shown by the sedimental textures¹.

3 NATURE CONSERVATION AND INDUSTRIAL AND TECHNOLOGICAL DEVELOPMENT: WHEN AND HOW?

Nature-protection activities are frequently a disturbing factor for the rapidly developing industrial world. For this reason, one of the most important goals of the nature-protection activity is the linking of nature conservation and technological development. The planning of interventions is frequently based only on the technical interpretation and the respect of legal provisions. Too little attention is given to the consequences of the interventions because industrial and technological development and nature conservation are mutually dependent. A better knowledge of environmental factors and their equilibration are of vital importance for a long-term and equilibrated development.

During the exploitation of the quarry the most care is given to the base function (the exploitation of raw material), while the sanation after the industrial exploitation was ended remained frequently only in plans. For this reason, the sanation of the quarry should

occur in parallel with the exploitation to be able to ensure, in this way, after the exploitation is ended, a new quality and significance of the area. The selection of the final purpose of the place and of its contents is very rich: the acquiring of a new rural surface, the settlement of a new recreational area, the protection of the quarry as cultural heritage and not lately as simple nature preservation. The last process signifies a new settlement of the natural equilibrium in the quarry area.

How to diminish the negative effects on the nature and prevent the destruction of natural values, how to establish new and substitute ecosystems and, at the same time, allow the necessary industrial development are great challenges for the spokesmen of nature protection. Surprising discoveries and findings about exceptional natural heritage occur frequently with projects, which were rejected from the standpoint of nature protection. By building the highways in Kras a site with dinosaur fossil remains was discovered,³ as well as more than 200 carstic caves and precipices¹⁴. Such discoveries require additional investigations and can lead to new knowledge of the geological history of the area.

4 SALONIT ANHOVO QUARRIES – PROTECTION OF THE GEOLOGICAL NATURAL HERITAGE

The system of protection of the geological natural heritage in Slovenia is prescribed by the Law of Nature Protection. In a section of this law including fossils and minerals, the protection of the geological natural heritage inside and outside their finding places is regulated. Such a protection can be efficient only if the administration is actively involved. The perception of the public of geological heritage and its active involvement are of vital importance for an active policy of protection².

Table 1: Natural heritage list (NH)

Tabela 1: Evidenca naravnih vrednot (NV)

Num.	Name	Short description	Importance	Type of NH	Extended description and evaluation	Protection measure
3619	flysch profile Anhovo-Lastivnica-	flysch profiles in the Anhovo quarry	national	geological	In the area of the Lastivnica quarry the exploitation was ended. In the profile it is possible to identify the complete, for turbidites, typical Bouma sequences. In the bench wall several smaller fractures are found with visible shifts and a water spring, which is an interesting structural and hydrological phenomenon. It represents an unique flysch sedimentation in the Slovenian region. State and purpose: The profile is being overgrown because of poor maintenance. It is easily accessible and suited for study purposes, for public visits and as a teaching path.	Proposed for protection as natural monument
3618	flysch profile Anhovo – Rodež	Cyclothem Podbrdo	local	geological	In the profile the composition and the structure of the marly calcareous breccia of the cyclothem Perunk are visible. It is a unique eroded surface with clearly visible composition and structure of the breccia. State and purpose: The profile is situated at the drive approach and it is endangered by the quarry enlargement. It is suited for study purposes.	Proposed for contract protection with the owner

PROPOSED NATURAL HERITAGE LIST					
Name	Short description	Importance	Type of N	Extended description and evaluation	Protection measure
Fold on the bench E 127	sedimentological phenomenon	local	geological	Clearly visible structure of an eroded and wrapped olistolite fold shaped and composed of interbedded siliciclastic distal and proximal calcareous turbidites; size 15 x 7 m; localisation on bench E 127 in the Rodež quarry.	It is endangered because of planned operations; the size does not permit moving. For this reason, an exact documentation should be prepared
Rudistna breccia	finding place – locus tipicus of rudists shells	local	geological	The profile is situated between the quarries Rodež and Perunk. Locus tipicus of rudist <i>Pironaea buseri</i> n. sp. (Pejović, 1996)	Endangered because of planned operations; specimens of shells are kept in the seat of the company SALONIT ANHOVO, d. d.



Figure 3: Fold on the bench E127 described in the table

Slika 3: Guba na etaži E127. Opis je v tabeli.

The Anhovo quarries belong to the biggest open pits in Slovenia. Several pits were opened to ensure the raw material necessary for the production (Deskle, Lastivnica, Rodež and Perunk), and some of them are abandoned. The quarries are environmentally closed units and represent a great lesion in the area. Only experts can see the quarry as a possibility for discovering and understanding natural phenomena, initially, the geological and geo-morphological natural heritage.

The area of the pits was investigated by several geologists for industrial and scientific purposes. The geologically specific sediments of Anhovo are the interweaving of three underwater plumes¹². This is very interesting and in the Slovenian area the only sedimentation of flysch stones of such dimension. In the process of exploiting quarries the stones are denuded and the profiles in the quarry easily accessible and suited for observation. Until today, in the quarry area two profiles were evidenced and are already included in the list of natural heritage (profile Lastivnica and the profile in the quarry Rodež). Also evidenced are some other geological phenomena (fossils findings, structural phenomena), which will be destroyed by the future exploitation of the quarry. Since these phenomena cannot be preserved in place or moved, careful documentation and investigation are even more pressing.

The cooperation between the Saloni Anhovo company and the representatives of the nature conservation activity have been cooperating for more than 10 years with an accent on the preparation of the arguments for the proclamation, as a natural monument, of the profile Lastivnica. The incentive was given and the professional documentation was already prepared by the beginning of the 1990s; however, the procedure was stopped for different reasons. The revival of the proposition for the protection of the profil Lastivnica should give to this area a new purpose, e.g., the protection of a unique geology (sedimentology, paleontology tectonic structures), education with the aim of better understanding of natural processes for professionals and interested public (school children, scientists, visitors, etc.) and the marketing of new content.

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