ΔΗΜΟΣΙΕΥΣΗ No 41

PROCEEDINGS INTERNATIONAL SYMPOSIUM ON ENGINEERING GEOLOGY AND THE ENVIRONMENT, ORGANIZED BY THE GREEK NATIONAL GROUP OF IAEG/ATHENS/GREECE/23-27 JUNE 1997

Engineering Geology and the Environment

Editors
P.G. MARINOS
National Technical University of Athens
G.C. KOUKIS
University of Patras
G.C. TSIAMBAOS
Central Public Works Laboratory, Athens
G.C. STOURNARAS
University of Athens

OFFPRINT / TIRE-A-PART

MARIOLAKOS, I., FOUNTOULIS, I., LOGOS., E. (1997). The geoenvironmental conditions at the proposed landfill site close to Varnavas village (Attiki, Greece). *Proc. Intern. Symp. Engin. Geology and the Environment (Editors: Marinos, Koukis, Tsiambaos, Stournaras) IAEG*, v. **2**, 2003-2006, Balkema, Rotterdam.

A.A. BALKEMA / ROTTERDAM / BROOKFIELD / 1997

PROCEEDINGS INTERNATIONAL SYMPOSIUM ON ENGINEERING GEOLOGY AND THE ENVIRONMENT,
ORGANIZED BY THE GREEK NATIONAL GROUP OF iaeg/ATHENS/GREECE/23-27 JUNE 1997

Engineering Geology and the Environment, Marinos, Koukis, Tsiambaos & Stournaras (eds)

The geoenvironmental conditions at the proposed landfill site close to Varnavas village, N. Attiki, Greece

I. D. Mariolakos, I.G. Fountoulis & E. K. Logos
Division of Dynamic Tectonic Applied Geology, University of Athens, Greece

ABSTRACT:In order to understand the geonviromental conditions of the Varnavas landfill site, the Geomorphology, Geology, as well as the tectonic and neotectonic deformation of the site were studied in detail. Thereafter for the purpose of judging to select an area with the more geoenvironmental advantages to be used as landfill site, all the above mentioned were quantified by using a multi criteria evaluation system. The results indicate that this site is not suitable, from the geoenvironmental point of view, to be chosen as a solid waste landfill site.

1 INTRODUCTION

Up to the present time, the landfill site selection was done following the "criteria" of the local authorities each time, without taking into account the geoenvironment. The Union of Local Authorities of Attiki (ESDKNA) tried to apply some standards, when entrusted for first time the study of environmental consequences from the function of a candidate landfill site at the area of Varnavas in the northern Attiki. For this purpose detail study of the Geomorphology, Geology, Tectonics and Neotectonics was not restricted only at the narrow landfill site, but it has been extended at the major area.

The proposed landfill site is located approximately 3 km north of Varnavas village (Northern Attiki), (Fig. 1).

2 GEOMORPHOLOGY

The candidate landfill site belongs to the upper part of a 3rd order hydrological basin, the sream of which drives out in the gulf of Euboea. The bigger part of the southern, eastern and northwestern boundaries of the candidate landfill site , coincide with the watershed, while the rest part of the boundaries are located in a small distance from it.

The drainage network has been developed on metamorphic rocks (gneiss, schists, marbles), while a very small part has been developed on post-alpine deposits. The main stream, which crosses the candidate landfill site, is of 3rd order and strikes NW-SE. At the exit of the study basin very intensive linear erosion is observed, which contributes to the instability of the slopes of the landfill site.

The morphological gradient of the landfill site is high and never lower than 9^0, while the higher reaches 25^0. The high morphological gradient, combined with: (i) the thick zone of weathered rocks, (ii) the already occurred landslides and creep phenomena, have caused very serious problems to the slope stability. Another negative factor is the already mentioned linear erosion, which is observed at the stream that cross the landfill site.

At the major area many surficial karstic forms occur on the marbles. These karstic forms have been developed along faults and joints sets. Karstification is also observed at the much younger conglomerates (breccia) and travertines.

3 LITHOSTRATIGRAPHY

At the study area the following post-alpine and alpine formations occur (Fig. 1):

GEOLOGICAL SCETCH - MAP OF VARNAVAS

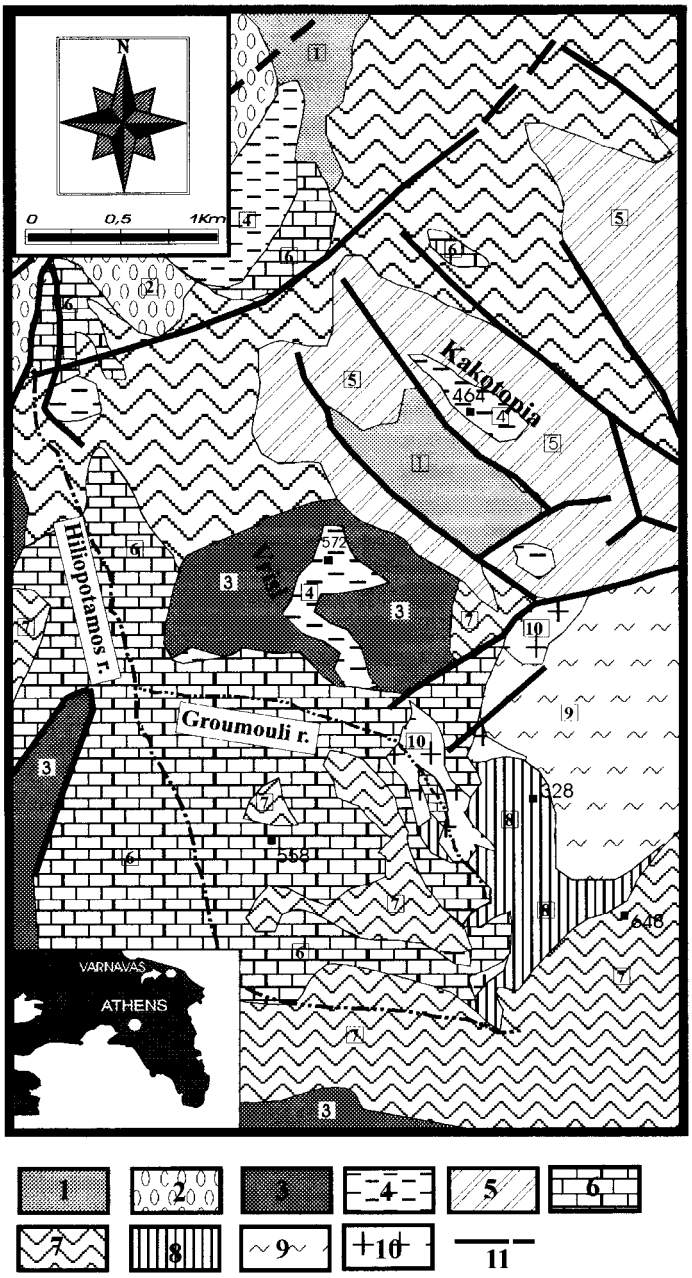

Fig. 1 Geological sketch map of Varnavas. 1:Holocene deposits (scree, talus), 2:Agioi Apostoli formation, 3:Varnavas conglomeratic breccias, 4:Kalamos travertine limestones, 5:Marbles, 6:Sipoline marbles, 7:Schists-marbles-gneiss, 8:Schists, 9:Gneiss-schists, 10:Gneiss, 11:Fault

3.1 Post-alpine formations

Holocene deposits: They consist of loose scree and talus deposits.

Agioi Apostoli formation: This formation consists of non cohesive conglomerates alternateing with brownish sands and silts.

Varnava conglomeratic-breccias: They are continental deposits and river terraces, consisting of pebbles and gravels from the basement (marbles, gneiss, etc.). Their size varies from few cubic centimeters to some cubic meters, whereas locally they are cohesive. The age of the formation is Late Miocene - Pliocene(?) (METTOS, 1992), and their thickness reaches the 150m.

Kalamos travertine limestones: They consist of thick-bedded travertines, which are multi-fractured and slightly folded. They overlie unconformably on the Varnava conglomeratic-breccias, as well as on the rocks of the alpine basement. Their thickness varies from 0 to 50m.

3.2 Alpine formations

Marbles: They are gray bedded or thickbedded multi-folded, multi-fractured and karstified marbles.

Sipoline marbles: They are gray, and locally reddish, green or blue laminated marbles (sipoline marbles). They are strongly multi-folded and multi-fractured whereas locally their schistosity is very intensive and they transform to calc-schists.

Schists-marbles-gneiss formation: It consists of schists, with laminated marbles intercalations which are difficult to be mapped, whereas locally gneiss occur. The rocks of this formation have been strongly deformed by isoclinal folds and multi-fractures. It's thickness is up to 100m.

Schists: It consists of reddish-brown schists, with intercalations of quartzites and locally with very intensive schistosity. Their thickness is up to 40m.

Gneiss-schists: They are gneiss intensively weathered, transforming to reddish schists which are intensively fractured.

Gneiss: They are gray to reddish gneiss inensively weathered and fractured. Their thickness is up to 20m.

At the major area, apart the alpine metamorphic rocks, non-metamorphic alpine rocks also occur (carbonates, ophiolites, sandstones, silts). It is remarkable that the described metamorphic rocks of the area overthrust the non-metamorphic ones (MARIOLAKOS et al., 1993). The latter are not depicted on the map.

4 TECTONICS - NEOTECTONICS

The deformation of the major area has taken place in two periods, the alpine and the post-alpine or neotectonic. Isoclinal folds in different scales, reverse faults and thrust faults, as well as faults, are the main alpine tectonic structures. The alpine deformation has affected only the alpine formations. Fault zones, and normal faults are the main tectonic structures, which characterize the neotectonic period. The neotectonic deformation has affected both alpine and post alpine formations.

The main strike of the fold axis of the macro-structures (few to some kilometers) is NW-SE, that is the same strike with the axis of smaller size folds, while all the axial surfaces dip towards east-norhteast (LOZIOS, 1994).

The neotectonic deformation has mainly formed the morphological margins of the metamorphic formations in NE Attiki, as well as the margins of the post-alpine basins. The predominating directions of the faults are NW-SE, N-S, NE-SW and E-W. All these four systems control the shape of the coastlines. However, the NE-SW striking faults predominate at the major area. It is also remarkable that the big valleys are controlled by the big faults.

The wide outcrop of marbles at the area located SW of Cape Kalamos, is related to two big fault zones striking NE-SW. These faults are characterized as probably active faults. It is believed that these faults is possible and resulting the creation of a multi-fractured block due to many faults striking NW-SE, which are bounded by the already mentioned NE-SW fault zones, creating very characteristic fault scarps. As these faults strike the same direction with the submarine active faults of northern Euboic gulf, they were characterized as active faults, which very probably can be reactivated in the future although it doesn't mean necessarily that they could cause a seismic event.

5 DISCUSSION - CONCLUSIONS

Taking into account all the above mentioned and more specifically, the geometry of all tectonic discontinuities, combined with the lithology and the high morphological gradient, which is related to the linear erosion due to the intensive uplift during the Quaternary, which has intensively fractured the rockmass, the slope stability has been disturbed. This fact has caused minor and large landslides, phenomena which characterize the whole geoenvironmental regime of the study area.

For the purpose of selecting an area with the more geoenvironmental advantages to be used as landfill site, all the above mentioned were quantified by using a multi criteria evaluation system. The results indicate that the study site is not suitable from the technicogeological and geoenvironmental point of view to be used as a solid waste landfill site.

REFERENCES

DOUNAS, A., KALLERGIS, G., MORFIS., A., PAGOUNIS, M. (1980) - Hydrogeological investigation of the Agioi Apostoloi - Kalamos brackish karstic springs. -*Publ. IGME,* No 31, 55 p., Athens.

LOZIOS, S. (1994). - Tectonic analysis of the metamorphic formations of NE Attiki. -*PhD Thesis, Dept. of Geology, Univ. of Athens,* 299 p., Athens, (in greek).

MARIOLAKOS, I., FOUNTOULIS, I., LOGOS, E. (1993). - Supplementary works for the compilation of complete maps at the Varnavas landfill site. -*Final Report,* 20 p., ESDKNA, Athens, (in greek).

METTOS, A. (1992) - Geological and palaeogeographic study of the neogene and quaternary continental formations of NE Attiki and SE Boeotia. -*PhD Thesis, Dept. of Geology, Univ. of Athens,* 259 p., Athens, (in greek).

PAPANIKOLAOU, D., MARIOLAKOS, I., LEKKAS, E., LOZIOS, S. (1988) - Morphotectonic observations at the Assopos basin and the coastal zone of Oropos. Contribution to the neotectonics of Northern Attiki. -*Procceedings of 3rd Congr.of Geol. Soc. Greece, Bull. Geol. Soc. Greece,* t. XX/1, p. 251-267, Athens, (in greek).