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Lithological and Mineralogical study of Quaternary Clastic Materials of the Internal Thermaikos Gulf

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Location & Geological Background

The basin of Thermaikos Gulf is located at the Northwestern part of the Aegean Sea, North Greece (Fig. 1). It is a tectonic draft with a varying depositional environment, formed as a result of the NNW-SSE trending tectonic rifting movements, which developed in this area during Tertiary. During the Pliocene to Pleistocene, the basement was effected by relatively rapid submergence. Consequently, the appropriate conditions were formed for the transportation and the deposition of sediments within the basin.

Figure 1. Location of the study area on the maps of Greece (upper right corner) and of the broader area of Thessaloniki (lower right corner). On the left, the positions of the wells of the drilling program "Widening of Coastal Avenue of Thessaloniki", which was executed in the Internal Thermaikos Gulf, close to the city of Thessaloniki. The yellow well names indicate the drillings from which borehole core samples were tested in laboratory (source: Google Earth).

Methodology & Results

In the present work, ten (10) samples of borehole cores from 7 different wells were studied to examine their mineralogical, textural and lithological features. These drillings were perforated in the spring of 1979 in order to study the subsoil of the Thermaikos Gulf, as part of the "Widening of Coastal Avenue of Thessaloniki" project. In this way, a drilling program was carried out involving seventeen (17) wells, which were numbered from Γ13 to Γ29 (Fig. 1). In-situ engineering geological tests, such as S.P.T. (Standard Penetration Test) were performed, and samples of borehole cores were collected.

Table 1. Grain size distribution (% w/w) of the studied samples. The double line frame includes the samples of the drilling Γ14, which was chosen for the vertical study of the sediment succession.

Sample *(depth)*	**Gravel** (>2mm)	**Sand** (2mm-63μm)	**Silt** (63μm-2μm)	**Clay** (<2μm)	**C.O.I.***	**Total**
Γ13 *(22.30-22.60m)*	4.1	49.4	22.4	16.0	8.1	100.0
Γ14 (1) *(14.85-15.15m)*	10.6	39.1	28.0	15.8	6.5	100.0
Γ14 (2) *(19.50-19.80m)*	7.1	45.8	21.5	14.3	11.3	100.0
Γ14 (3) *(25.20-25.50m)*	4.3	41.5	18.5	30.0	5.7	100.0
Γ14 (4) (31.20-31.50m)	3.6	26.7	27.5	31.3	10.9	100.0
Γ15 *(19.10-19.40m)*	8.7	42.1	22.1	15.9	11.2	100.0
Γ16 *(20.80-21.10m)*	19.4	33.0	23.5	17.4	6.7	100.0
Γ23 *(18.20-18.50m)*	22.4	24.8	30.3	13.9	8.6	100.0
Γ24 *(20.45-20.75m)*	9.9	32.5	28.9	23.0	5.7	100.0
Γ26 *(26.40-27.40m)*	15.4	41.5	15.1	22.7	5.3	100.0

* C.O.I.: Carbonates + Organic matter & MnO_2 + Iron (Fe) oxides and hydroxides

The ten samples were examined macroscopically and were sieved in ≥2 and <2 mm subsamples (Table 1). The ≥2 mm pebbles were inspected and characterized by using stereoscope and their textural and morphological characteristics were recorded. The <2 mm subsamples were treated according to Jackson techniques (1974), and sand, silt and clay fractions were measured (Table 1). The mineralogical composition of these fractions was studied by using X-ray diffraction (XRD) (Fig. 2).

According to Folk *et al.*, 1970 textural classification, the clastic materials of the studied area can be characterized as gravelly mud, sandy mud, gravelly muddy sand or muddy sand (Fig. 3). Their pebbles comprise of schist-gneiss (1.1-16.7% wt), quartz (0.5-6.2% wt) and limestone (0.1-4.6% wt). The Quaternary clastic materials display almost the same horizontal and vertical mineralogical composition regarding the whole samples. On the contrary, significant variations between sand, silt and clay fractions were observed (Table 1). Quartz (39-56% wt), feldspars (plagioclase 8-16% wt and K-rich 1-4% wt), chlorite (±kaolinite) (14-31% wt), illite (in the clay fraction) + muscovite (6-13% wt), illite/chlorite (2-13% wt), amphiboles (1% wt), pyroxenes (1% wt), calcite (1% wt) and dolomite (1-2% wt) were identified in three fractions (Fig. 2).

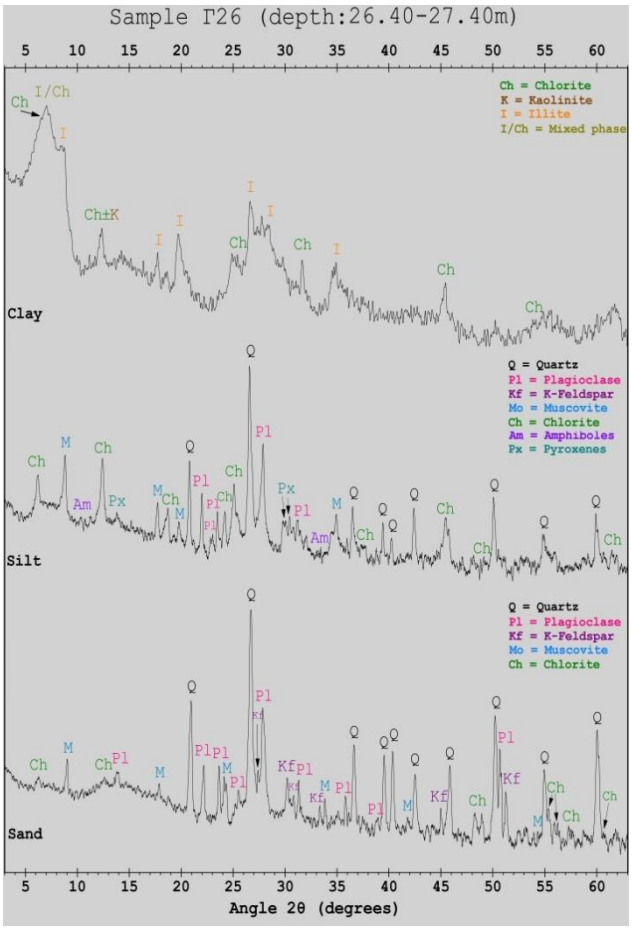

Figure 2. Representative X-Ray Diffraction patterns of sand, silt and clay of the sample Γ26.

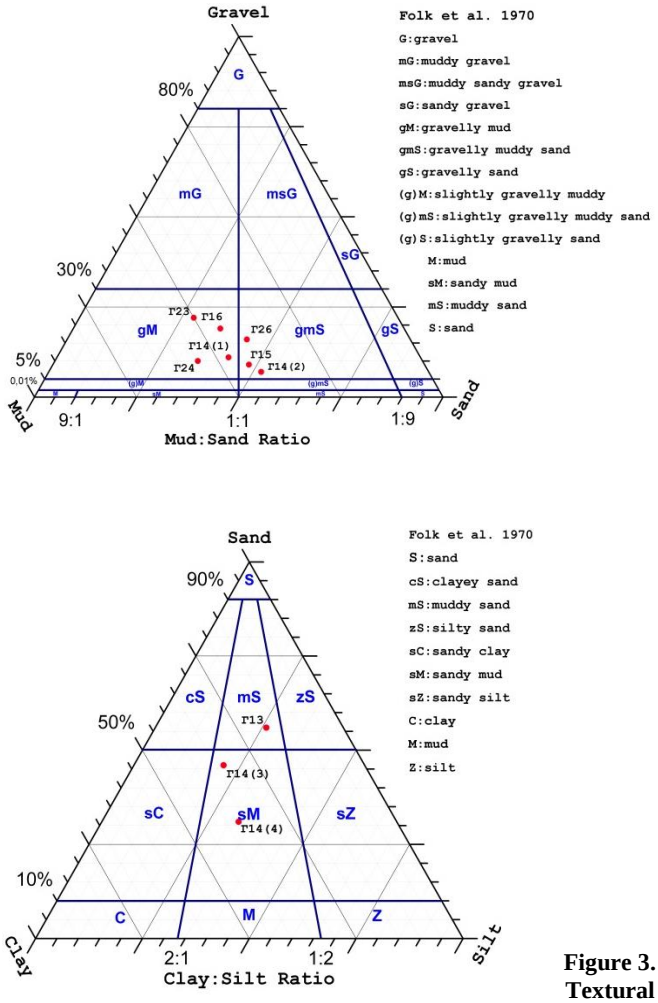

Figure 3. Textural classification (Folk *et al.* 1970): Gravel-bearing (upper) and gravel-free samples (lower).

Conclusions

All the above methods show that the deposition within the study area took place in a coastal marine depositional environment, in conjunction with the rapid transportation of sediments by the rivers and large streams, which leaked mainly through the hydrological basin of Thessaloniki and of Dendropotamos to some extent. The composition of Quaternary clastic materials of the Internal Thermaikos Gulf can be mainly considered as a result of the weathering which took place in the neighboring hydrological basins, where igneous and metamorphic rocks prevail. In addition, boulders of the Tertiary series (mainly from the Red beds) were also found.

References

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