DRAINAGE FEATURES AND THE DISCONTINUOUS STRUCTURE OF THE ISLAND OF NAXOS IN GIS PLATFORM

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ABSTRACT

Naxos, the biggest island of Cyclades, mainly consists of Quaternaries, Neogenes, Granodiorites, Marbles, Schists and Migmatites. Most Naxos morphological characteristics are strongly influenced by lithological, climatological and tectonical factors.

This paper studies the drainage system and its relation to the tectonical characteristics. For this purpose, an extensive fieldwork, supported by GPS and GIS, took place during 1999. All data were imported into a geographical database were each record is connected to a map objects at the GIS. All linear map objects, in our case tectonic lines and drainage system, were processed through a GIS algorithm, especially developed for orientation analysis. All primary and secondary data were presented through multiple diagrams and thematic maps, in order to compare and extract all possible relations between drainage system and tectonic activity.

KEYWORDS: Naxos, Discontinuous structure, morphotectonics, GIS

INTRODUCTION

Naxos is the biggest of the Cyclades islands. East of Naxos, Paros island is situated, south-southeast the islands of Heraklia, Schinousa, Coufonisi, Keros etc, while east we can see the islets of Makares, St Paraskevi, Strogili and Donousa (Fig. 1). The island's morphology mainly derives from tectonical and erosional processes (Sabot, V. & Papanikolaou, D., 1976, Sabot, V. & Papanikolaou, D., 1977, Sabot, V., 1978, Sabot, V., 1981, Riedl, H., 1982, Evelpidou, N., 2001). The main lithological formations of Naxos island are marbles-schists covering most of the island (330,89 Km^2), granodiorite (36,22 Km^2) (Fig. 2), migmatite (30,72 Km^2), Neogene (4,17 Km^2) and Quaternary deposits (18,69 Km^2). Finally a limited area is covered by alluvial cones and fans (9,27 Km^2) (Jansen, J., 1977, Altherr, R. et al. 1982, Lister, G.S. et al. 1984, Durr, St., 1986).

Marbles and schists-gneisses alternate frequently. In the west part of Naxos island granodiorite and sediments are prevailing.

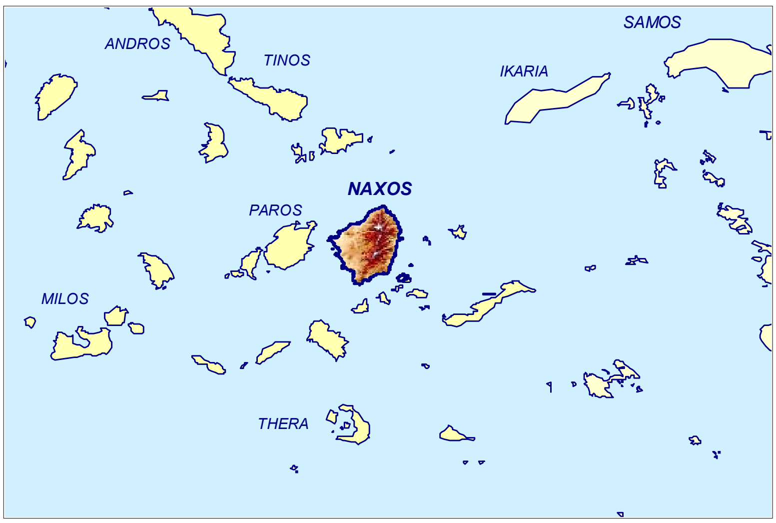

Fig. 1: Naxos island in the wider area.

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Fig. 2: Granodiorite and Tafoni formations in west Naxos.

CASE STUDY

During fieldwork the 694 fault and joint measurements, resulted to the conclusion that the prevailing tectonic line direction is WNW-ESE and the azimouthial direction (Fig. 3) is 100°. Directional analysis on the 71 faults, indicated at the geological map (National Institute of Geological and Mineral research) (Fig. 4), resulted to the same conclusion.

Most of the drainage system branches are situated to the marble-schist system, while the highest frequency is observed at the Neogene formations. The highest value of drainage density is found at the marble-schist system and then at Neogene formations.

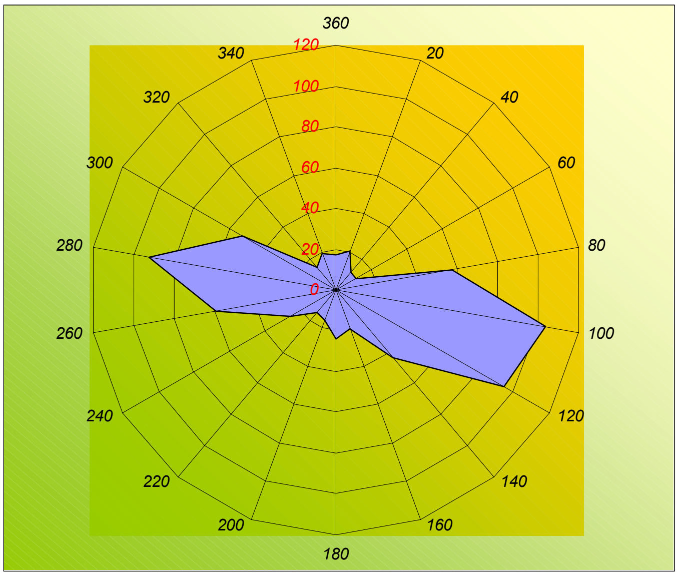

Fig. 3: Rodogram of the 694 directions of faults and cracks deriving from field measurements.

Branches of the first class are mostly present at the marble-schist system, then at the granodiorite and finally at the migmatite. The rest of the drainage system classes follow the previously described queue of development, except of the third class, in which most of the branches are situated at the marble-schist system, then at the migmatite and finally at the granodiorite.

In order to correlate the drainage system and the tectonical characteristics, directions of all linear map objects were measured and analyzed. For this reason a software called "Geoline Orientation Software" was developed in GIS environment using MapBasic programming language (Evelpidou, N., 2001). Using this software, the GIS database of all drainage system branches was updated with the corresponding object direction and finally presented with the graph of figure 5. As shown in the graph of figure 3, the prevailing direction of faults is 080° in a general range of 080°-120°. Except from this, main fault directions were in the direction of 020°. Comparing these graphs, one may conclude that the main fault directions coincide with those of drainage system, as most of the drainage system branches direction ranges from 100° to 120°.

Separate examination on each class shows that 1st class branches (Fig.6) have a general direction of 090°-110°, 2nd class branches (Fig.7) have a prevailing direction at 120°, 070° and generally in the range of 090°-110°, while the prevailing direction of the 3rd class branches (Fig.8) is 080°, in a general range of 075°-110°. Finally the 4th class branches (Fig.9) present two directional picks at 010° and 060°.

Concluding, the drainage system is highly affected by neotectonic deformations that have produced two general faulted directions: (080°-120°) and (00°-020°). This seems to coincide with the drainage system's direction, both as a whole and separately on each drainage system's class.

Finally the relation of drainage system's direction with the lithological formations was analyzed as shown in the following graphs (Fig. 10-13). The drainage system branches, which are situated at the marble-schist, have almost the same direction with the 1st class branches as most of them are situated at the marble-schist formation. Drainage system branches situated at granodiorite have prevailing directions ranges from 080° to 120° with prevailing at 100°. Similar development has been observed in the migmatite, while the directions are shifted 20° to the south, at least the prevailing direction. Finally, the drainage system's development at sediments, follows a direction of 070° and 090°.

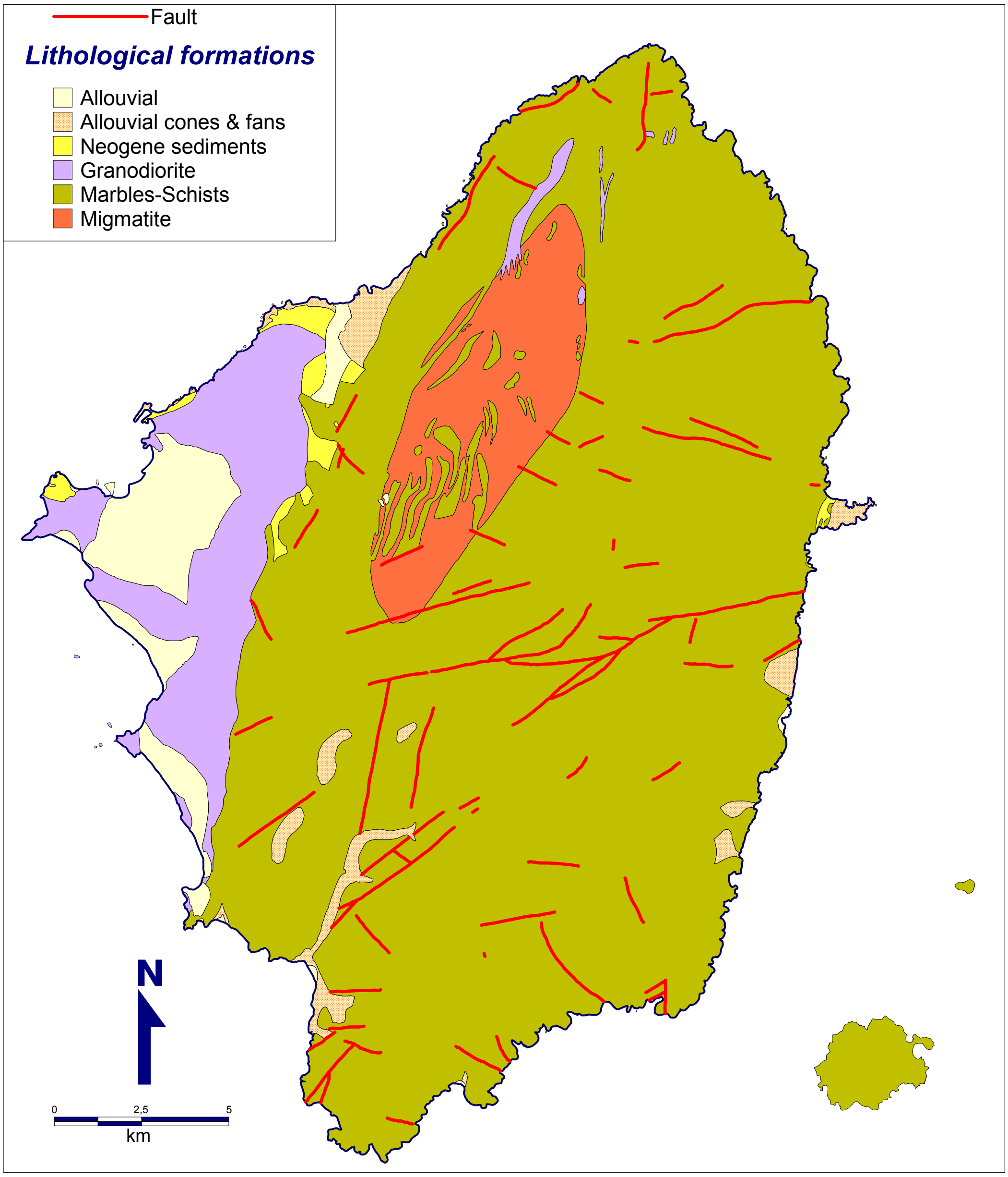

Fig. 4: Simplified geological map of Naxos island (ETHIGME, 1973, Jansen, J.B.H, 1977).

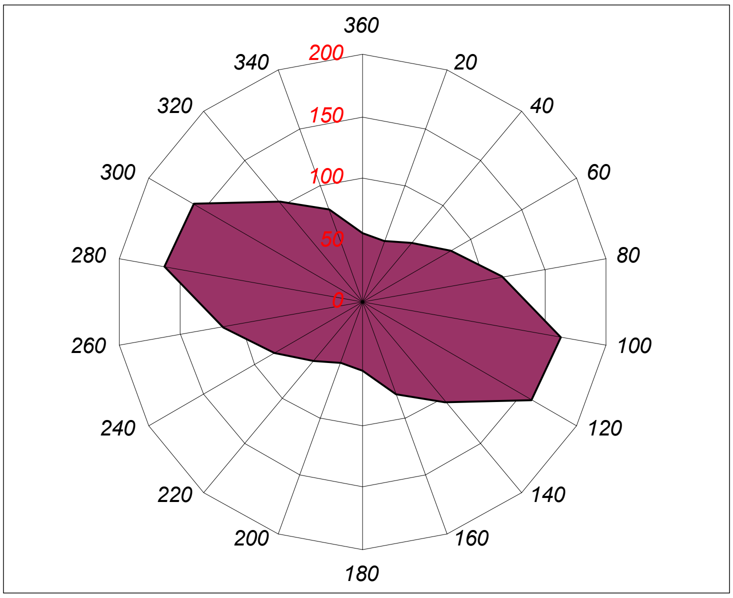

Fig.5: Rodogram of 871 drainage system branches.

CONCLUSIONS

The analysis of 694 faults and diaclases, deriving from fieldwork and from the 71 faults of the geological map, showed that the prevailing direction is WNW-ESE and in terms of azimuth 100°. This direction matches the main drainage system's direction. Most braches of the drainage system have been developed along tectonical zones. An algorithm was especially created to estimate class and fault directions, separately and together with lithological units as well. The range of the prevailing tectonical direction is 80-120°, while for the whole drainage system is 100-120°. The drainage system's analysis, related to lithology, indicated that directions in all lithological formations, follow the main direction that has already been mentioned through previous analysis, in this paper.

The rodogram of branch directions, situated in the marble-schist unit, is almost identical to the rodogram of the first class branches, indicating that most of the first class drainage system's branches have been developed on the marble-schist unit.

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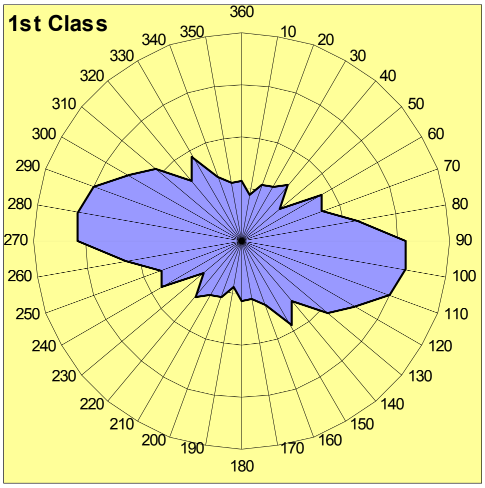

Fig.6: Rodogram of 645 1st class drainage system branches.

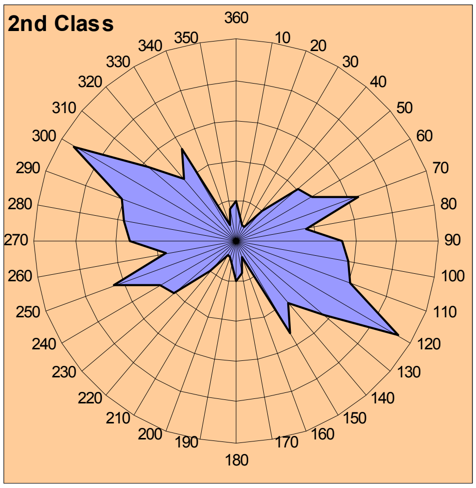

Fig.7:Rodogram of the 171 2nd class drainage system branches.

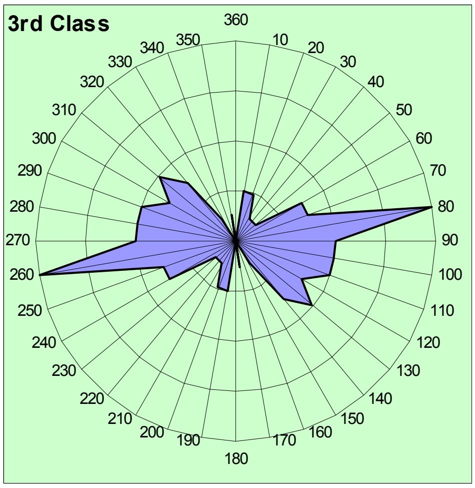

Fig.8: Rodogram of the 3rd class drainage system branches.

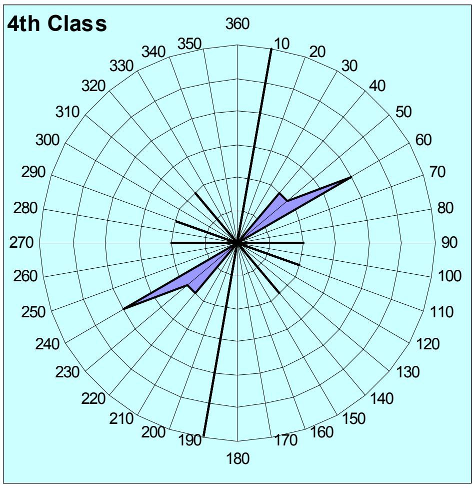

Fig. 9: Rodogram of the 4th class drainage system branches.

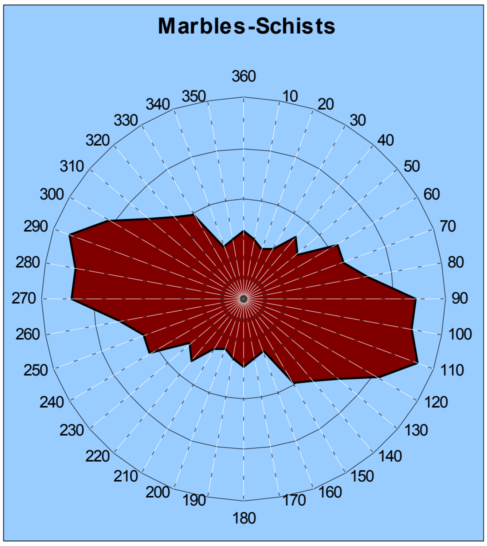

Fig. 10: Rodogram of drainage system branches direction in the lithological unit 'Marble-Schist'.

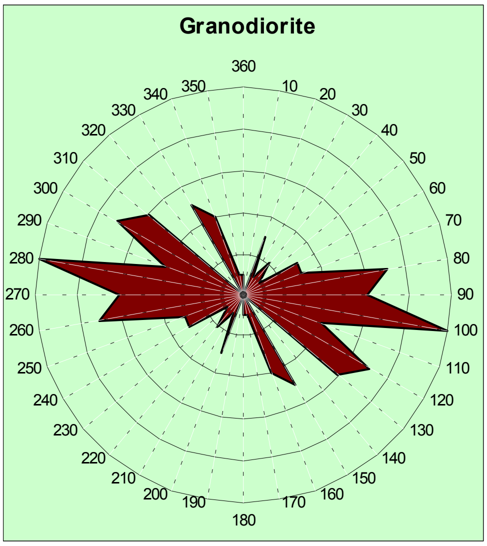

Fig. 11: Rodogram of drainage system branches in the lithological unit 'Granodiorite'.

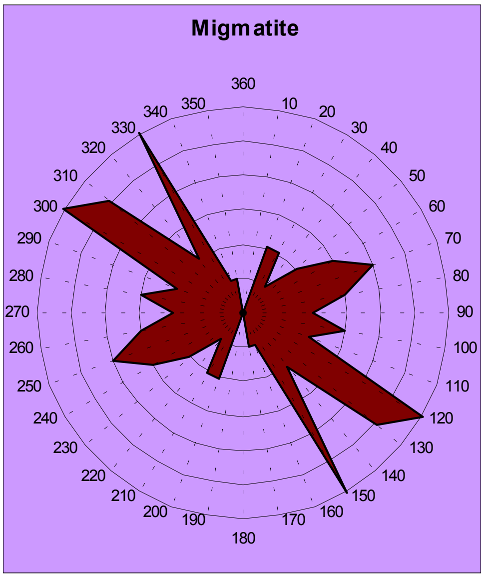

Fig. 12: Rodogram of drainage system branches in the lithological unit of 'Migmatite'.

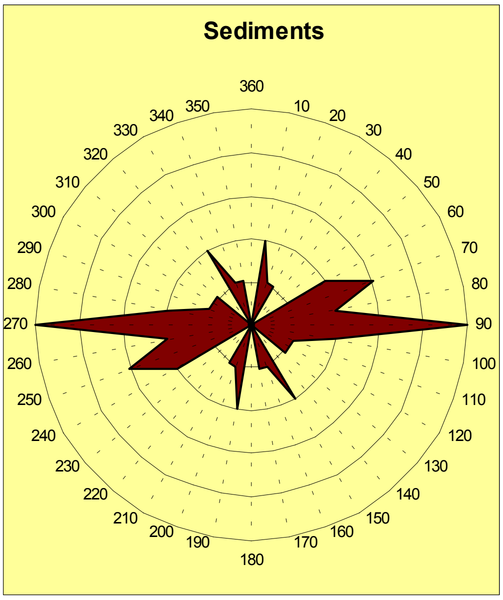

Fig. 13: Rodogram of drainage system branches in the lithological unit of sediments.