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OFFSHORE GEOLOGIC HAZARDS IN THE HELLENIC ARC

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Abstract

The Hellenic arc is located within one of world's most seismically active areas and has experienced extreme tectonism through Tertiary and Quaternary times. This tectonic activity controls the rates of uplift and subsidence and determines the sediment supply and depot centres.

This paper discusses the various geologic hazards detected in selected parts of the Hellenic arc and examines the causative factors. The areas surveyed were:the North Aegean Trough, the Gulf of Corinth and Patras; the Gulf of Amvrakia; the Zante/Cephalonia and the Kythera-Antikythera ridge in the outer island arc.

The potential geologic hazards observed are:(a) sediment instability and (b) Gas seeps and gas charged sediments.

The major types of slope instabilities that have been documented include:(a) surficial sediment creep in slopes ranging from 1 to 2° resulting in folding and faulting of the surficial sediments; (b) deep seated creep resulting in active faulting with up-hill facing scarps in slopes ranging from 3 to 4°. The height of the up-hill facing scarps ranges from 5 to 30m, (c) translational and rotational slides in slopes ranging from 2 to8°; (d) depris-flow and (e) turbidity currents of various sizes. Some small in size turbidity currents have been detected flowing in slopes between 0.5 and 8° up to a distance of 17 Km.

Factors that contribute to slope instability in the Hellenic Arc are:(a) sloping bottom; (b) thick accummulations of Plio-Quaternary sediments;(c) present day high rates of sedimentation; (d) closely spaced active faults;(e) active faulting and folding and (f) active diapirism. The contribution of large waves to slope failure in these areas appears to be of minor importance, as well the above mentioned slope failures occur in depths of more than 150m.

Gas seeps, gas charged sediments and pock-marks have been observed on areas associated with deltaic environments. This gas is presumably formed by the decomposition of biogenic material.

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GEOCHEMISTRY OF SAPROPELIC SEDIMENTS FROM EASTERN MEDITERRANEAN BASINS

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INTRODUCTION

Sapropels and sapropelic sediments have been the subject of considerable investigation recently and it appears that they have been formed under stagnant conditions caused by water mass stratification;however there has been some controversy over the source of their organic constituents (Kidd et al,1978;Calvert,1983;Sutherland et al , 1984;Shaw and Evans,1984) which is still an open question.Although the sedimentology, micropaleontology,mineralogy,stratigraphy and geographic distribution of sapropelic sediments have been extensively discussed,limited data are available on their chemical characteristics which may help to elucidate the above problem.In this work the chemical characteristics of sapropels,sapropelic and associated sediments,from the Cyprus, Antalya and Rhodes basins are described in an attempt to deduce their origin.

RESULTS AND DISCUSSION

Sapropelic sediments,sapropels,volcanic ash and marl ooze are the main lithological units recognized in the gravity cores analysed from the Cyprus,Antalya and Rhodes basins,eastern Mediterranean. Based on R mode cluster analysis it is demonstrated that of the trace elements examined Mo,V,Cd and Ba are associated with the organic fraction, Rb,Li,Be and La with aluminosilicates and Sr with biogenic carbonates,their variations reflecting the variations of these phases. Since it is well demonstrated that anoxic conditions favor the precipitation of Mo ,the lower concentrations of Mo in all surface sediments compared with those in the buried sediments suggest that environmental conditions in the three basins studied became more oxidizing towards the present.

All sapropelic sediments and sapropels are markedly enriched in Mo,Cd and V relative to the rest of the sediments.By contrast ,Ba shows enrichment only in the sapropel studied from the Heratosthenes seamount and the sapropelic sediments in the Rhodes basin,indicating the contribution of marine organisms to the organic constituents of the sediments here. The anomalously high Mo / Corg and Cd / Corg ratios found in some Rhodes basin buried sediments suggest an additional contribution of Mo and Cd by weathering of ophiolitic rocks occuring on the adjacent land.All sapropelic sediments and sapropel are enriched in Sr and depleted in Rb,Li,Be and La showing their enrichment in biogenic carbonates and their depletion in aluminosilicates.

A sapropel analysed from the Cyprus basin is from the Pleistocene Pseudoemiliania lacunosa zone and consists of calcite, nontronite, pyrite, gypsum and 4.2% organic carbon. The presence of abundant iron oxyhydroxides in the sapropel suggests that gypsum was formed from the oxidation of pyrite, while the significant enrichment of Ba, the franboidal texture of pyrite and the C inorganic/C organic ratio (≈1) support

Table 1. Compositions of sapropel and sapropelic sediments studied here in comparison with those of similar deposits from elsewhere. (data except C_{org} are expressed on a carbonate free basis).

		61	35	73	205	1	2	3	4	5	6	7	8	9
$CaCO_3$	%	38.5	33.4	11.9	40.3	49.9	35.9	22.35	22.8	1.34	33.2	34.3	48.3	
Corg	%	4.26	0.98	1.08	0.73	3.34	1.89	14.75	10.27	20.21	6.10	1.12	0.22	-
Mg	%	2.6	3.0	2.1	5.0	2.67	2.5	1.35	2.85	-	3.52	3.76	5.34	1.5
Na	%	2.99	2.54	2.61	2.78	-	-	-	-	-	-	-	-	0.96
K	%	1.53	1.44	1.49	2.11	1.95	2.5	2.05	1.57	-	1.71	2.15	2.51	2.66
Mo	ppm	137	12.3	11.8	26.1	80	55	225	106	144	109	21	5.8	2.6
V	ppm	390	131	165	184	-	-	-	-	-	-	-	-	130
Cd	ppm	6.01	3.90	2.11	2.60	-	-	-	-	-	-	-	-	0.3
Ba	ppm	634	176	205	704	1996	750	608	3291	418	1900	1303	1236	580
Li	ppm	50	60	59	64	-	-	-	-	-	-	-	-	66
Rb	ppm	49	56	61	75	109	132	31	60	39	70	84	101	140
Be	ppm	2.06	2.39	2.50	2.24	-	-	-	-	-	-	-	-	3
Sr	ppm	878	766	238	754	2277	925	953	648	127	967	1030	1587	300
La	ppm	36	39	39	33	-	-							92

61, 35, 73, 205: The present study
1: Core DI10103/8k on the Hellenic Outer Ridge (Sutherland et al., 1984).
2,3: DSDP site 379, Black Sea (Calvert and Batchelor, 1978).
4,5,6,7,8: DSDP sites 125, 126, 127, 128 and 130 (Calvert, 1983).
9: Average shale (Turekian and Wedepohl, 1960).

a marine origin for its organic constituents. Because the chemical, mineralogical, textural and micropalaentological features of this sapropel are similar to those described for sapropels from the same stratigraphic horizon at a number of sites east and west of Crete (Table 1) it is highly probable that this is a part of the same horizon which is extended in the Cyprus basin.

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