Mass Transport processes and their deposition architecture at escarpments of active faults : Examples from the Gulf of Corinth, Greece

G. PAPATHEODOROU and G. FERENTINOS

Laboratory of Marine Geology and Physical Oceanography, University of PATRAS **(Greece)**

Detailed high resolution seismic surveys using a 3.5kHz O.R.E. and a S.I.G. Sparker system in the eastern end of the Corinth Gulf, in the Aegean back-arc have revealed the formation of an active graben, the "Strava Graben". The Strava graben is an intrabasinal structure, trending E-W and interconnecting the Alkyonidhes and Corinth basins. The purpose of this paper is to reconstruct the principal events and processes responsible for the graben floor fill sequence during the synrift phase.

The Strava Graben is an asymetric graben. It is bordered to the south by a major E-W trending fault whilst to the north it is bordered by discontinuous NW-SE trending antithetic faults. The graben was formed after the submergence of the Alkyonidhes graben and its filling with turbiditic sequences, probably some time after upper Pleistocene. (LEEDER *et al.*, 1991). The wedge shape of the sequence within the graben together with the divergent character of the individual beds are indicative of the continuous activity of the faults bordering the graben.

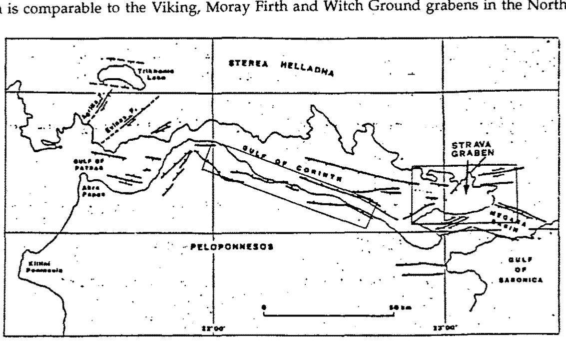
The acoustic character of the deposits in the floor of the graben, together with the spatial distribution of the seismic facies, reveal that gravity driven flows are the only sedimentation process and that the graben floor is exclusively filled by short term catastrophic events.

The emplacement of the individual deposits, which have a thickness ranging from 4 to 10m, in the floor of the graben appears to be a result of liquefied flows. Those flows are derived from the turbiditic sequence resting on the crest of the footwall block bordering the graben to the north. This transport mechanism is inferred by the sheet like appearance of the deposits, the acoustically transparent character indicative of the lack of any internal structure in the deposits, and the absence of non-disintagrative mass wasting deposits either in the source area or in the graben floor.

The liquefied flow deposits are locally seperated by stratified sequences which have a thickness of about 4 m. These sequences consist of thin parallel layers which probably represent turbidites.

Earthquakes which are a common occurence in the Gulf of Corinth can induce liquefaction of the sediments covering the crest of the footwall block bordering the graben to the north and create liquefied or turbidity flows.The mapped pattern of the seismic facies in the graben reveals that the liquefied and turbidity flows have accumulated as aggradational stacks consisting of sheet like lobes forming base of slope aprons that are fed by multiple sediment sources along active faults.

The findings of this study together with the results of the offshore studies in the Alkyonidhes bay by PERISSORATIS *et al.*, (1991) and LEEDER *et al.*, (1991)in the surrounding land area suggest that the tectono-sedimentary development of the present day active Strava graben is comparable to the Viking, Moray Firth and Witch Ground grabens in the North Sea.



General structural map of the Patras-Corinth and Megara rift zone. The location of the Strava graben is also shown.

REFERENCES

LEEDER M., SEGER M., and STARK C., 1991. - Sedimentation and tectonic geomorphology adjacent to major active and inactive faults, southern Greece. *Journal of the Geological Society of London* V. 148, pp. 331-343.

PERISSORATIS C., MITROPOULOS D., and ANGELOPOULOS I., 1986. - Marine geological research at the eastern Corinthiacos Gulf. *Institute of Geology and Mineral Exploration,* (I.G.M.E.), Greece, Special Issue pp 381-401.

Gas charged sediments in the Aegean and Ionian Seas

George PAPATHEODOROU, Thomas HASIOTIS and George FERENTINOS

Laboratory of Marine Geology and Physical Oceanography, Departement of Geology, University of PATRAS **(Greece)**

The Aegean and Ionian seas are parts of the Hellenic Arc-Trench system which is located within one of the world's most seismically active zones (MC KENZIE, 1972) and has experienced extreme tectonism through Tertiary and Quaternary times. Normal planar and listric faults which have been active since Pliocene are responsible for the formation of shallow and deep basins (Corinth and Patras gulfs, Trichonis lake, Amvrakikos gulf, Sporades basin) with high rates of uplift and subsidence and resulting high rates of erosion and deposition.

During the last ten years seismic surveys in various environments in the Aegean and Ionian seas revealed anomalous acoustic characters (acoustic turbid zones, gas pockets, gas plumes, enhanced reflectors, columnar disturbances, wipe outs) and meso to micro morphological features (pockmarks, domes mud volcanoes, elongated depressions) which were attributed to the presence of gas in sediment interstices (FERENTINOS, 1991). They usually occur in water depths less than 250 m. The gas charged sediments are found in (i) Pleistocene and present-day deltaic environments (ii) Pleistocene and present-day fjord-like environments (iii) lakes (iv) open sea environments.

Pleistocene and present-day deltaic deposits (foresets and bottomsets) in Amvrakikos gulf, Patras gulf and NW Aegean shelf are gas charged as is suggested by the acoustic turbidity, the enhanced reflectors, the gas plumes and mid-water reflections in 3,5 KHz profiles. Slides affecting these deposits and underlain gases suggest a cause-and-effect relationship. No pockmarks are found in these environments.

The Quaternary sedimentary cover of the Amvrakikos and Patras gulfs which represent present-day and Pleistocene fjord-like environments, respectively contains gas which is very often in the form of gas pockets and gas plumes and produce intrasedimentary and seabed small relief doming. Gas plumes migrating along active fault planes or seeping through the seabed to the water column were observed on the seismic records. Seabed displacements due to faulting are sometimes associated with depressions which follow the trace of the faults for some distance. According to HOVLAND (1984) we assumed that they are elongated depressions caused by the violent escape of gas via fault planes. In Amvrakikos gulf buried pockmarks (paleopockmarks) were identified in 3,5 KHz profiles.

Open sea environments where gas has been detected in the sediments are the NW shelf of the Aegean sea and the NE shelf of the Ionian sea (Corfu island). In the NW Aegean shelf the gas is found in Plio-Quaternary grabens and near fault planes. In the NW Ionian shelf the gas is associated with salt domes.

Gas has also been found in Trichonis take as it is indicated by the acoustic turbidity which appears in the sediments all over the lake.

Since big rivers and streams discharge into the aforementioned environments the gas is expected to be of biogenic origin. Only in the NW Ionian shelf and in the NW Aegean shelf where gas is found in association with salt domes and appears to migrate from deep horizons respectively, it is believed to be of thermogenic origin.

Grain size analysis of samples taken from all these environments reveals that although the seafloor is favourable for formation of pockmarks, their occurence in seismic records was very scarce. This may be due to the high seismicity which characterise these regions. The internal pressures are expanded by the cyclic loading of the seismic waves destabilizing the granular framework and thus cause the gas to release.

A rather unique acoustic character which has not been previously described in the literature was recognised in seismic profiles in Corfu shelf, Trichonis lake and Amvrakikos and Patras gulfs. Coarse-grained beds in parallel lying sedimentary sequences, giving rise to strong echo returns, sometimes seem to be laterally interrupted and producing intermittent reflectors with a permanent rhomboid shape for some distance. Because this acoustic character is found in relation with gas charged sediments it may be possible that upward migration of small amounts of gases disrupt the texture of the sediments and contemporary acoustic phenomena contribute for this acoustic response.

Vertically migrated gases around diapirs or faults may found porous horizons, and be expulsed producing coherent reflections of increased intensity or acoustic turbidity over short distances around these structures. Thus, is concluded that not only vertical seepage but also lateral migration of gases in permeable beds can create enhanced reflectors in seismic records.

REFERENCES

FERENTINOS G., 1992. - Offshore geological hazards in the Hellenic Arc: *Marine Geotechnology, (in press).*

HOVLAND M., 1984. - Gas induced erosion features in the North Sea: *Earth Surface Processes and Landforms*, 9, 209-228.

MC KENZIE D., 1972. - Active tectonics of the Mediterranean Region: *Geoph. J. R. Astr. Soc.*, 30, 109-185.