A Brief Outline of the Geophysical Properties of the Island of Gozo

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Introduction

The geo-morphology of Gozo is one of its environmental assets. Through the span of time, geo-morphological processes generated different landforms that today embellish the island with its scenic beauty and rural character. Various geo-morphological processes have produced a varied surface landscape and coastline, restricted in accessibility where it controls the inhabitants' lifestyle and their living.

The Stratigraphy

The origins of the Maltese archipelago can be traced to shallow marine carbonate sediments, superimposed phases of strike slip faulting and rifting and geo-morphological scars triggered by different climatic processes and complex tectonic repercussion of the advancing of the African and Eurasian plates towards each other.[1] This group of limestone islands rest on the Malta-Hyblean platform, which is a wide shelf bridge that connects the Ragusa platform of southern Sicily and the Tripolitana platform of northern Libya.[2]

The Maltese stratum comprises hard massive sometimes-reefal tectonically competent coralline limestone, ductile fine-grained biomicrites and plastic marls and clays of tectonically incompetent behaviour.[3] These sedimentary beds belong to the geologically recent mid-Tertiary period. The sediments settled in shallow marine waters and their deposition occurred in stages with five main geological strata, which differ in composition and structural resistance *(Refer to Figure 1).*

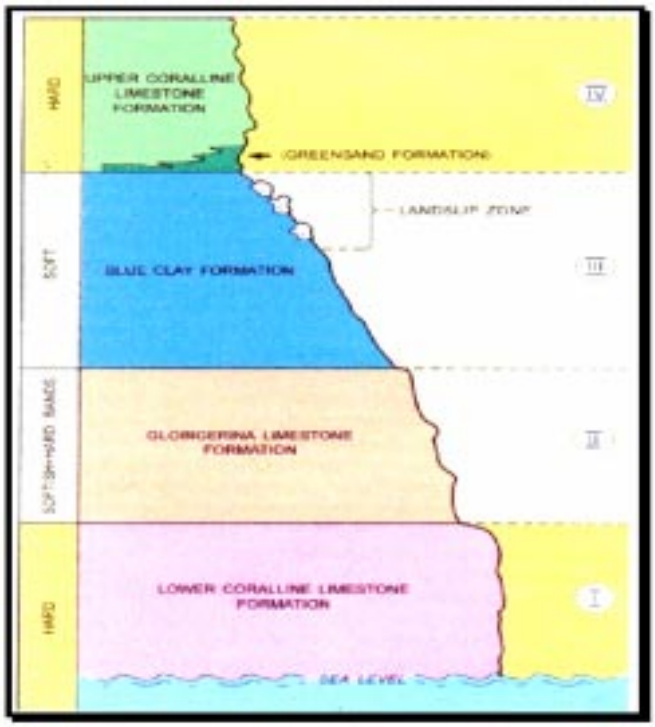

Figure 1: *The stratigraphic column of the Maltese Islands (Source: Dr. Michael Hughes Clarke)*

The circulation of ocean currents acting in the past geological times affected the deposition of this sedimentary succession. The way the stratification is presented on the limestone exposure gives an indication of the deposition, which had occurred during the formation period of that particular limestone band. Parallel layers indicate that deposition of that sediment bed probably took place where the activity of the waves and ocean currents was at a minimum. The exposed Tertiary section is divided into the following five rock units, which can be seen exposed on the islands.

Lower Coralline Limestone

The Lower Coralline Limestone is the oldest exposed formation in the Maltese Islands, which dates back to the Upper Oligocene period (38-24 million years BP). It is mainly exposed in the forms of sheer cliffs sections which show up to 140 meters near Xlendi in Gozo and somewhat less along the Maltese coastline between Fomm Ir-Riħ and Bengasia Point.

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[1] See Spratt, (1843),;Trechmann, (1938); Hyde (1955); Pedley (1976, 1978, 1983, 1985); and Zammit Maempel (1977).
[2] Grasso, 1992.
[3] Reuther, 1984

Globigerina Limestone
Above this geological stratum, lies the Globigerina limestone formation which was deposited in the Lower-Middle Miocene epoch, 24 to 15 million years BP. This rock is the largest outcrop in the Maltese Islands and its formation in Gozo is well exposed in the valley gorges and in the western part of the island. This is a fine grained sedimentary bed is further sub-divided into three members, the Lower, Middle and the Upper Globigerina members

Blue Clay
The Blue Clay formation dates back to the Mid-Upper Miocene epoch, Serravilian to Early Tortonian era i.e. 14 to 9 million years BP. Outcrops occur throughout the whole island of Gozo. The formation is an extremely soft rock, which weathers away easily and translates itself to 45° slopes and taluses that tend to slide further downhill over the underlying Globigerina Limestone formation. Blue Clay is non-permeable and rain water slides down to the valley systems.

Greensand
The Upper Miocene epoch, early Tortonian era, i.e., 9 to 7 million years BP, saw the deposition of the Greensand formation. Such stratification is composed of variable thickness of bioclastic, glauconitic limestones which are poorly cemented. Weathering leads to the release of iron oxides form the breakdown of the glauconite and imparts an orange brown colour to the formation. Maximum thickness of this geological member is at the Gelmus hill in Gozo where it attains a maximum of 11 metres.

Upper Coralline limestone
Next in sequence, is the Upper Coralline Limestone formation which also dates back to the Upper Miocene epoch but with a specific reference to the late Tortonian to early Messinian era i.e. 7 to 4 million years BP. This formation is similar in many ways to the Lower Coralline Limestone formation especially in colour and coralline algal content. It is a durable stratum frequently weathering into steep bound cliffs translating into well-developed karst topography. Outcrops occur an all the islands of the Maltese archipelago most often in the form of mesas. Thickness of this geological band ranges from 4 to 30 m, as various mesas do not have uniform thickness.

Quaternary Deposits
Another deposition feature in the Maltese Islands are Quaternary deposits. They occur as cavern and fissure infillings and valley infills. Deposits consists of alluvial fan deposits, caliche soil profiles and calcreted breccias all of which are stained red by iron oxidation. Some of these are found inside the Qawra doline in Gozo, in Comino and along vadose sections in Dingli in Malta. Dunes and raised beach deposits like those at Ramla in Gozo also belong to the Quaternary deposition processes. All these variety of deposits took place during the Late Pleistocene to Holocene era i.e. 1.5 million to 6,000 years BP.

Tectonics

Tectonic activity has distinct importance in shaping the islands. The fracture pattern of the islands has been created by tectonic processes governed by convergent to lateral motions taking place between the European and African plates. Most tectonic movements have been strike slip or extensional in the form of rifting. Two different rift systems, differing in age and trends control the tectonic setting in the Maltese Islands. The island of Gozo is characterised by a gentle regional 4° dip to the north east, producing 120 meter high cliff sides on the west coast of the island.

Tectonic differences are registered in Malta and Gozo. This is due to the presence of the synclinal deformation on the western Malta and Gozo which probably aided the land between the Victoria lines and Qala faults to be densely segmented by rifting processes into horsts and grabens, including the submerged Comino channel areas and the emerged Comino island group. *(Refer to Figure 2)*

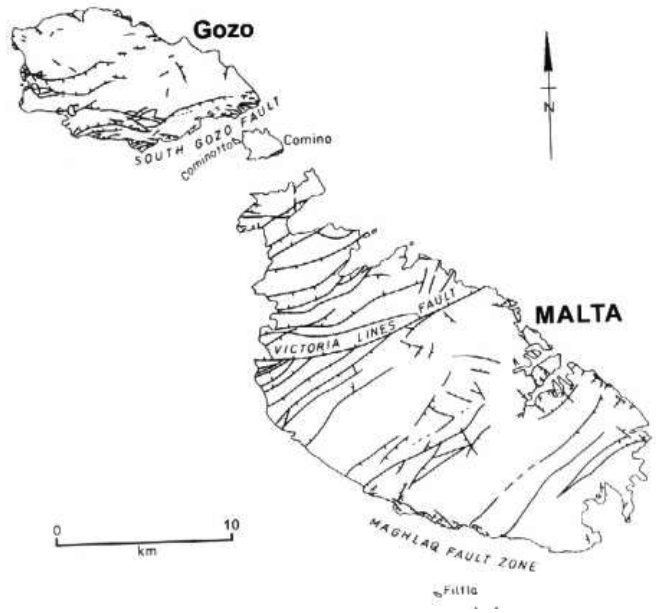

Figure 2: *A fault map of the Maltese Islands*

Such activity caused a complex density of faults to be formed in the south of Gozo with a special reference to the south east tip of the island where a feather faulting structure zone is present. It can be observed that from the geographical distribution of faults on the island of Gozo indicate that the island is a tectonic grip. This leads to the exposure of all bands of all the geological strata on diverse scales to be eroded to the extent of forming different surface landforms due to the various geo-morphological processes. The mesa rounded hilly topography accompanied by various valley systems and coastal formations are the results of tectonic presentation aided by various scales of sub-aerial and marine processes due to different climates which were acting in the latest phase of the formation of the Mediterranean Sea. *(Refer to Photo 1)*

Photo 1: *A Valley system surrounded by a mesa landscape in central Gozo*

Geomorphology

The central and eastern sections of the Island of Gozo exhibit a younger erosion surface than that of Malta. The west is dissected and the Upper Coralline Limestone is left exposed above the 45º Blue Clay slopes. It is probable that up to 130 m of the upper surface has been active enough to be removed by erosion, which has been active enough to prevent thick accumulations of soil, leaving instead bare limestone pavements on the more exposed locations. This has a direct effect on the drainage patterns on the island. The most striking aspect of the drainage patterns is the dominance of channels draining north eastwards over those draining to the south and south west. *(Refer to Photos 2&3)*

Photo 2: *Wied il- Ghasri – a submerged valley draining northward on the island of Gozo*

Such occurrence is also due to the shoulder up arching of the Pantelleria rift system, which has created high land on the western Malta and eastern Gozo and drowned the fluvial valleys of eastern Malta. However, shallow linear channels occur on the fault scarps of the horst and graben structures of Malta and south east Gozo. Tilting has made the drainage pattern of the islands highly asymmetrical, yet former marine and continental erosion surfaces can be detected. They occur mostly on the western part of Gozo, where the surface is progressively more dissected towards the west. Current sea level, in relation to recent and inactive past tectonics processes has led to the drowning of the rias, grabens, dolines and shore platforms.

Photo 3: *Hanging valley in the North West of Gozo where erosion was not powerful enough to cut the valley down to sea level because of the small catchment area*

Conclusions

The geology and geomorphology of the Maltese Islands are quite young in age, common phenomena in most islands. They are also lithogically uncomplicated, have a simple climate, heavily dependent on external controls and are areas of reduced landform scale. These physical assets have conditioned the set-up of agricultural activity, the distribution of settlement patterns and the economy as a whole of the Maltese Archipelago.

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A word of thanks goes to the Honorable Minister for Gozo, Mrs. Giovanna Debono, who for the past few years contributed an annual donation of Lm300-500 to meet some of the inherent expenses incurred in the running of the library. Another word of thanks also goes to the Honourable Speaker of Parliament, who weekly, almost without fail, sends to the library all, or almost all, copies of the Malta Government publications.

Students making use of the library resources

Many educational courses have been organised by the library during these 23 years. The number of student enrolments, especially, university students, has been growing at a steady rate. This, as already mentioned, is due to the fact that the library now specialises in books related to tertiary education such as philosophy, theology, sociology, psychology, archaeology, art and architecture, computer science and technology, and the physical sciences.

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