OIL EXPLORATION DIRECTORATE
OFFICE OF THE PRIME MINISTER
VALLETTA, MALTA.

GEOLOGICAL MAP OF THE MALTESE ISLANDS

SHEET 1

MALTA

Scale 1:25,000

Sheet History:

Original geological survey of the islands carried out at 6 inches to 1 mile scale by K.C. Dunham M.R. House and A.A. Wilson on behalf of the BP Exploration Company Ltd., in 1955.

Published at 1:31680 scale by the Ordnance Survey for BP in 1955.

Resurvey of the Upper and Lower Coralline Limestone formations at 6 inches to 1 mile scale by Martyn H Pedley, 1971-1975.

Resurveyed at 1:25,000 scale by Martyn H Pedley, School of Geography and Earth Resources, University of Hull, 1992.

Revised at 1:25,000 scale by Godwin Debono and Saviour Xerri, Oil Exploration Directorate, Office of the Prime Minister,1993.

Published by the Oil Exploration Directorate, Office of the Prime Minister, Malta, in 1993.

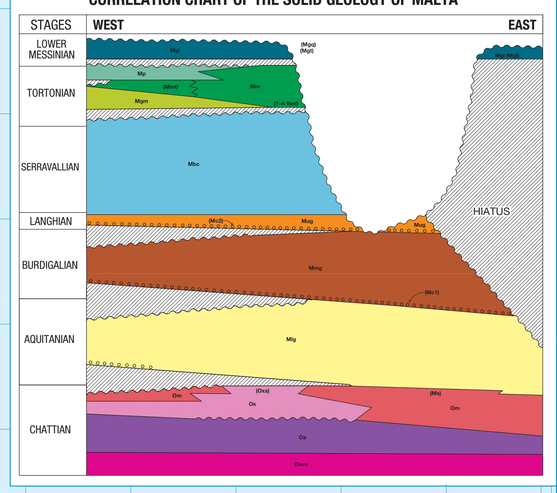
Printed by the British Geological Survey, Keyworth (C. Simpson, Cartographer).

Topographic details based on the Government of Malta 1:25,000 sheets of Malta and Gozo (series M898, edition 2) published in 1984. Grid lines are at 1 kilometre intervals and contours are in feet above sea level. The representation on this map of a road, track or footpath is no evidence of the existence of a right of way.

SCALE 1:25,000

Metres 1000 500 0 1 2 3 Kilometres

CORRELATION CHART OF THE SOLID GEOLOGY OF MALTA



KEY TO GEOLOGICAL SYMBOLS

- Horizontal beds
- Dipping strata with direction and inclination in degrees
- Stratigraphical boundaries (dashed where inferred)
- Faults (solid lines where observed; dashed lines where interpreted). Downthrow direction indicated by bars
- Sense of relative movement
- Fault controlled syncline axial trace
- Q — Quaternary Solution Subsidence Structures
- M — Miocene Solution Subsidence Structures
- A — A' — Line of geological section

KEY TO GEOLOGICAL MEMBERS AND FORMATIONS

QUATERNARY

Qs — **Modern beach sands:** (**Qs** HOLOCENE)

Qv — **Valley fill:** Low angle subaerial fanglomerate cones, terra rossas, local clays and alluvium. Fanglomerates frequently are dominated by subangular carbonate lithoclast breccias and interpenetrative channels. Intercalated terra rossa palaeosols often contain rhizoid (root) fabrics and nodular caliche of varying ages but all post date valley cutting. **Thickness 0-7m.** (**Qv** LATE PLEISTOCENE-HOLOCENE, TYRRHENIAN).

Qb — **Raised beach deposits:** Wind blown foraminiferal, marine mollusc and quartzarenitic grainstones. The Marfa Point deposit contains rhizoid fabrics, and pulmonate gastropods of undiagnostic age. Terra rossa palaeosols are intercalated in some sections. **Thickness 0-3m.** (**Qb** LATE PLEISTOCENE-HOLOCENE, TYRRHENIAN)

QT — **Tufa and travertine deposits:** Friable, cream coloured lime mudstones, and wackestones with abundant plant remains, pulmonate and hydrobid gastropods. All deposits developed before termination of valley incision. The Fiddien Valley deposit near Rabat pre-dates the terra rossa palaeosols but molluscan faunas are undiagnostic of age. **Thickness 0-16m.** (**QT** ? EARLY PLEISTOCENE).

MIOCENE

UPPER CORALLINE LIMESTONE FORMATION

Mgl — **Gebel Imbark Member:** Hard, pale-grey carbonates with sparse faunas. Deposits now restricted to erosional outliers and synclinal cores. Basal beds in western areas consist of cross stratified ooidal and peloidal grainstones (**Mgt** Tal - Torrna Beds), which lie above a marked erosion surface. The San Leonardo Beds (**Mgl** of E Malta) rest unconformably upon Globigerina Limestone Formation and consist of channelled packstones containing marine mollusc bioclasts, overlaid by charophyte-rich marls and unfossiliferous wackestones. The Qammieh Beds (**Mgk**) conformably succeed the Tal - Torrna Beds in western districts and consist of carbonate mudstones with grey marls in a multiple palaeosol sequence sometimes associated with rhizoid fabrics. An extensive stromatolite bed occurs in western districts otherwise marine fossils are rare. **Thickness 4-25m.** (**Mgl** MIOCENE, EARLY MESSINIAN).

Mp — **Tal - Pitkal Member:** Pale grey and brownish-grey coarse grained wackestones and packstones containing significant coralline algal, mollusc and echinoid bioclasts. In the lower beds large rhodoliths of *Mesophyllum* and *Lithophyllum* are abundant. The upper beds contain patch-reefs and biostromes (**Mpb** , Depiru Beds). These are dominated by peloidal and mollusican carbonate mudstones, with crustose coralline algae and scattered corals, especially *Porites* and *Tarbellastraea*. These reefs are best developed in the western extremities of the outcrops especially around Tat - Tomna, near Mellieha and at Tal - Pitkal, near Dingli. **Thickness 30-50m. thinning eastwards.** (**Mp** MIOCENE, LATE TORTONIAN TO EARLY MESSINIAN).

Mm — **Mtarfa Member:** Massive to thickly bedded carbonate mudstones and wackestones, yellow in their lower levels and unconformable upon Greensand in western outcrops. Carbonates become white and chalky in the upper two thirds of eastern outcrops. The lowest levels contain a facies independent brachiopod bed up to 1m thick containing *Terebratula* and *Aphelesia*. This is traceable throughout all basal outcrops. A bed containing *Pinna* bivalves is a local marker near the base of the white chalks. West of a N-S line from Rdum Il - Hmar to Rdum Dikkiena a prominant coralline algal biostrome, up to 16m thick, is developed (**Mmt**). This contains abundant bivalves, echinoids, microfauna and rhodolitic coralline algae. **Thickness 12-16m thinning eastwards.**(**Mm** MIOCENE, LATE TORTONIAN)

Mgm — **Ghajn Melel Member:** Massive bedded dark to pale brown foraminiferal packstones containing glauconite occur above a basal Upper Coralline Limestone erosion surface in western Malta. Large *Clypeaster* echinoids and *Macrochlamys* pectinid bivalves are common. Much of the member is composed of abraded *Heterostegina* foraminifer bioclasts. The glauconite-rich Greensand Formation is included in this member for convenience as it rarely exceeds 1m in thickness in Malta. **Thickness 0-13m.** (**Mgm** MIOCENE, LATE TORTONIAN).

BLUE CLAY FORMATION

Mbc — Medium grey and soft, pelagic marls, typically with well developed pale bands rich in planktonic foraminifera but lower clay content. Thickest deposits are in coastal sections from Ghajn Tuffieha to Dingli in W Malta and thinnest are near Siggiewi. Goethite concretions are common in the upper beds of NW Malta, associated with bivalves gastropods, cephalopods including *Aturia*, *Schizaster* echinoids and solitary corals. Miocene and later erosion has removed thinner parts of the formation from eastern Malta. **Thickness 15-75m.**(**Mbc** MIOCENE, LANGHIAN TO TORTONIAN).

GLOBIGERINA LIMESTONE FORMATION

Mug — **Upper Globigerina Limestone Member:** A tripartite, fine grained planktonic foraminiferal limestone sequence comprised of a lower cream coloured wackestone, a central pale grey marl and an upper pale cream coloured wackestone. Pectinid bivalves and occasional echinoids are present. A ubiquitous phosphorite conglomerate bed containing fish teeth and diverse macrofossils occurs at the base of the member (**Mc2**, Upper Main Phosphorite Conglomerate Bed). It is conformable in eastern outcrops but lies above a hardground and erosion surface in western areas. **Thickness 8-26m.** (**Mug** MIOCENE, BURDIGALIAN TO EARLY LANGHIAN).

Mmg — **Middle Globigerina Limestone Member:** A planktonic foraminifera-rich sequence of massive, white, soft carbonate mudstones locally passing into pale-grey marly mudstones. Fine bed laminae are frequent otherwise burrowing is ubiquitous. Thin-shelled pectinid bivalves and *Schizaster* echinoids are typical and coccoliths are abundant. The base of the formation is unconformable upon Lower Globigerina Limestone Member. Other minor breaks in the sequence are indicated in western outcrops by phosphorite clast beds. The sequence is thickest near Delimara. **Thickness 15-38m.** (**Mmg** MIOCENE, AQUITANIAN TO BURDIGALIAN).

Mlg — **Lower Globigerina Limestone Member:** Pale cream to yellow planktonic foraminiferal packstones rapidly becoming wackestones above the base. Glauconite is common in western outcrops south of Fomm ir-Rih. Pectinid bivalves and *Skioaster* echinoids are frequent. The top of the member is marked by a ubiquitous hardground. This is phosphatised in western areas and carries a conglomerate (**Mcl**, Lower Phosphorite Conglomerate Bed). Common fossils include fish teeth, molluscs, solitary corals and echinoids. **Thickness 0-80m.** (**Mlg** MIOCENE, AQUITANIAN

OLIGOCENE

LOWER CORALLINE LIMESTONE FORMATION

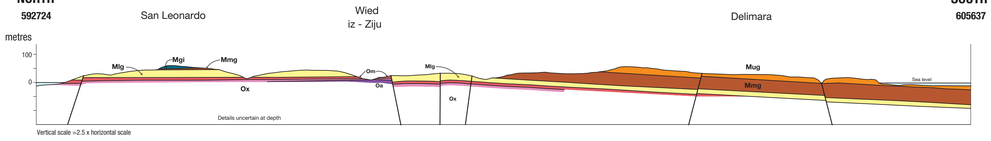
Om — **Il - Mara Member:**Tabular beds of pale-cream to pale-grey carbonate mudstones, wackestones and packstones in 1 to 2m thick units. Thickest developments are in eastern Malta between Il - Mara and Marsascala. These pass laterally northwards and west into the Xlendi Member. The top of the member is transitional with the Lower Globigerina Limestone Member with a *Scutella* echinoid bed at the junction (**Ms** *'Scutella* Bed'). Bryozoan fragments are common and banks of *Tepidocyclina* foraminifers occur locally. *Terebratula* is common in the Marsascala and Wied Has - Sabtan sections. **Thickness 0-20m.** (**Om** OLIGOCENE, CHATTIAN).

Ox — **Xlendi Member:** Planar to cross-stratified, coarse-grained limestones (packstones) with abundant coralline algal fragments. The member is best developed in a N-S zone extending from Wied iz-Zurrieq to St Andrews. The top of the member contains abundant entire and fragmentary *Scutella* echinoids, usually in a single bed (**Oxs** *'Scutella* Bed'). This bed is absent at Qawra, N Malta and Rdum Dikkiena, W Malta. A marked erosion surface separates the member from overlying Globigerina Limestone Member in W Malta. At Wied Maghlaq, SW Malta the member is developed into large north facing foresets containing reworked Attard Member rhodoliths. To the east, the member passes laterally into Il - Mara Member. The member thins rapidly westwards. It is thin or absent in W Malta except for the W Marfa Ridge where the*'Scutella* Bed' occurs in a cream coloured wackestone facies. **Thickness 0-22m.** (**Ox** OLIGOCENE, CHATTIAN).

Oa — **Attard Member:** Grey limestones (wackestones and packstones) are typical throughout Malta. Large *Archaeolithothamnium* coralline algal rhodoliths are ubiquitous and are locally associated with shrimbil gastropods and bryozoa. An extensive N-S trending belt of patch-reefs extends from Wied Maghlaq to Naxxar (**Oar**). These reefs are fine-grained and contain a diverse fauna of colonial corals, molluscs and echinoids. The reefs are truncated by one or more major erosion surfaces. The Attard Member is capped by thin Xlendi Member. **Thickness 10-15m.** (**Oa** OLIGOCENE, CHATTIAN).

Qwm — **Maghlaq Member:** Massive bedded, pale yellowish-grey carbonate mudstones are dominant, benthonic foraminifera alone are frequent. The member is poorly exposed at Wied Maghlaq, S Malta, at the base of the Attard quarries near Attard, and in the Naxxar Gap quarries of N Malta. The base of the sequence is not accessible, however, the member passes transitionally up into the Attard Member, **Thickness > 30m.** (**Qwm** OLIGOCENE, CHATTIAN).

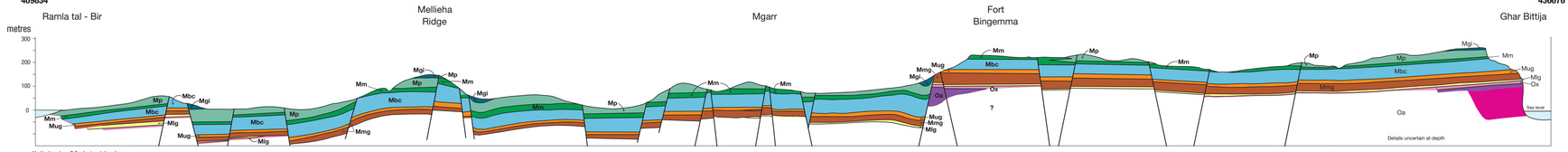
B NORTH 592724 — B' SOUTH 605637



Vertical scale =2.5 x horizontal scale

N-S PROFILE SECTION OF EAST MALTA

A NORTH 409834 — A' SOUTH 436676



Vertical scale = 2.5 x horizontal scale

N - S PROFILE SECTION OF WEST MALTA