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The St. Peter's Pool section (Malta Island): progress towards the Langhian GSSP

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The main goal of the project "In search of the Global Stratotype Section and Point of the Langhian Stage and paleoceanographic implication" granted by the Italian Ministry of University and Research and supported by the Subcommision on Neogene Stratigraphy, was to find a potential candidate for hosting the Langhian GSSP.

In the framework of the project several sections were investigated and among the others the St. Peter's Pool one (Foresi et al., 2011), spectacularly outcropping in the Delimara Peninsula, SE of the Malta Island.

This section was studied through high-resolution bio-magnetostratigraphy, which resulted in a remarkable improvement of the Mediterranean Langhian knowledge. Calcareous plankton quantitative analyses allowed the definition of several bioevents with a great potential for biostratigraphic correlations. To the well-known bio-horizons, such as the *Helicosphera ampliaperta* Last Common Occurrence (LCO), the *Sphenolithus heteromorphus* Paracme and the *Paragloborotalia siakensis* Acme, many others were added, such as the *Paragloborotalia bella* LCO and a new *P. siakensis* Acme, documented for the first time in the Mediterranean area.

The following aspects play in favor of the St. Peter's Pool section as a candidate for hosting the Langhian GSSP:

- the excellent exposure and the easy accessibility;
- the well-preserved and abundant content of calcareous plankton and the high number of significant bioevents. Two of these can be selected for approximating the Langhian GSSP, namely the LCOs of the nannofossil *H. ampliaperta* and of the planktonic foraminifer *Paragloborotalia bella*, both falling in the Chron C5Cn.1n. Particularly the LCO of *H. ampliaperta* represents a well-defined horizon, also recognizable in extra Mediterranean areas, and its choice could represents a good compromise between thee two recommended events for the definition of the Langhian GSSP (the Praeorbulina datum and the C5Cn/C5Br reversal);
- the stratigraphic continuity with the section yielding the Serravallian GSSP (Ras il-Pellegrin in Malta Island);
- the cyclic pattern of the succession.

On the other hand the magnetostratigraphic data show some uncertainties. Yet, the cyclostratigraphic reconstruction, which is the subject of ongoing studies, has a high potential for establishing a reliable astronomical tuning of the section, providing a further positive element for proposing it as a candidate for the Langhian GSSP. The study will be completed by Oxygen and Carbon isotopes analyses to individuate global paleoclimatic changes.

Foresi L.M., Verducci M., Baldassini N., Lirer F., Mazzei R., Salvatorini G., Ferraro L. & Da Prato S. 2011. Integrated stratigraphy of St. Peter's Pool section (Malta): new age for the Upper Globigerina Limestone Member and progress towards the Langhian GSSP. Stratigraphy, 8, 125-143.

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Large boulder deposits along the Maltese coasts

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The accumulation of large boulders related to large waves generated by tsunami and extreme storm events have been observed in different areas of the Mediterranean Sea. Along the NE and E low-lying rocky coasts of Malta a tens of large boulder deposits have been observed (Furlani et al., 2011; Mottershead et al., 2014). In the Sicily-Malta channel heavy seas are frequent and are originated by the NE and NW winds. Few severe earthquakes and tsunamis hit historically the Maltese Archipelago, where the seismicity is related mainly to the Malta Escarpment, the Sicily Channel Rift Zone and the Hellenic Arc.

A multidisciplinary study has been carried out on a large boulder deposit located between Armier Bay and Ahrax Point on the NE coast of Malta.

The boulder accumulation is 100 m wide and is located on a gently sloping coast, at an altitude ranging between 0 and 5 m asl. The boulders, metric in size, are made up by limestones and are Miocene in age.

An underwater surveying allowed to describe the submerged scenario, where fresh detachment scarps and isolated boulders can be observed.

Three different hydrodynamic equations (Nott, 2003; Pignatelli et al., 2009; Nandasena et al., 2011) were applied to assess the wave heights required to carry the boulders out of the sea in a joint-bounded scenario. The axis sizes were determined by means of 3D models achieved by digital photogrammetric technique. The rock densities were calculated by field campaigns using N-type Schmidt Hammer. The application of the formula developed by Katz et al. (2000) permitted to correlate sclerometer outputs and limestone densities of boulders.

Moreover Radiocarbon datings were performed on a tens of Serpulides samples.

The combination of the hydrodynamic equations and the Radiocarbon outputs suggests that most of the large boulders has been detached and moved by intense storm waves; conversely some of them have been transported by one or more tsunami events.

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