Project of Strategic Interest NEXTDATA

Scientific Report for the reference period **01/01/2012-31/12/2012**

WP 1.5 - Paleoclimate data from marine sediments (Resp: Fabrizio Lirer, CNR-IAMC)

Partners: CNR-DTA, URT Ev-K2-CNR, INGV

1. Planned activities and expected results

In the first year of the project we identified the potential keysites in the continental shelf areas of the Mediterranean Basin, on the basis of a bibliographic survey, which could preserve the marine records for the last 2000 years, with a sedimentary facies suitable for the high resolution paleoclimatic studies. The identification of keysites was preceded by a careful phase of specific data collection, in order to plan the identification of the drilling sites rationally, also in view of the optimization of the available economic resources.

Priority was given to the sites which potentially contain levels of tephra (sites located in the continental shelf areas close to the volcanic districts), which represent the first order stratigraphic markers, and provide an added value for the dating of paleoclimatic events.

In the executive plan an archival research in the ODP-IODP databases is expected, in order to detect keysites specific for the last millennium also in areas outside the Mediterranean Basin.

M1.5.1 (PM12): Identification of potential keysites suitable for the high resolution studies in the Mediterranean Basin. Identification of the data available in national and/or international archives in selected sectors outside the Mediterranean Basin.

2. Deliverables expected for the reference period

D1.5.1 (PM12): Report on the definition of the available measurements and of the keysites for new drilling activities.

D1.5.2 (PM12): Report on sedimentary cores available from the repository core, transmission of information to the archives and to the General Portal.

3. Activities actually carried out during the reference period

3.1 Research activities

The WP 1.5 research activities carried out in the first year allowed us to recover literature data (bibliography containing useful information for paleoclimatic studies) relating to the Holocene time interval, from which information about the last 2000 years were extracted. This study showed that data (biotic and abiotic proxies) from the marine sedimentary cores available for the last 2000 years are very few and characterized by a scattered geographical distribution. These data also associated with information from unpublished CNR-IAMC data were used to identify potential keysites in the Mediterranean Basin for the recovery of marine sediments containing sedimentary records of the last millennia. Additionally, the data available from some cores already collected by the CNR- IAMC in sites of interest (southern Tyrrhenian Sea, Gulf of Salerno) were reanalyzed and made available within the NextData project.

The choice to analyze in detail this time interval is due to the fact that one can compare the datasets (biotic and abiotic proxies) of marine sedimentary archives to information from historical documents, which are remarkable information for the calibration of paleoclimatic events recognizable in the last 2000 years. Furthermore the possibility to compare the recognized climatic events recorded in marine records, through the integration of biotic and abiotic proxies, with the succession of archeological periods, represents an important approach for studying past climatic changes. In addition, during this time interval anthropogenic pressure began to have an impact on marine ecosystems. Within this framework, the Mediterranean basin represents a suitable area for this type of research, in fact the occurrence of high sedimentation rates, mainly in continental platform environments, makes this basin a keysite for studying the past climate, in order to gather new information useful to calibrate climatic models.

This study has allowed to identify sectors located in the Central-Western Mediterranean Basin, where the national and international scientific literature and high resolution geophysical data (CNR-IAMC unpublished data) provide useful information to recover continuous and undisturbed marine records, useful for geochronological, paleoclimatic and paleoceanographic studies.

The identification of the keysites has been based on the following criteria:

1) the presence of levels of tephra which represent the first order stratigraphic markers and provide an added value for the dating of paleoclimatic events (keysites located close to the volcanic districts);

2) marine neritic successions (on the continental shelf), useful for the quantitative analysis of the calcareous plankton;

3) high sedimentation rates for the paleoclimatic reconstructions at secular and decadal scales.

The sites of interest detected are (Figs 1 and 2):

i) the Gulf of Gaeta (Central Tyrrhenian Sea);

ii) the Gulf of Salerno (Central-Southern Tyrrhenian Sea);

iii) Malta Continental Shelf (Central Mediterranean Basin, area between Sicily and Malta);

iv) Malta Continental Shelf (Central Mediterranean Basin, area south of Malta),

v) the Gulf of Taranto (Southern Ionian Sea);

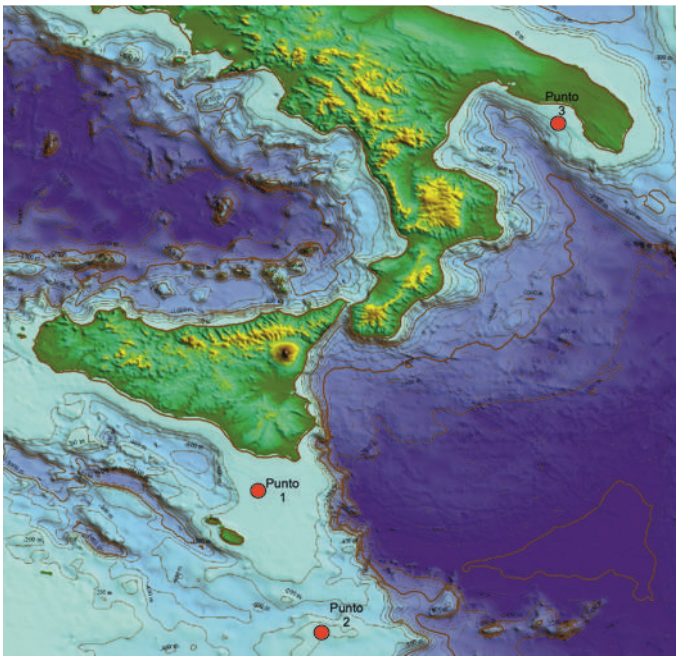

Figure 1. Location map of the keysites (Punto1, 2 and 3) located in the central Mediterranean Sea.

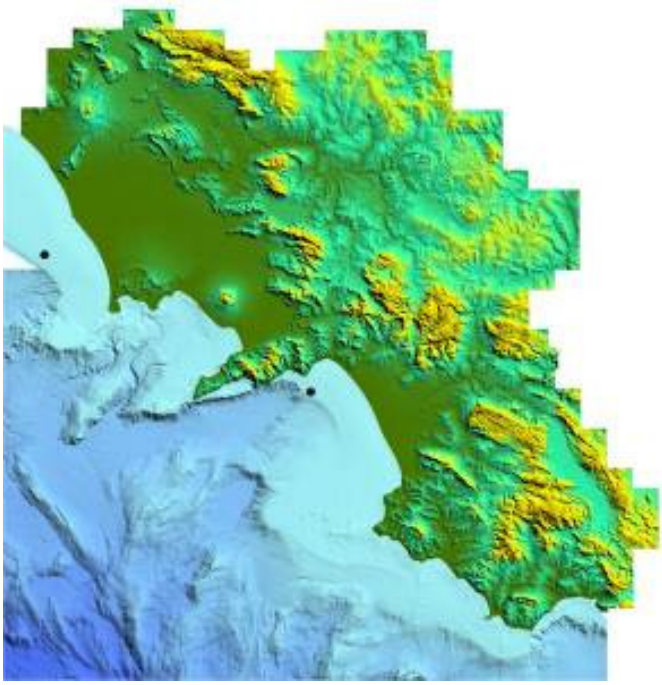

Figure 2. Location map of the keysites located in the central-southern Tyrrhenian Sea (Gulf of Salerno and Gaeta)

As indicated by Luterbacher et al (2012), high resolution paleoclimatic studies which integrate historical data and marine paleodata are desirable for a complete understanding of the climate changes in the Mediterranean Basin. In this framework, in view of the limited data available in the literature up to now for the marine cores relating to the last 2000 years, a high resolution study of marine sedimentary cores on the continental shelf of the Central-Western Mediterranean Basin represents a useful and new contribution which integrates the results obtained from the recent 2012 MedClivar International Project for the Mediterranean Basin.

At the beginning of the 1.5 WP research activities, during the second half of 2012 (01/07/2012-31/12/2012), the request for a NextData oceanographic cruise aboard the R/V Urania was forwarded to the CNR. The goal of this cruise is to collect gravity cores and to recover marine sediments in the sites of interest already identified in the first semester of 2012, using the SW104 core system. The oceanographic cruise was scheduled for the period from September 12 to 19, 2013, and it will be aimed at collecting new cores in the keysites of the Central-Southern Mediterranean Basin [Gulf of Taranto, Malta Continental Shelf (the area between Sicily and Malta), Malta Continental Shelf (the area south of Malta)]. For the site identified in the Gulf of Salerno, a core (C90-1m) of 1.20 m length, was already collected at the depth of -103 m in 2006 (N/O Thetis CNR) within the national project VECTOR (Vulnerability of Coasts and ecosystems Italian marine climate change and their role in the carbon cycle of the Mediterranean). This core was made available in the framework of the NextData project and it is currently stored at the CNR-IAMC core repository, in Naples. The study of this core showed the validity of this sedimentary archive of the continental shelf of the Central-Southern Tyrrhenian Sea as a natural laboratory for the short-term monitoring of the climatic oscillations, for to the last 500 years (Vallefuoco et al. 2012). The analyses on the C90-1m core to study the secular variations of the Earth's magnetic field and the environmental magnetism are currently under way at the INGV Laboratory of Paleomagnetism, in Rome, in collaboration with Dr. Fabio Florindo. In the same keysite of interest (the Gulf of Salerno), two cores - C90 (4.87 m) and C836 (5.70 m) were collected at a depth of 103 m in 1998, in the framework of the CARG project (Campania Region) (see Fig. 3).

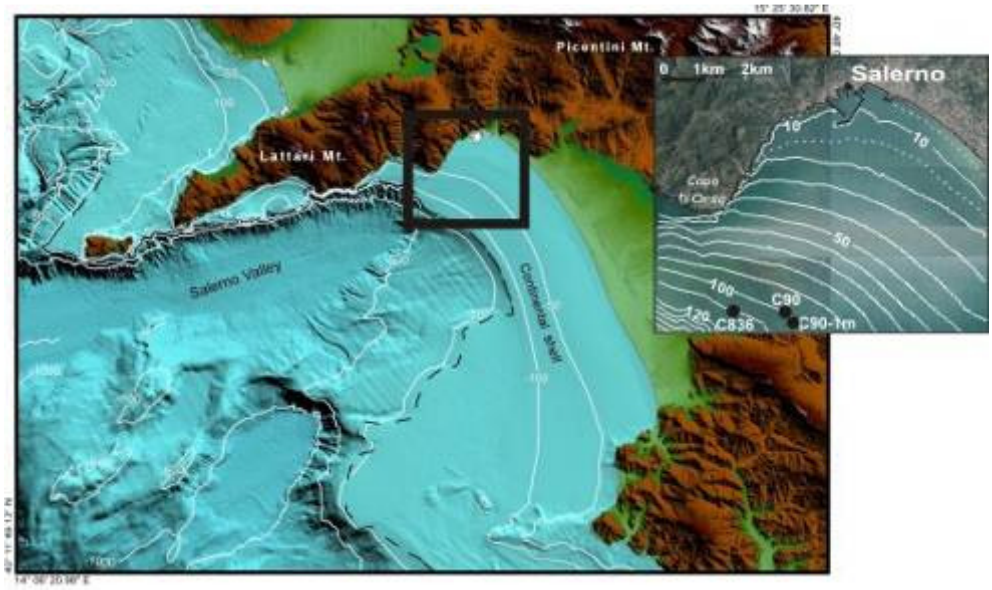

Figure 3. Location map of the sites of interest (C90_1m, C90 and C836) in the southern-eastern Tyrrhenian Sea (Gulf of Salerno).

3.2 Applicative, technological and information developments

None during the reference period.

3.3 Training activities

None during the reference period.

3.4 Dissemination

The NextData project has been included in the *ongoing RCMNS Project* of the 2013 RCMNS Bulletin (Regional Committe on Mediterranean Neogene Stratigraphy Newsletter , edited by the Museum of Natural History of Vienna). In addition, CNR-IAMC, with the support of the NextData Project, will organize the AIQUA 2013 Congress, which will be held in Naples (19-20-21 June 2013) at the Parthenope University.

3.5 Participation in conferences

- Oral Presentation: Budillon F., Senatore M., Ferraro L., Insinga D.D., Iorio M., Lirer. F., Lubritto C., (2012) The inner shelf stratigraphic record in the Salerno gulf (southern Tyrrhenian sea): an archive of the environmental changes along the coast over the last 3 KY. Abstract, pag. 15, Congresso AIQUA 2012 – The transition from natural to anthropogenic-dominated environmental change in Italy and surrounding regions since the Neolithic. 15-17 Febbraio 2012, Pisa.
- Poster Presentation: Lirer, F., Sprovieri, M., Vallefuoco, M., Ferraro, L., Cascella, A., Capotondi, L., (2012). Holocene climatic phases recorded in the shallow

water southern-east Tyrrhenian Sea marine sediments. Abstract, pag. 16, Congresso AIQUA 2012 – The transition from natural to anthropogenic-dominated environmental change in Italy and surrounding regions since the Neolithic. 15-17 Febbraio 2012, Pisa.

- Poster Presentation: Lirer F., Sprovieri M., Ferraro L., Vallefuoco M., Capotondi L., Cascella A., (2012), High resolution Holocene paleoclimatic events from the Southern-eastern Tyrrhenian Sea (Salerno Gulf), all'AGU Fall Meeting 2012, 3-7 Dicembre 2012 a San Francisco (USA).

4. Results obtained during the reference period

4.1 Specific results (databases, measurements results, models output, etc

The high resolution studies on the three cores (C90_1m-C90-C836) collected in 1998 and in 2006 on the continental shelf of the Gulf of Salerno (south-central Tyrrhenian Sea) at the depth of 103 meters, have been completed. This study has allowed us to complete the following analysis:

- Quantitative analysis of planktonic foraminifera (468 samples);
- Quantitative analysis of calcareous nannofossils (187 samples);
- Study on carbon and oxygen stable isotopes (468 samples) on the planktonic foraminifer species: *Globigerinoides ruber*;
- Tephrostratigraphic study (petrochemical analysis) on 8 levels of tephra;
- 8 AMS14C datings and ^{210}Pb e ^{137}Cs radionuclides dating of the first 40 cm of core;
- the age model has led to a very accurate estimation of the sedimentation rates relating to the last 2,000 years, revealing the great potentials of this site to develop more detailed studies at several scales, from the secular one to the decadal one;
- this study has enabled us to identify a succession of bio-events, useful to correlate the several sectors of the Central-Western Mediterranean Basin.
- a whole tephrostratigraphic study of the tephra detected in the Gulf of Salerno, associated with the major volcanic events characterizing the Holocene, has been published. Among these tephra, the one associated to the famous eruption in Pompei in 79 AD (about 2000 years ago) has been recognized;
- this work has let us to correlate the eco-biostratigraphy pattern of the western Mediterranean Basin with the Mediterranean geo-archaeological periors proposed by Roberts et al. (2001). This preliminary correlation has revealed that the planktonic foraminiferal assemblages, characterizing the various eco-biozones, indicate paleoenvironmental changes, which also find their counterpart in the continental sector.

4.2 Publications

None during the reference period.

4.3 Availability of data and modeling output (format, support, etc.)

- Quantitative data on the distribution of planktonic foraminifera and calcareous nannofossils during the last 2000 years. These data will be uploaded to the General Portal;
- $\delta^{18}O$ e $\delta^{13}C$ measurements data on the *Globigerinoides ruber* during the last 2000 years. These data will be uploaded to the General Portal;
- Quantitative data on the distribution of the benthic foraminifera during the last 500 years. These data will be uploaded to the General Portal;
- Petrochemical analysis of the 8 levels of tephra recognized in the C90_1m-C90-C836 composite core published in Lirer et al. (2012). These data will be uploaded on the General Portal.

4.4 Completed deliverables

D1.5.1: Report on the description of the available measurements and the keysites for new drilling sites.

Five keysites has been identified in the southern part of central-western Mediterranean basin and numerical data are available from the keysite from Salerno Gulf (southern-eastern Tyrrhenian Sea). This Deliverable has been completed.

D1.5.2: Report on the sedimentary cores available at the core repositories; transmission of information to the General Portal.
Currently the C90_1m core (Gulf of Salerno) and the ST137 50 cm core (the continental shelf between southern Sicily and Malta) are available for paleoclimatic studies at the CNR-IAMC core repository in Naples. These cores are kept at a temperature of 5 °C. The C90_1m core has been collected through the SW104 gravity core system, aboard the research vessel R/V Tethis CNR, while the ST137 core has been collected by a boxcore. Data have not been transmitted to the General Portal. This Deliverable has not been completed and it is postponed to the second year.

5. Comment on any discrepancies between activities / results / deliverables planned and actually realized

The Deliverable 2.5.2 has not been completed and it is postponed to the second year.

Some activities, originally expected in the second year of the project, have been anticipated as follows:

1. Scheduling and planning of a sampling oceanographic cruise, aiming at the recovery of marine successions from the continental shelf in the Mediterranean Basin. The decision to anticipate this activity is due to the need to submit a request for O/V Urania

to the CNR by July of the year prior to the execution of the oceanographic cruise. The request for the NEXTDATA oceanographic cruise was forwarded in July of 2012.

2. Reanalysis of the numerical data published in Lirer et al. (2012), referring to the cores collected in the Gulf of Salerno in 1998 and in 2006 by CNR-IAMC. These cores have been made available within the NextData project. This activity has been anticipated respect to the Executive Plan in order to develop a careful reconstruction of the past climatic events in the last 2000 years, which will be then correlated with the successions of paleoclimatic events that will be identified in the study of the marine successions acquired during the NEXTDATA 2013 oceanographic cruise.

6. Planned activities for the following period

The research activities of the second year of the project include the execution of the NEXTDATA oceanographic cruise in 2013 aboard the ship R/V Urania of CNR, which will be held in the period from September 12 to 22, 2013. During the cruise, high resolution seismic profiles will be measured in order to position the drilling sites correctly. For each drilling site two cores will be collected, one using the gravity corer and the other using the SW104 corer system of CNR-ISMAR (Bologna).
Furthermore, the cores will be opened, described and sampled on board. This sampling phase will speed up the analysis of the samples in the following months. After the oceanographic cruise, measurements of the secular variation of the Earth's magnetic field will be performed on all the cores at the INGV Laboratory of Paleomagnetism in Rome in collaboration with Dr. Fabio Florindo.
Steps for the quantitative analysis of calcareous plankton (foraminifera and planktonic calcareous nannofossils), of pollen (in collaboration with the La Sapienza University of Rome) and of dinoflagellates (in collaboration with the Utrecht University), and the petrochemical analysis on the potential layers of tephra recognized, in collaboration with the researchers of the Federico II of Naples University will begin.
In the second year of the project we will perform a detailed analysis of literature for the Atlantic Ocean (the Strait of Gibraltar area) to identify sites with numerical proxies (biotic and abiotic) useful to compare the response of this sector of the Atlantic Ocean (strongly connected with the Mediterranean) and of the Central-Western Mediterranean, to climatic fluctuations. This choice is in agreement with that recently reported for the MedClivar 2012 project by Abrantes et al. (2012).
Additionally the data already acquired will be transmitted to the General Portal.
In the second year of the project, we will organize the Congress of the Italian Association for the Study of the Quaternary - AIQUA 2013, entitled "The Coastal Marine Environment of the Mediterranean today and in the recent geological past: to know in order to understand", which will be held in Naples on 19, 20 and 21 June 2013, supported by the NEXTDATA project.