Marine and Transitional Environments

Services & Activities
Gruppo CSA S.p.A. laboratories are qualified for applied research and technological innovation (D.M. 26-2-87, Item 4 of the 46/82).

Gruppo CSA S.p.A. Laboratories are ACCREDIA-SINAL accredited (Lab. n. 0181) as provided for by the Standard UNI CEI EN ISO/IEC 17025, certifying the quality of both the methods used and the data obtained.

The main methods performed by the Labs are officially recognized by Italian and International Standards (APAT CNR IRSA, ICRAM, APHA, UNICHIM, ASTM, USEPA, UNI EN, NIOSH, etc.).

Gruppo CSA S.p.A. Environmental Chemistry, Physico-Chemistry and Microbiology laboratories are the heart of the company since they work with the best and updated high tech instruments and methods.

Thanks to the 25-year experience acquired in this field, the production processes were optimized and industrialized and, as a consequence, both the operating speed and data accuracy, that are often incompatible among them, could be related.

The computerization of each work phase decreased the number of error sources and the highest automation of the processes increased the speed of the analysis and reduced costs.

Over 70000 samples per year are analysed by the Labs and 800000 parameters are determined. These data place Gruppo CSA S.p.A. among the major laboratories in Italy for the environmental field.

ACTIVITIES
- Planning
- Sampling
- Analysis
- Environmental Impact Evaluation (EIE)

SAMPLES
- WATER
  - Drinking water
  - Waste water
  - Surface water
  - Ground water
  - Swimming pool water
- SOIL
  - Soil, Marine and River sediments
  - Agronomic soils, compost, biostabilized, ammendants
- AIR
  - Immission
  - Emission
- WASTE
  - Solid, liquid, waste products
- PLANTS & BY-PRODUCTS
- FOOD

ANALYSIS
- Chemical
- Physical
- Microbiological
- Toxicological

High quality work for high quality service
More than 300 different types of analysis are actually accredited (www.accredia.it).

Integrated management system of both quality and environment management systems of Gruppo C.S.A. S.p.A. is certified DNV. In this context, Gruppo CSA meets all the requirements of both technical and management competences according to UNI EN ISO 9001:2008 e UNI EN ISO 14001:2004 relatively to different services, such as: sampling, chemical, physico-chemical and microbiological analysis, planning, consulting and research. To maintain these accreditations, the laboratories are subject to periodic audits.

Data quality is ensured by:
- control charts;
- method validation procedures;
- national/international proficiency tests according to acknowledged organizations. In particular, from long time Gruppo C.S.A. S.p.A. has involved in intercalibration exercises (UNICHIM, QUALITY CONSULT e INCA).

To ensure quality of analytical results, all instruments are periodically checked and subjected to maintenance and calibration procedures.

Instrument calibration is performed using samples/standards international references.

Gruppo CSA Labs have more than 300 accredited analyses, which 60 are methods for seawater analysis and about 30 for marine sediment analysis. Water and sediment monitoring are performed by Gruppo CSA qualified technicians according to the national and international protocols (ICRAM, 2001-2003; ISPRA; etc.) and the existing legislation (D.Lgs 152/06; DM 56/09; etc.).

Some of our lab instruments:
- High resolution mass spectrometer with DFS Dioxine B type modelDFS Dioxine B – Thermo Electron Corporation (HRGC/HRMS)
- Quadrupole mass spectrometer HP GC/MS (HRGC/MS)
- Gas chromatograph
- High performance liquid chromatograph HP
- Plasma source mass spectrometer ICP/MS A7500 Agilent
- Atomic emission spectrometer with simultaneous inductively coupled plasma Varian
- Atomic absorption spectrophotometer Varian
- Atomic absorption spectrophotometer with gold amalgama for mercury determination
- Sedigraph III 5120 Micromeritics
- TSQ Quantum Acceff Max LC MS Thermo
Our team has gained a long experience in aquatic system studies (rivers, lakes, lagoons, groundwater, seas), with particular regard on marine coastal environments, their development and management. In this context, our team has specific competences in research studies on biogeochemical processes at the sediment-water interface and their impacts on the aquatic system (e.g. benthic fluxes, bio-geochemical proxies, interstitial waters).

Our team has been involved in several oceanographic, sedimentological and biogeochemical cruises to study marine environments in the framework of national and international studies.

Thanks to its long experience on the aquatic environments and a wide network of collaborations Gruppo CSA could develop also innovative sampling technologies for specific purposes.

Furthermore, our technical underwater team, with I.S.S.D. (International Scientific School Diving) licence by CMAS, has a long experience in sampling activities.

Our services

Environmental surveys supporting offshore oil and gas industry.

Environmental surveys for the assessment of the impact produced by industrial plants in coastal and lagoon environments.

Environmental studies for the development of new strategies oriented to the improvement of the coastal ecosystem quality.

Characterization services of contaminated areas also in sites of national interest (SIN).

Global Service for the Industrial plants.

Chemical analysis service for the characterization of land and coastal areas.

Our skills

Gruppo CSA includes qualified scientists coming from University and Research Institutions which gained a long experience in marine and transitional studies, including water column, sediments, sediment-water interface.

Moreover Gruppo CSA collaborates with several national and international Universities and Research Centres, in the framework of activities for improving and managing the aquatic ecosystems and preventing future scenarios (such as eutrophic and hypoxia/anoxia events and climate change).

The results of these studies are strongly interesting for Private Companies, Public administrations, environmental agencies.
Our equipment for marine studies

Multiparametric probe (SBE 19 plus) to perform water column profiles of physico-chemical (temperature, salinity, dissolved oxygen, pH, turbidity) and biological (chlorophyll a) parameters
Niskin bottles
Core sampling
Surface sediment sampling
Benthic chamber for measuring in situ fluxes at the sediment-water interface
Core incubator for measuring fluxes under temperature and hydrodynamic control
Glove box for core extrusion (under inert gas atmosphere)
Glove box for pore water extraction (under inert gas atmosphere).

Outline of R&D activities

Biogeochemical proxies

In the framework of the ANOCSIA Project (Italian Ministry of University and Research), Gruppo CSA in collaboration with the Columbia University set up some analytical methods for the Redox Sensitive Elements (Mo, Re, U, Cd) determination in the Northern Adriatic Sea. RSE results showed to have a promising potential as paleo-environmental proxies in marine sediments.

Analytical determinations

Gruppo CSA was involved in GEOTRACES Project by participating at several inter calibration exercises to improve its analytical methods for the marine environments.

Decision Support Systems (DSS)

In the framework of the EMMA Project (EU LIFE-Environment programme), Gruppo CSA in collaboration with the University of Siena developed a DSS for the Adriatic Coastal Zone, to predict and manage hypoxia/anoxia events. The DSS is an instrument aimed at supporting decisional pattern of policy makers in potentially crucial environmental crises and it is a key-tool for planning the coastal area management, by integrating different approaches merging environmental and socio-economic aspects.

Main References

Gruppo CSA has been involved in several oceanographic, sedimentological and biogeochemical cruises to study marine environments in the framework of national and international studies.

Furthermore, our technical scuba diver team, with I.S.S.D. (International Scientific School Diving) licence by CMAS has a long experience in sampling activities.

**Water column**

Chemical, physico-chemical and biological seawater characterization is performed by both qualified technicians and scientists with a long experience in aquatic ecosystem monitoring and management:

- water sampling at different depths by Niskin Bottle;
- water transparency measurements by Disco Secchi;
- acquisition of physico-chemical (Temperature, Salinity, Dissolved Oxygen, pH, Turbidity) and biological (Chlorophyll a) parameters by SBE 19plus multiparametric probe.

Data are shown in real time and processed with specific softwares.

![Example of physical-chemical and biological data elaboration.](image)

**Certifications**

ACCREDIA - SINAL n. 0181-UNI CEI EN ISO/IEC 17025


Highly Qualified Laboratory D.M. 26-2-87 PAR. 4 – Law 46/82 for applied research and technological innovation

Registration in the list of Laboratories of Emilia Romagna region, number 008/RN/002
**Sediment**

Chemical and physico-chemical sediment characterization is performed by qualified technicians and scientists with a long experience in aquatic ecosystem monitoring and management:

- Sediment sampling with gravity corer, box corer and Van Veen grab;
- Sediment stratigraphy sequences and macroscopic characteristics (colour, porosity, consistence, shell and vegetal presence/fragments, sedimentological structures, *etc.*);
- **In situ** pH and Redox measurements.

Furthermore, qualified technicians and scientists were involved in monitoring activities to measure the quantity of sinking particulate matter sampled with sediment trap.

Nowadays, thanks to the knowledge that we have acquired since 1980 and the importance of determining organic and inorganic matter fluxes from water column to sediment in a know area for a fixed time, we can use sediment trap not only in the ocean environments but also in the marine coastal areas and lagoons.

**Data quality**

Instruments are submitted to periodic maintenance and calibration for checking result reliability, accuracy and reproducibility.

Water and sediment monitoring are performed by our qualified technicians according to the national and international protocols and the existing legislation. To ensure data quality, analytical determinations are carried out according to international standards.

CTD profiles are performed according to the UNI CEI EN ISO/IEC 17025 certifying the quality of the operating procedures and the reliability of the results, together with checking for its maintenance.

Water and sediment analytical determinations are performed according to the UNI CEI EN ISO/IEC 17025 by Gruppo CSA laboratories which are qualified for applied research and technological innovation (D.M. 26-2-87, Item 4 of the 46/82).

**Main References**


Gruppo CSA has gained a long experience and a specific and technologically advanced knowledge in aquatic ecosystem monitoring and characterization. One of the main advanced competences of Gruppo CSA is to determine matter and energy fluxes at the sediment-water interface (benthic fluxes).

The quantification of the substance (oxygen, nutrients, carbon dioxide, organic and inorganic compounds) fluxes at the sediment-water interface is very important for monitoring and managing shallow ecosystems, especially related to their trophic and contamination status.

The mineralization of organic matter also involves the inorganic phases and their bonds inducing precipitation/dissolution processes and favouring benthic fluxes of dissolved substances at the sediment-water interface, from sediment to bottom water and/or viceversa.

The benthic fluxes for sediment surface unit can be calculated as the concentration gradient of dissolved substances in the overlying water.

The graph shows a study case where the benthic fluxes at the sediment-water interface influence the trophic level of the aquatic ecosystems. Note the fluxes of dissolved oxygen ($O_2$), phosphate ($PO_4$) and silicate ($SiO_2$) from the water column to the sediment and the release of ammonium from the sediment to the water column: this situation can occur in anoxic or sub-anoxic sediments and in shallow environments it strongly influences the water column quality.

Benthic chamber sketch.

Benthic chamber is a tool allowing a known sediment area and the corresponding bottom water for measuring the matter and energy fluxes at the sediment-water interface to isolate in situ.

Different chemical, physico-chemical and biological processes on the sea bottom affect sediment and bottom water quality. Most of them are driven by organic matter degradation. The organic matter present in the sediment or settled on the seafloor from the water column is mineralized by some microorganisms.

Benthic chamber sketch.

Benthic fluxes (mg m$^{-2}$ d$^{-1}$) of $O_2$, $NH_4$, $PO_4$ and $SiO_2$. Fluxes are positive (release from the sediment to the water column) or negative (from the water column to the sediment) and differ on temporal and spatial scales.
**Sediment incubation system**

Gruppo CSA has developed a sediment incubation system to study in laboratory and/or on board substance fluxes at the sediment-water interface. This tool consists of a microcosms in controlled atmosphere, temperature and circulation conditions.

In laboratory/on board simulations of the different environmental conditions (water warming/cooling, oxygen depletion, current, sediment resuspension) allow microcosm responses to be checked at various pressures and their effects on the aquatic ecosystems to be understood. In particular, studies on water warming/cooling could be included in a perspective of global climate change, a very interesting topic for the international scientific community.

In particular, incubation system consists in n.6 microcosms, 5 of which filled with sediment core and bottom water and 1 with only bottom water (blank/control sample). Each microcosm is equipped with an autonomous thermostatic and circulation system.

Studies on dissolved oxygen concentration is very important to determine possible ipo-anoxia (oxygen depletion) status and its effects on aquatic ecosystem (sediment reducing, nutrient and contaminant release from sediments, organism/fish plague, water quality decrease).

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**Main References**


Marine and transitional Environments

Research Projects
The Anocsia Project (2004-2007), funded by the Italian Ministry of Education University and Research FIRB Projects, studied current and recent hypoxic and anoxic events occurring in the Northern Adriatic basin.

In semi-enclosed, or partially closed and shallow basins subject to water stratification, such as the Northern Adriatic Sea, extraordinary episodes, even natural, of nutrient inputs can induce impressive algal blooms (eutrophication). Falling into the sea floor, they can produce anoxic conditions by consuming the O₂ present in the lower water layers, consequently causing stress on benthonic and pelagic populations living close to the bottom. The impact of anoxic events occurring in the Northern and Middle Adriatic concerns the marine ecosystem and fishing resources, benthic and pelagic fish communities, recreational (tourism) aspects and human health (toxicity).

**Objectives**

The Anocsia Project objectives are:

- formulating a database of known hypo/anoxic events occurring in the Northern Adriatic Sea based on historical records;
- characterising cause/effect relationships among benthic ecosystem and anoxic events with regard to different shelf contexts (basinal and coastal ones);
- setting up of an integrated experimental study aimed at following the evolution of anoxic events in the/a key area and the response of marine ecosystem;
- identifying biogeochemical tracers to both reconstruct the anoxic event history in sedimentary record and implement related analytical methods;
- evaluating the anoxia effects on demersal and fishing resources under different shelf conditions;
- setting up a descriptive and short-term forecast modelling of anoxic events for the Northern Adriatic Sea.

**Actions**

In the framework of the Anocsia Project, Gruppo CSA together with some Institutes of National Research Council (ISMAR-CNR of Bologna and ISMAR-CNR of Trieste) realized an instrument for sediment incubation to study oxygen and nutrient fluxes at the sediment-water interface.

**Some results**

**Redox Sensitive Element (RSE)**

Investigated Redox Sensitive Elements (RSE) were Mo, Cd, Re and U. The analytical determinations took place in fine sedimentation areas where the occurrence of anoxia episodes had been registered in the past. The sampling was made on cores through a detailed profiling, in order to get samples that can describe the typical seasonal variations of the area.

Data are referred to a 1 m core sampled in the South-East of Po Delta at a depth of 23 m. The local grain size is silty-clay with high concentrations of continental and marine organic matter.
**Incubation experiment**

Incubation experiments were performed on sediment sampled together with bottom water. Samples were put into a thermostatic incubation system to determine oxygen fluxes at the sediment-water interface. The incubation system was previously set up and tested by Gruppo CSA in collaboration with some Universities and Research Organizations.

Research on early diagenetic processes was performed by sampling interstitial water.

The differences in redox sensitive element (Mo, Cd, Re and U) trends underline an increase of the anoxic events at the top of the core (since early 80's) especially for Mo and Re. Peaks were verified with both previous data including measures of dissolved oxygen in the water column (Montanari et al., 1984; Rinaldi et al., 1993) and direct observations on the benthic macrofauna. The concentration of Cd was probably influenced by the different origin of the organic matter (continental or marine ones).

![Glove box for sediment extraction in controlled atmosphere.](image)

Concentrations, that are plotted vs. time, show the historic anoxia reconstruction. Magenta lines indicate the detrital background levels of Mo, Re, Cd, U and As estimated using the average shale metal to Th ratios (Taylor and McLennan, 1985).

These elements provide some good information about paleoenvironmental and historical occurrence of the anoxic events in the Northern Adriatic Sea; more studies are needed in order to intercalibrate the redox sensitive elements with other proxies.

**References**


The EMMA (Environmental management through Monitoring and Modelling of Anoxia) project was approved within the LIFE-Environment sector of the E.U.

The project coordinated by ISMAR-CN of Bologna has an application-managing value useful to improve the awareness of the need of implementing integrated observational-modellistic-predicting systems. This system is used to manage the environment by the authorities, who have to administrate the territory, to transfer the scientific-technologic knowledge to the public administration and to the socio-economic subjects, in order to start concerted steps and interventions able to counteract the causes of the marine ecosystem deterioration and to mitigate its impact.

EMMA stemmed from the awareness that the Adriatic coastal area, in particular its Central-Northern part, is subject both to eutrophication and anoxic events having a large impact on economic and social aspects, in particular marine ecosystem (fishery), tourism and human health.

**Objectives**

The overall objective of EMMA project is to exploit and translate scientific results into a local integrated strategy for improving the environmental quality by reducing the impact (environmental and socio-economic) of hypoxic and/or anoxic seasonal events in the marine and coastal zones of the north Adriatic Sea.

In particular the project is aimed at:

- transferring the scientific and technical knowledge to the local authorities and to the socio-economic actors in order to counteract the causes of marine ecosystem degradation and mitigate their impacts through an integrated effort;
- raising awareness about the usefulness and implementation of integrated environmental management systems, also including the local authorities not directly involved in the project;
- exchanging experiences and promoting the model in other Italian and European areas.

**Actions**

In the framework of the Emma Project, actions were performed to achieve the main objectives such as the setting up of a fixed and continuous monitoring station (E1 buoy), a monitoring network along the Emilia-Romagna coast and a Decisional Support System (DSS) for coastal area management.

Gruppo CSA was involved by the Rimini Municipality for developing the DSS. Gruppo CSA processed preliminary results acquired by E1 oceanographic buoy in collaboration with the University of Siena.

**Some Results**

**E1 buoy**

The E1 buoy, installed in Adriatic see at 6 km offshore Rimini, is the core of EMMA project and represents the fixed monitoring station. It allocates a sophisticated apparatus that measures meteorological and oceanographical parameters in continuum useful to identify hypo-anoxic episodes.

Operating since August 2006, every 30 minutes it has been recording at different depths: atmospheric pressure, temperature, relative humidity, wind speed and direction, solar radiation, temperature, salinity, dissolved oxygen, fluorescence and turbidity.

The data, transmitted via GSM every 2 hours at EMMA’s Local Information Centre (LIC), are daily validated and analysed, in order to be used into the forecasting model of hypo-anoxic events.
EMMA’s dynamic monitoring system, which was implemented along the Adriatic coast of the Emilia-Romagna region from Lido Adriano to Cattolica, catches many goals. It has been able to survey hypoxia-anoxia phenomena, improve the sensitivity of the forecasting system and operate as an effective Decision Supporting System (DSS).

Performed by ARPA-Daphne oceanography structure, a monitoring network of 18 stations perpendicular to the coastline has been identified and monitored every month (every 15 days in summer), since April 2006. It includes: CTD profiles of the water column (temperature, salinity, dissolved oxygen, pH and chlorophyll-a) and water samples for nutrient analysis.

DSS – Decision Support System

The DSS is a tool supporting the administrative and socio-economic subjects in the management of potentially critical situations deriving from the hypoxia/anoxia phenomena and assisting the decision-making bodies for a total improvement of the environmental quality. This is achieved through the elaboration of short and long term policies with the definition of strategies adapted to the needs.

References


The RISE Project (Research and development for a sediment Incubation SystEm) is co-funded by PRRIIT (Programma Regionale per la Ricerca Industriale, l’Innovazione e il Trasferimento Tecnologico) on POR-FESR Programme (Programma Operativo Regionale del Fondo Europeo di Sviluppo Regionale 2007-2013). This programme encourages local activities to improve the cooperation among companies and research organizations and promote both development and innovation sustainable processes, according to the Lisbona Strategy.

The project has a significant effect on the environmental field. In this context, it aims at achieving a sustainable development through the implementation of innovative technologies able to study the fluxes of matter and energy at the sediment-water interface. To better understand the global climate changes and hypo-anoxia events, according to the POR (Programma Operativo Regionale), QSN (Quadro Strategico Nazionale), Goteborg Strategy and Kyoto protocol, oxygen and carbon dioxide exchange at the sediment-water interface is of great relevance for the scientific community.

**Objectives**

The main objective of RISE is to provide a powerful and innovative tool to study the physicochemical and biological responses of the marine, lagoon, pond, lake benthic ecosystems. Quantification of the substances fluxes at the sediment-water interface (benthic fluxes of oxygen, nutrients, carbon dioxide, organic and inorganic compounds and contaminants) is very important in monitoring and managing shallow ecosystems, especially related to their trophic and contamination status.

These are the two main constraints for the development of social-economic activities (tourism, fishing, aquaculture, oil extraction, etc.).

Furthermore, marine and transitional ecosystems play a primary role in the CO\(_2\) balance and global climate change.

**Sediment Incubation system**

Incubation system allows to set up microcosms able to shut off in controlled atmosphere a known sediment area and its bottom water, previously sampled with suitable techniques. RISE incubation system can reproduce natural dynamics simulating different environment conditions (currents, bottom sediment handling and resuspension, warming, irradiance, water acidification, etc.).

In particular, the incubation system consists in n.6 independent microcosms, each one equipped with autonomous thermostatic, circulation, dark/light regulation and sampling systems and some electrodes to measure physico-chemical bottom water parameters in continuous (dissolved oxygen, temperature and pH).
The incubator system achievement is to study pressures/responses/effects of the marine and aquatic environments under different impacts, even though detecting all variables present in the natural environment is very difficult.

Moreover, it is aimed at giving answers to management and scientific issues.

Through the incubator system, local environmental information useful in the monitoring protocols (as reported by the Water Framework Directive 2000/60/EC and 152/2006 law), especially for the public administrations (Region, Environmental Agency, University, National Research Centre) and private firms (fishing, aquaculture and mussel-farming enterprises, hotel and tourism operators) can be acquired.

This leads to both understand the processes developing in the aquatic systems and predict hazards to the ecosystems through an integrated management of the environment (as defined by the European Community). The incubation system represents an innovative tool useful to provide real and reproducible responses in checking and predicting possible impacts (natural and anthropic) on the marine and aquatic environments.

**Partners**

The project leader is Gruppo CSA, that collaborates with CNR-ISMAR (Consiglio Nazionale delle Ricerche – Istituto di Scienze Marine) and ARPA Daphne of Emilia-Romagna.

In particular, CSA is responsible to develop the incubation system under technical-scientific support of the National Research Council (CNR-Ismar) of Bologna and Trieste. To test the efficiency of the system, validation data will be performed by CSA in collaboration with ARPA Daphne ER.
Coastal areas are constantly evolving complex systems characterized by various processes and resulting by the interaction of environmental, social and economic aspects. The main natural and anthropogenic effects affecting coastal areas at both global and local scales are: coastline morphology, hydrodynamic of the marine basin, continental inputs, drainage system, engineering structures along the coastline (harbours, breakwaters, groynes, seawalls, dykes, etc.), inhabitants and tourism increase, agriculture, aquaculture and fishing.

Erosion is the main stressor affecting the shoreline morphology. Since 1900, a new sandy shore formed/developed thanks to a lot of engineering structures that have been built along the Italian coast to stop erosional processes. Therefore, besides protecting the beach, breakwaters have also an important influence on both water-sediment quality and coastal geomorphology. Thus, attention has recently been paid to the impact of breakwaters on coastal environment, both for water-sediment quality and landscape.

**Objectives**

In the framework of an assignment of a Municipality of Rimini, studies aimed at involving management strategies to improve the environmental quality within the coastal defence barriers have been developed.

Coastline evolution and physicochemical characterization (mud, organic matter, nutrients, dissolved oxygen, municipal waste discharges etc.) of the coastal area of Rimini inside breakwaters were carried out to estimate the environment conditions (water and sediment quality) inside the barriers.

Degradation rates of organic matter **in situ** (anaerobic environment) and **ex-situ** (aerobic environment) were estimated.

**Coastline evolution**

Since the end of the 1950s interventions aimed at protecting and safeguarding the coastline against sea erosion have been carried out extensively in the coastal zone of Rimini.

The shoreline is also interested by some channel and municipal waste spillway mouths (Pedrera Grande, Cavallaccio, Branca, Fossa degli Orti, Scolo Sortile, Turchetta), discharging all their loads in the sea during rainfalls. The municipal waste waters are usually treated in the Santa Giustina purification plant by means of both a water pipe governed by pumps and some spillways usually opened in occasion of greater flows.

**Coastal area characterization**

Stations inside/outside breakwaters and near/far the canal mouths were sampled in 2002-2003 to determine water-sediment quality.

Shore parallel breakwaters protecting coast cause the build-up of muddy sediments (silt and clay), suspended solids, organic matter and nutrients in the inner area. These conditions favour the oxygen consumption, the development of algal blooms and the worsening of bathing conditions, with respect to the area outside breakwaters.
The TRIX trophic index showed that the inner area presents a water quality worse than the one of the outside area.

In a station inside breakwaters located in front of Brancona channel, a deepest core was collected to reconstruct sedimentation pattern and its variability through time.

**Inside breakwaters**

**Outside breakwaters**

![Study area characterization inside and outside breakwaters.](image)

From the breakwater deployment (1950s) to nowadays a succession between critical conditions and environment quality improvement are showed due to natural conditions, also favoured by anthropogenic activities.

**Actions**

**Organic matter remineralization**

Organic matter remineralization in situ determined in anaerobic conditions was 4 mol C / day, while 100,000 mol C per day was calculated for the removed sediments and placed on the beaches for three months. The comparison between the two experiments showed that the organic matter degradation in aerobic environment (three months) is faster than the one occurring in anaerobic conditions (seventy years).

**Future perspectives**

Breakwaters stopped coastal erosion favouring the building of a new beach. Nevertheless, critical aspects on the environmental quality inside breakwaters producing a consequent worsening of bathing conditions due mainly to secondary canals, directly discharging into the sea between shoreline and breakwaters, have been observed.

A new strategy of sewage and terrigenous inputs management should be considered.

The study has highlighted the environmental state and its critical conditions. Moreover actions were carried out in order to give an estimate of its compromising level. The sedimentation pattern reconstruction inside barriers from the breakwater deployment (1950s) to nowadays shows that a high recovery capacity of the environment inside breakwaters seems to characterize this area,

**References**


The lagoon of Venice is a coastal shallow water environment with a surface of 550 km² and an average depth of about 1 m. The QSEV Project focused on heavy metals (Al, Cd, Cr, Cu, Fe, Hg, Mn, Ni, Pb and Zn) and arsenic distributions in the sediment of the whole lagoon. Fifty centimetres-long cores were collected in 380 sampling sites. Each core was sliced in five parts, obtaining 1900 samples corresponding to the following depth layers: 0-5 (named layer “A”), 5-10 (“B”), 10-20 (“C”), 20-30 (“D”) and 30-50 (“E”) cm.
**Results**

Metals concentration shows a wide variability both spatially and along the vertical profile. The impact of the human activities affects the various shallow water areas to a different extent, in response to local water renewal and position with respect to the pollution sources. Higher metal concentrations (particularly Cd, Cu, Hg, Pb and Zn) occur close to sources already identified in previous studies (freshwater tributary inlets, industrial area, urban settlements), moreover, thanks to QSEV sampling grid, new sediment contamination areas are highlighted.

In the framework of the QSEV Project, Gruppo CSA, involved by CNR - ISMAR, carried out part of the grain size analyses and determination on metals. Gruppo CSA has supported the processing and the interpretation of data.

**Working group**

CNR - Istituto di Scienze Marine – Venezia (Coordinator)
Magistrato delle Acque di Venezia
Consorzio Venezia Nuova
SELC – Biologia e Geologia applicate
Istituto di Ricerca Gruppo C.S.A.
The activities of Istituto di Ricerca Gruppo CSA are oriented to manage large and complex environmental monitoring plans. The development of environmental monitoring planning, sampling and analytical determinations in atmospheric, soil, water, sediment and waste samples are the competencies and experiences of Gruppo CSA. Gruppo CSA is a private research institute, that can be qualified as a SME (Medium-Sized Enterprise with about 100 employees and a turnover of 7.8 million euro per year). Gruppo CSA is accredited according to the standard UNI CEI EN ISO/IEC 9001:2000 and UNI CEI EN ISO/IEC 14001:2004 for chemical analyses and environmental services. The labs of the Gruppo CSA are accredited according to standard UNI CEI EN ISO/IEC 17025 to evaluate data accuracy.

Gruppo CSA has been active in several fields since 1985, including sustainability analysis, sampling, physico-chemical and microbiological determination, research and consulting in the environmental, food farming, industrial safety, management system sectors and it has cooperated with national and international research centers, districts and cities administrations and environmental protection agencies. The human component has always been very important for the carrying out of the company’s activities. The increase in number of employees and collaborators that has taken place during the last years is of more than 100 employees and collaborators.

The strategies used to reach these goals are: the management of complex environmental monitoring plans; the continuous innovation achieved thanks to the collaboration with scientists working in italian and international Universities and Research Bodies; the participation in research projects. The results and the knowledge acquired from these activities are then applied by the Division, improving them thanks to the twenty-year experience of our scientists.

Investing money and resources in Research and Development to find for clients of Gruppo CSA innovative and interdisciplinary solutions to complex environmental problems is one of our most important goals. This is the aim of the Division of the Projects, Research and Development, in order to give to different public and private clients suitable solutions for the management of different environmental problems.

Research
- Systemic analysis
- Environmental analysis and assessment
- Risk Analysis
- Integrated management of the coastal region
- Air quality, atmospheric fall-out
Planning
- Environmental plans
- Monitoring plans
- Environmental impact assessment plans
- Sustainability plans
Innovation
- Environmental markers
- Technological solutions
Quality
- Quality system certification (ISO 9001)
- Environmental certification (ISO 14001 – EMAS)
- Product certification
- Social accountability (SA 8000)
Good Manufacturing Practice-Good Laboratory Practice
- Good Manufacturing Practice
- Good Laboratory Practice
Safety and Hygiene
- Industrial health and safety
- CE marking
- Industrial and environmental hygiene
- Waste management (Dir 91/156 CEE and followings)
Food Hygiene
- Compliance with the law in force (HACCP)
- Product labelling
- Food certification
Sanitary authorizations and recognitions
- DOP-IGP mark recognition

Support and Development Services
Company organization
- Analyses and optimization of processes
- Total Quality Management
- Training and optimization of human resources
The labs
- High resolution mass spectrometer with DFS Dioxine B type modelDFS Dioxine B – Thermo Electron Corporation (HRGC/HRMS)
- Quadrupole mass spectrometer HP GC/MS (HRGC/MS)
- Gas chromatograph
- High performance liquid chromatograph HP
- Plasma source mass spectrometer ICP/MS A7500 Agilent
- Atomic emission spectrometer with simultaneous inductively coupled plasma Varian
- Atomic absorption spectrophotometer Varian
- Sedigraph III 5120 Micromeritics

Analysis
Environment
- Environmental analyses and samplings of waters, air, soil, waste, noise and vibrations
Food
- Product analyses and sampling of raw material, semimanufactured and finished products.
Agriculture
- Sampling and analyses of irrigation watering, parasiticide, agronomic soil and fertilizers.

The “data”
More than 38,000 samples of soil and sediments
More than 2000 emissions from waste incineration plants
More than 66,500 samples analysed per year… giving a total of more than 3,000,000 parameters evaluated

Address: Via Al Torrente 22 – 47923 Rimini
T. 0541 791050 F. 0541 791045