

Scientific information to support the objectives of the Mediterranean Regional
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TOWARDS A MEDITERRANEAN CANYON INVENTORY

**PROMETEOS Project (PROtection of the MEdiTerranean Open Seas: Contributing to the
establishment of Marine Protected Areas over offshore seamounts and submarine canyons).
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Introduction

The importance of an effective marine environment cadastre representing the multidimensional nature of reality as closely as possible in order to facilitate good governance, it has been already pointed out. Physical, biological, socio-cultural and economic nature of the environment may be linked with information for a jurisdiction, on the effects of its formal law and community interests on the marine environment to give the cadastre a multipurpose function: *"ideally, the marine cadastre would be based on a marine parcel that would be the focus of information collection, storage, analysis, retrieval and dissemination"*.

Within the highly variable pelagic realm, habitats such as submarine canyons could provide an easier field for application because their *"static nature"*. Their particular density in the Mediterranean area as well as their fundamental role in the ecosystem functioning could drive the need of an inventory. Obviously, the first step for a complete Mediterranean submarine canyon list is to have an idea about their number and current names.

At the present, various and heterogeneous sources of information can help this task: several canyon names and positions can be easily found on Google Earth, which is based on SIO, NOAA, US Navy, NGA and GEBCO datasets; 518 canyons have been listed by using morphological criteria applied to ETOPO1 and Mediterranean Science Commission bathymetric datasets; on the other hand, at least than 270 have been identified through detailed geological maps of the Mediterranean sea floor.

Several Mediterranean submarine canyons have been investigated from many aspects, i.e. circulation, tsunamis effects, mass transport, turbidite systems, bottom morphology, biodiversity, cold water biocenoses, fishery impact as well as nursery and recruitment for commercial species, pollution, coast and deep sea exchanges, etc., thus information on names, numbers, geographical position, morphology, physical and biological processes of main submarine canyons can be now obtained from a broad kind of scientific sources done for several Mediterranean areas.

A very provisional list of canyon names is proposed. The list has been obtained by crossing the above-mentioned datasets with scientific and other sources of information (most can be obtained more or less easily through internet). Canyon names with some reference in literature are in italic style, an asterisk follows the names when it is arbitrarily assigned according to its correspondence with bay, cape, island, promontory, river, coastal settlement, city and other conspicuous geographical feature. The list also includes canyons still without name, but with some reference of their existence.

South Eastern Iberian Margin

From west to east the presence of 51 submarine canyons is well documented: *Algeciras, La Linea, Rio Guadiaro, Estepona, Bovedas, Baños, Torrenueva, Fuengirola, Almuñecar, Motril, Carchuna (Sacratif), Calahonda, Dalias, Almería, Andarax, Gata, Alias Almanzora, Palomares, Jolocular, Aguilas, Cabo Tiñoso, Cartagena, Negrete, Palos, Alicante, Benidorm, Valencia, Hirta, South Columbrete, North Columbrete, Benicasim, Ebro, Oropesa, Alcalá de Chivert, Benicarló, Marta, Peñíscola, Torreblanca, Tortosa, Tarragona, Foix, Cunit, Valldepins, Berenguera, Morràs, Besós, Arenys, Blanes, San Feliu, Palamos (La Fonera), Cap Creus.*

The type 2 canyons (incising the shelf without connection with rivers) are located on the eastern and western side, while those confined to the slope (type 3) seem to be mainly from Gata Cape to Ebro mouth.

Balearic Margin

No submarine canyons exist in the north-western slope of the Balearic Islands, while the southern margin is shaped by 4 main canyons: *Formentera (Pitiusas), Mallorca-Cabrera, Pera, Menorca* and it is deeply incised by at least 15 short and rectilinear canyons, from Mallorca to Ibiza.

Alborán Island

Three main canyons can be identified on the south and eastern slope off the Alborán Island: *Al Borani, Piedra Escuela* and *Castor*.

French mainland coast

Along the French coast from Cerbère to Menton, 28 canyons can be counted, those of the Gulf of Lion mainly belonging to the type 2 (Harris and Whiteway, 2011). From west to east: *Lacaze-Duthiers, Pruvot, Bourcart (Aude), l'Hérault, Sète, Catherine-Laurence, Marti, Montpellier, Aigües mortes, Petit Rhône, Grand Rhône, Estaque, Marseille, Couronne, Planier, Cassidaigne, Cassis, Sicié, Toulon, Porquerolles, Stoechades, Pampelonne, Saint Tropez, Estérel, Cannes, Var, Paillon and Monaco*.*

Corsica

The narrow continental shelf around the Corsica Island is incised by at least 16 canyons: *Centuri*, Saint Florent, Île Rousse, Calvi, La Revellata*, Galéria, Porto, Peru*, Sagone, Lava*, Ajaccio, Valinco, des Moines, Porto Vecchio*, Aléria* and Cervione*.*

Italian mainland coast

Combining information coming from various sources 48 canyons can be identified on the Ligurian, Tyrrhenian and Ionian margin, while two in the southern Adriatic sea. It must be pointed out that in many cases a single name corresponds to a system rather than a single canyon: *Roja, Nervia, Taggia, Verde, Mercula, Bordighera*, Laigueglia, Centa, Varatella,*

Imperia, S. Bartolomeo, Capo Mele, Pora, Finale, Noli, Vado, Polcevera, Bisagno, Di Levante, Civitavecchia, Gaeta, Garigliano, Volturno, Cuma, Punta Cornacchia, Magnaghi, Dohrn, Salerno, Maratea, Capo Suvero, Angitola, Gioia Tauro, Bovalino, Siderno, Gioiosa, Roccella Ionica, Caulonia, Stilo, Soverato, Catanzaro, Squillace, Corigliano, Neto, Lipuda, Cirò Marina, Taranto, Otranto, Bari.

Sardinia

A complex system of 29 canyons incises both the western and eastern Sardinia Island slopes: *Caprera, Posada, Gonone, Orosei, Arbatax, San Lorenzo, Capoferrato*, Carbonara, Cagliari, Spartivento (2 canyons), Teulada, San Antioco (2 canyons), Toro, Carloforte (4 canyons)*, at least 4 canyons off the south western coast (Costa Verde), *Oristano, Il Catalano*, at least 3 canyons off the coast from Bosa to Capo Caccia, *Castelsardo*.

Sicily

Around Sicily 21 canyons are mainly located off the northern and eastern coast: Egadi, Stromboli, Patti, Messina, Milazzo, Castellammare, S. Vito, **Cofano**, Zafferano, Eleuterio, Oreto, Arenella, Priola, Addaura, Mondello, Favignana, Pantelleria-Mazara*, Scoglitti*, Capo Passero and Catania, which indicate canyon systems.

Malta

Heron is the canyon name located off the south-eastern side of the shelf around the Maltese archipelago. This canyon is divided in two branches in its deepest portion.

Tunisia

The long *Bizerte* canyon cuts northward the channel between Sardinia and Tunisia, while its eastward branch reaches Rass Sidi el Mekki (Cape Farina). Other 3 canyons carve the shelf around the Galite Island.

Algeria

The Algerian steep slope is shaped by 24 canyons. References about *Annaba, Skikda, El Kebir, Nil, Bejaïa, Dellys, Sebaou, Nif, Sefsaf, Algiers, Dahra, Guelta*, and *Khadra* canyons can be found both in scientific literature and Google Earth digital atlas. Between Algiers and Dahara at least 11 unnamed canyons can be identified.

Morocco

The southern portion of the Alboran sea is mainly characterized by submarine hills and banks, the only submarine canyon is close to *Ceuta*.

Greece

The Hellenic Trench, stretching from Ionian Islands to Rhodes (southern Aegean arc), is featured by numerous canyons as well as the northern part of the Aegean sea: *Kerkyra, Paxoi*, Lefkas, Kefalonia, Zakynthos, Pirgos*, Kiparissiakos*, Proti*, Messini*, Kalamai*, Kyparissia*, Kalamata*, Skoutari*, Mirampelou* (Crete), Samaria (Crete), Paximades, Sfakia* (Crete), Ptolemy (Crete), Lithinon (Crete), Pliny (Crete), Strabo (Crete), Nereus (NW Rhodes), Brigitte (NW Rhodes), Trianta (NW Rhodes), Kalliathea* (NE Rhodes, 2 canyons), Psalidos (NE Rhodes), Pera (NE Rhodes), Lutani* (NE Rhodes), Tsampika* (NE Rhodes, 2 canyons), Malóna (NE Rhodes), Vlichá* (NE Rhodes), Lindos* (NE Rhodes), Samoträki* (2 canyons), Strymonik*, Thermaikos (2 canyons). Very likely the number of canyons in this area is underestimated.*

Turkey

At least 10 main submarine canyons can be identified off the western and southern Turkish coast, as for the Greece their number may be underestimated: *Xeros**, *Bosphorus*, *Sarköy*, *Fethiye*, *Megisti**, *Finike*, *Antalya*, *Anamur*, *Boziazı**, *Antakya**.

Cyprus

Around Cyprus 5 canyons have been identified: *Famagusta**, *Larnaka**, *Akrotiri**, *Chrysochou** and *Morphou**.

Middle East coast

Latakya, *Baniyas*, *Tartus* are the names identifying submarine canyons off the Syrian coast and *Junieth*, *Saint Georges*, *Beirut*, *Zahrani*, *Sayniq* off Lybanese coast. *Akhziv*, *Saar*, *Nahariya*, *Shomrat*, *Hilazon*, *Qishon*, *Haifa*, *Atlit*, *Cesarea*, *Hadera*, *Netanya*, *Ashodod* and *Afiq* are the names of the well-documented canyons off the Israel coast.

Egypt

The Egyptian passive margin is incised by 12 canyons: *Damietta** (a system with at least 7 branches), *Rosetta* (a system with at least 9 branches), *Alexandria**, *Ras Alam er Rum*, *Solum** and *Habu Ashafa**. At least 6 canyons from Solum to Habu Ashafa still remain unnamed.

Lybia

Canyon density is higher off the eastern coast, many of which have been arbitrarily named or still unnamed: *Tobruk**, *Derna** and at least five canyons in the between, one canyon on west from Derna. *Susah** and other four canyons on west before *Melita*, *Misratah* and *Tripolitanian*.

Concluding remarks

Roughly a total of 348 submarine canyons can be allocated on the slopes of the eastern and western Mediterranean basins, 237 have a name quoted in scientific literature or other sources of information. The geographic position of remaining 111 can be identified, but it was not possible to find references in order to assign a shared name, nevertheless here for 43 of which it has been arbitrarily created a nomenclature. Comparing these figures with the results obtained by Harris and Whiteway (2011), this list greatly underestimates the number of Mediterranean submarine canyons mainly for the southern Tyrrhenian coast of Italy, Algeria, south Aegean Arc and Turkey. It must be stressed that this very provisional inventory is roughly based on the available information coming from scientific literature and other kind of sources; it does not fit specific criteria in order to identify various type of canyons and, sometime, canyon systems from a single canyon. Even if available, in some cases, data such as geographic position (i.e. head and mouth coordinates), length, shape (V and U shaped), type (i.e. shelf incising, shelf incising with river connection, slope confined), habitat type (i.e. sandy, muddy, rocky), biocenoses (i.e. cold water corals), role for fisheries (i.e. nursery, breeding, ground), threats, exploitation for non-renewable resources, pollution, conservation status, etc. have not been considered at the moment. Obviously, considering the fundamental role of such structures for shelf and open sea exchanges, a Mediterranean submarine canyon inventory could be a priority tool for a better governance of the Mediterranean pelagic ecosystem.