



# Book of abstracts

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# **XX-1. The Archaeology of Submerged Landscapes.**

# Archaeological evidence from drowned landscapes: informing understanding of dispersal, adaptation and connectivity.

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Human recolonisation and dispersal across north west Europe followed the major Devensian stadial. When the climate ameliorated, people migrated from far afield in the south and east, taking thousands of years before arriving around the North Sea and Channel. Once here, they occupied expansive plains that were exposed while the sea levels remained low. As populations grew, comparable cultural technologies of the Upper Palaeolithic Magdalenian, Hamburgian, Federmesser, Creswellian and Ahrensburgian are found across great distances. This also applies to the Early Mesolithic Maglemosian, Sauveterrian and Azilian although the return of cold climatic conditions pushed people away from the northern plains and uplands. When the temperature warmed once again about 10,500 years ago people now returned rapidly suggesting there had been a continual presence in the region. It is probable that the Channel and North Sea region acted as a refugium for more resolute populations. The next challenge was the subsequent rise in sea level rise and advance of forests from the south that changed the landscape, interrupting the migration patterns of large megafauna and imposing new restrictions on movement. The impact of change was most acute along the coastlines that were constantly shrinking as the water levels rose. People were forced to adapt if they were to continue exploiting the landscape. This talk will look at the process of human dispersal with reference to the discoveries from submerged sites; particularly Bouldnor Cliff. Here, a high-quality level of preservation has enabled the recovery of artefacts that has revealed specialisation and high levels of sophistication that is not witnessed in comparable mainland British sites. Flint tools and timber have been fashioned in ways not seen on the mainland UK for another 2,000 years. It will present some of the techniques used to recover material and results of the analysis. In addition, cultural influences and DNA evidence suggest a widespread social network that extends to the fringes of the Neolithic world. The presentation will show where the methods used to recover material have been applied further afield in Arabia where analogies can be drawn with the evidence of human migration further north. Here, the discovery of analogous archaeological material could have implications for research on human dispersal out of Africa and of the earliest modern civilisations. The potential to find physical evidence has been enhanced by the assessment of seismic survey data that has revealed submerged palaeo-landscape features in the Arabian/Persian Gulf. If we want to increase our understanding of these early human communities the next step is to dig deeper into this rich resource that can contain uniquely well preserved material.

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**Keywords:** submerged landscapes, excavation, Bouldnor Cliff, Mesolithic, North Sea: Arabia



# Deeply Drowned and Highly Stranded: Investigating High Latitude Early Post-Glacial Coastal Landscapes on the British Columbia Coast

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With the fall of the "Clovis-First" paradigm, archaeologists are increasingly interested in the hypothesized west coast route of first peopling of the Americas. The dynamic deglacial history, and associated isostatic and eustatic changes, of the early British Columbia coast means contemporaneous terminal Pleistocene shorelines can be deeply drowned, close to modern, and highly stranded. For example, the 14,000-year old marine shore is now 150 m below modern in Haida Gwaii, within a few metres of modern at Hakai on the Central Coast, and 195 m above modern on Quadra Island on the south coast. Relative sea level can therefore be a very local phenomenon at the scale of a few tens of kilometres. We are using detailed local sea level histories to focus archaeological investigation of early post-glacial human use of the coast. Here we highlight some of our approaches to the archaeological record of these dynamic early landscapes. This work shows that, at least in high latitudes, underwater, intertidal **and** terrestrial research can effectively explore early post-glacial (17,000 to 8,000 years ago) coastal landscapes. In effect, the Americas' west coastal plain is only partially drowned, so archaeological research should include coastlines at all elevations below and above modern shores.

**Keywords:** coastal, prehistory, sea levels, Northwest Coast

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# SPLASHCOS-viewer - First online atlas of submerged prehistoric sites in maritime Europe and the example of the Mesolithic site of Strande, Kiel Bay

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From 2009 to 2013 the EU-funded SPLASHCOS network promoted the fledgling discipline of 'Continental Shelf Prehistoric Research'. This discipline is based on an interdisciplinary research approach combining archaeological, geophysical, geological, oceanographic and biological methods. Investigations so far have already enormously expanded the available knowledge about prehistoric life on the now-submerged landscapes that were drowned with final sea level rise at the end of the Last Glacial. In many cases the excellent preservation conditions in waterlogged sediments for everyday objects, tools and structures made of organic materials have provided completely new insights into prehistoric life. The 25 states which have joined the project have screened their databases and publications for relevant data on prehistoric sites and agreed to publish the archaeological data via a web based viewer, which will be presented in detail. All in all there are approx. 2900 sites from 19 countries. For practical reasons all Stone Age sites were accepted. Because of the chronological simultaneity of the Neolithic in northern Europe and the Mediterranean Bronze Age, the latter was accepted, too. This data provides an excellent basis to start further investigations, which are needed to understand and protect our underwater cultural heritage.

As an example for such further research, the current investigations on the Mesolithic site of Strande, dating from 5400 to 4900 BC, are presented. The site has excellent preservation conditions and lies in a water depth of six meters. Tree stems, organic layers with tools of flint-stone and wood, remains of dug-outs, animal bones and even human bones are present, which have been investigated by means of aDNA.

**Keywords:** submerged sites, stone age, maritime, Europe, online viewer, Strande, Kiel Bay

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# Submerged Landscapes and Deep History of Sea Country in Western Australia

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Given the current time range, 65,000 to 50,000 years ago, for earliest human colonisation of the Australian continent, first landfall and the earliest processes of settlement and dispersal must have occurred in coastal territory that is now under water. Yet, despite the critical relevance and considerable extent of this now-drowned territory, relatively little underwater exploration has so far taken place in Australia. Here, we report on the preliminary results of a project that is one of the first in Australia to examine the drowned continental shelf in a systematic way and to seek to integrate the existing on-land terrestrial record of human occupation with investigation of the drowned shelf. The area of study is the Pilbara region of Western Australia, which has a well-established 50,000-year on-land record of cave occupation, rock art, stone fish traps and shell middens. The aim of the research is to map the offshore landscape and to identify and investigate archaeological and palaeoenvironmental features using predictive archaeological modelling, underwater acoustic survey and airborne LiDAR, coring and inspection by divers. The project includes acoustic and geoarchaeological investigation and excavation of a submerged Danish shell midden, one of the few known submerged shell middens anywhere in the world, to establish whether this type of underwater feature can be discovered by remote sensing and to establish guidelines for use in underwater research elsewhere. The research is expected to promote investigation of the underwater archaeology associated with traditions of ‘Sea country’, to provide the first detailed modelling of an underwater archaeological landscape in Australia, a morphometric and marine geophysical template for the identification of key cultural features including the development of a Danish model for the prospection and identification of submerged shell middens, and the basis for comparison with similar research now being conducted in other

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**Keywords:** Submerged landscapes, Australia, Denmark, shell middens, rock art, underwater archaeology, LiDAR, acoustic survey

# Sítio Saco da Pedra: A Recently Submerged Shell Midden

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Early on researchers focused on the archaeology of coastal sites and resources face the dynamic nature of such areas. However, most often than not the time scale for understanding changes in the coast is in the order of centuries or millennia. Recently our team were shocked by the partial destruction of a shell midden, Saco da Pedra, located in Alagoas state, northeastern Brazil. In a matter of five months the opening of a bar resulted in more than half of the midden's area to be taken by water. Such a situation is one example of the drastic changes that can occur in a short-term time scale. Despite the loss of part of the site, the opening fortuitously revealed remnants of a shell workshop. This is the first recognized as such within a shell midden in Brazilian territory. In this paper, we discuss the preliminary findings from Saco da Pedra and how the site fits in the previous research done in shell middens located in Northeastern Brazil. Witnessing the dramatic dynamics that is currently affecting this midden may lead to new possibilities to understand the low density of shell sites on Brazil's northeast coast. An issue that has for some time troubled specialists seeking to understand the history of human occupation in South America and the many parts played by the rivers and the ocean in it.

**Keywords:** sambaquis, shell middens, coastal adaptations, seascapes

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\*Speaker

# Tracing Palaeolithic Occupation along the Eastern Red Sea Coastline

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The role of coastal landscapes and resources in dispersals has long been the subject of debate, particularly in assessing the conditions and timing of global dispersals of modern humans from Africa. Coastal landscapes potentially provide highly attractive concentrations of different marine and terrestrial resources but are not uniformly attractive to exploitation. Current discussions into the extent to which Pleistocene coastal areas were exploited by hominin populations are hampered in large part due to their submergence by Holocene sea level rise. New data on Palaeolithic coastal occupation directly related to palaeoshorelines, from both terrestrial and underwater contexts, are therefore urgently needed. A UK-Saudi team DISPERSE is addressing these issues through archaeological survey along the Red Sea coastline of Saudi Arabia, a region key to dispersals along both the Northern Nile/Levant) and Southern Route (Bab el Mandab/Hanish Sill) from Africa into Arabia. This paper presents new data on Early and Middle Stone Age artefacts, primarily from the Red Sea coastline of the Harrat Al Birk lava fields, located by the UK-Saudi team between 2012-2017. This 100km coastline contains numerous raised fossil beach deposits and coral terraces, some associated with Palaeolithic artefacts. In particular, the Dhahaban Quarry site has yielded over 400 lithics, 19 of which were stratified in deposits below a fossil beach complex. The nature of these deposits and their associated archaeology are discussed in the context of the challenges involved with identifying and assessing the Palaeolithic record of coastal region exploitation, and the future potential for offshore investigation in the region.

**Keywords:** Palaeolithic, coastlines, geomorphology, sea level, dispersals

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\*Speaker

# Palaeolithic archaeology and submerged landscapes in Greece: The current state of the art

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During the 20th century Palaeolithic research in the NE Mediterranean operated on a mainland-focused epistemological paradigm that saw the NE Mediterranean Sea as a barrier, peripheral to the Palaeolithic world and hence not worthy of systematic exploration. As a result, Greece remained marginal to human origins research despite its position at the crossroads between Africa, Asia and Europe. During the last twenty years the new sites discovered on the islands of the Aegean and the Ionian Seas lend credence to the view that islandscapes, coastal zones and submerged seascapes ought to become part and parcel of Palaeolithic research in a country with 17,000 km of coastline – a quarter of the total Mediterranean coastline – the greater part of this figure being represented by islands. Unless island, coastal and underwater geographies are incorporated into the palaeogeographic reconstructions many of the shortcomings in Greek Palaeolithic narrative are bound to remain. In this paper we focus on underwater investigations conducted in the Aegean and the Ionian shelf and reconstructions of their submerged landscapes in order to present the state of affairs on the subject. We bring together in a coherent narrative marine geophysical and archaeological perspectives and results from interdisciplinary work conducted in the field and the lab. The palaeogeographical evolution of the shallow coastal and shelf areas of Greece is determined by a complex interplay between active tectonics and eustatic sea-level change. Long-term and episodic vertical tectonic movements involving both subsidence and uplift have played a major role in shaping the most promising areas for underwater archaeological survey. They have also determined the variable presence of land bridges between islands and their adjacent mainlands and the distance of sea crossings between them. We will examine these issues in parallel with the terrestrial archaeological record.

**Keywords:** Palaeolithic, submerged landscapes, Aegean, Greece, palaeogeography, Lower Palaeolithic, Middle Palaeolithic, Middle Pleistocene

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# Les amas coquilliers du Delta du Saloum, étude archéologique subaquatique

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Situé à 150 km au sud de Dakar, capitale du Sénégal, le Delta du Saloum est une zone de 2250 km<sup>2</sup> où domine la mangrove. Il est habité par des communautés qui y mènent depuis plus de deux millénaires, des activités basées principalement sur les ressources halieutiques dont une grande partie concerne l'exploitation des mollusques.

Cette zone inscrite depuis 2011 sur la liste du patrimoine mondial de l'UNESCO constitue un paysage culturel exceptionnel grâce à ces multiples aspects culturels, naturels et archéologiques.

Les multiples recherches archéologiques ont montré que le delta est surtout caractérisé par la présence de plusieurs amas coquilliers anthropiques dont l'édification se situe entre le IV<sup>e</sup> siècle av. J.C au IV<sup>e</sup> siècle après J.C (THILMANS et al. 1974 ; 1982 ; 2000). Mais surtout ce qui fait la particularité de ces amas, c'est qu'ils sont associés parfois à des tumulus coquilliers funéraires dont l'édification, beaucoup plus tardive, débute seulement au IV<sup>e</sup> siècle pour se poursuivre jusqu'au XVI<sup>e</sup> siècle.

Ces amas coquilliers du delta du Saloum surmontés de tumulus funéraires sont considérés comme une exception mondiale. Plusieurs recherches archéologiques, ethnographiques, paléoclimatiques ... y ont été effectuées, depuis 1939 à aujourd'hui. Ces recherches ont permis de mieux comprendre une grande partie de l'histoire de cette zone, qui occupe une place importante dans la cartographie des sites protohistoriques de la Sénégalie.

Aujourd'hui, avec les multiples menaces qui pèsent sur ces sites, que ça soit anthropique ou naturel, on assiste à la disparition d'une partie de ces amas coquilliers. En effet, avec la reconstruction climatique de la zone, occasionnant la montée du niveau de l'eau et l'érosion marine, une grande partie de ces amas est submergée par les eaux, causant une perte de la stratigraphie complète de ces nécropoles. Ce phénomène est aussi causé par l'exploitation des coquillages par les populations locales.

Notre présentation portera sur les nouvelles recherches archéologiques subaquatiques qui ont été entamées sur les parties submergées des amas coquilliers de *Fadanga*, situé à 2,5 km au sud-est de Niodior et à quelques dizaines de kilomètres de *Diorom Boumak*, un peu plus au sud avec 400 m du nord au sud, pour une hauteur de 12 m environ. Ces recherches sans précédent dans la zone ont pour principal objectif d'étudier la partie submergée de ces sites afin de posséder des données sur le niveau de submersion.

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\*Speaker



**Keywords:** amas coquilliers, tumulus funéraire, delta du saloum, archéologie subaquatique

# Before, after or around the Ice. South Cuidrach and the earliest occupation of Scotland's north-west.

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During the Late Glacial and Early Holocene periods, Scotland was a mountainous north westerly peninsula that jutted into the Atlantic. Recently a small number of sites across Scotland have demonstrated a human presence here during the different continental Late Glacial cultural periods. Though so far, no secure radiocarbon datable material has been recovered, typologically the artefacts include evidence for Hamburgian, Federmesser, Ahrensburgian and Fosna-Hensbacka material cultures, which date to between around 12700 – 9800 BC. During the Younger Dryas, parts of Scotland were reglaciaded and it is not yet clear whether a human population remained in the region. South Cuidrach is a newly discovered site in the north west of the Isle of Skye. At present, it comprises a lithic scatter with LUP/Early Holocene features, much of which is rolled, which was recovered following the creation of a new farm track cut through a potentially redeposited beach. The scatter lies on the west facing shore of a sea loch, adjacent to a river mouth in an area of coastline that is relatively protected. Sea level change during the Late Pleistocene/Early Holocene was dynamic in this region and the rolled nature of the artefacts, the relatively broad distribution pattern and the potentially redeposited nature of the beach, suggests the likely presence of an offshore site.

**Keywords:** Scotland, Late Pleistocene/Early Holocene

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\*Speaker

# Recent research on submerged prehistoric landscapes in the Bay of Kiladha, Greece, and its archaeological implications

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The Bay of Kiladha, in Southern Greece, is well known for the presence, on its northern shore, of Franchthi Cave, a major prehistoric site. Excavations in the cave by Indiana University in the 1960s and 1970s revealed an exceptionally long occupational sequence, starting in the Upper Palaeolithic and spanning the entire Mesolithic and Neolithic. During most of this time, because of sea level change, the Bay of Kiladha was a small coastal plain, and the cave, which is now very close to the sea, could be as far as a few kilometres away from it.

In the Neolithic, the cave was not the main focus of human activity anymore, as local groups turned to village life. Architectural remains dating to this period were found in front of the cave (the "Paralia" sector overlooking the modern pebble beach), but the main settlement was probably further away, in the small coastal plain that was later submerged by postglacial sea level rise. Accordingly, underwater research was carried out in the Bay of Kiladha in the 1970s and 1980s, before coming to a halt.

The University of Geneva and the Greek Service of Underwater Antiquities resumed research in the Bay of Kiladha in 2012, using different methods, including geophysical measures (in the course of the University of Geneva *Terra Submersa* Expedition in the Argolic Gulf) and piston coring from a platform at sea. The results have far-reaching implications, both for our understanding of human response to a changing environment, and concerning prospects for future research in the bay.

**Keywords:** Submerged prehistoric landscapes, Neolithic, Franchthi Cave, Greece, geophysical measures, piston coring

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\*Speaker

**XX-2. Shell mounds, shell middens  
and coastal resources.**

# Shellfishing and shell midden construction in the Saloum Delta, Senegal

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The Saloum Delta, Senegal, is renowned for its vast shell middens which date to at least 5000 BP and in many cases, also contain numerous burials. Though archaeological work has been conducted here for over 70 years, the focus has been on obtaining radiocarbon dating sequences and rescue excavation; little is known in detail about the middens or the people who built them. Today, the Sereer Niominka people of the Saloum Delta continue to collect and trade shellfish using traditional methods. This has offered an opportunity to observe these processes in practice, and examine the archaeological footprints they produce. These ethnoarchaeological observations have provided new perspectives on the development of large shell middens that will contribute to a better understanding of the archaeological landscape here and will also be of relevance to midden-rich environments, more widely.

**Keywords:** Saloum Delta Senegal, Ethnoarchaeology, Shellfishing and shell middens, Sereer Niominka

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\*Speaker

# Exploitation and use of marine invertebrates during the Protohistoric period on the French Channel-Atlantic seaboard

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This paper focuses on the use and exploitation of marine invertebrates (molluscs, crustaceans and echinoderms) during the protohistoric period (2200 to 30 B.C.) on the French Channel-Atlantic coast. It is based on the inventory of 197 sites with remains of this type of fauna. An archaeomalacological study was carried out on thirty-two of them, seventeen of which were analyzed as part of my PhD research. The results obtained enable us to broach varied themes, such as the environments exploited, the subsistence economy (diet, geographic characteristics, exchange network), artisanal activities (dyeing, personal ornaments, construction materials, etc.) and funerary and ritual practices (deposits, ritual meals). The study of marine invertebrates thus contributes to a better understanding of the socio-economic and cultural systems of coastal and continental communities during the protohistoric period.

**Keywords:** archaeomalacology, Bronze Age, Iron Age, Western Europe, economy and subsistence, ritual

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\*Speaker

# Shell Midden Isotope Sclerochronology and the History of Seasonal Subsistence Networks on the Pacific Northwest Coast of Canada

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Identifying the timing of seasonal site occupation of hunter-fisher-gatherer activity on the Pacific Northwest Coast of Canada has been a central question for interpreting resource management strategies, and understanding patterns of sedentism and mobility. High-resolution stable isotope sclerochronological analysis of archeological shells reveals both a precise season of shellfish collection and age estimates of the harvested shellfish population. The high-resolution stable isotope analysis of over 200 valves of the butter clam (*Saxidomus gigantea*), recovered from over 25 distinct shell middens distributed along the coast, shows local variability in the season(s) of shellfish gathering. Through further analysis of the growth patterns in thousands of shell valves, relative age assessments of shells recovered from over 50 shell middens demonstrates regional and site-level variation in the rate of harvest collection. By examining clusters of villages and camps from three distinct regions of the coast, encompassing over 6000 years of history, a comprehensive understanding of the importance of shellfishing and variation in seasonal-subsistence strategies can be achieved. Addressing local and regional variability is essential for nuanced interpretations that consider the specific temporal, environmental and cultural contexts that shape the actions surrounding shellfish harvesting. The results demonstrate varied patterns of locally-based shellfish harvesting practices, challenging the ethnographic record and previous interpretations of the role of shellfish, subsistence and sedentism on the Pacific Northwest Coast.

**Keywords:** shell middens, stable isotopes, sclerochronology, hunter fisher gatherers, coastal resources, seasonality, Pacific Northwest Coast

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\*Speaker

# Invisible Mediterranean shell middens: Clues from inland sites

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There are no known Palaeolithic shell middens in Israel, however, several Upper and Epi-Palaeolithic sites do contain edible marine shells. The species present are *Patella* sp. and *Phorcus* sp., the same ones that are abundant in other circum-Mediterranean sites during these periods. Because the sites, Kebara Cave, Manot Cave, Neve David and el-Wad Cave and Terrace, are today inland, at a distance of between 1–10 km from the current shoreline, during the Late Pleistocene, and in particular during the LGM they were at least five km further away. Because shellfish are usually consumed at or near the location of their collection, it is unlikely that they would have been transported as food into inland base camps that were at a distance of several hours walk. However, the presence of a few shells of these species in each of the above-mentioned sites demonstrates that some of the shells were taken either as food for people who stayed behind, or as keepsakes from shellfish gathering expeditions. The abundance of the same shell species in other sites such as Ksar Akil in Lebanon, which is much nearer to the Mediterranean coast, confirms their use as a food source. It is thus likely that shell middens did exist close to the Pleistocene coastline of the eastern Mediterranean, but they are now submerged.

**Keywords:** Shells, *Patella* sp., *Phorcus* sp., Upper Palaeolithic, Epi, Palaeolithic, Levant, Mediterranean

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\*Speaker



# ON THE TRACK OF THE MESOLITHIC MOTION ALONG THE SOUTHWEST PORTUGUESE COAST: THE CASE STUDY OF CASTELEJO SHELL MIDDEN

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## Abstrato

O mudo de cascas de Castelejo, localizado na margem do canto sudoeste da Iberia, será apresentado e discutido para fornecer novos conhecimentos nas estratégias sazonais de exploração e padrões de mobilidade desenvolvidos pelos grupos costeiros mesolíticos.

O acampamento temporário de Castelejo apresentou enormes capturas de marisco (não foram encontrados mamíferos, peixe ou restos de pássaros). Os artefactos de sílex / chert foram muito escassos. Os grupos de tarefas retornariam recorrentemente para explorar os recursos sazonais presumivelmente para trazê-los de volta aos campos de base para consumo e / ou armazenamento. Além da coleta de marisco, o site provavelmente desempenhou outros papéis funcionais em todo o cenário regional de tarefas, como um marcador territorial significativo onde os caçadores-pescadores-coletores assinaram sua identidade e propriedade do território usado de forma extensiva e experiente. Assim, a territorialidade e o nomadismo podem ser articulados enquadrando Castelejo no sistema de assentamento regional.

## Palavras-chave

Costa do sudoeste do Português; Mesolítico; shell midden; acampamento temporário; Castelejo.

**Keywords:** Keywords: Southwest Portuguese coast, Mesolithic, shell midden, temporary campsite, Castelejo.

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# Coastal life on the isle of Formentera (Balearic Islands) during the Bronze Age. Terrestrial and marine resources in Cap de Barbaria II

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The first settlement on the isle of Formentera (Balearic Islands, Mediterranean Sea) dates from the beginning of the second millennium cal BCE and is documented during the second millennium cal BCE. This late occupation is probably related with harsh living conditions and insularity factors. Cap de Barbaria II (ca. 1650-850 cal BCE) is an open-air *naviform* village that was occupied during this first colonization. The faunal remains from Naviform 9, which is the best-preserved structure, are studied in this work. This faunal ensemble consists principally of marine mollusc shells (above all, the turbinate monodont *Phorcus turbinatus* and different species of limpets *Patella* sp.). Terrestrial mammals, crustaceans, birds and fish remains are documented. The diversification of resources shows an intensive exploitation of the environment.

**Keywords:** Formentera, coastal exploitation, animal resource, Islands archaeology, Naviform societies

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\*Speaker

# Molluscs and Crustaceans in the SE Iberian Peninsula in the late Palaeolithic: new data from the caves of Nerja (Mina Chamber) and Victoria (Malaga, Spain)

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This presentation offers new information about the remains of marine invertebrates (molluscs and crustaceans) from two sites with late Pleistocene levels in the Province of Malaga (southeast Spain): *Mina Chamber* in Nerja Cave (Maro) and Victoria Cave (Rincón de la Victoria).

The mollusc assemblages, from Levels 15 and 16 at Nerja and the shell-midden at Cueva Victoria, dated to ca. 12,100 BP (ca. 14,200 cal BP), consist mostly of grooved carpet clams *Ruditapes decussatus* (> 75%). Mussels (*Mytilus edulis*), limpets (*Patella* sp.) and turbinate monodonts (*Phorcus turbinatus*) are also present. Additionally, some shells of mollusc species with no nutritional value were picked up on beaches and turned into beads (e.g. *Littorina obtusata* and *Tritia pellucida*)

In turn, an opportunistic gathering of different crab species has been observed. Crustaceans have also provided indirect evidence of the consumption of beached cetaceans at both sites. The presence of plates of *Tubicinella major*, a barnacle endemic to the southern right whale (*Eubalaena australis*) shows that meat and fat of this cetacean were consumed by the hunting-gathering-shellfishing groups that lived on the Mediterranean coasts of Iberia in the upper Magdalenian

**Keywords:** Nerja Cave, Victoria Cave, coastal exploitation, animal resources, Mediterranean Iberia.

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\*Speaker

# Shell mound formation and transformation in relation to palaeo-environmental changes, Albatross Bay, northern Queensland, Australia

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The more than 500 shell mounds recorded in the Albatross Bay region of northern Queensland, Australia, likely considerably underestimate the true number. However, rather than comment on mounds in the region in general, we report on the results of an intensive study of mounds from just one sub-region, Wathayn, where the age, abundance, and form of mounds correlates broadly with palaeo-environmental changes. Intensive studies of mound formation and post-formation changes through assessments of the geochemistry of mound deposits and studies of shell fragmentation indicates considerable within mound and between mound variability. If the mounds from other locations are similar in their formational histories to those from Wathayn, much of the final form of shell mounds reflects the impact of local formational history. We assess the impact of these results for current interpretations of shell mounds.

**Keywords:** shell mounds, palaeoenvironment, Australia

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# Coastal occupations and resource exploitation from the Middle Pleistocene to the Holocene in Northwestern Africa

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There are two main periods that document prehistoric coastal area occupations, both in Africa and in Europe: 1) during high sea levels of MIS 5 (130-75 ka) and 2) during the rising of the sea level at the latest Pleistocene-Holocene boundary. These two periods differ completely in terms of human socio-economic organizations, with changes in population densities, technological and social behaviors. Moreover, the Pleistocene records did not yield real "shell middens", but rather mollusk shells into a sediment matrix, while real "shell middens" were recorded for the Holocene. Northwestern Africa is a key region to document the evolution of the coastal settlements and resource exploitation, both on the Atlantic and Mediterranean coasts. Even if shells correspond mainly to food waste, symbolic behaviors are also attested and the use for technological purposes must be considered. This presentation focuses mainly on preliminary results from two North African archeological records: 1) the Témara-Rabat region, located on the Atlantic coast of Morocco, and 2) the Oran region in Algeria, located along the Mediterranean coast. These archeological evidences are completed by exploratory ethnological observations of current Moroccan mussel gatherers producing "shell middens" on the Atlantic coast, providing new outlooks to understand past coastal occupations.

**Keywords:** North Africa, Coastal settlements, Pleistocene, Holocene

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\*Speaker

# Pits for what? A comparative perspective on shell midden intra-site use between Late Mesolithic Atlantic Europe and Jomon Japan

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The Atlantic Europe and the Japanese Archipelago are two major areas of the temperature regions in the Northern Hemisphere in terms of quantity of shell middens produced by Holocene hunter-gatherer groups. The occurrence of these sites is especially associated to the Holocene Climatic Optimum (around 8000-5000 cal BP) and the consequent formation of new and rich aquatic environments, which became attractive to the establishment of human groups. Despite the diversity presented in terms of external characteristics and functions, numerous shell middens in these two regions testify more than mollusk gathering and shell deposition practices, documenting other activities performed in and out of the site, essential to the daily life of the hunter-gatherer groups.

Among the variety of features which have been found in the excavations of Late Mesolithic and Jomon shell middens, pits are one of the most frequently registered types. Their implantation, morphology, stratigraphic context and fills are very diversified, as well as the presumable functions. Several pits constitute evidence of combustions, refuse disposals, dwelling constructions, storage practices, funerary activities or intentional depositions of animal remains. These features are essential elements to discuss about site function and settlement, as well as the adaptation to aquatic environments, the economic development and the social complexity achieved by the post-glacial hunter-gatherers. For many negative structures, however, their identification or attribution of a function are not so clear, especially those presenting small dimensions or uncharacteristic fills.

Through a comparative perspective of archaeological data between Atlantic Europe and Japan, we aim to systematize the variety of pits identified in shell middens attributed to the Late Mesolithic and Initial-Late Jomon periods, to evaluate the recurrence of these features and their relation with the shell deposits, and to analyze their importance on intra-site organization and functionality, with a focus on case-studies from central-southern Portugal, northwest France and western Japan.

**Keywords:** Pits, shell middens, site use, Late Mesolithic, Jomon

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# Iron Age shell middens in North Germany – An underrated field of research

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Shell middens have played an underestimated role in German archaeology so far. Only few such sites on the shores of the Baltic Sea – mainly fjords – and on some North-Frisian islands in the northernmost German state of Schleswig-Holstein are known. Some surveys were undertaken in the past, whereby just one site is to be dated to the late-Neolithic and all other middens to the Iron Age. But the results and the material of the excavations were just poorly published and the shell midden sites did not get sufficient attention during the last decades.

According to the dating to the Iron Age and compared to older sites, the majority of North German shell middens occur as a result of enormous hunting and gathering activities mainly in a time of developed societies and productive agricultural economies. This raises questions regarding the reconstruction of settlements in Northern Germany at that time. Therefore, research on North German shell middens was picked up again in the past few years, resulting in a master thesis in 2015.

The focus of the study was on the region of Eckernfórde at the Baltic Sea with the by far largest conglomeration of shell middens in the country. The results and the material of two excavations on the biggest shell midden in the beginning of the 20th century were reconstructed and newly interpreted. Furthermore, radiocarbon-datings were carried out on some excavation finds. The results showed that the midden was erected in the second half of 1st mill. AD and is therefore one of the youngest shell middens on the Cimbrian Peninsula at all. Together with the results of some corings in the 1960s on other shell middens in Eckernfórde, a picture can be drawn of a region where mollusks were consumed in the Roman Iron Age and even the Early Medieval Age.

In addition to that, new environmental information could be assumed by analysing the mollusks. It was possible to prove the existence of oysters which were found in the shell middens in the South-Western Baltic Sea even around 1000 AD, pointing to an unexpected salinity level due to salt water intrusions from the North Sea.

**Keywords:** shell middens, Iron Age, North Germany, oysters

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# Environmental conditions and marine subsistence practices during the Mesolithic in Northern Spain

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Shells are biomineralized structures periodically formed by the mollusks throughout their life. Their deposition occurs in tight connection with the surrounding environment and results in the recording of local environmental fluctuations into the carbonate material. This highly resolved information, in form of geochemical and structural properties, is extremely suitable for the investigation of past subseasonal environmental conditions. In this study, the shells of the mussel *Mytilus galloprovincialis* are used to infer the conditions occurring during the Mesolithic period (10,700 - 6,800 cal BP) in Cantabria, Northern Spain. Shell oxygen composition ( $\delta^{18}\text{O}_{\text{shell}}$ ) is used to reconstruct water temperature and precisely determine the time of shellfish collection by the local populations. The preliminary results show that marine shellfish was a resource predominately exploited during the cold months. Furthermore, the oxygen isotope composition of the shells show a trend toward more negative values with time. This may indicate a progressive increase in the water temperature in the coastal area of Northern Spain during the Mesolithic period.

**Keywords:** Paleoclimate, stable isotopes, mollusk shells, middens

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# Archaeological and Climatic data from elemental ratios using rapid analysis of shell carbonate

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The chemical composition of carbonate shell from palaeoecological and archaeological assemblages is laborious to analyse, yet the information that is locked within the tens of thousands of shell deposits worldwide contains valuable insights on past environments and human ecology. At present, studies struggle with the acquisition of sufficient amounts of data to make robust interpretations. Large amounts of information is inaccessible due to costly and time-intensive techniques, resulting in small, unrepresentative studies and a lack of comparability between them. Here we apply Laser Induced Breakdown Spectroscopy (LIBS) in an automated setup to map the Mg/Ca composition of whole shell sections with an acquisition speed of over 4,000 data points per hour and at a resolution of 40–50 $\mu$ m. By assessing the spatial variability of Mg/Ca ratios, this method has the potential to mitigate distorted results while increasing the resolution of derived palaeoenvironmental information. We have successfully tested method on various molluscan species (among others: *Patella* sp., *Ostrea* sp., *Mytilus* sp.) around the world, to develop a rapid and affordable method and to globally advance the reconstruction of climate change.

**Keywords:** Shell midden, sclerochronology, geochemistry, climate change

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\*Speaker

# How to interpret a shell mound? An inter-continental comparison of shell mound formation processes

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The huge number and high visibility of shell mound deposits across the world has attracted the interest of archaeologists, geomorphologists and geologists for centuries. Studies on the local scale have largely focussed on understanding the palaeoeconomy of past communities who used coastal resources, how their actions impacted resource populations, and how coastal foraging and planning is incorporated into an annual seasonal cycle of resource procurement. At a global scale, the foraging of sessile and reliable shellfish resources and the subsequent deposition of mollusc shells in large piles during the Holocene are generally understood as signatures of intensification/low-level food production (signifying an increased need for edible resources most often due to assumed population increase), or as indicators of ceremonial/ritualistic activities. Consequently, shell mounds have assumed a status as indicators of increasing social complexity at the times and places where they occur. However, a number of factors exist that have highly complicated the assessment of shell mounds as global indicators social complexity. Differing research objectives, methodologies and reporting have created a situation where few (if any) of these mounds outside of isolated research ventures can be directly compared. As shell mound formation and taphonomy are still poorly understood this creates a problematic situation for understanding how shell mounds can serve as archives of past human behaviour. This paper refocuses attention to the formation (and deformation) of shell mounds over time and space by presenting comparative data from shell mounds from two areas with very different histories: Weipa, Australia and the Farasan Islands, Saudi Arabia.

**Keywords:** shell mound, shell midden, formation processes, taphonomy, Farasan Islands, Weipa

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# Rinnukalns revived – new interdisciplinary research on a Neolithic freshwater shell midden in northern Latvia

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Rinnukalns, in northern Latvia, is unique in the context of Baltic Sea region prehistory. Discovered and first investigated by Count C. G. Sievers in the 1870s, it is the only well-stratified Stone Age shell midden in the East Baltic and one of the rare sites consisting of freshwater mussel species. The artefacts recovered in the first excavations include ceramics, bone tools and some art objects. Human burials were also found stratified within and under the shell midden. Consequently Sievers considered these human remains the first Stone Age graves found in the Eastern Baltic. However, this interpretation was heavily critiqued, and the age of the presumed Stone Age graves remained in dispute.

After a break of almost 70 years, new research on this important site started as a close cooperation between the Institute of Latvian History, Latvia, and the Centre for Baltic and Scandinavian Archaeology, Germany. In 2011, a geophysical survey allowed us to lay out small trenches; a short excavation proved the survival of intact midden deposits, despite extensive excavations during the 19th and early-mid 20th century. The new midden exposure provided new samples for malacozoological, archaeozoological, isotopic and 14C analyses. It was dated to the late 4th millennium cal BC, and the potential existence of large freshwater reservoir effects in human bones was demonstrated on a human maxilla fragment found in the deposits. In addition, the human remains from the 19th-century excavations were rediscovered in the Rudolf Virchow Anthropological Collection of the Berlin Society of Anthropology, Ethnology and Prehistory, Berlin, Germany. New osteological, stable isotope and radiocarbon investigations on these remains resolved the old research dispute. They showed that two of the burials excavated by Sievers are indeed from the Neolithic. Nevertheless, stable isotope analyses show that these people were still fishermen, hunters and gatherers and not farmers.

Since 2017 we are able to continue research on this important shell midden site in the frame of a new interdisciplinary research project funded for 3 years by the German Research Foundation (DFG). The first excavation campaign in summer 2017 provided important new insights into the preservation status of the shell midden and into older human occupations of the site. Of

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\*Speaker

particular importance, however, is the discovery of another Stone Age burial from the Neolithic shell midden phase.

The paper will provide a summary of the most important results of the investigations since 2011 and an overview of the new research project, including the first excavation campaign in 2017.

**Keywords:** Shell midden, Eastern Baltic, Baltic Middle Neolithic, Comb ware, Narva, Fischer, Hunter, Gatherer, Freshwater diet

# SHELL MIDDEN FORMATION AT THE BEAGLE CHANNEL

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Shell midden formation can be seen as a long-term practice where the generation of these deposits - consciously or unconsciously - would promote subsequent reuses (e.g., Bailey 1977, Piana and Orquera 2010). In this sense, the human exploitation of molluscs and shell accumulations can be seen as a niche construction process for future occupants. The distribution of shell middens along the coast of the Beagle Channel presents a discontinuous configuration, with dense clusters in some sectors and with the absence of occupations along extensive coastal segments. This distributional pattern is also commonly observed in the archaeological record of other coastal environments of the world.

There are several factors involved in the shell midden formation: a) Shell deposits do not necessarily represent a gradual accumulation of waste. b) These middens can represent occupations of very varied duration that are expressed independently of the thickness of the deposit and the rate of accumulation of the material. c) The formation of shell middens includes the action of several cultural and natural processes that state at variable time spans. d) Reoccupations generate modifications on the shell deposits produced by previous occupations in the same sector.

The aim of this paper is to analyze natural and cultural processes that operate in the formation of shell middens at the Beagle Channel, and to evaluate their interpretive potential and implications in regard to the mobility and subsistence of human populations in the past. Archaeologists usually rely on radiocarbon analysis for temporal assessments. However, time has many measurable properties in archaeological deposits, which can use as taphochronometric tools (e.g., bone weathering, shell fragmentation, soil formation, etc.) to understand the processes that play in shell midden formation (Wandsnider, 2008). By addressing these issues, the parameters to understand the structure of shell middens and to develop interpretations about different behavioral aspects in the past are established.

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**Keywords:** Coastal archaeology, Time averaged deposits, Holocene, Southern South America

# Shell midden research in Denmark: State of the art, research problems and future perspectives.

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Denmark is the northern European region with the highest number of shell middens "køkkenmøddinger", of which we have a record of *c.* 500-550 sites. However, the shell middens are just a special type of coastal settlement, and along the coasts we find a mixture of middens and sites without a shell accumulation. Additionally, we have a series of "natural" Stone Age mollusk banks, -important reference points to what species were available and which ones were favoured by the Stone Age population. Research on shell middens in Denmark goes back to *c.* 1831. The middens from the Late Mesolithic Ertebølle Culture (*c.* 5400-4000 cal. BC) are the most famous. However, middens are not only a Mesolithic phenom, but are also known from the Neolithic and even later periods; they vary greatly in numbers, sizes and contents depending on the period. The development in Danish shell midden research could be described as a trend from objects to contexts and from chronology to analysis of site formation and function. Besides excavation technique has changed from investigation of sections and small areas to whole middens and habitation surfaces (today). Of special importance has been modern investigations of the areas around the middens – especially to the rear.

Today we have *c.* 300 14C dates from Stone Age middens. The oldest kitchen middens date back to *c.* 5600 cal. BC., and stratigraphic series of datings through the sites demonstrate a surprising stable, whole year pattern of coastal habitation system during a very long span of time, *c.* 1000-1200 radiocarbon years.

The middens always lie directly on and along prehistoric shorelines, close to natural shell banks and always at good "fishing-localities". They have an oblong outline and vary in size from small up to very large (*c.* 30 x 700 m), with a thickness of *c.* 0,10 – 1.80 m and a cubic content from 10 - 5000 m<sup>3</sup>. The series of dates reflect a gradual, horizontal and vertical manner along the prehistoric coast, thereby creating the characteristic form. **The middens are accumulations of layers of different species of shellfish (mainly oysters, which were collected in March-April) and mixed with many cultural remains. The dominance of oysters and the high content of cultural debris is a characteristic aspect of the Danish, køkkenmøddinger. However, shells have very rarely been used as raw material for artefacts and only sporadically for beads.**

**The shell matrix also contains scattered human bones and many settlement structures, mainly hearths of different types, pits and stake holes. However, graves of**

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humans and dogs are few in the Danish middens. Modern excavations and analysis have demonstrated the presence of a deliberate and clear internal "layout" with "living floors" and functional areas for food processing, the position of the fireplaces, areas for artefact production - esp. flint knapping and discard areas for shellfish / food waste etc. This internal organization has also been constant through long periods of time. Recent research has now also demonstrated that the midden surface has functioned as areas for the daily life of the populations, while the habitation proper was located behind / to the rear of the shell deposits.

Future research must be aimed at questions such as: What was the function of the middens in the total coastal settlement pattern? did the middens have a "special" social and/or ritual importance? is it possible to observe a sort of "ranking" among the middens in a restricted area? how much of the midden surface was in use at the same time?

In order to obtain more information on the midden formation it is also necessary to carry out micro-stratigraphy and especially to do comparative studies with ethnographic information from regions where the collecting and disposal of marine molluscs have taken place up to modern times.

**Keywords:** Denmark, køkkenmøddinger, Late Mesolithic Ertebølle Culture



# Coastal resources exploitation patterns throughout the Mesolithic in northern Iberia: evidence from the shell midden site of El Mazo (Asturias, Spain)

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Long-term changes in coastal resource exploitation patterns, such as those identified between the Upper Palaeolithic and the Mesolithic, are relatively well established in northern Iberia. However, despite the existence of investigations on the Mesolithic in the region since the early 20th Century, information on short-term changes over time is still very limited. In this paper, we use archaeomalacological analysis and oxygen stable isotopes ( $\delta^{18}\text{O}$ ) on shells from the shell midden site of El Mazo (Asturias, northern Iberia) to address this topic. The shell remains studied here were recovered from a total of 21 stratigraphic units dated by  $^{14}\text{C}$  AMS between 9000 and 7500 cal BP. The results provided information about species representation, taphonomy, collection areas, seasonality of shell collection, biometry and size selection, revealing the existence of different exploitation patterns over time. Limpets (*Patella vulgata*, *P. depressa*) and topshells (*Phorcus lineatus*) were the most abundant species in the shell assemblages. They were mainly collected in lower and exposed areas of the intertidal zone. Environmental factors were probably responsible for decreasing amounts of topshells ca. 8.2 ka cal BP, while human pressure was the cause for reduced shell size of both limpets and topshells, suggesting the existence of intensification in the exploitation of these species over time. In terms of seasonality, limpets were exploited year-round, while topshells were collected exclusively in late autumn and winter.

**Keywords:** Mesolithic, Cantabrian region, Shellfish exploitation, Subsistence strategies, Palaeoclimate conditions, Coastal resources intensification

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# Depositional volumes, discard rates and site functions: a case study from the Western Cape, South Africa

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It is clear from the stratigraphic analysis of radiocarbon dates from South African stone age sites that deposition in rock shelters, during the Holocene at least, has been anthropogenic and episodic. This is particularly so in shell midden accumulations, where visits may have been measured in days and weeks rather than years, and where absences are sometimes measured in millennia. These subtleties are too great to have been detectable by radiocarbon dates. The result is that the research trajectory from measuring artifact or foodwaste densities per unit volume, to understanding these as rates of discard through time and on to the interpretation of changing site function, is fraught with challenges. Here I show these challenges and present some solutions in the arena of Holocene shell middens along the Atlantic coast of the Cape, South Africa.

**Keywords:** shell midden, food waste density, discard rate, site function

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# New paradigms in the exploitation of Mesolithic shell middens in Atlantic France: a review of the last 15 years

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The erosion by the sea of the Beg-er-Vil site in north-western France led to the resumption of excavation in 2012. It is one of four known Mesolithic shell middens along the French Atlantic coast. Those of Téviec and Hoedic were explored in the first half of the 20th century, while Beg-an-Dorchenn and Beg-er-Vil were excavated in the 1980s. The major scientific advances that had taken place in archaeology since these field operations had led us to ask several questions. What new advances can we make with our current scientific means? And how can we anticipate the technical advances of tomorrow to protect archaeological information?

The current dynamism of research on maritime hunter-gatherers of the Mesolithic is changing the image of the shell layer from an archaeological reserve to a more global research object. The interest in physical anthropology at the beginning of the 20th century led to a strong light on the necropolises preserved in these layers, leaving in the shadows the dumps where the deceased were buried. Indeed, if some components of their diets were identified, the matrix of the shell midden was not accurately described. The excavations of the 1980s remain fixed once again on the elements describing the material culture of these populations, while the specific fauna are exploited only in the form of a list of species.

The professionalization of archaeology in the late 20th century and the development of analysis and observation techniques led to a re-reading of these sites. The activities of the occupants of these habitats are then described in addition to what we know about the deceased. Research is carried out beyond the shell layers, finally delivering clear remains of peripheral dwellings. Thus, the image of human beings in the Mesolithic becomes clearer as research progresses. However, it remains very difficult to anticipate what should be saved from our trowels, in systems where shell mass dissolves over time as the accuracy of analysis changes.

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**Keywords:** Shell, midden, Maritime archaeology, Mesolithic, Maritime Hunter, Gatherers, Atlantic

# Teviec revisited: new insights on a Late Mesolithic Coastal Atlantic Cemetery

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After the excavations of M. and S. -J. Péquart between 1928 and 1930, followed by an exemplary monograph published in 1937, the shell midden of Téviec, in the south of Morbihan (France), became one of the legendary sites of the European Mesolithic. With 10 graves (23 individuals), the cemetery cut into a shell layer that in turn helped preserve the skeletal remains. The study of the excavated materials (human and artefactual) has continued since the excavations. However, the dispersal of the collections between several institutions, the outbreak of World War II and neglect of the archive has led to a reduction in the quantity of data. The CIMATLANTIC research program (World of the Dead / World of the Living in Atlantic France: From the Anthropology of Populations to the Prehistoric Identities) made it possible to create an inventory of surviving materials and carry out new specialised studies. The grave goods have been reconsidered after technological and functional studies. Reappraisal of the body ornaments informs on their selection, manufacture and use, and their function as a vector of social information is discussed. Flint tools appear to have had a limited life history, suggesting they were commissioned for the grave. A critical examination of the depositional practices at the site allows for new understanding on the social organisation. The study of faunal remains, which have remained unpublished, allows us to refine our understanding of the economic networks of these marine hunter-gatherer populations. Finally, new radiocarbon dating places this site at the temporal heart of the cultural dynamics of Late Mesolithic Atlantic Europe.

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**Keywords:** Mesolithic, burial, grave good, radiocarbon

# Shell middens on Rakushechny Yar site: early Neolithic societies in southern part of Eastern Europe

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Site Rakushechny Yar located in the Low Don River basin is one of the earliest Neolithic sites in this region. Unique stratigraphy of this site, consisted of shell middens, remains of "wattle and daub" constructions, covered by sterile interlayers six meters thick in total made it one of the key sites for Neolithic period of Eastern Europe. The site was first investigated in the 1960–1970s by T.D. Belanovskaya, and recently new investigations were started.

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\*Speaker

Investigations conducted here during 2016-2017 allowed revealing undisturbed cultural layers, including the lowest and the most ancient one which were never excavated before due to a high water level of the Don River. 14C dates achieved recently testify that different parts of the site were inhabited and used during various periods of time.

Part of this site located in the past near the lake on the river shore, might be attributed to a specialized place of water resources exploration. Remains of big fish species, mainly catfish and sturgeon, were found in different layers of shell middens and on sandy parts of the layers. Specific flint and bone industry can be traced here, as well as elaborated complex of flat-bottom pottery of different volumes. Along with shell middens and shell mounds, pits filled with different layers of *Unio* and *Viviparus* shells, fish bones, pottery fragments, polishing stones, flint tools and bone artefacts were found here. Walls of the pit were covered by clay, that served as a sort of a waterproofing layer. Remains of pile constructions were found also on the site among shell middens. Faunal remains testify use of different ecological niches and their resources. Recent finds of bones of domesticated species suggest even a more complicated organization of this ancient society.

Further investigations and new methods implemented will allow making more reconstructions of the life of one of the most ancient Neolithic societies on the territory of Eastern Europe.

**Keywords:** shell middens, early Neolithic, Low Don basin, Eastern Europe, neolithisation



# Coastal landscapes and shell mounds: archaeological investigations in Southeastern-Southern Brazil

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Brazilian shell mounds (*sambaquis*) represent deposits of many sizes and shapes distributed along the coast, concentrated at intersections of different types of ecosystems ranging from 8000 to 500 BP. They contain thousands of cubic meters of shells, sediments with animal remains, cultural remains (lithic, flaked and polished, bone, teeth and shell artefacts), hearths, burials, postholes and habitation structures. Huge shell mounds, acting as landmarks, occur near smaller ones, other types of coastal sites and even sites with deposits containing small amounts of shells and black earth, displaying a very complex settlement pattern. Archaeological researches indicate long-term populations, specialized in exploitation of sea resources (fish and shellfish), using shells as a constructive material to build *sambaquis* with different sizes, deposits, geographical distribution and site functions. This paper presents and discusses ongoing projects along the coast of São Paulo and Paraná states (southeastern and southern Brazil) showing the distribution and variability of hundreds of shell mounds and their settlement patterns applying a GIS analysis. This paper also presents two case studies, focusing on site formation processes and geoarchaeological investigations in very different types of shell mounds as examples of the great diversity of their dimensions, content and functions: Mar Virado and Rio Claro. Mar Virado is a funerary site located at an island on the north coast of São Paulo State, on a fluvio-marine terrace presenting lithic artefacts, ranging from flakes to polished stone axes, bone and shell artefacts, faunal remains, hearths and burials. Radiocarbon dates place human occupation at this site between  $3.465 \pm 31$  BP and  $2.570 \pm 70$  BP. Rio Claro site is a huge shell mound, 20m high, located on a Pleistocene / Holocene alluvial fan associated to Cubatão river, in Guaratuba bay, Paraná State. This site is situated about 5 km from the estuary and 20 km from the current coastline and its interiorization is related to eustatic and geomorphic dynamics from at least 7000 years BP. A geoarchaeological investigation is carried out using sedimentary indicators, geochronological data and GPR to map old channels and the alluvial fan to understand the chronology and compare with the occupation of the shell mound and its substrate. The constitution of the alluvial fan can be explained by the effects of climatic changes on hydrographic and

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sediment dynamics on the Guaratuba bay and that may have influenced strategies of resilience or abandonment of the site.

**Keywords:** shell mounds, coastal landscape, sambaquis, Brazil, geoarchaeology

# On the chronology of shell midden formation: a bayesian model from the Mesolithic site of El Mazo (Asturias, northern Iberia)

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Shell midden sites generally present complex stratigraphies generated by the accumulation of large amounts of shells and other organic and inorganic remains by coastal human populations in a relatively short period of time. This stratigraphic complexity needs to be approached using precise excavation techniques complemented with micromorphology in order to isolate short depositional events and identify general formation and erosion processes. This information, together with the construction of chronological models is key to understand settlement patterns through time. In northern Iberia, ~130 Mesolithic shell middens have been identified in the so-called Asturian area, located between the cities of Ribadesella and Santander. Most of these shell middens have been affected by heavy erosion and present severe preservation issues (e.g. in most of them only patches of cemented shell midden are preserved), becoming useless for chronological studies. However, in the last few years, some well stratified shell midden sites have been excavated in the region, such as El Mazo and El Toral III, providing a new framework for the study on the chronology of shell midden formation. In this communication we present 58 radiocarbon dates from the Mesolithic shell midden units of El Mazo rockshelter (Asturias, northern Iberia). The dates, together with the stratigraphic information of the deposit, have been used to create a Bayesian model in order to determine with precision the different phases of accumulation of the shell midden, as well as to identify moments of abandonment and reoccupation of the site.

**Keywords:** Shell midden, Mesolithic, chronology, northern Iberia, site formation

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# Hunter-gatherer-fishing societies of the south-eastern part of the Atlantic Coast of Tierra del Fuego Island (Argentina, South America): social strategies and shell midden formation

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Isla Grande de Tierra del Fuego (between lat. 53-55°S and long. 66-74°W) lies in the Subantarctic zone and constitutes the highest latitude landmass in the Southern Hemisphere populated by hunter-gatherer groups during the Early Holocene. The archaeological research carried out in this island has showed diverse historical trajectories along the shorelines in relation to both: fishing activities and the intensity of the human use of coastal landscapes.

In this presentation we focus on the south-eastern part of the Atlantic façade. This region was occupied by hunter-gatherer-fishing societies who exploited marine resources without the development of sailing technology. The earliest evidences are dated around the 1500 BP and extent to the moment of arrival of European populations to the region. These human groups left a rich archaeological record which mainly includes shell bearing deposits of distinct size, extension and distribution which range from thin lenses of broken mollusks to variable accu-

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mulations of waste that form a raised dome. These differences do not seem to be related with process of settlement re-occupation. The faunal and technological assemblages, that encompass lithic and bone tools, also exhibit outstanding variations in terms of composition and frequencies.

The objective of this presentation is twofold. In first instance we intend to understand and to discuss the diversity of archaeological record exploring subsistence and technological strategies, and landscape use. In second instance, we aim to disentangle site formation processes and site occupation intensity using different proxies.

To accomplish this proposal we apply a multidimensional approach that includes technological and use-wear studies of lithic and bone tools, zooarchaeological analysis (taxonomic and quantitative studies) and geostatistic methods to unveil settlement patterns.

The final goal is to explore the role of marine resources in the social organisation of hunter-gatherer societies under study as well as to assess the significance of the method presented here to analyse occupation intensity.

**Keywords:** Shell midden, Hunter, gatherers, Tierra del Fuego, Variability, Site formation processes

# Reconstructing intra-site temporal and spatial history of two ethno-archaeological shell middens of Tierra del Fuego (Argentina)

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The archaeological visibility of shell middens and the good preservation of their organic remains have led to a long and rich history of research dating back to the 19th century. The development of a range of new recovering methods and analytic techniques has been accompanied by a growing work on comparing shell midden sites over large geographical areas and among different chronologies and coastal communities worldwide. All of this has resulted in a richer understanding of the large variability of this particular type of archaeological site both from the taphonomic and typological / functional perspectives.

Using ethno-archaeological data from Túnel VII and Lanashuaia, two Yamana shell midden excavated between 1989 and 2005 and located in the northern coast of the Beagle Channel (Tierra del Fuego, Argentina), we present new results of a very fine-grained intra-site spatial analysis, and implications for understanding the variability in shell midden site-formation processes and its relationship with social use of space in Hunter-Fisher-Gatherer societies.

Both sites have similar characteristics, particularly a ring-shaped shell midden resulting of the daily accumulation of food remains around a central hut. However, despite those similarities, the combined use of different resolutions (average accumulation vs. discrete occupations episodes) and several analytical and technic methods –including the reconstruction of the accumulation history of fine deposition sub-units; 3D modelling; refitting analysis and geostatistical techniques regarding the spatial distribution of waste and debris from production, consumption and cleaning activities; as well as the integration of results from microstratigraphy, malacology, anthracology, use-wear analysis or chemical analysis of fireplaces– allowed to reveal distinct patterns of occupation. These analyses provide an opportunity to obtain a high-resolution record of the different formation process and human activities carried out in both shell middens. Moreover, results reinforce the assumption that scale and resolution of each particular type of shell midden have to be taken into consideration in order to achieve a comprehensive understanding of their complex site-formation process.

**Keywords:** Tierra del Fuego, Hunter Gatherers, Shell middens, Site formation process, Intrasite analysis, modelling

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\*Speaker

# Intensification or longevity? An assessment of shell mound accumulation rates from the Farasan Islands.

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This paper explores the dichotomy between intensification versus long-lived shell mound accumulation, with analyses of data from 16 sites in an area with a record of over 7000 years of shellfish exploitation. Did these mounds form as part of a short burst of intensive exploitation, or did they take longer to accumulate? Our data shows that different sites experienced very different formation histories with a high degree of variability; however, with a dataset from multiple sites we are able to begin to detect some common patterns for both modes of accumulation. The Farasan Islands in the southern Red Sea are arid, resulting in excellent preservation of the sites, and integrity of the stratigraphic layers, which have very homogenous composition. Previous research has demonstrated that rather than the layers being representative of single depositional events, they are actually composed of multiple events – often spread across a year or more (multiple seasons). The analysis of the accumulation rates builds directly on these findings – showing that accumulation rates within individual mounds can vary, which has implications for the way we date and interpret shell mounds.

**Keywords:** Accumulation Rates, Formation, Dating, Shell Mound

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# L'AMAS COQUILLIER DE SOUCOUTA (DELTA DU SALOUM, SENEGAL) QUARANTE TROIS ANS APRES (1973-2016). NOUVELLES DONNEES CULTURELLES EN SENEGAMBIE.

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Les fouilles archéologiques du site de Soucouta (Centre-ouest du Sénégal) ont révélé de nouvelles données relatives à l'extension de la sphère de l'activité métallurgique (production et utilisation du fer), aux familles céramiques du delta du Saloum (liens entre sites et groupes culturels) et aux échanges induits par le commerce à longue distance. La découverte des vestiges ferreux (scories, fragments de tuyères) et l'analyse de divers attributs céramiques relancent la problématique de la cartographie archéologique (amas coquilliers comme une zone où on ne fait que manger des mollusques tout en réutilisant les dépôts comme nécropoles), du déterminisme environnemental (absence de matière première-absence d'activité artisanale) et des liens entre le littoral et son hinterland.

**Keywords:** amas coquillier, céramique, métallurgie, échange, littoral, hinterland, identités

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\*Speaker



# Late Holocene Shell Midden and Human Remains from Praia da Rocha, Moçambique

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Praia da Rocha is an open-air site at Cabo das Correntes, Inhambane Province, Moçambique where human bones were reported eroding out of a coastal dune near a beach resort in 2016. Cabo das Correntes is one of several rocky headlands along the Indian Ocean coast of Inhambane associated with shell middens and archaeological sites. The geologic context at Praia da Rocha consists of a shifting coastal dune field and older stabilized dune sand resting on Holocene beach rock. Several thin shell middens (10-30 cm) outcrop in the dune field. Human skeletal remains were excavated from one of these middens (PR1) in June 2017, along with pottery and a hearth feature.

Radiocarbon ages were determined on a human hand bone (phalanx) and a marine mussel shell (*Perna perna*) at the excavation site. The radiocarbon age on the bone is  $267 \pm 15$  BP (1637-1673 cal AD, 79% probability). The age on the shell is  $612 \pm 15$  BP, which after marine reservoir correction suggests the shell is no older than 1681 cal AD ( $< 260$  cal BP, 95% probability). These ages place the site and human remains in the era of Portuguese colonization in Mozambique. The site is also contemporary with later stages of occupation at the Chibuene site, an important shell midden and trading post located north near Vilankulos.

The skeletal collection at Praia da Rocha likely consists of 2 individuals. The first individual is a nearly complete skeleton represented by 152 bones (73.8% of skeleton). A cranium and possibly some long bones of this specimen were re-buried by local residents in a ceremony and were left undisturbed. The second individual is represented by only 2 bones.

We analyzed age, sex, stature, health, and diet for the first individual. Age at death was estimated as mature to senile ( $> 50$  years) by evaluation of the auricular surface, pubic symphysis, and mandible. Sex was estimated to be male, based on visual evaluation of the hip bone. Stature was estimated as 1.65-1.79 m, based on metrical evaluation of the radius, ulna, and fibula. The skeleton presented no obvious evidence of trauma or pathology. Despite the coastal context, isotope data on the dated phalanx (13C and 15N) suggest a predominantly C4 terrestrial diet. Four teeth recovered in the excavation demonstrated advanced dental abrasion associated with age and environmental conditions.

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**Keywords:** Shell midden, human skeletal remains, Moçambique, Late Holocene

# Adaptation et soutenabilité des populations protohistoriques. État des connaissances sur la pêche et la collecte des coquillages sur la côte de Tarragone pendant la protohistoire (IXe-Ier siècle av. J.-C)

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L'exploitation des ressources alimentaires d'origine aquatique au temps des Ibères constitue l'un des domaines les moins connus de la recherche protohistorique. En général cela est dû au manque d'informations permettant une approche bien argumentée du point de vue archéologique sur les stratégies de capture et de conservation du poisson, ainsi que sur l'outillage utilisé, ou moins encore sur une commercialisation bien documentée. C'est surtout pour cette raison nous nous sommes proposé de réunir les données relatives aux pratiques de pêche ou de ramassage des coquillages pendant l'âge du fer dans le district hydrographique de Tarragone - au sud de la Catalogne - non seulement sur la côte mais également sur les bords de l'Èbre. À cette fin, nous passons en revue certains matériaux tels que les vestiges archéozoologiques (ossements de poisson et restes de coquillages), des déchets culinaires qui ont été récupérés sur différents sites. Également nous y avons inclus des engins de pêche (hameçons, poids...) ainsi que des représentations iconographiques de poissons sur céramique peinte et sur des objets métalliques, ce qui nous permet d'avancer une interprétation de leur éventuelle signification. Nous essayons donc de présenter une vue panoramique sur l'état d'avancement des connaissances à l'heure actuelle qui nous permette d'envisager une étude plus approfondie sur la matière dans le futur.

**Keywords:** Catalogne, iconographie céramique, représentation de poissons/ IXe, Ier siècle av. J., C.

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\*Speaker

# The efficacy of genus-level data: a case study of the Hawaiian limpet (*Cellana* sp.), Moloka'i, Hawaiian Islands

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The level to which faunal remains are taxonomically identified is of fundamental importance in zooarchaeological analysis. Species level identifications enable researchers to utilise specific ecological data and facilitate fine-grained reconstructions of human-animal relationships. These reconstructions may pertain to a range of research pathways including prehistoric subsistence strategies, diet, human impact to marine resources, and contemporary animal management. When taxonomic identifications are limited to family or genus levels, interpretations may be incomplete or unsupported. A case study from a late prehistoric habitation complex at Kealapupuakiha, situated along the windward shore of Moloka'i, Hawaiian Islands, was employed to contrast the importance of genus vs. species-level identifications in zooarchaeological research. Excavations at Kealapupuakiha yielded a large, well-preserved shellfish assemblage dominated by three endemic limpet species: *Cellana exarata*, *C. sandwicensis*, and *C. talcosa*—commonly found along rocky windward coastlines throughout the Hawaiian Islands. Despite comprising three species, endemic Hawaiian limpets are routinely investigated at the genus level (*Cellana* sp.). Our results characterised the Kealapupuakiha inhabitants as a flexible group of harvesters who adjusted their species-specific subsistence strategies in response to fluctuations in the availability of *C. exarata* and *C. sandwicensis*. The possibility of seasonal mobility and prehistoric management, potentially conservation of a resource, is suggested. We show that species-level determinations yield higher resolution data which is more appropriate for addressing a broader suite of research questions and promotes refined interpretations of the past.

**Keywords:** archaeomalacology, Hawaiian Islands, sustainability, foraging behaviour

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\*Speaker