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*Entre terre et mer. L'exploitation des coquillages marins du Néolithique à l'âge du Fer en Iran : le site de Ruwar (Nord-Ouest de l'Iran)*

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# BETWEEN LAND AND SEA. THE EXPLOITATION OF MARINE SHELLS FROM THE NEOLITHIC TO THE IRON AGE IN IRAN: THE SITE OF RUWAR (NORTHWEST OF IRAN)

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The relationship between humans and the marine environment has played a pivotal role in the development of modern societies. The exploitation of marine resources for food and for the collection of raw materials has been an integral part of the development of human communities near coastal areas throughout the world. The circulation of raw materials, such as shells, has allowed the connections between different groups dating from the Pleistocene to be identified. These artefacts are markers tracing the circulation “roads” that resulted in the spread of knowledge and goods between coastal and inland communities. Here we focus in particular on marine shell artefacts used for the production of ornamental objects in Iran from the Neolithic to the Iron Age. The ultimate aim is to synthesise our understanding of the production of these objects and to establish the technological characterisation by studying the Iron Age series from the Ruwar site. This site, which is very distant from the sea, provides new information on the circulation of marine resources in the remote mountainous region of western Iran. The ornamental objects here are composed of shells from the Mediterranean and the Persian Gulf, demonstrating that geographical distance did not necessarily prevent contact with neighbouring groups. The shells are an exception testament to either long-distance interactions or, more likely, to extensive networks of indirect trade, with repeated exchanges over short distances, during the Iron Age.

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**Entre terre et mer. L'exploitation des coquillages marins du Néolithique à l'âge du Fer en Iran : le site de Ruwar (Nord-Ouest de l'Iran)**

La relation entre les communautés humaines et le milieu marin a joué un rôle important dans le développement des sociétés modernes. L'exploitation alimentaire des ressources marines et la collecte des matières premières ont permis la subsistance de divers groupes humains situés à proximité des zones côtières. La circulation des matières premières, et notamment des coquilles, a facilité les liens entre les différents groupes depuis le Pléistocène, traçant de véritables « routes » de circulation des artefacts et des humains, permettant des échanges de connaissances et de savoir-faire techniques, économiques et de production entre les groupes vivant à proximité des zones côtières et ceux situés à l'intérieur des terres. Cette contribution se concentre en particulier sur les artefacts en coquilles marines qui ont été utilisés du Néolithique à l'âge du Fer pour la production des objets de parure en Iran. L'objectif est de résumer les principales connaissances sur la production de ces objets et de débiter la caractérisation technologique de ces productions par l'étude d'une série de l'âge du Fer provenant du site de Ruwar. Ce site, étant très éloigné de la mer, fournit de nouvelles informations sur la circulation des ressources marines dans une région montagneuse et difficile d'accès de l'ouest de l'Iran. Les objets de parure sont ici constitués des coquilles provenant de la Méditerranée et du Golfe Persique démontrant que l'isolement géographique n'a pas forcément empêché les contacts avec les groupes voisins. Les coquillages sont un témoin privilégié d'interactions à longue distance ou, plus vraisemblablement, de commerces indirects, avec des échanges répétés sur de courtes distances, au cours de l'âge du Fer.

## MOTS-CLÉS

Environnement marin, coquillages, Préhistoire, Protohistoire, Iran, Ruwar, relations Homme-Mer, circulation des matières premières, commerce.

## INTRODUCTION

The relationship between human being and the marine environment has played a pivotal role in the development of past societies (e.g. Braun *et al.* 2010; Cunnean, Stewart 2010). The exploitation of coastal resources as food (fish, molluscs, echinoderms, crustaceans) and as raw materials (bones of marine mammals and fish, turtles and shells) has been a vital contribution to the subsistence and the craftsmanship of various human groups located near the coastal areas throughout the world since the Pleistocene (e.g. Campmas *et al.* 2018; Colonese *et al.* 2011; Cortés-Sánchez *et al.* 2011; Romagnoli *et al.* 2016) and across the Holocene (e.g. Bicho *et al.* 2011; Claassen 1998; Szabó *et al.* 2014). The variety and complexity of marine environments (lagoons, cliffs, sandy or rocky substrate), which also change over time (seasons, tides), stimulated many exploitation strategies of these resources that contributed to the technical and economic evolution of ancient groups. In addition, the circulation of raw materials, such as shells, has facilitated the identification of connections between different groups dating from the Palaeolithic, following circulation “roads” that allowed the exchange of economic and production knowledge and traditions between the groups living near the source areas and the inland consumers (Gensheimer 1984). The study of the relationships between man and the marine environment is therefore a subject of crucial importance in order to understand the anthropological, social and cultural dynamics of ancient societies. Elements available to archaeologists that allow these relationships to be studied consist of faunal remains (malacofauna, fish remains; e.g. Cleyet-Merle 1990; Thomas 2015a, 2015b) and material culture that has been produced using coastal resources as raw materials (ornamental objects and tools; e.g. Bar-Yosef Mayer *et al.* 2017; Bar-Yosef Mayer, Bosch 2019; Cuenca Solana 2013; Cuenca Solana *et al.* 2011; Manca 2013, 2016; Perlès, Rigaud 2020; Vanhaeren *et al.* 2019).

In Southwest Asia, recent research has underlined the importance of coastal resources as food within the Arabian prehistoric and protohistoric groups (e.g. Berger *et al.* 2020; Lidour *et al.* 2020; Marrast *et al.* 2020; Martin 2005; Mashkour *et al.* 2016; Uerpmann, Uerpmann 2005, 2018) as well as the role of coastally sourced objects in symbolic behaviours (Charpentier, Méry 2012). Evidence for the manufacture and use of shell tools as well as shell ornaments is also very abundant, illustrating the systematic exploitation of marine resources since the early Neolithic and in later periods (e.g. Cleuziou, Tosi 1988; Charpentier, Méry 1997; Charpentier *et al.* 2004, 2012, 2016; Salvatori 2007). However, knowledge of coastal exploitation in the regions on the other side of the Persian Gulf mostly remains limited to the Indo-Pakistani region (e.g. Deshpande-Mukherjee, Shinde 2014; Kenoyer 1984, 1985). In the Iranian Plateau, despite an increasing amount of data over the last few decades as the result of recent archaeological excavations, our comprehension of the subsistence strategies related to the exploitation of coastal resources is limited to a few important contexts in south-eastern Iran (Desse-Berset, Desse 2008; Martin 2008; Mashkour *et al.* 2013).

On the other hand, studies on the circulation of raw materials and prestige goods have included sea shells, and their use as ornaments and circulation from coastal to inland areas in order to reconstruct inter-regional relations and long-distance trade between prehistoric and protohistoric communities around the Persian Gulf (During Caspers 1971; Cortesi *et al.* 2008; Lamberg-Karlovsky 1972; Kenoyer *et al.* 2013; Kohl *et al.* 1978; Marcucci 2012; Tosi, Biscione 1981; Wright, Johnson 1975). During the 1970s, numerous studies were published on the production of shell artefacts indicative of contact and trade between Mesopotamia, Iran and Pakistan from the 4<sup>th</sup> to the 2<sup>nd</sup> millennium BCE (Beale 1973; Durante 1979). In the last few decades there has been a proliferation of new discoveries on this subject that contribute to defining the role of shell material in the reconstruction of relations between the interregional groups during this period (e.g. Gensheimer 1984; Kenoyer 1997, 2008, 2013). In respect to other archaeological periods no specific studies have been done, but the discovery of non-local shells in various Iranian sites has prompted debate concerning the origin of these raw materials and the existing trade networks during these periods. In the Iranian Plateau, recent research has provided more precise knowledge of the technological and functional aspects of shell productions (Manca *et al.*, 2018, 2022) but these studies remain very sporadic compared to those on neighbouring regions (e.g. Bar-Yosef Mayer 2014; Groman-Yaroslavski *et al.* 2013; Heit 2014; Kenoyer 1983, 1984, 1985). For this reason, many fundamental questions still remain unanswered.

To what extent is Iran unique, and important to the circulation of marine shells from the coast to inland areas? What artefacts are produced and how were they processed and used in this region? This article attempts to answer these questions by compiling the most important data on marine molluscs in Iran from the Neolithic to the Iron Age (without claiming to be exhaustive) and by contributing to the technological and functional study of these productions with the presentation of the results of a case study: the Iron Age collection from the Ruwar burial site – Kurdistan province, western Iran. The results obtained from the study of this series, enriched by regional and extra-regional comparisons, make it possible to reconstruct the areas of circulation of these shell finds in Southwest Asia during the Bronze Age and Iron Age.

## 1 | METHOD

Shell artefacts from the Ruwar site were studied through a technological analysis articulated in several stages (see Averbough 2000; Christensen *et al.* 2018; Manca 2013). An initial taphonomic evaluation made it possible to assess the state of conservation of the surfaces and the reliability of the technical observations. The next step was the identification of taxa for each piece. Afterwards, the preserved technical stigmata and macro-traces of use were identified and precisely described (type, location, position, extent, organization, orientation). Each artefact was observed first with the naked eye, then under a portable digital microscope (Insize ism-pm 200sb with 10× to 200× zooming capability) and photographed with a Reflex Nikon D5500 digital camera with a Nikon DX, AF-S Nikkor 18-105 mm lens.

## 2 | A DIACHRONIC OVERVIEW OF SHELL ORNAMENTS IN THE IRANIAN PLATEAU FROM THE NEOLITHIC TO THE IRON AGE

During the Pleistocene and the first phases of the Holocene in the Iranian Plateau, prehistoric and protohistoric societies abundantly exploited various species of marine shells. Their presence is recorded not only in sites located near the coast but also at sites situated several kilometres inland. At the present state of research, no evidence has been identified of specialised production workshops in this region. Alternatively, it appears that these materials were perhaps distributed through exchanges between different communities, for example the habitual displacement of nomadic groups, rather than through a direct supply line as has been observed in neighbouring regions (see for example Kenoyer *et al.* 2013). Some studies have traced trade routes of volcanic raw materials such as obsidian from the south and east of Turkey, including the methods of circulation of the raw material (cores, blanks, finished objects) and identifying the degrees of dispersion within the territory (Barge *et al.* 2018). This type of study is more difficult to achieve for marine shells due to the small amount of material found, the state of conservation of the finds and their intense degree of transformation that often prevents a precise identification of taxa, limiting the ability to identify the probable origin of the shells. Despite these research shortcomings, some general considerations can already be made. Through a first bibliographic census, it is possible to identify the most common types of objects, their anatomical origin and the main methods of transformation for the production of some classes of artefacts. During the first phases of the Holocene, the production of ornamental objects is by far the most widespread and understood, and is the subject of the greatest amount of published data. Shell tools are observed but their presence is reported only in the rare Neolithic (Tepe Abdul Hosein – Luristan; Pullar 1990; Manca *et al.* in preparation) or Chalcolithic contexts (Tell-and Bakun A – Fars; Alizadeh 2006; see [fig. 1](#) for the location of the Iranian sites cited in the text). More frequent is the evidence of bivalve tools, often obtained from *Cardiidae*, used as containers for colorant matters around the final 4<sup>th</sup> and 3<sup>rd</sup> millennium BCE in the graves of south-eastern Iran (Hajjiabad-Varamin, grave 1 – Kerman, Eskandari *et al.* 2020; Khaje Askar, burials 103 and 109 – Kerman, Alidali Soleimani *et al.* 2016, Kamtarlan I – Lorestan, Schmidt *et al.* 1989, and Bampur 14 / Saidabad *et al.* 2020), in the northernmost area, as evidenced at the site of Shahr-i Sokhta – Sistān (Cortesi *et al.* 2008), and at other numerous sites occupied during the 3<sup>rd</sup> millennium BCE in Mesopotamia (Moorey 1994).

With regard to ornamental objects, from a typological and diachronic point of view, the most frequently attested in Iranian Plateau are discoidal beads, perforated bivalves, and gastropod shells.

### 2.1 | The discoidal beads

These artefacts are attested in contexts already related to the Epipalaeolithic of the Levant (final Natufian site of Ain Mallaha – Eynan) from where they were probably trans-



— FIGURE 1 —

Map of Iran and adjacent regions with the location of Ruwar (red triangle) and other relevant prehistoric and protohistoric sites mentioned in the text (circles).

Carte de l'Iran et des régions adjacentes avec l'emplacement de Ruwar (triangle rouge) et d'autres sites préhistoriques et protohistoriques mentionnés dans le texte (cercles).

ported to more eastern areas (Bar-Yosef Mayer 2014). In the Iranian region they are certainly attested starting from the Early Neolithic (site of Tappeh Sang-e Chakhmaq - Semnam, ongoing study of L. Manca) but the in-depth study of the shell production of Ali Tappeh Epipaleolithic site (East of Alborz Range) allowed us to hypothesise a probable native Iranian production area already from the most ancient phases (Manca *et al.* 2018). Their use is also attested during the Chalcolithic period (Tell-and Bakun A

– Fars, Alizadeh 2006; **fig. 2a-f**) and up until contexts dating to the Iron Age (as in the “Zagros Graveyard” site – Iranian Kurdistan, Amelirad *et al.* 2011, p. 53). The discoidal beads are found at several Iranian sites (e.g. Tell-and Jari B – Fars) both in the circum-Caspian areas, in the north of the country, and in the more central areas throughout the Iranian Plateau (e.g. Tepe Yahya – Kermān; Mutin and Lamberg-Karlovsky 2013). These ornamental objects are mostly produced from bivalve shells belonging to the family of

*Cardiidae* (*Cerastoderma* sp., *Didacna* sp., *Anadara* sp.) or more rarely from *Spondylidae* shells (e.g. Ali Kosh – Ilam, Ghaderi, Darabi 2021), but in the hinterland, the processing of freshwater bivalves, such as the *Unio* sp. from Tepe Abdul Hosein during the early Neolithic, is also attested (Manca *et al.* in preparation). The main supply areas for marine shells are the Persian Gulf, the Gulf of Oman and the Caspian Sea. For the production of discoid beads, different transformation phases have been implemented (Manca *et al.* 2018; Manca *et al.* in preparation). A first phase concerns the collection of shell valves that can be harvested fresh or collected on the beaches. The selection of the valves must respect particular dimensions relating to the measurements of the finished object and a specific morphology (the valves must not have an excessive concavity) so only some species are suitable for this type of production (selective collection of certain species or specimens). A second phase includes the fracturing of the valves after which the most suitable supports are chosen for the conformation of the pearls. The blanks are often rectangular or polygonal. A third step involves perforation of the blanks using a drill with a lithic tip. Variants of the drilling techniques are recorded across different sites and periods (drilling realised from one side or two sides of the blanks; use of a bow drill or a hand drill). A final phase produces the discoid conformation of the pearl by retouching followed by the abrasion of the surfaces. These transformation phases have been described for some pearls found in the circum-Caspian area (MPS4 Neolithic site – Azerbaijan, Heit 2014) and in the Levant (Huzuq Musa site – Israel, Groman-Yaroslavski *et al.* 2013<sup>1</sup>). Some steps of this production have been identified at the Neolithic site of Tepe Abdul Hosein in the central Zagros (Manca *et al.* in preparation).

## 2.2 | The bivalve shells used with their natural morphology

This is the type of ornament with the largest chronological distribution: they are found in Neolithic contexts as well as in later periods (Roustaei *et al.* 2015; Manca *et al.* 2018; Martin 2008; unpublished data, ongoing study). These shells are used without any modification of their general morphology except for perforation. Numerous families of bivalves, coming from different areas (Caspian Sea, Persian Gulf but also the Mediterranean Sea) have been collected in the marine environment or on the beaches. The shells may have a fresh appearance or a varying degrees of natural erosion after the death of the mollusc before collection. Several techniques (percussion, incision, sawing, abrasion), sometimes used singularly or in association, were used for drilling. The geographical spread of these artefacts is not yet well-defined (lack of research, tricky species identification, and poor description of the artefact morphology), but it seems that they are distributed both in coastal and inland areas (Richardson 2017). At the present state of research, studies seem to indicate a larger concentration in some coastal sites or in sites located at a moderate distance from the collection areas (sites around the Caspian Sea: *Didacna*

shells in Tappeh Sang-e Chakhmaq site – Semnan, Roustaei *et al.* 2015, p. 587 and *Didacna* and *Cerastoderma* shells in Ali Tappeh site, Manca *et al.* 2018).

## 2.3 | The *Dentalium* shells

These beads have been found in the northeast of Iran (site of Sang-e Chakhmaq – Semnan; Roustaei *et al.* 2015), in Zagros (for example Bestansur, Jarmo and Karim Shahir – Iraq, Howe 1983; Matthews *et al.* 2014) and in other regions to the south (e.g. Tall-e Muški – Fars, Alizadeh *et al.* 2006) during the Neolithic period. The use of *Dentalium* is also seen in later periods including the Chalcolithic (as for example at Tall-e Bakun A and Tall-e Bakun B; *idem*) and the Iron age (site of Ruwar, this paper). The *Dentalium*, conical, hollow and slightly curved scaphopoda, are often used without major transformations. Generally, only one extremity is eliminated, the thinnest, simply by flexion or sawing, to facilitate suspension. Some artefacts are obtained through the transversal subdivision into several parts of shells to get a discoid or cylindrical ornament. These beads are often stacked one on top of the other and supported together by a central thread to be able to form necklaces and bracelets. However, the sewing on clothes and accessories of single elements or several elements is not excluded.

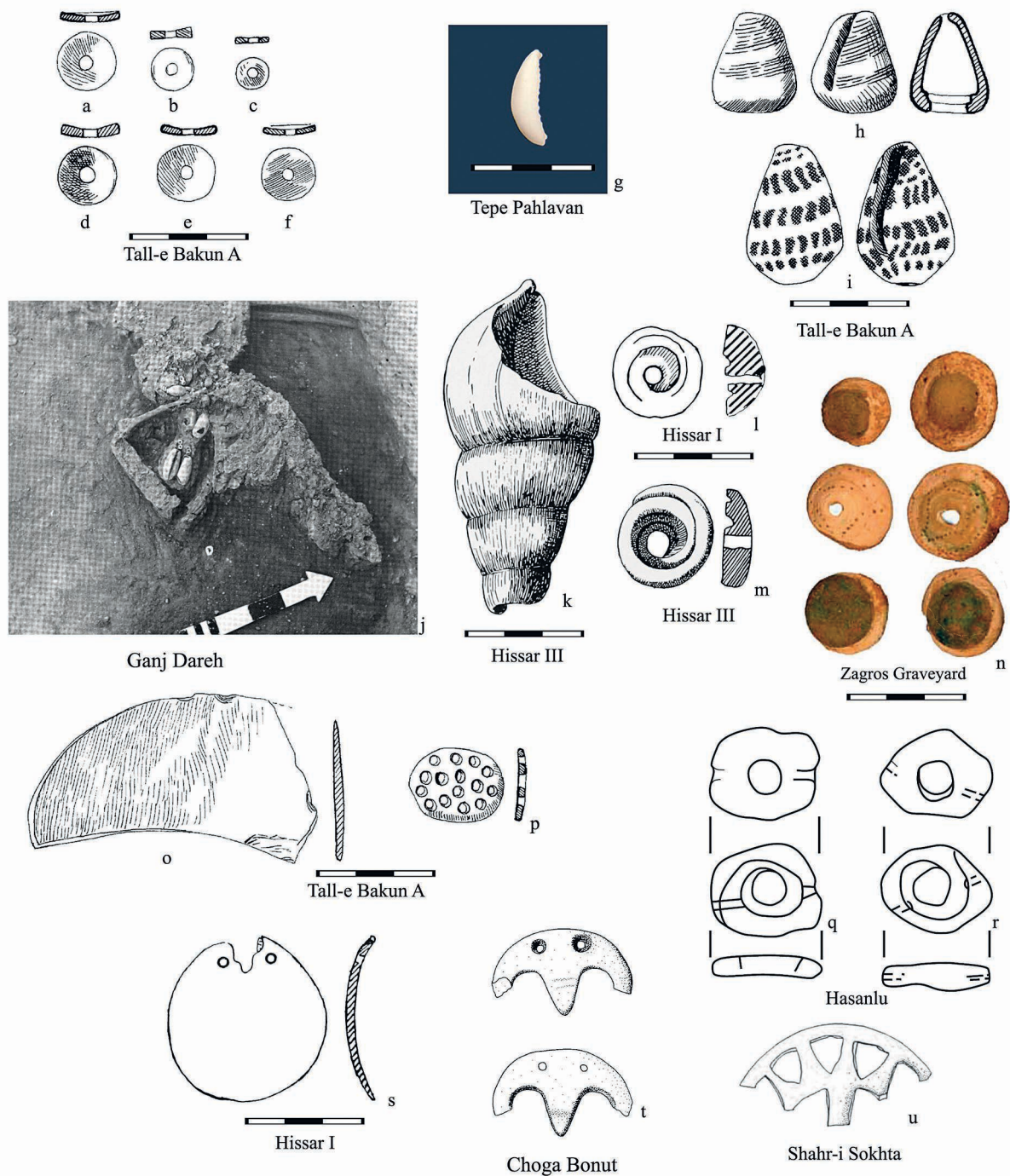
## 2.4 | The *Cypraeidae* shells

Their use is documented during the early phases of the Neolithic but their circulation is continuously present, even until the later phases of the Bronze and Iron ages (e.g. site of Dinkha Tepe – West Azarbaijan, Muscarella 1974; Gohar Tappe – Mazandaran – and adjacent sites, Mahfrouzi, Piller 2009, Kul Tarike – Kurdistan, Rezvani, Roustaei 2007, and several sites in Pusht-I Kuh region – Ilam, Overlaet 2003). They are distributed in coastal regions but also in regions of the hinterland, several hundred kilometres from the coast, highlighting the symbolic value shared by many groups throughout a long period. The *Cypraeidae* shells, commonly called cowries, are particularly useful for tracing “roads” of circulation of men and objects because they are often identified and mentioned in the bibliography (e.g. sites of Bestansur – Sulaimaniyah, Iraq, Matthews *et al.* 2014; Hajji Firuz Tepe – West Azarbaijan, Iran, Voigt 1983; Tepe Pardis – Tehran, Iran, Fazeli *et al.* 2007; Tall-e Jari B and Tall-e Mushki – Fars, Iran Alizadeh 2006; Tepe Pahlavan – Khorassan, Vahdati 2010; **fig. 2g** and **j**). These shells are commonly found whole, without any modification, or completely separated from the dorsal section. These shells are often associated with red-coloured mineral substances, located on the surface and in the internal part of shell.

## 2.5 | The *Conidae* shells

Some shells obtained from the *Conidae* sp. are also reported in regions far from the coast, both in contexts of the early Neolithic, such as Qasr-e Ahmad – Fars, Kamjan *et al.* 2018; in contexts of the final Neolithic and the Chalcolithic (Tell-and Bakun A – Fars, Alizadeh 2006; **fig. 2h-i**; Sialk I, II and III – Isfahan, Badel 2012; Tepe Hissar, phases I and III – Semnan, Schmidt 1937, **fig. 2k-m**), and the Iron Age (e.g.: “Zagros Graveyard” site – Iranian Kurdistan, Amelirad

[1] To provide a better legibility of the map in fig. 1, the site was not located because it is too far away from Iran and neighbouring area. For more information, please refer to the publication by Groman-Yaroslavski *et al.* 2013.



— FIGURE 2 —

Shell artefacts found in different prehistoric and protohistoric Iranian sites. a-f). Disc beads from Tall-e Bakun A – Fars (after Alizadeh 2006, p. 235, fig. 26, I, J, K, S, T, U); g) Fragment of cowrie shell from Tepe Pahlavan – North Khorasan (after Vahdati 2010, p. 30, pl. 9); h-i) Gastropods from Tall-e Bakun A – Fars (after Alizadeh 2006, p. 235, fig. 26, AA, EE); j) Child burial in level D with shell beads from Ganji Dareh – Kermanshah (after Smith 1974, p. 209, fig. 2); k) Gastropod from Tepe Hissar III, H1873 – Semnan (after Schmidt 1937, p. 232, planche LXX); l) Gastropod from Tepe Hissar I, H3799 – Semnan (after Schmidt 1937, p. 61, plate XIX); m) Gastropod from Tepe Hissar III, H1755 – Semnan (after Schmidt 1937, p. 232, plate LXX); n) Gastropods from “Zagros Graveyard” site – Iranian Kurdistan (after Amelirad et al. 2011, pl. 17, p. 76); o-p) « Plaquettes » from Tall-e Bakun A – Fars (after Alizadeh 2006, p. 235, fig. 26, Z, GG); q-r) Gastropods from Hasanlu – West Azerbaijan (after Danti and Cifarelli 2015, p. 94, fig. 15, H 7-8); s) « Plaquette » from Tepe Hissar I, H3444a – Semnan (after Schmidt 1937, p. 61, plate XIX); t) Chogha Bonut – Khuzestan (after Alizadeh 2003, p. 79, fig. 33, C-D); u) Artefact from Hasanlu – West Azerbaijan (after Cortesi et al. 2008, p. 27, fig. 22).

Objets en coquillage découverts dans différents sites iraniens préhistoriques et protohistoriques. a-f) Perles en forme de disque de Tall-e Bakun A – Fars (d'après Alizadeh 2006, p. 235, fig. 26, I, J, K, S, T, U); g) Fragment de cauris de Tepe Pahlavan – Nord Khorasan (d'après Vahdati 2010, p. 30, pl. 9); h-i) Gastropodes de Tall-e Bakun A – Fars (d'après Alizadeh 2006, p. 235, fig. 26, AA, EE); j) sépulture d'enfant du niveau D avec des perles de coquillage de Ganji Dareh – Kermanshah (d'après Smith 1974, p. 209, fig. 2); k) Gastéropode de Tepe Hissar III, H1873 – Semnan (d'après Schmidt 1937, p. 232, planche LXX); l) Gastropode de Tepe Hissar I, H3799 – Semnan (d'après Schmidt 1937, p. 61, planche XIX); m) Gastropode de Tepe Hissar III, H1755 – Semnan (d'après Schmidt 1937, p. 232, planche LXX); n) Gastropodes du site « Zagros Graveyard » – Kurdistan iranien (d'après Amelirad et al. 2011, pl. 17, p. 76); o-p) « Plaquettes » de Tall-e Bakun A – Fars (d'après Alizadeh 2006, p. 235, fig. 26, Z, GG); q-r) Gastropodes de Hasanlu – Azerbaïdjan occidentale (d'après Danti et Cifarelli 2015, p. 94, fig. 15, H 7-8); s) « Plaquette » de Tepe Hissar I, H3444a – Semnan (d'après Schmidt 1937, p. 61, plaque XIX); t) Chogha Bonut – Khuzestan (d'après Alizadeh 2003, p. 79, fig. 33, C-D); u) Artefact de Hasanlu – Azerbaïdjan occidentale (d'après Cortesi et al. 2008, p. 27, fig. 22).



*et al.* 2011; Bard-i Bal and Shurabah – Ilam, Overlaet 2005; Hasanlu – Western Azerbaijan, Cortesi *et al.* 2008; **fig. 2n, q-r**). These shells are used in a complete form, or transformed into discs or rings (transformation more common in the Bronze and Iron Ages).

## 2.6 | Other types of ornamental objects

Other types of shell artefacts, generally described as beads, pendants, and plaques, have been found in the phase of Ali Kosh, in the southwestern foothills of Zagros (Hole *et al.* 1969). On the site of Tall-e Bakun A – Fars, in a Chalcolithic context, shell fragments resembling small plates of mother-of-pearl have been found (Alizadeh 2006; **fig. 2o-p**), whose origin (marine or freshwater) remains unknown. From the site of Tepe Hissar, phase I, related to the Chalcolithic period, comes a sub-circular shell plaque and concave-convex section with two holes at one end for suspension (Schmidt 1937; **fig. 2s**).

## 2.7 | Figurines and plaquettes

Finally, abstract figurines and other motifs that are more complex have been cut from large shells, generally large gastropods, whose precise species are unknown due to the high degree of transformation of the shells. An example can be found in the Neolithic site of Chogha Bonut – Khuzestan (Alizadeh 2003, p. 79, fig. 33, C-D; **fig. 2t**), interpreted as a pendant with a “bucranium” form. A more recent piece, dated to the Chalcolithic/Bronze Age and produced from a *Turbinella pyrum* shell, comes from the site of Shahr-i Sokhta – Sistan (Cortesi *et al.* 2008) (**fig. 2u**).

## 3 | NEW INSIGHTS ABOUT MARINE SHELL EXPLOITATION: ONE CASE STUDY FROM THE IRANIAN SITE OF RUWAR

The shell artefacts studied here come from the tomb of Ruwar (Kurdistan province, Northwest of Iran), dated to the Iron Age I-II (Ghasimi *et al.* 2021).

### 3.1 | Archaeological background

The tomb of Ruwar is located on a steep slope, at north-west of modern Ruwar village in the Hawraman mountainous region (Kurdistan province; **fig. 1**). This monument is part of a larger archaeological area in which a settlement site, frequented during the Chalcolithic and Iron Age, was also discovered (Mucheshi *et al.* 2017a, 2017b, 2019a, 2019b) during the archaeological surveys realised in the framework of Darian Dam Archaeological Salvage Project (DDASP), under the general direction of Fereidoun (Biglari, Shidrang 2019).

The site of Ruwar includes a dome-shaped tomb and a stone structure on the steep slope of Kosalan Mountain. The tomb was investigated in 2015 by one of the authors of this paper, Taher Ghasimi (Ghasimi *et al.* 2017, 2019, 2021; Ghasimi 2019). The grave has a circular outline with a partially domed structure (**fig. 3a-c**). The tomb is accessed through a narrow rectangular corridor made of large slabs and covered with large slabs on the south side. The roof of the chamber is made of two large slabs, only one of

which is well preserved. A curved wall was built on the side facing the slope towards the river. This structure probably had the function of containing the sediment and ensuring the stability of the funerary monument over time.

In the Ruwar tomb the remains of at least eight individuals, six adults, a child and a young individual, were found. Various objects were found in the tomb: decorative objects, tools, weapons, burial vessels and chipped stone artifacts (**fig. 3d-f**). Decorative objects include pendants, beads, rings, tinsels, bracelets, gems, knucklebones, earrings and fillets produced in various raw materials (bronze, iron, silver, stone, agate, frit and bone), including marine shells.

### 3.2 | The shell ornaments

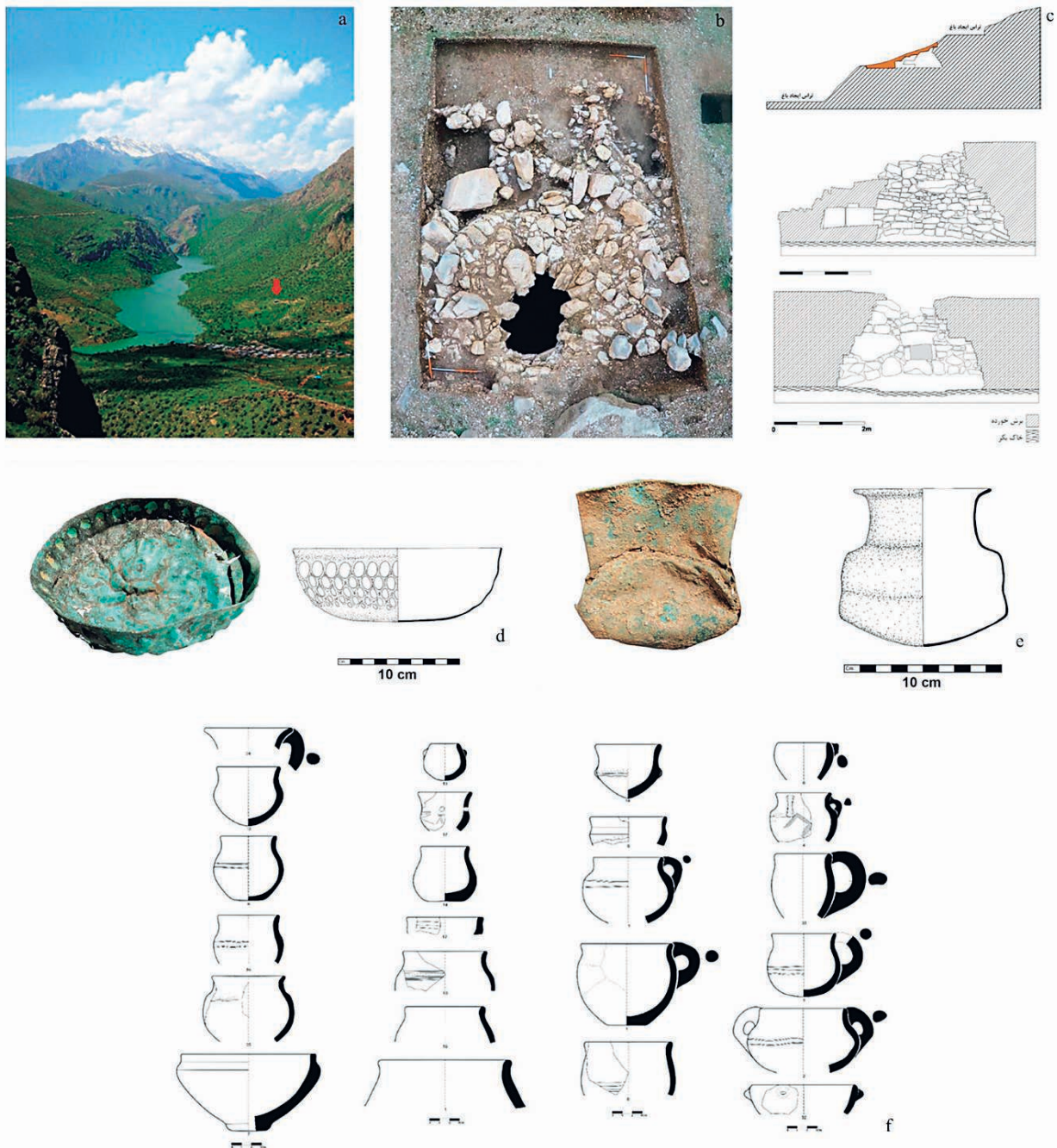
The 111 shells found in Ruwar were obtained from two taxa of gastropods, *Conus* sp. (NR: 4 shells; **fig. 4b**) and *Nassarius* shells (total NR: 96 shells of which 18 individuals identified as *Tritia gibbosula* and 78 individuals as *Tritia gibbosula* or *Nassarius circumcinctus*<sup>2</sup>; **fig. 4a**), and one scaphopod taxon, the *Dentalium* sp. (NR: 1 shell; **fig. 4c**). Ten ornaments were obtained from unidentified taxa. The raw material seems the same for all of these objects: it is composed of alternating aragonite and calcite layers that can be common to various gastropods and bivalve taxa (**fig. 4d**). Some anatomical details identified on the pendants suggest that they are obtained from *Conus* sp. shells but the high degree of transformation does not allow for a definitive determination.

These different taxa were used for the production of various types of ornamental objects. The *Tritia gibbosula* or *Nassarius circumcinctus* shells and *Conus* sp. were exploited for the production of pendants (NR: 99 pieces) and a ring (NR: 1 piece). The *Dentalium* sp. and the indeterminate shells were used for the production of beads (NR: 12 pieces). *Nassarius* shells have retained their natural shell morphology, as well as *Dentalium*. *Conus* and indeterminate shells have been completely modified assuming respectively a tabular hexagon or circular form and a tabular sub-rectangular or cylindrical morphology.

### 3.3 | The state of conservation of shells

Of the corpus as a whole, 41 shells are fragmentary and of these, 2 shells have modern fractures. With the exception of four beads obtained from unidentified taxa, all the shell surfaces are in a very poor state of preservation: the outer nacre layer is not preserved, exposing the different inner layers. In these shells, it is not possible to make a complete technical analysis, because of the rare small portions of surfaces still preserved. The shells of *Nassarius* and *Conus* show several characteristics that lead back to their collection on beaches after their damage resulting from post-depositional agents: global rounding of the surfaces and natural perforations that mainly occur in

[2] During a preliminary report, the shells have been identified as *Tritia gibbosula* (Ghasimi *et al.* 2021). A more detailed study has established that for the majority of shells, the state of conservation does not allow discrimination between the species *Tritia gibbosula* and *Nassarius circumcinctus* following to the morphological characteristics described in the literature (Olivierorio and Tringali 1992; Bar-Yosef Mayer 2015). Both species occur in the eastern Mediterranean.



— FIGURE 3 —

The site of Ruwar: a) general panoramic of the area where is the site; b) zenithal vision of the monument; c) sections of the burial monument; d-e) metal and pottery finds.

Le site de Ruwar : a) panorama général de la zone où se trouve le site ; b) vision zénithale du monument ; c) sections du monument funéraire ; d-e) objets en métal et en céramique.

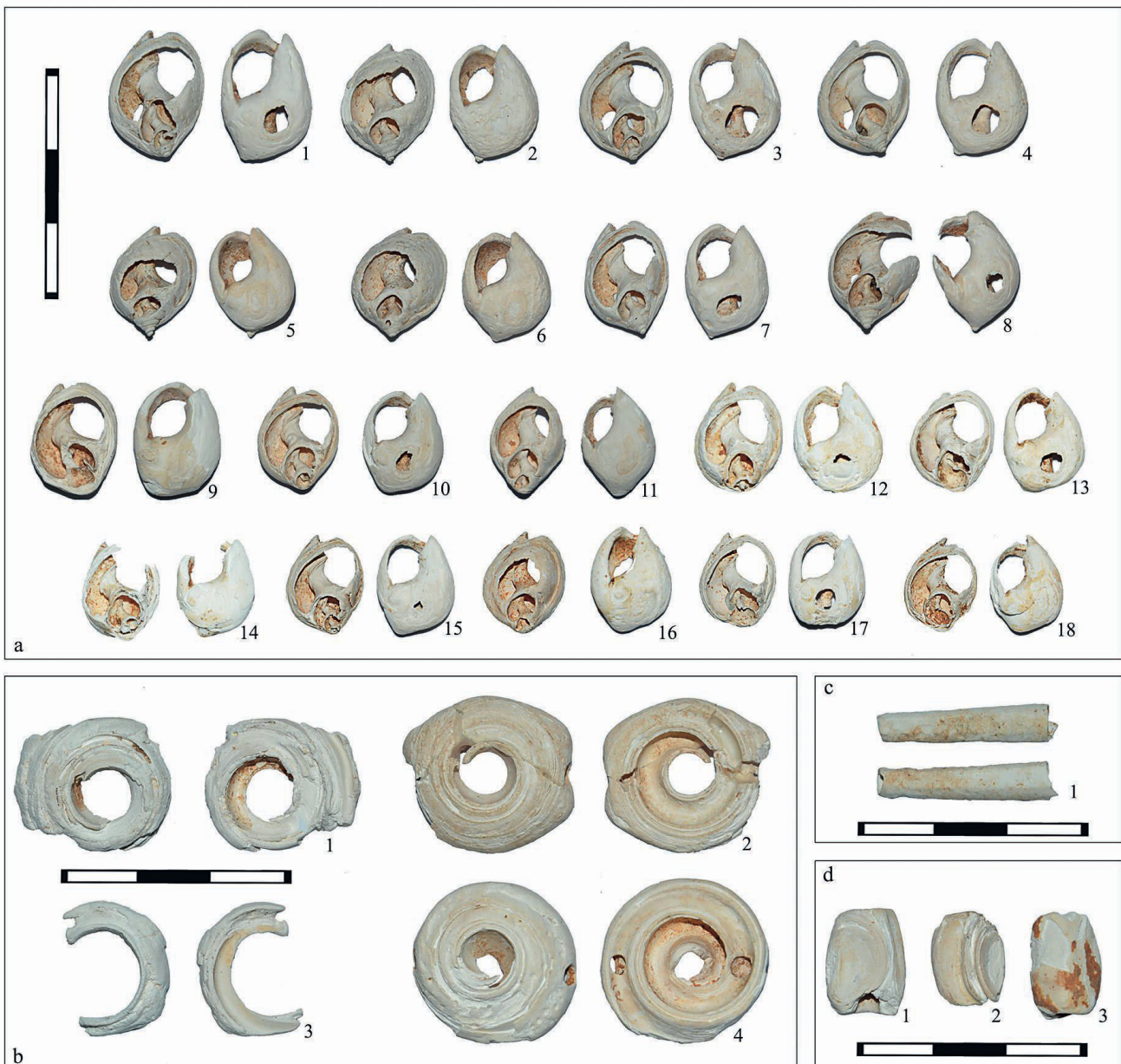
structurally weak zones, especially in the dorsal (NR: 96) and ventral sides (NR: 35) of *Nassarius* shells (Bosch *et al.* 2019). Traces of surface dissolution are observed in some specimens of *Nassarius* and on two unidentified shell specimens.

### 3.4 | The shell-bead technology

Only two *Nassarius* pendants have preserved technical stigmata related to the abrasion of the dorsal and ventral faces (fig. 5a, 2): a flattened abrasion plane characterised

by the presence of parallel short striations. Most of the pendants in the collection, being in a poor state of preservation, have not retained the technical traces of anthropogenic origin. It is therefore not possible to assess exactly how many shells are used without prior processing from the worked ones.

The *Conus* sp. pendants are obtained from a blank including the last spire and the shoulders of the shells. No traces of anthropogenic general transformation are visible. The few technical stigmata observable are those



— FIGURE 4 —

Shell beads from Ruwar: a) *Nassarius* shells (1-8 *Tritia gibbosula*; 9-18, *Tritia gibbosula* or *Nassarius circumcinctus*); b) *Conus* sp. shells; c) *Dentalium* sp.; d) Bead on indeterminate shell.

Objets de parure en coquilles provenant de Ruwar : a) coquilles de *Nassarius* (1-8 *Tritia gibbosula* ; 9-18, *Tritia gibbosula* ou *Nassarius circumcinctus*) ; b) coquilles de *Conus* sp. ; c) *Dentalium* sp. ; d) perle sur coquille indéterminée.

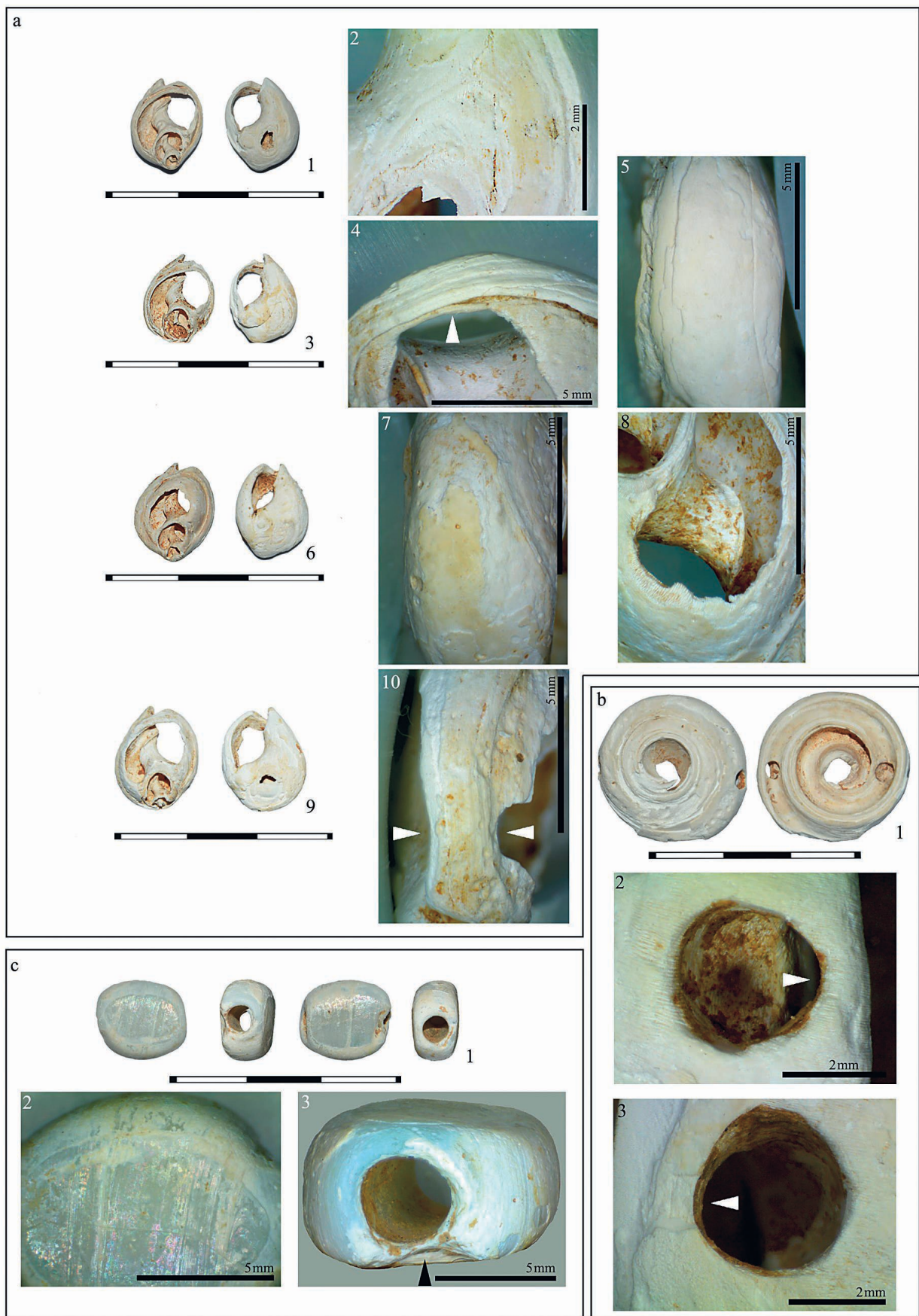
of circular perforations with a biconical drill-hole section. These perforations are realised from the outer and inner faces of shells, on the two sides of the pendants.

The sub-rectangular beads obtained from undetermined shells are shaped by transversal and oblique abrasion on the entire external surface (fig. 5c, 2). They are perforated along the main axis of the beads and some concentric striations have been observed in the edges of the perforation, indicating the use of a drill.

Finally, the *Dentalium* shells are used without any transformation.

### 3.5 | The use-wear traces

Once the dorsal side was removed for abrasion or naturally absent, the *Nassarius* pendants were suspended by the upper part of the perforation, as indicated by the macro-traces from use (fig. 5a, 4, 10). Observations of the surfaces reveal different intensities of use-wear traces suggesting different suspension times (fig. 5a, 4 vs 10). The preserved use-wear traces also show that at least some of the shells were tied together and were part of a single object (fig. 5a, 5, 7). In only one case, a flattened area along the edge of the shell suggestive of friction with other suspension elements or a more intense rubbing against clothes. For the *Conus* shells, the location of the use-wear suggests that the shells were attached by a horizontal



— FIGURE 5 —

Shell beads from Ruwar, techno-functional aspects: a) technical stigmata (2 and 8) and use-wear traces (4, 7, 10) on *Nassarius* shells; b) use-wear traces on *Conus* shells; c) use-wear traces on indeterminate shells.

*Perles en coquilles de Ruwar, aspects techno-fonctionnels : a) stigmates techniques (2 et 8) et traces d'usure (4, 7, 10) sur des coquilles de Nassarius; b) traces d'usure sur des coquilles de Conus ; c) traces d'usure sur des coquilles indéterminées.*

system of suspension (fig. 5b). For the sub-rectangular ornaments obtained from indeterminate taxa, the use-wear traces are more pronounced on a symmetrical area on both sides of the beads, suggesting a free suspension (fig. 5c).

## 4 | DISCUSSION

The study of the Ruwar ornaments and the bibliographic information collected on the exploitation of marine resources in the Iranian Plateau during the protohistoric period provide new insights into the circulation of shell raw materials between coastal and inland areas and their interregional spread. Three immediate and fundamental observations emerged from this study: i) the ecological aspects of the identified taxa and the data on the probable source areas, ii) the presence of artefacts obtained from the same species on Iranian sites and neighbouring regions and iii) the data concerning the circulation/trades of shell raw materials in the Iranian Plateau.

### 4.1 | Ecological and ethological aspects and probable source areas of shells

The *Nassarius* shells include both intertidal and subtidal species. They are found in rocky environments near the limit of the low water mark in hollows and under rocks especially in sandy or in muddy areas. *Nassarius* feed on crabs and carrion. The predation technique consists of lurking in the marine substrate and then waiting with only the siphon protruding, until they smell the food nearby. Their geographic distributions are the Mediterranean Sea for the *Tritia gibbosula* and its eastern basin for the *Nassarius circumcinctus* (Bar-Yosef 2015). Other species, such as *Nassarius arcularia*, also live in the Persian Gulf (Hosseinzadeh *et al.* 2001).

Some *Conus* species live on sandy and rocky substrates, in shallow water and often in intertidal and subtidal zones. It is a predatory shell family and they move to hunt worms and molluscs. At rest, they can lie buried in the sand or stay in coral reefs and hide under stones or other objects. Depending on the species, the *Conus* shells can have some very variable characteristics, such as the morphometry, the tuberculation of the spire and the body-whorl, colours and the pattern of colouring. They are commonly found in some areas of the Persian Gulf (Hosseinzadeh *et al.* 2001; Röckel *et al.* 1995).

*Dentalium* shells live on sandy and muddy seabeds in low and mid-intertidal zones. They are carnivores feeding on microscopic organisms, detritus and foraminifera (Lindberg 2001). Two species, the *Dentalium longistrosum* and the *Dentalium octangulatum*, live in the present-day waters of the Persian Gulf (Hosseinzadeh *et al.* 2001). However, the use of fossil species found in terrestrial contexts cannot be excluded.

For the other indeterminate shells, their origin unfortunately cannot be precisely defined.

### 4.2 | Typological comparisons in the regional and extra-regional areas

*Nassarius* shells circulate in south-west Asia even in regions far from the sea, from the Middle Palaeolithic onwards and were used extensively during the Pleistocene and Holocene (Bar-Yosef 2015; Pickard 2016). Species from the Mediterranean most commonly discovered on archaeological sites, such as *Tritia gibbosula* and *Nassarius circumcinctus*, are found in prehistoric and protohistoric sites in Lebanon and Syria (Adachi, Fujii 2018; Bar-Yosef 2015). From tomb 50 of the Iranian site of Marlik – Gilan – comes a necklace made of several perforated *Nassarius* shells that seem to belong to species that were living in the Mediterranean (Negahban 1996, plate 74). In the site of Hasanlu – West Azerbaijan –, ornaments obtained from *Nassarius arcularia* were founded from the middle Bronze through the Iron Age periods (Cifarelli 2014). These shells, coming from the Persian Gulf, appear in this site during periods when there is evidence of relations with northern Mesopotamia (Cifarelli 2018). In addition to funerary contexts, these shells have been found in the treasury of Temple BBII with other thousands of beads, suggesting probably their use in cultural activities (*ibid.*).

During the Iron age, the *Conus* sp. shells were exploited for the production of pendants or rings. The selected part of the shell is the spire cap with sometimes a portion of the shoulder. The general morphology of this portion of the shell is modified by the abrasion technique and there is typically a perforation in the centre part of the spire cap. These ornaments were documented in the north-western region of Iran near the site of Ruwar, as attested in Hasanlu – Western Azerbaijan (Danti, Cifarelli 2015), in the “Zagros Graveyard” site – Iranian Kurdistan (Amelirad *et al.* 2011; fig. 2n) and in Pusht-i Kuh funerary sites (Overlaet 2003). In the Mesopotamian region, at the site of Susa, seven rings made from *Conus* sp. were found in the acropolis. Further north-east, these shells are used as ornamental objects in the site of Tepe Hissar – Semnan (fig. 2l-m) and the site of Marlik – Gilan (Negahban 1996, plate 74). Further south, at Shahr-i Sokhta, as well as in the nearby site of Tepe Yahya, evidence of the use of pendants, rings and beads obtained from *Conus* sp. underline the assiduous trade of these shells (Marcucci 2012; Tosi, Biscione 1981).

The *Dentalium* sp. shells were found in Ilam graves – Pusht-i Kuh region, Lurestan – dated from the Early Bronze Age to the Iron Age (Haerinck, Overlaet 2010), and at several other sites in this region, as in the Banesh period of Tall-i Malyan site – Fars – where worked and unworked *Dentalium* shells were found, including one cache of 110 shells in room II (Sumner 1974, p. 164).

### 4.3 | Objects and people in motion: tracing “trades” through marine shells circulation during the Bronze and Iron Ages

The research on the circulation of non-local objects highlights the movement of peoples and objects to/from different areas of Iran, beginning in the early phases of the Neolithic.

During the Bronze and Iron Ages (from the late IV<sup>th</sup> to the II<sup>nd</sup> millennium BCE) in Iran and neighbouring regions, many precious raw materials (cornelian, agate, lapis lazuli, turquoise, obsidian, bitumen, quartz, metals, shells etc.) circulated in different areas, highlighting long-distance trade accompanied by large-scale specialisation of craft production (e.g. Butterlin, Sauvage 2022; Inizan 2000; Kenoyer, Frenez 2018; Sauvage 2012, 2020; Tosi, Biscione 1981). The coexistence of various complex economic systems (reciprocal, redistributive, and commercial structures) from the 3<sup>rd</sup> millennium BCE onwards is already evoked and demonstrated in areas with a higher density of sites, such as the Mesopotamia and Elam regions (e.g. Amiet 1986; Butterlin, Sauvage 2022) but the reconstruction of the circulation roads of these materials in more peripheral areas is more difficult.

The study of the Ruwar collection helps to define the circulation of marine resources in a region situated very far away from the sea. At this site the shells have come from the Persian Gulf (*Conus* sp. and probably *Dentalium*) and from the Mediterranean Sea (*Nassarius* sp.).

At the current stage of research, no production area of *Conus* sp. has been identified in Iran. Based on the technological results of *Conus* sp. finds from the Ra'al-Junayz-2 (RJ-2) and from HD 60 at Ras Al-Hadd, the currently known production sites are located in Oman, and dating between the IV<sup>th</sup> and III<sup>rd</sup> millennium BCE at these sites, all the elements of production are documented (blanks, wastes, finished objects, raw material blocks), making it possible to reconstruct the various stages of the manufacturing sequence of rings and discs (Charpentier 1994; Marcucci 2012). The technical evidence studied from other nearby sites, dating from the early half of the III<sup>rd</sup> millennium BCE to the II<sup>nd</sup> millennium BCE, underline that the *chaîne opératoire* was performed with the same procedures (Charpentier 1994; Marcucci 2012; Biagi 1990; Santini 1988). The location of the manufacturing workshops and the distribution of similar artefacts in a very large area of Southwest Asia between Mesopotamia and the opposite side of the Persian Gulf, suggests a long-range circulation of these artefacts directly from the region of Oman. It is possible, however, that other production areas could be located along the Iranian coast of the Persian Gulf (Mesopotamia, Indus valley or south-eastern Iran?) as assumed by some authors (see bibliography in Marcucci 2012). In support of this second hypothesis, we can specify that if only one ring comparable to those produced in Oman has been found in Ruwar, the circular and hexagonal discs with doubled-side perforations find closer comparisons in the Iranian area (site of Hasanlu, Danti, Cifarelli 2015, and Tepe Yahya, Durante 1979).

The presence of *Nassarius* shells in Anatolian and Syrian sites and their rarity in Iranian contexts suggests their introduction through several short-range exchanges with the groups from the interior. *Dentalium* shells, on the other hand, are often found on the archaeological sites mentioned above. These shells could have been traded along the same trade routes as the *Conus*. These two shells are in fact often found in the same contexts.

## 5 | CONCLUSIONS

Despite the small amount of available bibliographic data and the paucity of a technological characterization of marine shell productions, this preliminary research reveals insight directly into the trends of marine shell exploitation from the Neolithic to the Iron age in the Iranian region. The exploitation of marine shells seems to mainly focus on the production of ornamental objects, with the selection of particular species (*Nassarius*, *Dentalium*, *Cypraea*, *Conus*) chosen for their aesthetic characteristics and their morphometric properties. These artefacts therefore seem to have a particular social value that is maintained, with some regional variations of preferred taxa and types of manufactured products, throughout the Neolithic and up to the Iron Age. As underlined by different authors (Bar-Yosef Mayer, Bosch *et al.* 2019; Trubitt 2003), the presence of marine shells in archaeological contexts may reflect patterns of social organisation of past society (social organization of production and circulation of raw materials or artefacts, social identity of artisans, social identity and social status of users). In Iran, these aspects are little understood - especially for the Neolithic and early Chalcolithic periods - due to the lack of systematic technological studies of this category of objects in a broad chronological scale. As from the end of the IV<sup>th</sup> millennium, with the emergence of proto-statal organisations, the exploitation of some species of marine shells is indicative of a systematised craft production but the lack of systematic reconstruction of *chaînes opératoires* and the scarcity of systematic taxonomic identification do not allow the manufacturing procedures to be assessed from a diachronic point of view and on a large geographical scale.

Considering the fact that Ruwar is situated in a remote mountainous region of western Iran, located actually about 600 km from the Persian Gulf and 900 km from the Mediterranean Sea, the presence of marine species is significant evidence of long-distance interactions or, more likely, of indirect trade, with repeated exchanges over short distances, during the Iron Age. In adjacent regions, for example at the Hasanlu and Zagros graveyard sites, the shell ornaments are similar (with the exception of the *Nassarius* from the Mediterranean) demonstrating a widespread and organised trade network, rather than an exceptional find. These shell ornaments imply social status as do other precious materials (metal, gold, cornelian, lapis lazuli etc.) that are also present in the grave goods of these groups.

The technological study of a larger number of marine shell collections may help in the deeper definition of the exploitation of coastal resources and the methods of circulation of raw materials, artefacts, and of technical knowledge and ideas during the prehistory and protohistory of these regions. It seems necessary to go beyond these preliminary observations to document with higher resolution the system of trades, their evolution on a larger chronological scale and their impact on the evolution of prehistoric and protohistoric societies in Iran and neighbouring regions.

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