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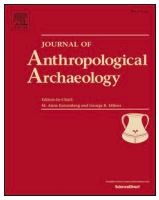

Spatial and temporal trends in the distribution of engraved eggshell fragments: A comparative view from the Holocene archaeological record of southern Africa and southern South America

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ABSTRACT

We compare motifs engraved on ostrich and rhea eggshell fragments from southern Africa and southern South America respectively. These elements were part of water flasks used, transported and cached by hunter-gatherers. We define trends in the motifs engraved on eggshells, inquire about their temporal and spatial distribution, their diversity and their information content in the context of the social interactions and boundaries developed among mobile peoples. A typology of basic motifs occurring on each side of the Atlantic was built to perform a three-step analysis. The first evaluates motif composition through three periods that we name 'middle', 'initial late' and 'final late' Holocene, the second examines image circulation within each period and the third assesses the information content of the engravings. Even though the ostrich and rhea eggshells' visual repertoires are similar, motif variability and motif spatial distribution between the periods analyzed present differences related to the particular social processes that took place in each region. Ostrich eggshells' higher information content could imply that interaction networks in southern Africa were more extensive than in southern South America. However, sample bias could also be affecting the results obtained.

1. Introduction

The eggs of the large flightless birds *Struthio* sp. (occurring throughout much of Africa and, in the past, the Middle East and Asia as far as Mongolia) and *Rhea* sp. (occurring in South America as far north as 5°S) have been used as containers by people today and in the past. Whole eggshells and eggshell fragments have been recovered in archaeological assemblages from several continents, some bearing engraved and/or painted designs. The most ancient contexts with engraved ostrich eggshells (EOES) are in southern and eastern Africa, dating back to the Middle Stone Age (MSA) in South Africa (Henshilwood et al., 2014; Mackay et al., 2022; Parkington et al., 2005; Texier 2010, 2013), Namibia (Vogelsang et al., 2010; Wendt, 1972,1976) and Ethiopia (Assefa et al., 2018). Examples from the terminal Pleistocene are reported from the southernmost part of South Africa (Wadley, 1993) and India (Bednarik, 1993; Kumar et al., 1988). Within the Holocene, an important focus of EOES is the Maghreb region of North Africa, where these elements have been retrieved in Epipalaeolithic and Neolithic contexts (Belouchet, 2008; Camps Fabrer, 1966; Mulazzani and Brugal, 2016; Vernet et al., 2006). As we show in this paper, in southern Africa, the use of eggshell flasks persisted throughout the Holocene, continued up to post-contact times and is a present practice among the San peoples. Engraved rhea eggshell fragments (ERES) come from hunter-gatherer contexts situated in the Pampean and North Patagonian regions of Argentina, whose ages range from the middle Holocene to the late Holocene, probably reaching post-contact times. Our study focuses on the comparative analysis of EOES and ERES from the Holocene period. The archaeological and ethnographic information from both regions shows that these fragments were part of water flasks, although archaeological observations indicate that most flasks were not decorated (Carden and

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Martínez, 2014; Lander and Russell, 2020; Martínez et al., 2023; Messineo et al., 2018, 2019, 2021). Our objectives are:

- to define trends in the motifs engraved on eggshells;
- to inquire about the temporal and spatial distribution of these motifs during the middle and late Holocene; and
- to explore motif diversity through time and space with a view to determining what this may suggest in terms of practices of information exchange operating within the interaction networks of mobile societies.

Archaeologists have approached different aspects of ancient people's social dynamics, such as mobility, interaction networks, identity and territoriality, using the concept of style through information exchange theory (Whallon, 2006,2011; Wiessner, 1983; Wobst, 1977). In these kinds of studies, the socio-ecological context in which symbols are exchanged has been considered a relevant factor for understanding stylistic behavior (Hartley, 1992). From this standpoint, Osborn (1996) explained the decoration of calabash milk gourds among the East African Il Chamus pastoralists as a means of allocating critical resources for feeding children in a risky environment where catastrophic losses of livestock were caused by droughts, epidemic diseases, raiding and warfare. In a similar vein, Gamble (1982) proposed that the broad spatial distribution of similar stylistic traits in Upper Palaeolithic portable art was compatible with environments where resources were temporally and spatially unpredictably distributed. In such kinds of settings, the exchange of stylistically similar items strengthened social ties through alliances and kin networks, and buffered resource shortages. One of the most studied cases in the Kalahari Desert of Botswana and Namibia is the complex delayed and reciprocal exchange system known as *hxaro* practised by the Ju/'hoansi (!Kung) and (under other names) some other San peoples (Hitchcock, 2012; Wiessner, 1977,1982). The variety of objects that circulate within *hxaro* networks through distances covering up to 200 km include arrows, ostrich eggshells, clothes, blankets and especially ostrich eggshell beads. This gift-giving system reinforces social alliances, creates safety nets under situations of resource scarcity (Hitchcock, 2012; Osborn and Hitchcock, 2019; Wiessner, 1982, 1986, 2009; 2014) and signals social variation through the objects exchanged (Hitchcock and Bartram, 1998: 43).

Wiessner's study of Ju/'hoan *hxaro* networks has become an important source of analogy in southern African archaeology for analyzing past patterns of seasonal aggregation and dispersal and broader demographic trends since it has been argued that the manufacture and exchange of *hxaro* items occurs largely in aggregation contexts and during times of enhanced ecological stress (Wadley, 1987; cf. Wilmsen, 2015). It has also proved fruitful for inferring networks of exchange and interaction from the spatial distribution of items such as marine shell ornaments, stone projectile points and ostrich eggshell beads (Mitchell, 1996; Orton, 2012; Stewart et al., 2020). Similar models of extended networks have been applied for explaining the broad spatial distribution of marine shell beads (Leonardt, 2016), engraved rock plaques (Acevedo, 2015; Belardi, 2004; Fiore et al., 2021; Lynch et al., 2018) and ERES (Carden and Martínez, 2014; Fiore and Borella, 2010) in the semiarid regions of Pampa and Patagonia in South America.

The study of information exchange through social networks requires assessing variability in material culture. On the Northern Colorado Plateau of North America, Hartley (1992) explored rock art as a function of intergroup relations through measuring the information content of panels. His model predicted rock art panels with low information content in contexts of competitive behavior and panels with high information content in co-operative contexts that favored information exchange and intergroup communication. He found that rockshelters used to store food and tools among kin-related groups exhibited highly redundant rock art (with low information content) as a means of displaying ownership and/or restricting access. On the contrary, rock art on open air boulders showed high information content. From ethnographic sources it was known that one of these places had served as a shrine and a landmark when Hopi men procured salt from a nearby deposit and carved their clan symbols on the boulder (Hartley, 1992: 110). Hartley's model can be applied to the portable art evidence from southern Africa and southern South America. We explore whether the engraved eggshell flasks circulated widely through mobility and exchange networks and whether these networks were influenced by shared stylistic rules in different regions and at different times.

2. Ethnographic and archaeological sources on the use of ostrich and rhea eggshell flasks in southern Africa and southern South America

In the Kalahari Desert, ostrich eggshell flasks were usually made by women by drilling a hole, most often at the narrow end of an egg, emptying its content, rinsing and deodorizing the interior and finally making a grass stopper (Lee, 1979). The apertures were also sealed with beeswax, clay necks, mastic stoppers or seashells pasted on with clay (Henderson, 2000; Jerardino et al., 2009; Rudner, 1953). Besides water, some ostrich eggshell flasks were used to carry red pigment (Humphreys, 1974; Morris, 1994; 2006; Rudner, 1971) or as containers for beetle larvae cocoons for making arrow poison (Chaboo et al., 2016). Lee (1979: 276) reports that among the Ju/'hoansi most households had a stock of six ostrich eggshell canteens. They were kept in the domestic units and filled with water daily by women. However, San also transported them away from the camp in carrying bags and nets when men and women went out foraging or when groups moved from one place to another (Lee, 1979; Hitchcock, 2012). They were cached as sources of water to serve the future needs of people moving in the landscape (Duggan Cronin and Bleek, 1942; Dunn, 1931; Schapera, 1930; Yellen, 1977).

The production of engraved designs on ostrich eggshell flasks has been documented among the San; however, most flasks were not decorated (Dunn, 1931; Lee, 1979; Marshall, 1976). Motifs were skillfully carved with pointed tools; afterwards, the engraved designs were rubbed with charcoal, ash or red pigment to give the designs a dark colour (Hitchcock, 2012; Jacobson and Noli, 2018). Both the ethnographic and archaeological engraved eggshells bear geometric designs. This does not imply that the images are necessarily nonrepresentational, since Khoe-San engravers described these kinds of motifs as depicting actual things and events, whether in this world or the spirit world (Hollmann, 2014; Valiente-Noailles, 1993). Other recent engraved designs depict naturalistic imagery that Western observers can recognize more easily as representational (e.g., Meiring, 1943,1951; Walton, 1957). These stylistic changes may be related to the influence of missionary and/or travelers in the original native worldview, to European demands within a market economy that now includes tourism, and to increased access to metal tools with which to undertake the engraving itself (Hoffman and Baard, 1969; Jacobson and Noli, 2018; Lange, 2006; Nteta, 1975). However, the infill of these designs using thin hatching and cross hatching has remained consistent (Hoffman and Baard, 1969; Jacobson, 2006; Lange, 2006; Rudner, 1971).

Whole engraved or non-engraved ostrich eggshell flasks have been found buried in the sand (e.g., Halkett and Hart, 1997; Jacobson and Noli, 2018; Jerardino et al., 2009; Morris, 1994; Rudner, 1953), cached among rocks, in stone structures or rockshelters (Henderson, 2000; Jacobson and Noli, 2018; Kinahan and Kinahan, 2003; Sandelowsky, 1971; Wendt, 1972) and deposited as grave goods (Pfeiffer et al., 2020; Rudner, 1971) (Fig. 1a and Table 1). On the other hand, EOES fragments are most commonly retrieved at residential bases. Flasks were regularly

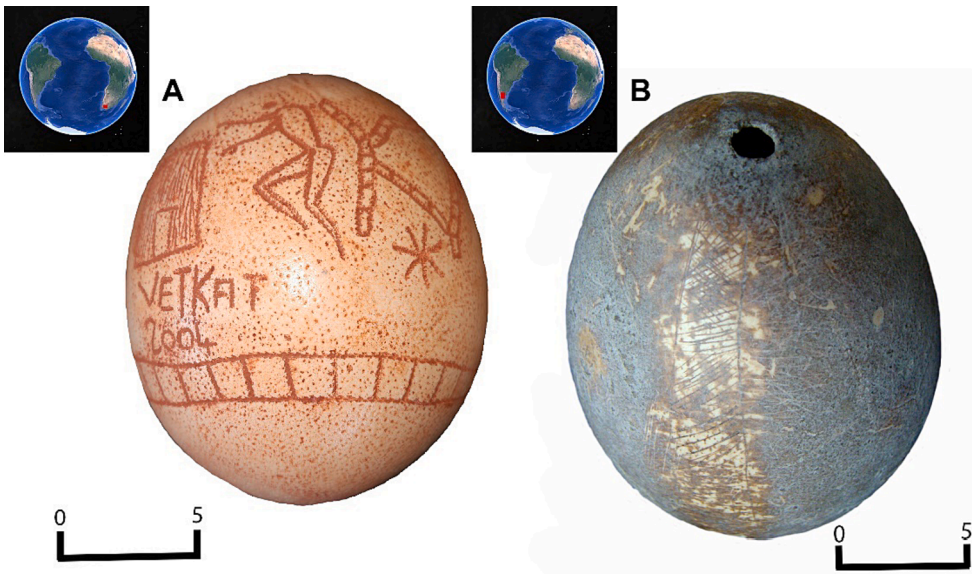


Fig. 1. A. Ostrich eggshell flask engraved and rubbed with ochre by the ǂKhomani San artist Vetkat Regopstaan Kruiper in the Northern Cape of South Africa. Courtesy: Mary Lange. B. Rhea eggshell water flask from Pintado II site. Asociación Cultural de Guaminí collection. Scales are in cm.

used in domestic spaces, subsequently reused for other purposes when broken (bowls, spoons, bead blanks, etc.) and finally discarded (Orton, 2008, 2012; Stewart et al., 2011). Nevertheless, they spent much of their life away from living spaces because they accompanied people on their foraging expeditions. Thus, base camps were just a stop for ostrich eggshell flasks within a geographically broader network of use (Stewart et al., 2011).

There are no ethnographic or ethnohistoric sources reporting the use of Rheidae eggshells as water flasks in Pampa and North Patagonia. The archaeological record provides a different picture, since complete rhea eggshell flasks have been found in open sites. In the central dune fields of the Humid Pampas (Argentina), they were located on lagoon borders (Messineo et al., 2018; Oliva and Algrain, 2004). Their preservation suggested that they were cached to store water when groups moved to other areas (Messineo et al., 2019, 2021). Among the 23 eggshell flasks retrieved in the Pampa, only two are engraved with geometric designs (Carden and Martínez, 2014; Oliva and Algrain, 2004) (Fig. 1b and Table 1). Two further engraved flasks belong to private collections in North Patagonia. One was found in San Antonio Oeste city, on the north coast of the San Matías Gulf, Río Negro province (Argentina). Although its exact provenance is unknown, it comes from an area of shell middens within a dunefield (Favier Dubois et al., 2008; Fiore and Borella, 2010). The other engraved eggshell was retrieved in a sand dune along the middle section of the Negro River valley (Mange, 2019) (Table 1).

3. Archaeological and environmental contexts of EOES and ERES during the Holocene

(a) EOES.

The South African evidence studied in this paper is distributed in six zones:

1) the Richtersveld,
2) the Sandveld.
3) the Knersvlakte.
4) the southwestern coast.
5) eastern Bushmanland.
6) the Kuruman Hills.

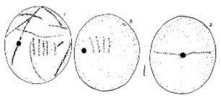
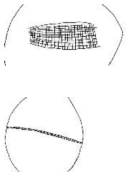
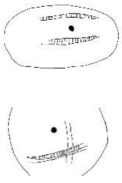
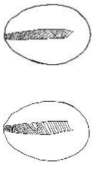
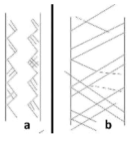
The first three zones are in Namaqualand where the Richtersveld extends from the Holgat River in the Northern Cape Province of South Africa to the Huns Mountains in Namibia. The EOES contexts are open sites on the bank of the Orange River (Fig. 2). Jakkalsberg N (JKB N) and Jakkalsberg L (JKB L) date to the mid and late-mid Holocene, respectively. They are characterized by large microlithic assemblages and bead manufacturing debris (Table 2) (Orton and Halkett, 2010). Jakkalsberg A (JKB A) and Jakkalsberg B (JKB B) are pottery period sites where faunal assemblages dominated by young sheep suggest pastoralist occupation (Webley, 1997). A similar context pertains at Hei-/Khomas, where sheep/goat bones, abundant pottery remains and ostrich eggshell beads were retrieved (Table 2).[1]

The Sandveld is the westernmost strip of Namaqualand within 20–30 km of the Atlantic coast. The archaeological evidence from this zone shows that it was visited by small groups of people throughout the last 6000 years to obtain and process terrestrial and marine species. Sites from the mid-Holocene–MB2005/005B and KN2001/008C–and late mid-Holocene–PN2009/001, TP2004/003, SK2005/084, SK2001/025 and KN2001/008C-upper–are shell middens located in dune fields along the coastline (Dewar, 2008; Dewar and Orton, 2013; Orton, 2012; Webley and Orton, 2013) (Table 2, Fig. 2 and Fig. 3 a). Namaqualand evidence from the last 800 years BP takes the form of small processing sites and longer-term base camps at the coast. A larger variety of material culture items is registered, including lithic artifacts, shell pendants, bone awls, tortoise carapace bowls, intentional tortoise burials, link shafts, pottery and debris from bead manufacturing (Dewar and Orton, 2008; Orton, 2012 a and b). Sites with EOES dated within the latest 1000 years are SK2005/096 Patch A, SK2006/006 Patch 2 and KN2005/067 Patch 1B (Table 2 and Fig. 2). Spoeg River Cave (SPR) is the most significant excavated Holocene deposit in Namaqualand (Webley, 2002). It presents the oldest evidence of domesticated sheep in southern Africa, with an age of c. 2100 years BP. Eight EOES were recovered in the pre-pottery units (Table 2).

The Knersvlakte is largely characterized by extensive quartz gravel plains cut by the Sout and Varsche Rivers. Buzz Shelter and Reception Shelter are small caves located on the north and south banks of the Varsche River respectively, 43 km from the Atlantic coast (Figs. 2 and 3 b). EOES from Buzz Shelter are associated with mid-Holocene and late Holocene occupations (Orton, 2012) and EOES from Reception Shelter were recovered from the latest occupation together with lithic, bone and

[1] On the Namibian side of the Richtersveld, Apollo 11 is an important focus of EOES with a MSA and LSA occupational sequence (Vogelsang et al., 2010; Wendt, 1972). The site is not included in our analysis because the Holocene period to which the LSA EOES belongs is not specified (Wendt, 1972).

Table 1
Examples of engraved eggshell flasks from Southern Africa and Southern South America.

Location	Site name	Chronology	Context	N engraved flasks	Engraved designs	Hole position	Observations	Source
48 km north of Upington, Northern Cape, South Africa	Unknown	Last few hundred years	Cache under a tree in dune field	5		On sides	Flasks also exhibit intersecting lines drawn with charcoal. Two non-engraved eggshell flasks were also found. Related to Bushmen	Rudner (1953)
Between Upington and Prieska Northern Cape, South Africa	Unknown	Last few hundred years	Graves in dune field	2		On pole and side	Assigned to Khoe-Khoe people. One of the engraved eggshells was rubbed with ochre. A third non decorated egg was found filled with red pigment (powered specularite).	Rudner (1971)
Koichab River basin, South Namibia	Unknown	Unknown	Cache between a boulder and protective stones with a lid	2		On side	A third non decorated eggshell was found. One of the engraved eggs was rubbed with red ochre.	Jacobson and Noli (2018)
Port Nolloth, Northern Cape, South Africa	Unknown	Unknown	Cache in dunes	2		On side	Housed in Port Nolloth Museum	Jacobson and Noli (2018)
Namaqualand, Northern Cape, South Africa	Swartduinen ZD6	Last few hundred years	Cache in dunes	2		On pole	Design information available for one eggshell	Halkett and Hart (1997)
Guaminí, Buenos Aires, Argentina	Pintado II	Unknown	Open site in lagoon border	2		On pole	Four additional eggshells with a carbonate crust. Image shows two sides of the same eggshell. The second is cross-hatched	Oliva and Algrain (2004); Carden and Martínez (2014)
San Antonio Oeste, Río Negro, Argentina	Unknown	Unknown	Shell middens in sand dunes	1	- cross-shaped band placed around the aperture	On pole	Private collection. Image not available.	Favier Dubois et al. (2006)
middle section of Negro River, Río Negro, Argentina	Pomona	Unknown	Sand dunes	1		On pole	Private collection. A and b refer to opposite sides of the same eggshell	Mange (2019)

wood artifacts, a small amount of pottery and ostrich eggshell beads (Orton et al., 2011) (Table 2).

The Southwest Coast of South Africa extends from Cape Town to the Olifants River mouth and from the Atlantic coast to the Cederberg Mountains. Sites with EOES considered here for the Holocene period are Faraoskop, Steenbokfontein and Deurspring (DSS8-3). Faraoskop and Steenbokfontein rockshelters are located in prominent rock outcrops overlooking coastal plains. The former is 30 km east of Lamberts Bay, at the sandveld/mountain interface (Fig. 2). Its chronology spans from the late Pleistocene to the late Holocene. Although pieces of smoothed, polished and notched OES appear almost throughout the sequence, suggesting the use of water flasks, the only engraved fragment comes from Layer 2, dated between c. 4400 and c. 2000 years BP (Manhire, 1993) (Table 2). Steenbokfontein is a large rockshelter located 8 km

Fig. 2. Sites with EOES mentioned in this paper. 1. Apollo 11, 2. Jakkalsberg A, B, L and N, 3. /Hei-/khomas, 4. Port Nolloth 2009/001, 5. Tweepad 2004/003, Sandkop 2005/084, Sandkop 2001/025, Sandkop 2005/096, 6. Koingnaas 2001/008C, Koingnaas 2005/067, 7. Seal Midden (MB2005/005B), Spoeg River Cave, 8. Buzz Shelter (VR005), Reception Shelter (VR001), 9. Deurspring (DSS8-3), 10. Steenbokfontein, 11. Faraoskop, 12. Klipgatspan 2014/016, 006, 008 and 013, 13. Wonderwerk Cave.

south of Lamberts Bay and 2 km inland (Fig. 2). EOES were recovered throughout the sequence, dated from c. 6000 to c. 2200 years BP (Table 2).[2] Ritual gatherings were periodically held there between c. 3000 and c. 2000 years BP, when populations increased and residential bases became more permanent (Jerardino, 1996). Deurspring lies in a coastal setting north of Lamberts Bay (Fig. 2). Excavations were conducted in three shell middens; DSS8-3 yielded five refitting OES fragments that formed a flask mouth with engraving just below it in deposits dated to the mid-Holocene (Jerardino et al., 2021).

Bushmanland and the Kuruman Hills are in the Northern Cape interior. The former is a semi-arid region between the Orange River, Namaqualand and the Karoo. Klipgats Pan is located in the far east of Bushmanland, near the town of Copperton (Fig. 2). EOES come from four surface sites also including lithic artifacts and a small amount of pottery. These contexts are dated within the last 1000 years BP (Orton and Parsons, 2018) (Table 2). Wonderwerk Cave is located on the eastern flank of the Kuruman Hills, on the western edge of the Ghaap Plateau (Fig. 2). Many decades of excavations have revealed a 6 m deep sequence extending back to before the onset of the Middle Pleistocene (Beaumont and Vogel, 2006). The LSA sequence, mainly from the Holocene, was excavated near the entrance (Humphreys and Thackeray, 1983). EOES was recovered from the middle Holocene and Late Holocene strata (Table 2). The latter are characterized by the presence of pottery.

(b) ERES.

In the North Patagonian and Pampean regions of Argentina there are seven areas with ERES:

1) the Atlantic coast of North Patagonia.
2) the eastern Pampa-Patagonia transition
3) the middle Negro River basin
4) the middle Limay River basin
5) the middle Chubut River basin
6) the Humid Pampa.
7) the Humid-Dry Pampa ecotone.

The Atlantic coast of North Patagonia extends from the mouth of the Colorado River to the mouth of the Chubut River. ERES were retrieved as surface findings in three open sites on the north coast of the San Matías Gulf, Río Negro province (Fig. 4). A mid-Holocene age was obtained from the direct dating of an ERES associated with a human burial at Bajo de la Quinta site (Fiore and Borella, 2010) (Table 3). ERES from San Antonio Oeste site come from a private collection and a surface context. Human burials recovered from the latter were dated to the Late Holocene, and Bahía Final 10 site was also dated to this period (Favier Dubois, 2013; Favier Dubois et al., 2009; Fiore and Borella, 2010) (Table 3).

The eastern Pampa-Patagonia transition refers to the area between the lower reaches of the Negro and Colorado Rivers, in the southernmost portion of Buenos Aires province. ERES were recovered in La Modesta and Loma de los Morteros sites, which are dune blowouts next to ancient paleo-channels of the Colorado River (Fig. 4 and Fig. 5 a). Surface findings of La Modesta were dated to the mid-Holocene, and Loma de los Morteros yielded mid and late Holocene ages (Table 3) (Martínez et al., 2023). Similar contexts with ERES in the lower course of the Colorado River are El Puma 3 and El Caldén sites. The former was dated to the Late Holocene (Table 3) and the age of the latter, based on the material culture, also indicates this period (Martínez et al., 2012; Martínez, 2017). The evidence from these archaeological assemblages shows that they were residential bases where domestic activities and human burials occurred (Martínez et al., 2023).[3] At the Lower basin of the Negro River, two ERES fragments were retrieved at the Goyenola site, located in a dune above a cliff that overlooks this water course. No radiocarbon dates are available so far but these findings in association with specific

[2] EOES was also found in the nearby site Tortoise Cave, dated between c. 4300 and c. 1800 years BP (Jerardino, 1996; Robey, 1987). It is not included in our analysis because images of the engraved designs are not available.

[3] La Serranita A site is in San Blas Bay, 100 km south from the Colorado River. ERES were retrieved in a deflation surface of a line of dunes, next to a shell-midden dated to c. 5600 years BP (Sanguinetti de Bórmida, 2005). Engraved designs are described as lines, dots and geometric figures, but no images are available.

Table 2
Contextual information about South African sites with EOES.

Zones	Sites	Chronology years BP	Dated materials	n EOES	n IMG EOES
1	JKB N	4960 ± 40, 4860 ± 40	marine shell and EOES	127	7
	JKB L	3330 ± 70 BP	charcoal	38	6
	JKB B	1420 ± 25	charcoal	1	1
	JKB A	1330 ± 60, 1300 ± 25	charcoal	3	3
	/H-/K	420 ± 50, 330 ± 45, 106 ± 0.6	charcoal	4	4
2	PN2009/001	2670 ± 30	marine shell	17	7
	TP2004/003	2230 ± 25	marine shell	3	2
	SK2005/084	2420 ± 30	marine shell	18	1
	SK2001/025	2172 ± 25	bone (*Raphicerus campestris*)	31	1
	SK2005/096A	611 ± 23, 654 ± 23	bone (*Chersina angulata*)	22	1
	SK2006/006	377 ± 24	charcoal	39	1
	KN2001/008C	lower: 4630 ± 70	marine shell	1	1
		upper: 3720 ± 45	marine shell	2	2
	KN2005/067	321 ± 23	bone (*Chersina angulata*)	2	1
	MB2005/005B	5390 ± 70	marine shell	2	2
	SPR	L13: 3520 ± 50	charcoal	n/d	1
		*L*11	not dated	n/d	2
		L8	not dated	n/d	1
		L7: 1490 ± 50, 1260 ± 50*	bone (*Ovis aries*)	n/d	2
		L2	not dated	n/d	2
3	VR005	L6a: 5452 ± 54	bone (terrestrial mammal)	3	3
		L4: 4551 ± 54, 3890 ± 20	bone, grass bone	3	3
		L3: 1921 ± 25	(terrestrial mammal)	3	2
	VR001	L1: 679 ± 44	ostrich eggshell	2	2
4	FSK	L2: 4420 ± 60, 2510 ± 60, 2000 ± 70	charcoal	1	1
	SBF	L4b: 6070 ± 80 (base), 3990 ± 60 (top)	charcoal	1	1
		L4a: 3640 ± 60—–3510 ± 50	marine shell	8	8
		L3: 2690 ± 60, 2490 ± 50	charcoal and twigs	4	2
		L2: 2360 ± 45	microfauna	2	2
	DSS8-3	Spit 7: 4810 ± 25	marine shell	1	1
5	KGP2014/016	1050 ± 20	ostrich eggshell	4	1
	KGP2014/006	700 ± 20	ostrich eggshell	1	1
	KGP2014/008	570 ± 20	ostrich eggshell	1	1
	KGP2014/013	420 ± 20	ostrich eggshell	2	2
6	WWK	S4a: 4890 ± 70, 4240 ± 60	charcoal	20	7
		S3b: 3990 ± 60	charcoal	13	13
		S3a: 2120 ± 80, 1890 ± 50	charcoal	24	24
		S2b: 1210 ± 50	charcoal	10	10
		S1c: last 100 years	estimated	n/d	1

References: 1) Ritchersveld, 2) Sandveld, 3) Knersvlakte, 4) South West Coast, 5) eastern Bushmanland, 6) Kuruman Hills; JKB N: Jakkalsberg N, JKB L: Jakkalsberg L, JKB A: Jakkalsberg A, JKB B: Jakkalsberg B, /H-/K: /hei-/khomas, PN2009/001: Port Nolloth, TP2004/003: Tweepad, SK2005/084: Sandkop surface 3, SK2001/025: Sandkop midden area C; SK2005/096A: Sandkop Patch A, SK2006/006: Sandkop Patch 2, KN2001/008C: Koingnaas, KN2005/067: Koingnaas Patch 1B, MB2005B: Mitchells Bay-Seal Midden, SPR: Spoeg River Cave, VR005: Buzz shelter, VR001: Reception shelter, FSK: Faraoskop, SBF: Steenbokfontein, DSS8-3: Deurspring, KGP2014/006, 016, 006 and 013: Klipgatspan sites, WWK: Wonderwerk. L: layer, S: stratum. N EOES: number of directly analyzed engraved ostrich eggshells or engraved ostrich eggshells reported in tables or text, n IMG EOES: number of engraved ostrich eggshells whose designs are available whether by direct observation or by published images. * Considered intrusive by Webley (2002); n/d: no data.

projectile point designs and the absence of pottery suggest chronologies of c. 5000–2000 BP (Martínez, 2023).

The Negro River originates from the confluence of the Neuquén and Limay Rivers and flows in a NW-SE direction through the northern portion of Río Negro province to reach the Atlantic Ocean. In the Middle Basin, Colforta 1 site is associated with ancient riverbeds and dry lagoons near the island of Choele Choel (Fig. 4). This setting was selected as a residential base from which fluvial resources were exploited c. 800 years BP (Mange, 2019; Prates, 2008) (Table 3). The Limay River originates in the Nahuel Huapi lake and flows in a NE direction as a natural boundary that divides Neuquén and Río Negro provinces. Casa de Piedra de Ortega rockshelter is located on the western margin of the Pichileufú stream (Río Negro), which flows in a S-N direction towards the middle basin of the Limay River (Fig. 4). This site was occupied during the last 3000 years (Crivelli Montero, 1988, 2010). ERES were retrieved from different strata, with most being from the top one (Table 3) (Fernández and Ramos, 2008). With its sources in Río Negro province, the Chubut River crosses Chubut province in a W-E direction towards the Atlantic Ocean. Campo Cerdá 1 is a rockshelter situated in a dune environment on the middle basin of the Chubut River (Figs. 4 and 5 b). An ERES fragment was recovered from the upper component in a domestic context dated to c. 600 years BP (Table 3) (Bellelli, 1994).

The Pampean region, in central Argentina, is characterized by extensive flat grasslands. It is subdivided in two subregions: the Humid Pampa in its eastern part, and the Dry Pampa in its western portion. The ERES evidence from the Humid Pampa comes from Paso Otero 4, an open site on the middle course of the Quequén Grande River, Buenos Aires province (Fig. 4). The site was occupied during the early and middle Holocene and the ERES fragments correspond to the latter period (Álvarez et al., 2013) (Table 3). The lithic and faunal evidence shows that it was a base camp where multiple activities were carried out. In the Humid/Dry Pampa transition, an ERES fragment was recovered from Laguna del Fondo site, located in an ecotonal caldén (*Prosopis caldenia*) forest in La Pampa province (Fig. 4 and Table 3). It was retrieved on the eastern margin of a lagoon among lithic artifacts and faunal remains (Curtoni, 2006,2007). Although it couldn't be dated, similar geoforms from a nearby site were dated to c. 1200 years BP.

4. Methodology

Our analysis adopts a coarse-grained temporal resolution in order to visualize general trends in motif distribution through time and space. The EOES from Southern Africa and ERES from southern South America are divided into three radiocarbon (uncalibrated) temporal blocks

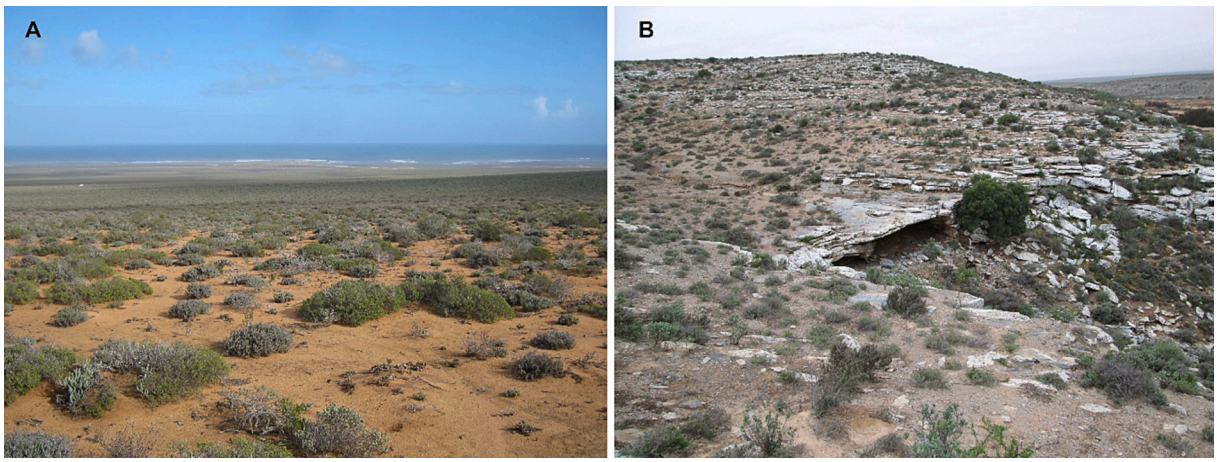


Fig. 3. Settings where Holocene EOES occur. A. Coastal area south of Kleinsee near the Sandkop sites in the Sandveld. B. Buzz Shelter, Varsche River (Knersvlakte).

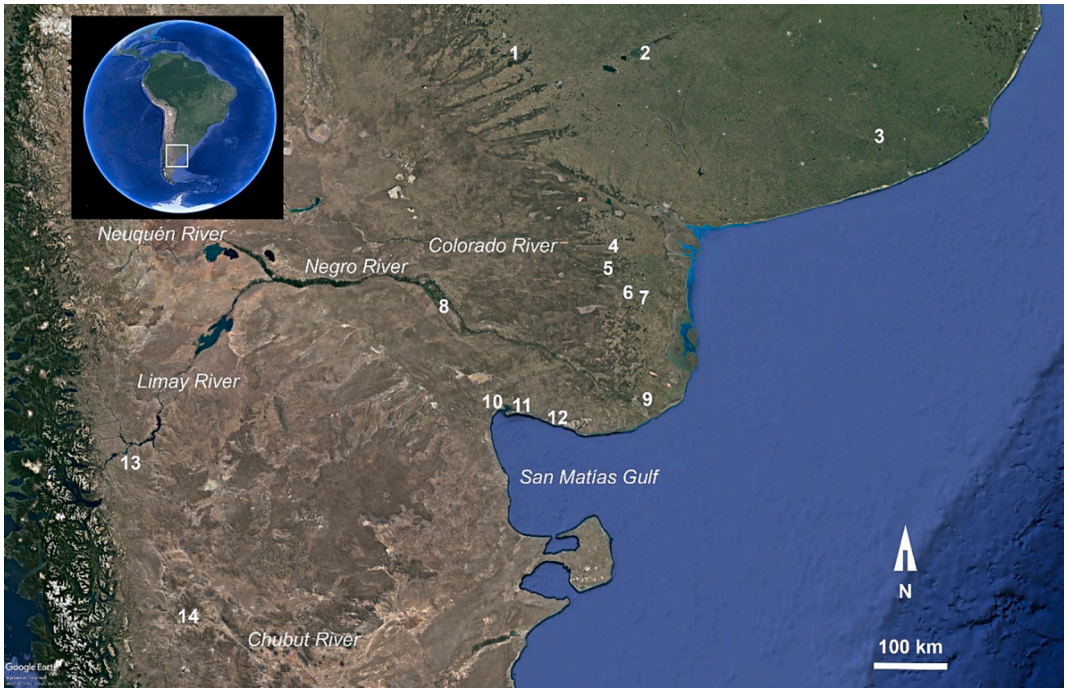


Fig. 4. Sites with ERES mentioned in this paper. 1. Laguna del Fondo, 2. Pintado II, 3. Paso Otero 4, 4. El Caldén, 5. El Puma 3, 6. La Modesta, 7. Loma de los Morteros, 8. Pomona and Colforta 1, 9. Goyenola, 10. San Antonio Oeste, 11. Bahía Final 10, 12. Bajo de la Quinta, 13. Casa de Piedra de Ortega, 14. Campo Cerdá.

within the Holocene period: middle Holocene (c. 6500 to c. 3000 years BP), initial late Holocene (c. 3000 to c. 1500 years BP) and final late Holocene (c. 1500 years to recent times).[4] The comparative study considers 25 sites with EOES from South Africa and 13 sites with ERES from Argentina (Tables 2 and 3). In sites with more than one occupation yielding engraved eggshell fragments, the information from each occupation is considered separately.

The analysis is based upon both directly studied eggshell fragments (Carden and Martínez, 2014; Carden and Borges Vaz, 2017; Orton, 2012; Orton and Parsons, 2018) and those illustrated in other publications. Even though the number of reported EOES and ERES is larger than our sample, we restricted our analysis to illustrated examples to allow for more accurate comparisons than textual or numerical information alone. Illustrated examples lacking temporal information are also excluded because they cannot be fitted into our temporal divisions. Because of this bias towards image precision and coarse temporal resolution, certain categories may be under-represented. Thus, the South African sample is composed of 133 EOES which encompass 31,5% of 422 reported EOES from the region under study (Table 2). The South American sample includes 289 ERES (Table 3). This number was then further increased using tabulated and graphic information from the San Matías Gulf which could be linked to a specific temporal block (Fiore and Borella, 2010: Tables 1 and 2). Including these data, our southern South American sample rises to 440 fragments, covering 93 % of 474 ERES reported from the region under study.

A typology of basic motifs occurring on each side of the Atlantic was

[4] The final Late Holocene of southern South America (Martínez, 2017) was heuristically extended 500 years to encompass processes that may exhibit some diachrony between both continents. Chronology is expressed in uncalibrated radiocarbon dates due to the disparity of methods used (conventional and AMS), the variability of the dated materials and the calculations of reservoir effect, among other reasons. Furthermore, chronology is not deep enough to expect significant differences between calibrated and uncalibrated ages.

Table 3
Contextual information about Southern South American sites with ERES.

Zones	Sites	Chronology years BP	Dated materials	N ERES	N ERES IMG
1	BQ	4647 ± 45	ERES	84	3
	SAO	3135 ± 52	bone (*Homo sapiens*)	12	2
	BF10	1638 ± 54	bone (*Otaria flavescens*)	74	0
2	LMO	5904 ± 37	bone (*Homo sapiens*)	141	141
		5890 ± 52	bone (*Homo sapiens*)		
		5846 ± 51	bone (*Myocastor coypus*)		
		5641 ± 66	bone (*Lama guanicoe*)		
	LLM	6364 ± 38	bone (*Rhea americana*)	111	111
		4454 ± 60	bone (*Homo sapiens*)		
		4269 ± 59	bone (*Lama guanicoe*)		
		1114 ± 25	bone (*Homo sapiens*)		
	EP3	2219 ± 47	bone (*Lama guanicoe*)	8	8
		2209 ± 48	bone (*Lama guanicoe*)		
	EC	–	ERES date under study	1	1
	GOY	–	no date available	1	1
3	CF1	790 ± 50	charcoal	13	8
4	CPO	stratum h: 2710 ± 100	charcoal (hearth)	2	1
		stratum c3: 1440 ± 80	charcoal (hearth)	2	2
		stratum c2: 280 ± 50	charcoal (hearth)	10	3
		stratum b2: modern	charcoal (hearth)	11	4
5	CCE	unit 2-3: 580 ± 60	charcoal (hearth)	1	1
6	PO4	5559 ± 43	sediment organic matter	2	2
7	LF	–	no date available	1	1

References: 1. San Matías Gulf, 2. Lower Colorado River, 3. Lower and Middle Negro River, 4. Limay River basin, 5. Chubut River basin, 6. Humid Pampa: inter-hill area 7. Central Pampean Dunefields and xerophytic forest ecotone. BQ: Bajo de la Quinta, SAO: San Antonio Oeste, BF10: Bahía Final 10, LMO: La Modesta, LLM: Loma de los Morteros, EP3: El Puma 3, EC: El Caldén, GOY: Goyenola, CF1: Colforta 1, PO: Pomona, CPO: Casa de Piedra de Ortega, CCE: Campo Cerdá, PO4: Paso Otero 4, PIII: Pintado II, LF: Laguna del Fondo. N ERES: number of directly analyzed engraved Rheidae eggshells or engraved Rheidae eggshells reported in tables or text, n IMG ERES: number of engraved Rheidae eggshells whose designs are available whether by direct observation or by published images.

built for comparative purposes to examine the spatial and temporal distribution of the designs on both continents. The classification scheme is based largely on Carden and Martínez (2014), with additional observations from Fiore and Borella (2010), Orton (2012), Texier et al. (2013) and other sources (Table 4). Each engraved fragment was considered as a unit for motif analysis; when refitting could be achieved, the refitted pieces were treated as a single unit. A motif refers to the largest configuration of engraved geometric elements that can be observed on the surface of an eggshell fragment or refitted fragments. Motifs were divided into five classes: dots, lines, geometric figures, bands and unidentified. These general categories include different subclasses which also exhibit internal variation (Table 4). Dots were divided into simple, clustered or aligned; lines into straight, curved, zigzagged, angular and cross-hatched. Geometric figures were classified according to the kind of infill they exhibit and whether their geometric shape (e.g., triangular, rectangular etc.) could be identified or not. Bands consist of two subparallel lines with interior elements between them, such as hatched or cross-hatched lines. Motifs were considered unidentified when a break passed through a design, preventing its ascription to a single type. For example, hatching extending between a major enclosing line and a break could have been from an identified shape or a band (Table 4).

The analysis is divided into three steps; the first one evaluates motif composition of each sample through the middle, initial late and final late Holocene periods as defined above. Diversity is expressed through the number of subclasses present in each time division. The second step examines image circulation within each period through the comparison of motifs from different areas of South Africa and southern South America. The third step evaluates the information content of EOES and ERES through calculating the average amount of information as a numerical value through the Shannon formula (Hartley, 1992). Hartley's unit of analysis for assessing the information content of rock art on the northern Colorado Plateau was the rock art panel. The equivalent of the panel in our study should be the complete engraved eggshell flask. However, because of the high fragmentation rate of eggshells, this paper analyzes eggshell fragments out of necessity, with some engraved fragments measuring no more than 1 cm^2. For this reason, and following the guiding questions of this paper, the selected unit of analysis for measuring the information content of EOES and ERES is the period.

According to information theory, which grew out of message transmission, information causes a change in knowledge and reduces uncertainty. The number of symbols in a code reflects its diversity and the relative frequencies of the symbols reflect their information content (Hartley, 1992). In the Shannon formula, H is the measure of the amount of information, P*i* is the proportion of each subclass of motif in the distribution and *n* represents the number of motifs in the distribution: $H_n = {}^{n}\sum_{i} pi \log_2 (1/pi)$. Two additional measures are calculated to evaluate the degree of dispersion of the proportions of motifs (p*i*): the index of uniformity (Rel. H_n) and redundancy, expressed as follows:

$$\text{Rel. } H_n = \frac{{}^{n}\sum_{i} pi \log_2 (1/pi)}{\log_2 n}$$

$$\text{Redundancy} = 1 - \text{Rel. } H_n$$

The index of uniformity (Rel H_n) equals 1 (the maximum value) when each motif subclass contains the same number of units (most diverse), and 0 (minimum value) when only one motif subclass is observed. An advantage is that its value is independent of the value of *n*, which allows comparison between assemblages that differ widely in the number of items present. Complementarily, redundancy (R = 1-Rel H_n) measures the number of unutilized possibilities for carrying information. It is at a maximum (1) when all motifs correspond to the same subclass and at a minimum (0) when each motif represents a different subclass. In the realm of communication, a redundant message minimizes mistakes in its reception. Following Hartley's model, in which he expected to find panels with high information measures in cooperative contexts and low information measures in competitive contexts, our expectation is to find higher information contents in EOES and ERES from periods in which the socio-ecological scenario points towards open social networks. To test these expectations, it is necessary to rank the values of the index of uniformity (Rel H_n) through the three considered periods in both regions.

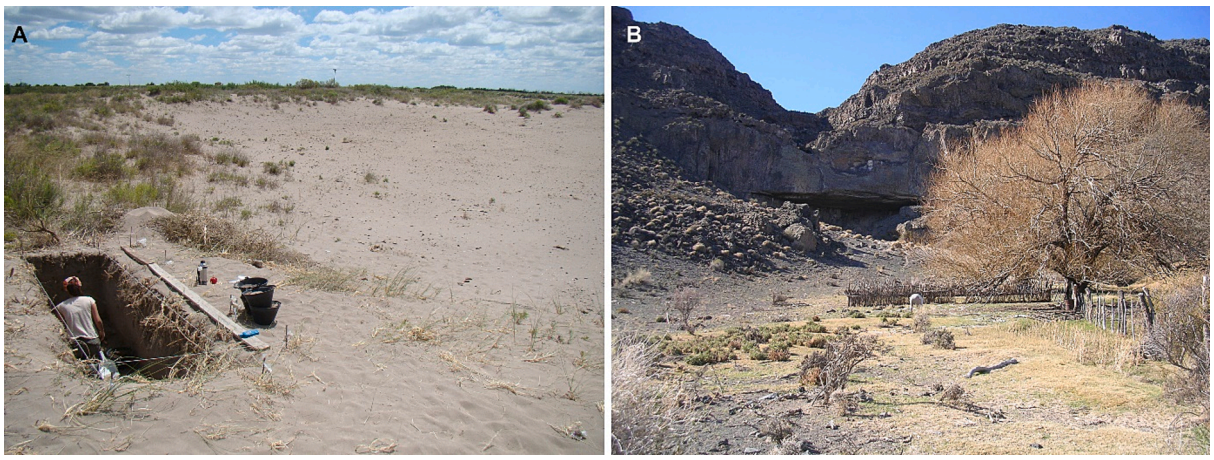


Fig. 5. Settings where Holocene ERES occur. A. La Modesta site in the Pampa-Patagonia transition. B. Campo Cerdá rockshelter in the middle course of the Chubut River. Courtesy: Cristina Bellelli.

5. Results

(a) Temporal and spatial distribution of South African EOES during the Holocene

Among the 133 South African studied EOES, 58 (44 %) correspond to the middle Holocene, 42 (31 %) to the initial late Holocene and 33 (25 %) to the final late Holocene. The total sample is widely dominated by lines (n = 83, 62 %), followed by bands (n = 22, 17 %), unidentified motifs (n = 16, 12 %), geometric figures (n = 7, 5 %) and dots (n = 5, 4 %). This distribution remains relatively constant throughout the three periods (Table 5).

Among the 15 subclasses defined for the analysis (Table 4), all except simple dots/dashes are present (n = 14). If the three periods are considered separately, 13 subclasses are represented in the middle Holocene, 11 in the initial late Holocene and 11 in the final late Holocene. Straight lines (especially hatched) are always the predominant motifs (Fig. 6). They are followed by different kinds of motifs according to the period considered. Zigzag lines, cross-hatched bands, hatched bands and curved lines tend to be among the most popular. The remaining subclasses of motifs are scarce.

The middle Holocene sample (from c. 6000 to c. 3300 years BP) comprises 58 EOES from nine sites situated in the Richertsveld, Sandveld, Knersvlakte, Southwest Coast and Kuruman Hills (Table 6). Among the 14 subclasses that represent the South African region, 13 are present in this period, with nine repeated in more than one zone and four only present in one zone. Composite infilled bands are the absent subclass (Table 7). The singularity and absence of certain motifs may be explained by the low frequencies of the subclasses, as is the case with dots, geometric figures (because breakage prevents their identification) and composite infilled bands. This distribution suggests that engraved ostrich eggshell water flasks circulated through mobility or exchange networks throughout almost 3000 years, although it is also possible that distant groups shared similar standards in their engraving practices. The average amount of information (H_n) expressed in the EOES from this period is 3.371, the index of uniformity (Rel H_n) is 0.575 and redundancy (1-Rel H_n) is 0.425.

The initial late Holocene sample (from c. 2700 BP to c. 1900 years BP) is composed of 42 EOES retrieved from nine sites. The spatial distribution of EOES during this period is more uneven than in the previous one, since sites with engraved fragments are more abundant in the Sandveld than in the Knersvlakte, Southwest Coast and Kuruman Hills (Table 6). Even though the number of sites bearing EOES remains constant with respect to the previous period, the number of EOES decreases. Eleven of the 14 South African subclasses are present in this period; eight of them are repeated in more than one zone and three occur only in one zone (Table 8). As in the middle Holocene, absent motifs (aligned dots, cross-hatched figures and hatched unidentified) and motifs which are only present in one zone (clustered dots, composite infilled bands and hatched bands) tend to be low frequency subclasses. Although two zones (the Richtersveld and Bushmanland) lack sites bearing EOES, perhaps because of sampling bias, the evidence suggests that engraved eggshell water flasks continued circulating through mobility and/or exchange networks throughout a further 800 years. Another possibility is that standard rules in the engraving practices were shared among different groups. The average amount of information (H_n) of EOES from this period is 3.183, the index of uniformity (Rel H_n) is 0.591 and redundancy (1-Rel H_n) is 0.409.

The final late Holocene sample (from c. 1500 years BP to recent times) is composed of 33 EOES from 13 sites. They are located in the Richtersveld, Sandveld, Knersvlakte, Bushmanland and Kuruman Hills (Table 6). Even though the number of sites bearing EOES increases during this period, which is expected in more recent contexts with better preservation, the actual number of EOES decreases. Eleven of the 14 South African subclasses are present in the period, among which six are repeated in more than one zone and five are only present in one zone (Table 9). The restriction of some motif subclasses to one zone (e.g., clustered dots, angular lines and cross-hatched figures) and the absence of other subclasses (aligned dots and composite infilled bands) may be explained by their low frequencies in the overall EOES sample. However, the more limited distribution of the most popular motifs (e.g., zigzag lines, curved lines and cross-hatched lines) suggests that their spatial circulation through mobility or exchange networks became more restricted or that standard rules in the engraving practices ceased to be shared widely (Table 9). Although the average amount of information (H_n) in EOES decreases to 2.892, the indices of uniformity (Rel H_n) (0.573) and redundancy (1-Rel H_n) (0.427) remain similar to those of the preceding period.

(b) Temporal and spatial distribution of South American ERES during the Holocene.

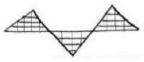
The South American sample is composed of 440 ERES of which 338 (77 %) correspond to the middle Holocene, 83 (19 %) to the initial late Holocene and 19 (4 %) to the final late Holocene. As in the South African case, lines are the most abundant motifs (n = 377, 86 %) in the total sample. However, the percentages for the remaining motifs (geometric figures: n = 31, 7 %, unidentified: n = 16, 4 %, bands: n = 15, 3 % and dashes: n = 1, 0,2%) are lower. This distribution changes in the final late Holocene, when the percentage of lines decreases and the percentage of bands increases (Table 10).

Among the 15 subclasses defined for the analysis (Table 4), all of them except aligned dots and clustered dots are present (n = 13). If the three periods are considered separately, 11 subclasses are represented in the middle Holocene, eight in the initial late Holocene and seven in the

Table 4
Typology for motifs engraved on ostrich and rhea eggshells.

Class	Subclass	Variant *	Example
1. Dots, dashes	A. simple	–	
	B. aligned	i. single line	
		ii. subparallel lines	
	C. clustered	i. simple	
		ii. combined with other elements	
2. Lines	A. straight	i. simple	
		ii. scattered	
		iii. hatched	
		iv. hatched intersecting	
		v. subparallel & perpendicular	
		vi. perpendicular	
	B. curved, wavy	i. simple	
		ii. subparallel	
		iii. subparallel and perpendicular	
	C. V, zigzag	i. simple	
		ii. subparallel	
		iii. subparallel intercalated	
		iv. on line	
		v. on line symmetric pattern	
		vi. on V line + subparallel	
		vii. on subparallel lines	
	D. angular	i. intersecting	
		ii. non-intersecting	
	E. cross-hatched	i. regular pattern	
		ii. irregular pattern	
3.Geometric Figures	A. hatched	i. identified shape	
		ii. identified shape in symmetric pattern	
		iii. unidentified shape	

Table 4 (*continued*)

Class	Subclass	Variant *	Example
	B. cross-hatched	i. identified shape	
		ii. identified shape in symmetric pattern	
		iii. unidentified shape	
4. Bands	A. hatched	i. simple	
		ii. subparallel	
		iii. subparallel attached	
		iv. in complex pattern	
	B. cross-hatched	i. simple	
		ii. subparallel	
		iii. subparallel attached	
		iv. in complex pattern	
	C. with composite infill	i. simple	
		ii. subparallel	
5. Unidentified	A. hatched	i. simple	
		ii. combined with other elements	
	B. cross-hatched	i. simple	
		ii. combined with other elements	

* Further variation is given by the combination of variants with other geometric elements. Variants also diverge in their orientation. Gray lines in unidentified motifs represent breaks.

final late Holocene. Straight lines (especially simple and hatched) are always the predominant motifs (Fig. 7). They are followed by cross-hatched lines in the middle and initial late Holocene and by hatched bands in the final late Holocene. The remaining subclasses of motifs are scarce.

Table 5
EOES motif class distribution along the mid Holocene (MH), initial late Holocene (ILH) and final late Holocene (FLH).

Motifs	n MH	%	n ILH	%	n FLH	%
Dots	3	5 %	1	2 %	1	3 %
Lines	35	60 %	28	67 %	20	61 %
Geometric Figures	4	7 %	2	5 %	1	3 %
Bands	9	16 %	9	21 %	6	18 %
Unidentified	7	12 %	2	5 %	5	15 %
Total	58	100 %	42	100 %	33	100 %

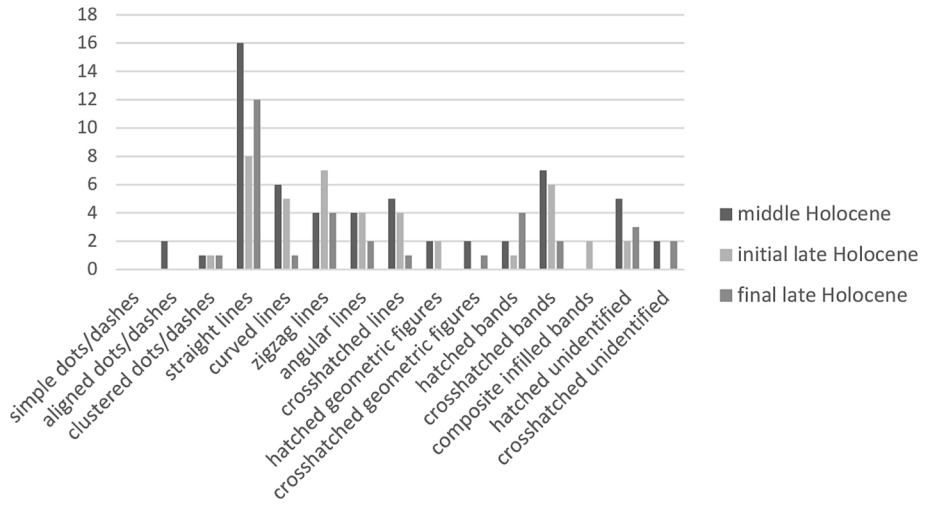


Fig. 6. EOES motif distribution across the mid Holocene, initial late Holocene and final late Holocene.

Table 6
EOES spatial distribution during the middle Holocene (MD), initial late Holocene (ILH) and final late Holocene (FLH).

Zones	N sites MH	N motifs MH	N sites ILH	N motifs ILH	N sites FLH	N motifs FLH
Ritchersveld	2	13 (22 %)	–	–	3	8 (24 %)
Sandveld	3	9 (16 %)	5	10 (23 %)	4	7 (21 %)
Knersvlakte	1	6 (10 %)	1	2 (7 %)	1	2 (6 %)
SW Coast	2	10 (17 %)	2	5 (12 %)	–	–
Bushmanland	–	–	–	–	4	5 (15 %)
Kuruman Hills	1	20 (34 %)	1	25 (58 %)	1	11 (33 %)
Total	9	58 (100 %)	9	42 (100 %)	13	33 (100 %)

The middle Holocene sample (from c. 6300 to c. 4600 years BP) is composed of 338 ERES from six sites situated on the Atlantic coast of North Patagonia, in the eastern Pampa-Patagonia transition and the Humid Pampa (Fig. 4 and Table 11). Among the 13 motif subclasses representing the southern South American region, 11 are present in the period, among which seven are repeated in more than one zone and four are only present in one zone (Table 12). Some motifs which are only present in one zone (e.g., curved lines) and all the absent motifs (simple dashes and composite infilled bands) are low frequency subclasses. Therefore, the middle Holocene distribution implies that engraved rhea eggshell water flasks circulated through mobility and/or exchange networks throughout more than 2000 years between Northeast Patagonia and the Humid Pampas. The pattern also suggests widely shared standard rules among distant populations. The ERES average amount of information (H_n) is 2.153, the index of uniformity (Rel H_n) is 0.256 and redundancy (1-Rel H_n) is 0.744.

The initial late Holocene sample (from c. 3100 BP to c. 1600 years BP) is composed of 83 ERES from four sites situated in the Atlantic coast of North Patagonia, the eastern Pampa-Patagonia transition and the middle Limay River basin (Table 11). Although the number of sites bearing ERES is slightly lower than in the previous period, the number of ERES is reduced to a quarter of that for the middle Holocene, which implies that the practice of engraving eggshell water flasks became less frequent. This situation is reflected in motif distribution, given that among the 13 southern South American subclasses, eight are present in the period. Two of them are repeated in more than one zone and six are only in one zone (Table 13). Shared motifs are the most abundant ones (e.g., straight lines and cross-hatched lines) and absent motifs (curved lines, angular lines, hatched geometric figures, composite infilled bands and hatched unidentified) are mostly low frequency subclasses. This distribution implies that standard rules continued to be shared in the image circulation on rhea eggshell flasks, restricted mainly to Northeast Patagonia and the Pampa-Patagonia transition. The ERES average amount of information (H_n) is 1.655. The indices of uniformity (Rel H_n = 0.259) and redundancy (1-Rel H_n = 0.741) show a low information content.

The final late Holocene sample (from c. 1500 years BP to recent times) is composed of 19 ERES from four sites. The distribution pattern is more dispersed, since sites are in the middle Negro River basin, middle Limay River basin, middle Chubut River basin and Humid/Dry Pampa ecotone (Table 11). The number of sites with ERES remains the same as in the previous period, although the number of ERES is considerably reduced. Seven of the 13 southern South American subclasses are represented in this period, among which one is repeated in more than one zone and six are only present in one zone (Table 14). The almost complete absence of ERES motif circulation during the final late Holocene is a consequence of the rarity of eggshell engraving practices, which is limited to small areas of the North Patagonian interior and the Humid/Dry Pampa ecotone. In this context, the average amount of information (H_n) of ERES is 2.353, the index of uniformity (Rel H_n = 0.553) increases respect to the previous period and redundancy (1-Rel H_n = 0.446) decreases.

6. Discussion

Because of the different timing of the cultural trajectories in Africa and South America, the incorporation of ostrich and rhea eggshells as material culture into hunter-gatherer social organization presents differences. Traditions of engraving ostrich eggshell are tens of thousands of years older in southern Africa than in southern South America, reflecting *Homo sapiens*' much longer presence there. Early examples include those from sites within the areas studied here, notably Diepkloof in the Southwest Coast region of South Africa where five distinct motifs have been identified on over 400 pieces of engraved eggshell from levels

Table 7
EOES motif distribution during the middle Holocene. Variants are indicated by Roman numerals.

Motif subclass	Richtersveld	Sandveld	Knersvlakte	SW Coast	Bushmanland	Kuruman Hills
1.B. aligned dots/dashes	–	–	–	–	–	i  ii 
1.C clustered dots/dashes	i 	–	–	–	–	–
2.A straight lines	iii  v 	i  iii 	iii.  i 	i.  iii.  v. 	–	iii 
2.B curved lines	ii. 	–	–	–	–	i.  ii.  iii. 
2.C V, X, zigzag	iv. 	vii.  iv. 	–	–	–	vii. 
2.D Angular lines	–	ii. 	i. 	ii. 	–	–
2.E cross-hatched lines	i. 	–	–	i. 	–	i. 
3.A hatched geometric figures	–	–	i.  ii. 	–	–	–
3.B cross-hatched geometric figures	–	i. 	–	i. 	–	–
4.A hatched bands	–	i. 	–	–	–	ii. 
4.B cross-hatched bands	i. 	i. 	–	–	–	iii. 

(*continued on next page*)

Table 7 (*continued*)

Motif subclass	Richtersveld	Sandveld	Knersvlakte	SW Coast	Bushmanland	Kuruman Hills
	ii. 					i.  iv. 
4.C Composite infilled bands	–	–	–	–	–	–
5.A hatched U/ID	i. 	i. 	i. 	–	–	ii. 
5.B cross-hatched U/ID	–	–	–	i.  ii. 	–	–

Sources for images: Richtersveld: Orton (2012), Orton and Halkett (2010); Sandveld: Orton (2012), Dewar (2008), Webley (2001); Knersvlakte: Orton (2012); SW Coast: Jerardino (1996), Jerardino et al. (2021); Kuruman Hills: Humphreys and Thackeray (1983).

assigned to the Howiesons Poort industry (Porraz et al., 2021). Although the precise meanings of the designs engraved by Middle Stone Age people on ostrich eggshell or ochre (e.g., Henshilwood et al., 2009) remain elusive, they are widely held to document symbolic thought and fully syntactical language from at least 100,000 years ago (Henshilwood and d'Errico, 2011). However, following the end of the Howiesons Poort Industry, whose most likely age is 66,000 to 58,000 years BP (Lombard et al., 2022), the parts of southern Africa explored in this article currently lack examples of EOES before the Holocene. The initial human peopling and colonization of southern South America occurred in the terminal Pleistocene at ca. 12,000 years BP (Borrero, 2016; Politis et al., 2016). However, the earliest evidence for the engraving of rhea eggshell flasks corresponds to the middle Holocene.

Characterizing the composition of the two regions' samples, we can state that the most popular motifs engraved on the South African ostrich eggshells are straight lines (mainly hatched), followed by zigzag lines, cross-hatched bands and curved lines. The southern South American engraved rhea eggshells are widely dominated by straight lines (mainly simple and hatched), followed in lower numbers by cross-hatched lines and geometric figures (hatched and cross-hatched). Rectangular and triangular shapes could be identified among the latter. Despite these differences in motif distribution, 12 of the 15 subclasses considered in Table 4 are shared by both continents. Exceptions are the different kinds of dots/dashes, whose frequencies are low, which are simple in South America and aligned or clustered in South Africa. Other subclasses, such as curved and zigzag lines, as well as hatched and cross-hatched bands, are more complex in EOES, where they tend to be organized in sub-parallel rows, whether alone or intercalated by other elements (Fig. 8 a-d). In South America, symmetric movements such as translation and rotation were most observed in hatched and cross-hatched geometric figures on ERES (Fig. 8 e-g).

As regards the temporal and spatial distribution of motifs, the main results in the South African case indicate that clustered dots, angular lines, straight lines, hatched bands, cross-hatched bands and cross-hatched unidentified motifs are represented throughout the middle Holocene, initial late Holocene and final late Holocene. Among these, straight lines and cross-hatched bands occurred in coastal Namaqualand, the Southwest Coast and the Northern Cape interior across all three periods. The general trend is one of a gradual decrease in the number of EOES over time and of a slight decrease in motif diversity and image circulation. However, the values of the index of uniformity (Rel H_n) remain relatively constant through the three periods (0,575, 0,591, 0,573). The practice of engraving eggshells, although less common, continued in recent times, when the ethnographic record documents their circulation through *hxaro* networks and hunter-gatherer foraging trips and residential mobility.

In the South American example, straight lines, zigzag lines, cross-hatched lines, cross-hatched geometric figures, hatched bands and cross-hatched bands are represented throughout the middle Holocene, initial late Holocene and final late Holocene. Motif distribution is widespread during the middle Holocene, when ERES was present from Northeast Patagonia to the Humid Pampas. During the initial late Holocene, it becomes restricted to Northeast Patagonia and the Pampa-Patagonia transition, with a weak expression in the middle Limay River basin, and during the final late Holocene it is dispersed through the interior of North Patagonia and the Dry Pampa. While there is a sharp decrease in the number of ERES over time, their information content expressed through the index of uniformity (Rel H_n) is low during the middle (0,256) and initial late (0,259) Holocene and increases in the final late Holocene (0,553). Thus, motifs were more redundant in the two former periods. Unlike South Africa, there is no ethnographic record about the use of eggshell flasks, whether decorated or not. However, their patterned distribution in the archaeological record, where fragments appear in camp sites and whole flasks are recovered in caches, shows that they were also immersed in hunter-gatherers' movements through the landscape.

We identify the following major patterns:

1. During the middle Holocene and initial late Holocene, the decoration of water flasks followed standard rules that were widely shared across different zones. However, EOES exhibit a higher information content (Rel H_n) than ERES.
2. The general trends indicate a gradual decrease of EOES and a sharp decrease of ERES with time.
3. EOES motif diversity, expressed through the number of subclasses that circulated, does not show major changes throughout the middle Holocene, initial late Holocene and final late Holocene.
4. ERES motif diversity, expressed in the number of subclasses that circulated, decreases over time.

These patterns lead to the following questions which need to be addressed in the context of the major socio-environmental changes that

Table 8
EOES motif distribution during the initial late Holocene. Variants are indicated by Roman numerals.

Motif subclass	Richtersveld	Sandveld	Knersvlakte	SW Coast	Bushmanland	Kuruman Hills
1.B aligned dots/dashes	–	–	–	–	–	–
1.C clustered dots/dashes	–	–	–	–	–	ii. 
2.A straight lines	–	iii. 	–	v. 	–	iii. 
2.B curved lines	–	ii. 	–	–	–	i.  ii. 
2.C V, X, zigzag lines	–	–	–	i. 	–	ii.  iii.  iv.  v.  vii. 
2.D angular lines	–	–	i. 	ii. 	–	ii. 
2.E cross-hatched lines	–	i.  ii. 	–	–	–	i. 
3.A hatched geometric figures	–	ii. 	ii. 	–	–	–
3.B cross-hatched geometric figures	–	–	–	–	–	–
4.A hatched bands	–	ii. 	–	–	–	–
4.B cross-hatched bands	–	–	–	i.  iv. 	–	i. 
4.C composite infilled bands	–	–	–	–	–	ii. 
5.A hatched U/ID	–	–	–	–	–	–
5.B cross-hatched U/ID	–	ii. 	–	–	–	i. 

Sources for images: Sandveld: Orton (2012), Dewar (2008), Webley (2001); Knersvlakte: Orton (2012); SW Coast: Jerardino (1996); Kuruman Hills: Humphreys and Thackeray (1983).

took place in the Holocene.

1. Why do the numbers of engraved eggshells reduce with time?
2. Why are motifs more redundant in southern South America than in southern Africa during the middle and initial late Holocene?
3. Why did the information content (Rel H_n) increase in southern South America during the final late Holocene and why did it remain relatively constant in South Africa?

The mid-Holocene and initial late Holocene archaeological records from Pampa and North Patagonia suggest open social networks through the widespread spatial distribution of objects, raw materials, and images (Martínez, 2017). For example, the exotic raw materials in the lithic assemblages of the eastern Pampa-Patagonia transition came from the Tandilia and Ventania ranges in the Humid Pampas (orthoquartzites, metaquartzites, quartz sandstones; 370–200 km distant from the sites), Del Fresco Plateau, El Carancho Lagoon and Bajos sin Salida in the Dry Pampas (siliceous chert and chert; ca. 450–80 km) and the Somuncurá Plateau and San Matías Gulf in Central-Northeastern Patagonia (translucent chalcedony; ca. 500–300 km away) (Martínez and Santos Valero,

Table 9
EOES motif distribution during the final late Holocene. Variants are indicated by Roman numerals.

Motif subclass	Richtersveld	Sandveld	Knersvlakte	SW Coast	Bushmanland	Kuruman Hills
1.B aligned dots/dashes	–	–	–	–	–	–
1.C clustered dots/dashes	–	–	–	–	–	ii. 
2.A straight lines	i.  ii. 	i.  ii. 	i. 	–	–	ii. 
2.B curved lines	ii. 	–	–	–	–	–
2.C V, X, zigzag lines	–	–	–	–	–	ii.  vii. 
2.D angular lines	–	–	ii. 	–	–	–
2.E cross-hatched lines	i. 	–	–	–	–	–
3.A hatched geometric figures	–	–	–	–	–	–
3.B cross-hatched geometric figures	–	i. 	–	–	–	–
4.A hatched bands	–	–	–	–	i.  ii. 	i.  ii. 
4.B cross-hatched bands	ii. 	ii. 	–	–	–	–
4.C composite infilled bands	–	–	–	–	–	–
5.A hatched U/ID	i. 	–	–	–	i. 	–
5.B cross-hatched U/ID	–	ii. 	–	–	i. 	–

Sources for images: Richtersveld: Orton (2012), Orton and Halkett (2010), Webley (1997); Sandveld: Orton (2012), Webley (2001); Knersvlakte: Orton (2012); Bushmanland: Orton and Parsons (2018); Kuruman Hills: Humphreys and Thackeray (1983).

2020). Furthermore, exotic raw materials recovered in the San Matías Gulf indicate distant sources ranging between 225 and 560 km, such as quartzites from the Humid Pampa and obsidians from the eastern edge of the Somuncurá plateau and Neuquén province (Alberti et al., 2016). Macroregional motif similarities in ERES covered almost the same area as the exotic lithic raw material circulation, which suggested the existence of exchange networks and/or shared engraving rules (Carden and Martínez, 2014; Martínez, 2017).

In such a context of open social networks, our expectation was to find a high information content in ERES. However, the analysis showed low Rel H_n values or, in other words, highly redundant engraved designs. It is possible that these results could be a product of sample bias, given that among the 338 mid Holocene motifs analyzed here, 75 % (n = 252) come from La Modesta and Loma de Los Morteros sites, which are 5 km apart in the lower Colorado River basin. Similarly, the initial Late Holocene assemblage (n = 83 motifs) is widely dominated by the evidence

Table 10
ERES motif class distribution during the middle Holocene (MH), initial late Holocene (ILH) and final late Holocene (FLH).

Motifs	n MH	%	n ILH	%	n FLH	%
Dots	0	0	1	1	0	0
Lines	290	86	76	92	11	58
Geometric figures	26	8	3	4	2	10
Bands	7	2	2	2	6	32
Unidentified	15	4	1	1	0	0
Total	338	100	83	100	19	100

from Bahía Final 10 and San Antonio Oeste sites, approximately 20 km from each other on the north coast of the San Matías Gulf. These sites include 74 motifs which equates to 89 % in the period (Table 11). Therefore, this tendency towards a low information content which is heavily influenced by the above-mentioned sites is most probably illustrating short-distance residential movements of closely related people more than long-distance exchange networks and visits. However, these results should not deny by any means the existence of motif circulation during these periods (through networks and/or shared stylistic rules), which is clearly evidenced by the similarities found in the ERES from the remaining areas (Tables 12 and 13).

Hunter-gatherers from the Pampas and North Patagonia have undergone a strong process of cultural change and reorganization since c. 1000 years BP (Berón, 2004; Favier Dubois et al., 2009; González, 2005; Loponte et al., 2002; Martínez et al., 2017; Politis, 2008; Quintana and Mazzanti 2014 and references cited therein). Increased human population, reduced mobility, greater territoriality, subsistence diversification and intensification, variations in local/exotic raw material acquisition and complex funerary practices are some of the most important changes that occurred. A process of regionalization operating on a widespread spatial scale that included both the Pampas and North Patagonia has been proposed from the archaeological record of the eastern Pampa-Patagonia transition (Martínez et al., 2017). Unlike the earlier periods, the final late Holocene saw relatively closed social networks in a scenario of social differentiation and more intense and competitive interaction networks. Regionalization produced the establishment of social boundaries and the emergence of territorial protocols that undoubtedly influenced interregional connections. As part of this process, the presence and spatial distribution of some archaeological items changed drastically in the eastern Pampa-Patagonia transition since 1000 BP, as illustrated by variations in the exotic lithic raw materials present. During the final Late Holocene, rocks from the Humid Pampas (e.g., quartzites) decreased in number or disappeared, while other exotic raw materials from North Patagonia (e.g., translucent chalcedony) increased. This pattern suggested social protocols related to the control of quarries and definition of territories where the access to lithic resources was socially regulated (Martínez and Santos Valero, 2020). As shown in this work, ERES virtually disappeared in most of the analyzed regions, with just a few isolated examples in the interior of North Patagonia and the Humid/Dry Pampa ecotone (Table 11). Even though engraving eggshells was becoming more occasional, motif information content expressed through Rel H_n increases. Unlike Hartley's model's predictions, this value is not interpreted as a product of exchange networks but as the result of a practice whose frequency had decreased considerably, and which became dispersed in distant spots of Pampa and North Patagonia. In such a context, information exchange through engraved eggshells is less expected.

What is most important for understanding the almost complete absence of ERES in the final Late Holocene archaeological record is the fact that rhea eggshell flasks ceased being used by hunter gatherers. The paleoclimatic information for the eastern Pampa-Patagonia transition and northeastern Patagonia is relevant for explaining this behavioral

Table 11
ERES distribution during the middle Holocene (MH), initial late Holocene (ILH) and final late Holocene (FLH).

Zone	N sites MH	N motifs MH	N sites ILH	N motifs ILH	N sites FLH	N motifs FLH
Atlantic North Patagonian Coast	1	82 (24 %)	2	74 (89 %)	–	–
Eastern Pampa-Patagonia transition	4	254 (75 %)	1	8 (10 %)	–	–
Middle Negro River	–	–	–	–	1	8
Middle Limay Limay River	–	–	1	1 (1 %)	1	9
Middle Chubut River	–	–	–	–	1	1
Humid Pampa	1	2 (1 %)	–	–	–	–
Humid/Dry Pampa	–	–	–	–	1	1
Total	6	338 (100 %)	4	83 (100 %)	4	19 (100 %)

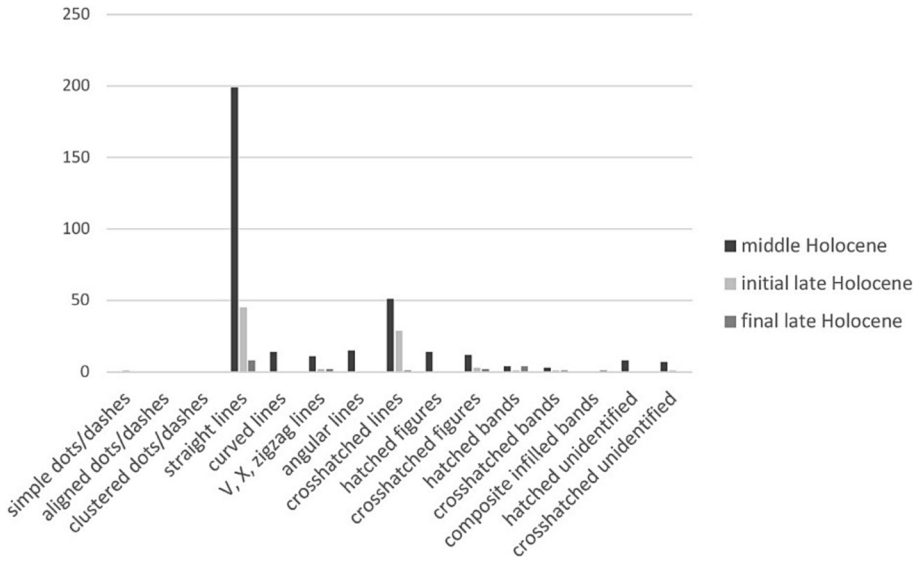


Fig. 7. ERES motif distribution across the mid Holocene, initial late Holocene and final late Holocene.

Table 12
ERES motif distribution during the middle Holocene. Variants are indicated by Roman numerals.

Motif subclass	Atlantic North Patagonian coast	East Pampa Patagonia transition	Humid Pampa
1.A simple dashes	–	–	–
2.A straight lines	i. ii. iii.	i. ii. iii. iv. v. vi.	–
2.B curved lines	–	i.	–
2.C V, X, zigzag	i.	i. ii. iv.	–
2.D angular lines	ii.	i. ii.	–
2.E cross-hatched lines	i.	i. ii.	i.
3.A hatched geometric figures	?	i. ii. iii.	–
3.B cross-hatched geometric figures	i.	i. ii. iii.	–
4.A hatched bands	?	i. iv.	–
4.B cross-hatched bands	?	i.	i.
4.C composite infilled bands	–	–	–
5.A hatched unidentified	?	i.	–
5.B cross-hatched unidentified	i.	i.	–

Sources for images: Fiore and Borella (2010); Álvarez et al. (2013).

change. The mid-Holocene, when ERES prevailed, was characterized by warm-arid conditions and intense aeolian morphodynamic processes, with a shift towards semi-arid conditions at the later part of the period (Schäbitz, 1994,2003). During the Late Holocene, isolated paleosols began to appear at c. 2000 years BP, and a paleosol with a broad areal distribution indicates environmental stability at c. 1000 years BP (Martínez et al., 2023). Thereafter, annual rainfall increased, causing higher fluvial discharge rates and lake expansion from which warm, humid, and more stable conditions are inferred (Schäbitz, 1994,2003; see discussion in Martínez et al., 2023). There may thus have been less need to use Rheidae eggs as water containers at this time.

The emergence/adoption of pottery in Pampa and North Patagonia, which became more popular after c. 2000 years ago, but mostly from 1000 BP (Di Prado, 2013,2015; González, 2005; Borges Vaz et al., 2016, among other), is another factor worth considering for understanding why eggshells were no longer engraved as frequently. In a context of reduced residential mobility, it is not expected that pottery as a water container should have replaced Rheidae eggs, for instance, in daily foraging trips. Surely other artifacts such as leather bags (Prates, 2009), would have played a role simultaneously with the use of eggshell flasks and after their disappearance as containers. Nevertheless, this technological innovation, besides acting as a new way of containing liquids (among other relevant functions), could also bear designs and, before firing, was far easier to decorate. Pottery thus probably became a more popular medium. Among the analyzed sites, the copresence of ERES and pottery sherds was registered in the upper layers of Casa de Piedra de Ortega (c.1400 and c. 300 years BP) and Campo Cerdá (c. 600 years BP) rockshelters, in northwestern Patagonia (Bellelli, 1994; Fernández 2001; Fernández and Ramos, 2008), and in Colforta 1 open site (c. 800 years BP), along the middle reaches of the Negro River (Mange, 2019). Although the use of rhea eggshell flasks became rare, the visual communication system formerly engraved on these fragile elements survived and circulated on pottery, stone plaques, and as rock art (Acevedo, 2015; Carden and Borges Vaz, 2017; Fiore and Borella, 2010; Fiore et al., 2021; Lynch et al., 2018).

Relative to the Pampas and North Patagonia, greater diversity is seen in South Africa in all three periods analyzed and the information content of the designs is also higher. This could be a consequence of the deeper temporality of the EOES, whose origin dates to the MSA, when they already displayed a significant motif diversity (Texier et al., 2013). Furthermore, this situation could imply that interaction networks were consistently more open and/or more extensive in western South Africa than in southern South America. The sample is in agreement with these results because EOES are always more evenly distributed across the different zones considered (Table 6). Conversely, during the middle and initial late Holocene, ERES are geographically concentrated between the

Table 13
ERES motif distribution during the initial late Holocene. Variants are indicated by Roman numerals.

Motif subclass	Atlantic North Patagonian coast	East Pampa Patagonia transition	Middle Limay River basin
1.A simple dots/ dashes	i. -	–	–
2.A straight lines	i. ii. iii.	ii. iv.	–
2.B curved lines	–	–	–
2.C V, X, zigzag	i.	–	–
2.D angular lines	–	–	–
2.E cross-hatched lines	i.	i. ii.	–
3.A hatched geometric figures	–	–	–
3.B cross-hatched geometric figures	i. ii.	–	–
4.A hatched bands	?	–	iv.
4.B cross-hatched bands	i.	–	–
4.C composite infilled bands	–	–	–
5.A hatched unidentified	–	–	–
5.B cross-hatched unidentified	–	i.	–

Sources for images: Fiore and Borella (2010), Fernández and Ramos (2008).

Table 14
ERES motif distribution during the final late Holocene. Variants are indicated by Roman numerals.

Motif subclass	Middle Negro River	Middle Limay River	Middle Chubut River	Dry/ Humid Pampa
1.A simple dots/ dashes	–	–	–	–
2.A straight lines	i. iii. iv.	?	–	–
2.B curved lines	–	–	–	–
2.C V, X, zigzag	–	i.	–	–
2.D angular lines	–	–	–	–
2.E cross-hatched lines	–	–	–	i.
3.A hatched geometric figures	–	–	–	–
3.B cross-hatched geometric figures	–	ii.	ii.	–
4.A hatched bands	–	i.	–	–
4.B cross-hatched bands	–	i.	–	–
4.C composite infilled bands	–	ii.	–	–
5.A hatched unidentified	–	–	–	–
5.B cross-hatched unidentified	–	–	–	–

Sources for images: Mange (2019), Fernández and Ramos (2008), Curtoni (2006). The middle Chubut River ERES was depicted from a photograph kindly shared by Cristina Bellelli.

northern coast of the San Matías Gulf and the eastern Pampa-Patagonia transition (Table 11). Obvious indicators of the extent of such networks in Southern Africa are the frequent presence of marine or estuarine shell ornaments at inland sites. Examples include a string of *Nassarius kraussianus* beads from the Roggeveld (175 km inland; Orton, 2023) and several other instances from relatively recent contexts associated with pottery at sites in southern Namibia (Wendt, 1972).

The South African record shows trends toward spatially more restricted designs and an overall reduction in the practice of engraving eggshell with time. This is particularly marked in the final late Holocene, i.e., the period from about 1500 years ago until European colonization. Unlike the southern South American example in which engraving and use of eggshell flasks almost ceased during the final Late Holocene and their use is not recorded after the Spanish occupation, in Namaqualand, the regular presence of flask mouths demonstrates that ostrich eggshell flasks continued in use, although engraving became less frequent, and motifs became simpler from c. 1000 years BP (Orton, 2012). Given that water is a critical resource in western Southern Africa and that the engraving of eggshell flasks that were cached in these dry landscapes could have worked as a visual communication system reducing the risks associated with water allocation and sharing, it is understandable that EOES were more frequent during the mid-Holocene Altithermal, when a warmer and drier climate prevailed compared to the following periods (Dewar and Orton, 2013).

Another relevant factor for explaining the decrease in eggshell engraving practices is the significant shift in regional subsistence

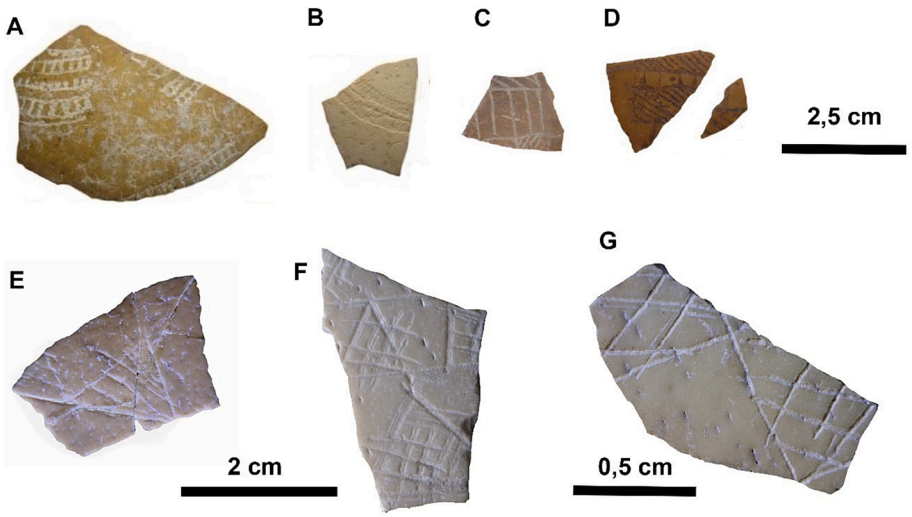


Fig. 8. A-B: EOES from Port Nolloth 2009/001, South Africa; C-D: EOES from Buzz Shelter, South Africa; E-G: ERES from Loma de los Morteros, Argentina.

strategies across much of western South Africa that began around 2000 years ago with the introduction of sheep and adoption (or possibly the innovation; Sadr and Sampson, 2006) of pottery. It is not clear whether cattle were also introduced to the region at the same time as sheep, but both domestic species occur in northern Botswana about 2000 BP (Robbins et al., 2005) and cattle were certainly present in Namaqualand 400–500 years after this (Orton et al., 2013). They reached areas closer to Cape Town by the end of the first millennium AD, but perhaps only became nutritionally significant as a source of dairy products even more recently (Klein and Cruz-Uribe, 1989; Sealy, 2010). While it is difficult to identify differences in material culture assemblages that can be neatly assigned to different populations (Orton, 2012; Sadr, 2014), at least some element of demic movement was probably associated with the initial introduction of livestock to the region, if not its spread within it (Güldemann, 2008; Smith, 2008).

The consequences of these changes for our data are twofold and parallel the evidence for regionalization and intensification which is much more strongly evident in the Argentine record. First, at least in principle, pottery provided a new way of transporting and storing liquids and it appears to have been widely used by both herders and by residual hunter-gatherer groups with little or no access to livestock (Sadr and Sampson, 2006; Sadr, 2008). However, ethnohistoric accounts and residue analyses suggest that ceramics were principally used to cook food, including meat, milk, and plants, or—at the coast—to render the fat of marine mammals. Milk was, it seems, rarely, if ever, stored in pots, but instead either consumed directly or kept in wooden, leather or basketry containers before being used (Copley et al., 2004; Hopper et al., 2023). Moreover, pots are heavier than eggshell containers and require people to invest considerably more effort in their manufacture, whereas eggs provide a significant source of food prior to their reuse as receptacles. A straightforward replacement, however partial, of ostrich eggshell containers by ceramics therefore seems dubious. EOES fragments, and flask mouths more generally, coexist with pottery sherds in contexts from Namaqualand and the Northern Cape's interior from c. 1400 years BP to post-contact times (Orton, 2012: Figure 6.20; Orton and Parsons, 2018; Rudner, 1971). Nevertheless, the fact that pots would have been highly visible in day-to-day activities and were certainly exchanged between individuals and groups (Bleek and Lloyd, 1911; cf. Kinahan, 2020 for Namibia) might have encouraged a shift toward decorating them rather than ostrich eggshell flasks. That said, decoration is by no means universal on the pottery found along the Southwest Coast, Namaqualand, or the Northern Cape (Sadr and Sampson, 2006) and nor is any direct transfer of designs from one medium to the other evident, although some similarities exist, for example in Namaqualand (Orton, 2012: Tables 6.3 and 6.4).

Potentially more relevant may have been the overall impact of pastoralist presence on the regional landscape. Unambiguous archaeological evidence for herder communities remains sparse and their numbers no doubt fluctuated considerably over time and space, presumably emphasizing better-watered regions and, especially in drier environments, periods when effective precipitation was higher rather than those when it was lower. Nevertheless, several tens of thousands of people practicing pastoralism as a way of life were present in western South Africa by the time the Dutch initiated their colonization of the Cape in 1652 (Deacon, 1984). By then hunter-gatherers had, in much of this area, likely been relegated to the more marginal, pastorally less desirable parts of the landscape (Parkington, 1984), their numbers perhaps further reduced by a degree of intermarriage with herder groups and/or adoption of livestock for their own use. Two consequences follow for our dataset; first, since ostrich eggshell containers are almost exclusively associated ethnographically with hunter-gatherers (Lander and Russell, 2020), reduced forager numbers should have resulted in fewer flasks. However, flask mouth fragments continue to be common in Late Holocene contexts showing that eggshell flasks remained in regular use. The problem lies in knowing which sites were deposited by which group. Notwithstanding the work of Smith et al. (1991), this remains a consistent challenge in southern African archaeology, especially on the West Coast (Orton, 2012). Second, and more interestingly, increasing pastoralist dominance of regional landscapes likely disrupted hunter-gatherer movements and exchange networks as well as creating new poles of attraction around which exchange could occur in the form of ties to herder camps (see Wadley, 1996 for a comparable discussion with respect to the impact of Bantu-speaking farmers on hunter-gatherers in another region of South Africa). If so, then reduced investment in items of potential exchange interest such as engraved eggshell containers might well be expected.

7. Conclusions

This work has compared two dry regions where hunter-gatherer groups used the eggs of large flightless birds to store and transport water. The comparison was focused on the designs engraved on the eggshell fragments remaining from these flasks to define trends in the motifs employed, their diversity and their spatial distribution throughout the middle and late Holocene. These patterns were evaluated in the socio-ecological contexts of the mobile societies, considering their social interaction networks and boundaries. Results show that both regions share 12 among 15 basic motifs. Even though the EOES and

ERES visual repertoires are similar, motif diversity and motif spatial distribution during the analyzed time periods present differences related to the particular social processes that took place in each region. EOES's higher diversity and higher information content could imply that interaction networks in western South Africa were more extensive than in southern South America. The decrease in eggshell engraving practices there is probably a consequence of the pastoralist presence from c. 2000 years BP, which had impacts on hunter-gatherer populations, their movements, and their exchange networks. Nevertheless, as ethnographic sources show, hunter-gatherers continued to use—and on occasions engrave—ostrich eggshells in the harshest deserts of Botswana and Namibia as a way of enabling them to successfully persist in challenging environments and, perhaps, of signaling their unique identity within a geopolitical landscape increasingly dominated by food-producing communities.

The Argentinean evidence shows that during the mid-Holocene eggshell water flasks, whether engraved or not, were used in the dune environments from Northeast Patagonia and the eastern Pampa-Patagonia transition, in the central dunefields of the Humid Pampa and in a riverine setting between the Tandilia and Ventania Ranges (Buenos Aires province). These practices decreased considerably during the late Holocene, when they became almost completely restricted to northeast Patagonia and the eastern Pampa-Patagonia transition, and virtually disappeared after c. 1000 years BP with a scattered pattern. The low information content during the mid-Holocene and initial late Holocene is likely to have been influenced by sample bias, and the Rel H_n increase registered for the final late Holocene is interpreted as the product of an occasional and dispersed ERES record. Paleoclimatic information suggests that eggshell flasks were used, transported and stored when dry conditions prevailed during the mid-Holocene, with ERES almost disappearing in the final Late Holocene archaeological record when eggshell water flasks fell into disuse. Whether the adoption of pottery during the late Holocene is relevant or not for explaining this change needs to be further explored. What is interesting, however, is that the geometric visual repertoire formerly expressed on eggshells survived and continued circulating, not only through ceramic vessels, but also through rock art and stone plaques.

The analyzed archaeological record shows that people consistently used ratite eggs as containers for much of the Holocene in both western South Africa and the Pampa-North Patagonia regions of Argentina. This long-term persistence is probably connected to the fact that pottery was a late development or introduction. Both areas show that the engraving of eggshell water flasks was more frequent during the mid-Holocene's drier climate. In these settings where water was undeniably a critical resource, motifs engraved on eggshells that were cached in the landscape may have provided information about the identity of the engravers and owners, thus strengthening social ties through regulating sharing practices. In this way, the engraved designs had an adaptive role in reducing the risk of dwelling in unpredictable environments (Gamble, 1982; Osborn, 1996). Contrary to the expectation of finding more evidence of visual communication and stylistic behavior in the Late Holocene contexts because of population growth, territoriality and better material preservation, both study cases show a decrease in the engraving of eggshell flasks along time. The difference is that, in southern South America, eggshell flasks almost ceased being used in the final late Holocene while in southern Africa they continued in use, although engraved less frequently. This fact likely explains the survival of the imagery on other media in the Pampas and North Patagonia while these kinds of motif similarities are less obvious on other southern African material culture.

Decoration of eggshell containers, though showing differences between the two continents in the specific motifs used and in the variability of the motifs employed, also took similar forms in Argentina and South Africa, with a clear preference for relatively simple combinations of lines and hatched or cross-hatched bands that probably reflects the limitations of a lithic-based engraving technology and the structure of the eggshell itself. However, the use of these linear patterns as artistic resources goes beyond the continents, periods and materials considered here, and also requires aesthetic (Morphy, 1989) and cognitive approaches to understand it as a widespread phenomenon that is hard-wired in the visual system through human evolution (Lewis-Williams and Dowson, 1988; Washburn, 1999; Watson, 2007,2008). We hope that this and the other conclusions drawn here from our preliminary investigation of one broadly similar aspect of the material culture used in two completely unconnected regions either side of the Atlantic Ocean demonstrates the value of thinking outside the conventional geographical/historical/linguistic boundaries that structure so much archaeological research. In conjunction with other efforts by ourselves and colleagues (e.g., Martínez and Mitchell, 2017) it is intended to encourage further attempts to develop a dialogue between the archaeologies, and archaeologists, of the drylands of the southern hemisphere.

CRediT authorship contribution statement

Natalia Carden: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Writing – original draft, Writing – review & editing. **Gustavo Martínez:** Conceptualization, Investigation, Resources, Writing – original draft, Writing – review & editing. **Peter Mitchell:** Conceptualization, Funding acquisition, Investigation, Project administration, Resources, Writing – original draft, Writing – review & editing. **Jayson Orton:** Conceptualization, Formal analysis, Investigation, Writing – original draft, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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