Modelling the earliest north-western dispersal of Mediterranean Impressed Wares: new dates and Bayesian chronological model

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 DOI: 10.4312/dp.44.4

ABSTRACT – *The authors attempt to specify the diffusion pattern of the Impressed-Ware Neolithic (Impresso-cardial complex, ICC), from south-eastern Italy onto the French Mediterranean coasts. Using ChronoModel® software, a Bayesian model was built with sets of dates obtained on well-contextualised, short-lived samples. The results highlight a clear tightening of the chronology in the so-called nuclear area (Apulia, Basilicata, Calabria) and a pioneer dispersal at record speed in the Tyrrhenian Basin. Moreover, they question the origins and initial developments of the Impressed-Wares techno-complex.*

KEY WORDS – *Italy; France; Neolithic; Impressed wares; Bayesian modelling*

Modeliranje najzgodnejše severno-zahodne širitve posod tipa Impresso v Sredozemlju: novi datumi in Bayesov kronološki model

IZVLEČEK – *Avtorji poskušajo definirati vzorec difuzije neolitskih posod tipa Impresso (kompleks Impresso-cardium, ang. kr. ICC) iz jugovzhodne Italije do sredozemske obale Francije. Bayesovo modeliranje je bilo postavljeno s pomočjo programske opreme ChronoModel® na podlagi serije datumov kratkoživih vzorcev iz dobro definiranih kontekstov. Rezultati kažejo jasno oženje kronologije na t. i. jedrnih območjih (Apulija, Bazilikata, Kalabrija) in pionirsko širitev z rekordno hitrostjo v Tirenskem morju. Avtorji prav tako opozorijo na težave pri interpretaciji začetkov in prvotnega razvoja tehno-kompleksa posod tipa Impresso.*

KLJUČNE BESEDE – *Italija; Francija; neolitik; posode tipa Impresso; Bayesovo modeliranje*

Issues

The western dispersal

Western Mediterranean Neolithisation processes are thought to have been supported by a polythetic complex defined as Impressed Wares or the Impresso-cardial complex (ICC). Its precise sources are still controversial, despite genetic evidence concerning animals, cereals as well as humans that now clearly inscribe it in the framework of a peopling movement, originating from the Eastern Mediterranean (*Hofmanová 2016*). Indeed, in terms of intensity, rhythms, routes and recombination, the scenario of this dispersal is still poorly known (*Binder, Guilaine 1999; Manen 2014*). ICC provides huge internal diversity within, for instance, pottery styles, which makes the visibility of interaction and evolution processes rather fuzzy (*Guilaine 2003*). Moreover, towards the West, the Eastern-Mediterranean Neolithic package lost many of its attributes, especially in the symbolic range, and the farther West we go, the greater is this loss (*Binder* et al. *2014*). This addresses the problem of a cultural or social drift and admixture that could be at the origin of such a declension of the Neolithic paradigm in the Western Mediterranean.

What could be at the origin of such apparent variability? On the one hand, as shown by its typical coastal impact, the north-western Mediterranean colonisation by Neolithic people was certainly based on maritime seafaring (*Bernabò Brea 1950*) or voyaging (*Ammerman 2013*), which is evidenced by the diffusion of the whole set of western Mediterranean obsidian sources, a diffusion that did not exist at all in the same area before the farmers' dispersal (*Ammerman, Polgase 1997; Binder* et al. *2012; Muntoni 2012; Pessina, Radi 2006; Tykot* et al. *2013*), and whose speed has been several times discussed (*Isern* et al. *2017; Zilhão 2001*). In addition, such movements could have been more or less erratic, and even from diverse origins. On the other hand, the evidence of the Late Mesolithic setting in a large part of the Franco-Italian area during the 7th millennium as well as a few Mesolithic radiocarbon dates from the first half of the 6th millennium (*e.g.*, in the Middle Rhône valley and in the Tosco-Emilian Apennine) could support the coexistence of groups of early farmers and late hunter-gatherers, which could be at the origin of several scenarios of admixture, with consequences in terms of cultural mosaic and biological diversity (*Binder 2013; Binder* et al. *2017; Franco 2011; Perrin, Binder 2014; Marchand, Perrin 2017*).

Building reliable datasets and chronicles

Comprehensive data are required to make this story clearer, including reliable radiocarbon chronicles from clear contexts, which is the topic of this paper.

Building reliable and accurate chronicles depends on the rules governing proof, the capacity to run a *quality approach*, which means outlining some basic and generally well-known premises for dating, *i.e.* to use only short-lived samples (abridged SLS) and to guarantee their association with well-defined events.

The earliest ICC settlements dated within such conditions are localised in Corfu (n = 1), in southern (n = 8) and central Italy (n = 3), in the Tuscan archipelago (n = 1), in Liguria and eastern Provence (n = 4), and Mediterranean Languedoc (n = 2). As a comparison, Dalmatia also provided nine ICC sites with reliable SLS-dates (*Forenbaher* et al. *2013; McClure* et al. *2014; Produg* et al. *2014*).

The south-eastern and central Italian settlements considered here are significant because of the stylistic variations of Impressa pottery, following Santo Tiné's periodisation (*Cipolloni Sampò* et al. *1999; Grifoni Cremonesi, Radi 1999; Tiné 1987*): *archaic*, with rather disorganised impressed decoration; *evolved* or Guadone, with structured impressed decoration; *recent*, with '*graffita dentellata*' and painted Lagano-da-Piede wares; a *final* phase, with Matera engraved and Masseria La Quercia painted styles.

For this study, we did not take into consideration the late dispersal towards the North along the Adriatic coast, and we omitted late SLS-dates from Molise (Monte Maulo) and Abruzzo (Fonti Rossi) (*Skeates 1994*). Likewise, among the southern Italian set of sites, late dates from Masseria Santa-Tecchia and Masseria Candelaro which pertain to the development of Red Painted *Figulina* Wares, mainly in the second half of the 6th millennium BCE (*Skeates 1994*), are not to be taken into account in our topic, which focuses on the Impressa aspects predating the mid-6th millennium BCE.

In Provence and Mediterranean Languedoc, ICC settlements display diverse pottery styles, marked by the importance of stab-and-drag, instrumental and pinched decoration, compared to the occurrence of shell impression, especially Cardium, which is very variable depending on the sites (approx. 50% at Pont de Roque-Haute as opposed to almost zero at Pendimoun). These Impressa aspects definitely predate the Franco-Iberian Cardial, a phase which develops during the second half of the 6th millennium, and even mainly the last third of it (*Binder* et al. *2017*).

Data from the major western Mediterranean islands is lacking. A significant number of Pre-Stentinello and Early Stentinello settlements, including Kronio style, is attested in Sicily, but with no SLS-dates published. No evidence of Impressa pottery sets is as yet provided in Sardinia, despite very early evidence of obsidian trade, such as at Peiro Signado (*Briois* et al. *2009*) and Arene Candide (*Ammerman, Polgase 1997*). Only one early date made on charcoal is known from Su Carroppu (*Lugliè 2014*), with uncertainties concerning the cultural attribution of the few sherds discovered. On the basis of pottery typology, a few Impressa indices, probably predating the Tyrrhenian Cardial, are now known in Corsica at Campu Stefanu (*Cesari* et al. *2014*) and at the Albertini rock-shelter (*Binder, Nonza-Micaelli 2016* and *forthcoming*) but not dated yet.

Data are critically lacking in Tuscany, Lazio and Campania. It has been thought that Late Mesolithic groups in the Tosco-Emilian and Ligurian Apennine were still settled during a part of the ICC dispersal and its early development; this is based on a few radiocarbon dates obtained from Castelnovian deposits, *e.g.*, at Lama Lite 2, US6, *c.* 5770–5640 cal BCE (6620±80 BP, Rome-394, charcoal) (*Castelletti* et al. *1994; Dini, Fioravanti 2011*) and Monte Frignone 2, US2, *c.* 5630–5480 cal BCE (6624±45 BP, LTL-2656A, charcoal) (*Dini, Fioravanti 2011*). In southern and central Tuscany, with the exception of new dates from Giglio Island discussed below, the available dates concern Cardial aspects from the Tuscan Archipelago (*Tozzi, Weiss 2001*) which are rather late in the perspective of this paper; in addition, no SLS-date are available for these contexts. In Lazio, the lacustrine settlement of La Marmotta displayed different early pottery assemblages, including Impressa, whose clustering is debatable, and which did not provide SLS-dates (*Fugazzola Delpino, Pessina 1999*).

The situation in Campania is very challenging, with very early dates associated with diverse Impressa aspects probably connected to Apulia via the Ofanto valley, *e.g.*, at Baselice (*Langella* et al. *2003*) and at La Starza d'Ariano Irpino (*Albore Livadie 2002*); unfortunately, the associated dates are suspected of suffering from the old-wood effect.

In total, a set of 17 sites offering 94 AMS dates (Fig. 1, Tab. 1) is considered here for a first appraisal of the earliest Neolithic dispersal from southern Italy and Corfu towards the North-West, using Bayesian modelling. Among these sites, when available, SLS-dates from the period immediately following (*i.e.* Red Painted Wares and Cardial) were used to provide constraints on the probabilities of the earlier dates. Controversial SLS-dates from Mesolithic Terragne (*Gorgoglione* et al. *1995*) are also discussed infra.

To build this database, all material potentially affected by the marine or fresh-water reservoir effect, *i.e.* shells, was rejected. We kept the few (n = 5) directly dated human remains available from Pendimoun (early Cardial levels; *Le Bras-Goude* et al. *2006*) and from Arma dell'Aquila (Impressa levels; *Biagi, Starnini 2016*), since stable isotopes indicate that none of them were questionable. Collagen samples from animal bones (n = 14), including mostly domestic remnants, are also considered with a small risk, as the feeding of livestock with marine products (*Balasse* et al. *2005*) was never evidenced in the region (*Le Bras-Goude* et al. *2006*).

Considering charcoal, we have selected 10 dates, after rejecting long-lived tree samples (*e.g.*, oak or juniper) whose anatomical characterisation (*e.g.*, twigs or last rings samples) was not explicit. However, we kept, with question marks, a series of six unspecified charcoal samples from Trasanello due to the close connection of this site with Trasano. In addition, one date from Monochrome Sidari obtained on oak charcoal was used to constrain successive impressa deposits at this site. We also considered 58 dates from charred fruits and seeds, and primarily cereals, including husk.

We used Bayesian statistics through ChronoModel® software, version 1.5 (*Lanos, Philippe 2015a; 2015b; Lanos* et al. *2015*) and IntCal13 ^{14}C curve (*Reimer* et al. *2013*) to model each site separately.

Similar methods have been classically applied using OxCal, for example, for the whole of Northern Italy (*Pearce 2013*) with consistent results at the general level, albeit with limited relevance due to the random intrinsic quality and stratigraphic accuracy of the samples.

ChronoModel software is based on the Bayesian event date model, which is aimed at estimating the date of a target event (*Dean 1978*) from the combination of individual dates derived from relevant dated events. This model has a hierarchical structure, which makes it possible to distinguish between a target event date (any date of interest for the archaeologist) and dates of events (artefacts) dated by chronometric methods, typo-chronology or historical documents. One assumes that these artefacts are all contemporaneous, which is relevant to the date of the target event. On the other hand, the dates can be affected by irreducible errors, hence the possible presence of outliers. To take into account these errors, the discrepancy between the chronometric dates and the target date is modelled by an individual variance, which allows the model to be robust to outliers, in the sense that individual variances act as outlier penalisation (*Lanos, Philippe 2015a; 2015b*). Thanks to this modelling, it is not necessary to discard outliers because the posterior (in the Ba-

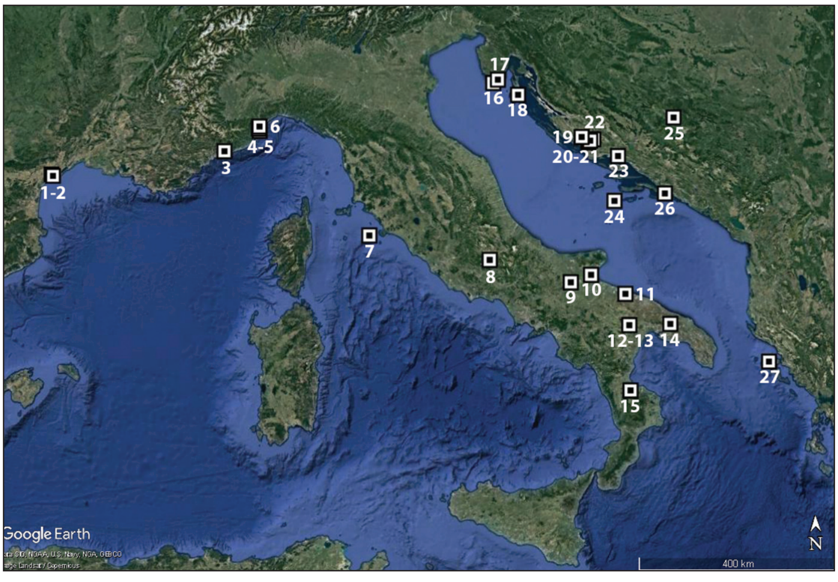


Fig. 1. Earliest Central and Western Mediterranean Impressed Wares sites dated with short-lived samples: 1 Portiragnes – Peiro Signado; 2 Portiragnes – Pont de Roque-Haute; 3 Castellar – Pendimoun; 4 Finale-Ligure – Arene Candide; 5 Finale Ligure – San Sebastiano di Perti; 6 Orco Feglino – Arma dell'Aquila; 7 Giglio Island – Le Secche; 8 Ortucchio – Colle Santo Stefano; 9 Lucera – Ripatetta; 10 Manfredonia – Coppa Nevigata; 11 Molfetta – Pulo; 12 Matera – Trasano; 13 Matera – Trasanello; 14 Ostuni – Sant'Angelo; 15 Corigliano Calabro – Favella della Corte; 16 Vižula – Medulin; 17 Ližnjan – Kargadur; 18 Lošinj Island – Vela Špilja; 19 Rašinovac; 20 Drniš – Pokrovnik; 21 Šibenik – Konjevrate; 22 Mirlović – Škarin Samograd; 23 Zemunica; 24 Orebić – Nakovana; 25 Kakanj – Obre; 26 Sušac Island; 27 Corfu – Sidari.

yesian sense) high values of the individual variances will automatically penalise their contributions to the estimate of event date.

Stratigraphic constraints, when available, are applied between event dates. Note that there is often only one chronometric date per target event date. Consequently, modelling makes sense only if there are order constraints between the event dates.

In ChronoModel, a phase is defined as a group of target event dates, with no statistical model. The group of events may belong either to a 'stratigraphic' phase defined as a group of ordered contexts, or to a 'chronological' phase defined as a set of contexts built on the basis of, inter alia, archaeological, architectural, geological, environmental criteria. In practice, a 'context' is defined by the nature of the stratification at a site, and the excavation approach used by the archaeologist. Together, these two phases determine the smallest units of space and time (*i.e.* the context) that can be identified in the stratigraphic record at an archaeological site. Some target events are then dated in these contexts.

We estimate the beginning, end and duration of a phase directly from the group of target dates, without adding any supplementary parametrisation.

Within 'multi-phase' sites, each chronological or cultural phase can include distinct clusters of stratigraphic units (Fig. 2) that could have been defined by spatial criteria, or in some cases, by the subdivision of a single phase deposits in distinct features directly (*i.e.* successive) or indirectly connected (*e.g.*, covered by deposits from the following phase); in addition a single feature (*e.g.*, stratigraphic unit) can provide one or several dates.

Within 'mono-phase' sites which display several features, constraints can be applied based on their relative chronology (*e.g.*, overlapping) or their internal stratigraphic subdivisions; each one of the so-called events can provide one or several dates.

A few 'mono-phase' sites provide several available dates which are not connected as yet to defined features with an explicit relative chronology. In such cases, the different dates are considered as potentially different events included in a single phase.

For this paper, each site was modelled separately. As a result, the dates *a posteriori* for a multi-phase or mono-phase site are totally independent of those obtained from the others sites.

Each phase modelling is based on three runs of Markov's chains of 10 000 iterations each. In order to compare the modelled phases, we calculated the probabilities of anteriority for each phase's beginnings compared to the others. For each couple of phase beginnings [ΦA≤ΦB], the distance is expressed as a percentage of the number of agreements (If $A_i \leq B_i$ then agreement = 1, otherwise agreement = 0 for each iteration i). The phase classifications using these anteriority probabilities and using the modes *a posteriori* (MAP) are similar, since the boundary distributions are mono-modal. This indicates that the MAP are very good *representations* of the relative position of the modelled boundaries of the different sites and phases (BMAP for the beginning and EMAP for the end of the considered phase). In this perspective, we assume that such representations are concepts, not values.

Southern sites and samples

The south-eastern dataset taken into consideration for this paper is composed of nine sites from the Ionian Islands, Apulia, Basilicata, Calabria and Abruzzo. It includes three multiphase sites (Pulo di Molfetta, Trasano and Trasanello), two mono-phase sites with several events (Coppa Nevigata and Favella della

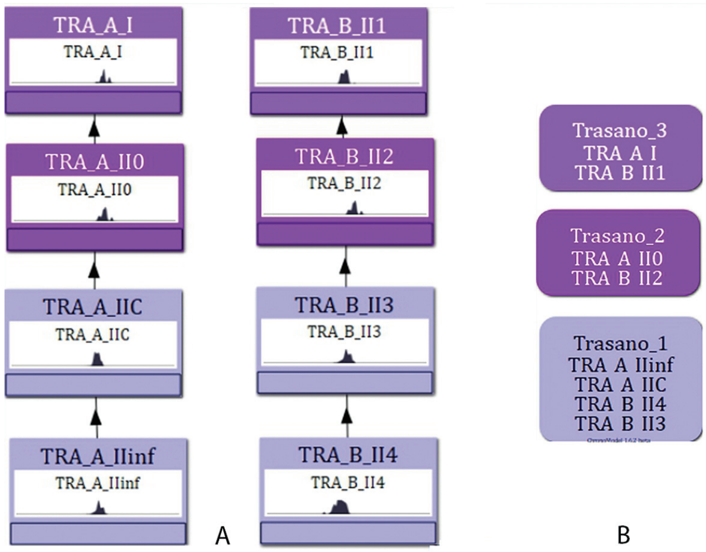


Fig. 2. Example of events (A) and phases (B) diagrams at Trasano (ChronoModel 1.5). Arrows indicate the stratigraphic constraints applied to the successive events; no constraints are applied between phases which are defined on stylistic criteria.

Corte), two sites where single Impressa events within multiphase sites were SLS-dated (Ripatetta and Colle Santo Stefano) and two settlements with single SLS-dates from multiphase contexts (Sidari and Sant'Angelo di Ostuni). For the final discussion we also took into account the Pokrovnik series in Dalmatia, which offers a set of 12 SLS-dates for the stratified Impressa and Danilo deposits (*McClure* et al. *2014; Produg* et al. *on line*).

At *Sidari* (Corfu), rescue excavations organised in 2004 provided a new stratigraphic record of the Holocene sequence (*Berger* et al. *2014; Sordinas 1967*).

Above Mesolithic deposits which were partly reworked during the first half of the 7th millennium, the Neolithic 'Monochrome', Phase 1 (US4a-b and pits F1 and F2), can be placed during the second half of the 7th millennium at the earliest, thanks to seven AMS dates on oak charcoal. Neolithic Impressa, Phase 2 (US5b-c), provided a single SLS-date (one event). The more recent date from Phase 1 can be usefully considered as a *terminus post quem* for constraining the beginning of Phase 2.

At the village of Pulo di Molfetta (Apulia), the excavation of Trench 3 in 1997–1999 allowed the recognition of three successive phases within the Neolithic deposits (*Fiorentino* et al. *2013; Muntoni 2003; 2009, Radina 2005*). Phases I (US10 with two SLS-dates available, US14 and 19) and II (US2 and 4) both belong to archaic Impressa, while Phase III (US9 and 17) belongs to the Serra d'Alto Culture (5th millennium). The further extension of Trench 3 in 2001, 2004 and 2007–2008 allowed the connection of US46 to Phase I and, directly above it, of US49 to Phase II, each with one SLS-date available.

The Sant'Angelo cave (Ostuni, Apulia), known since the 1930s for the tremendous richness of its pottery deposits, was re-excavated in 1984 (*Coppola 2001*). Two SLS-dates are available from Level 9 (evolved Impressa, *i.e.* Guadone) and Levels 6–7 (late Impressa, *i.e.* Masseria La Quercia).

The enclosed village of Ripatetta (Apulia) was excavated between 1982 and 1992. Inside the ditch enclosure, a rectangular wattle-and-daub building was identified in sector A, while a wide rectangular cobble-paved area was identified within sector B. The latter are related to the evolved Impressa, *i.e.* Guadone, with unusual painted and red-slipped pots; they predate deposits from recent Impressa linked to the Lagnano-da-Piede style, which are not SLS-dated as yet (*Costantini, Stancanelli 1994; Tozzi 2002; Tozzi, Verola 1991*). From two distinct parts of area B, three SLS-dates are available, clustered as two distinct events within the same phase.

Coppa Nevigata (Apulia) was considered an archetype of the archaic Impressa style, with closely paralleling pottery assemblages from Tremiti Islands and Pulo di Molfetta (*Cassano, Manfredini 1987*). Samples from Phase II-III provided a couple of SLS-dates, both belonging to the archaic Impressa phase and considered as distinct events within a single phase.

The site at Terragne (Apulia), excavated by M. Gorgoglione in 1985–1991, yielded a Neolithic deposit attributed to the evolved and final Impressa (US3) above a layer devoid of pottery and whose lithic series suggested a Late Mesolithic occupation (US4-5). The latter could be currently the sole Late Mesolithic settlement from southern Italy providing SLS-dates (*Gorgoglione* et al. *1995*); those two samples from wild fauna collagen are included as distinct events in a single phase, although their attribution to the Mesolithic is controversial.

Trasano (Basilicata), excavated by Jean Guilaine and Giuliano Cremonesi between 1984 and 1991, is a key enclosed village providing a clear succession of the three Impressa aspects: archaic, evolved and recent (*Angeli 2012; Guilaine, Cremonesi 1987; Radi* et al. *2000*).

Following a first set of dates with large standard errors, and the implementation of alternative methods to radiocarbon (*e.g., Vartanian* et al. *2000*), new AMS dates were obtained from sectors A and B. Within each one, four SLS-dates were obtained, as yet unpublished: Sector A: archaic (C2inf beneath C2c), evolved (C2.0) and recent (C1); Sector B: archaic (C2.4 beneath C2.3), evolved (C2.2) and recent (C2.1).

At Trasanello Cementificio (Basilicata), at approx. 1200m from Trasano, detailed stratigraphy has been recorded within Trench 11 in 2011 (*Angeli 2012*). A final Impressa occupation (US5 with four dates corresponding to different contemporary contexts) predates the Red Painted Wares (US3 with two superposed dated samples). Although unspecified charcoal was used, these dates, as yet unpublished, were taken into account in this paper regarding their connection with recent Impressa at Trasano.

Favella della Corte (Calabria) is a remarkable village, excavated from 1990 to 2002. The settlement, dated to the archaic phase, has a large set of pits considered as mono-phase, with partly staggered multi-events. Pottery analysis suggests a slight evolution of the archaic assemblages from structures A and D towards structures E and G (*Tiné 2009*). From this site, six SLS-dates are available from Structure A (middle part of Pit Z, US4), Structure D (bottom and top of Pit Y, US4), Structure E (Pit 30, US4, predating Pit T, US3) and Structure G (Pit 10, US3).

The village of Colle Santo Stefano (Abruzzo) offers multiphase stratigraphy covering the evolved Impressa aspects. This designates the site as the first pioneer settlement to be identified so far in Central Italy that was connected with the evolved Guadone aspects from the South-East. The earliest occupation is characterised by a cobble-paved area (US17) and the successive episodes (US8 and US3) provide diverse dated features (*Fabbri* et al. *2011; Radi* et al. *2001*). A set of eight overlapping dates on charcoal suggested less than four centuries for the whole occupation. A couple of new SLS-dates were run on samples from the same event within the earliest deposits.

North-western sites and samples

The north-western dataset is composed of two multiphase sites (Arene Candide and Pendimoun), one multi-event within the deposits of a mono-phase site (Pont de Roque-Haute) and one mono-phase site for which no distinct events have been recorded (Peiro Signado).

In addition, three sites are useful for the final discussion, although they provided SLS-dates which are not strictly connected to stratigraphic series and/or to stylistic phases (Le Secche, San Sebastiano di Perti and Arma dell'Aquila).

At Le Secche (Giglio Island, Tuscan archipelago), a thick deposit with abundant pottery and lithic series filled a narrow joint in a context of typical eroded granite 'marbles'. The Impressa pottery assemblage consists mainly of sherds offering parallels with the south-eastern archaic style, and a smaller set of later remains (*e.g.*, probably later Cardial, Linear pottery and Diana sherds) (*Brandaglia 1991; 2002*).

In 2016, new sampling of in situ deposits allowed AMS dating. Unfortunately, the samples were not found in a stratigraphic context and the three SLS-dates have to be included within a single generic cluster.

The vast cave of Arene Candide (western Liguria) is well known for its extended stratigraphic record of Upper Palaeolithic and Neolithic settlement (*Branch* et al. *2014; Maggi 1997a*). For various reasons – mainly the excavation of extended stratigraphic units lying over wide areas – the ICC periodisation from Bernabò Brea's and Tiné's operations has been debated since vertical movements of pottery were observed in different sectors of the site (*Biagi, Starnini 2016; Del Lucchese, Starnini 2010; Maggi 1997b*). The Neolithic chronology has improved thanks to new fieldwork adjacent to Tiné's operation carried out in 1997 (*Binder, Maggi 2001*), 2002 and more intensively in 2012 (*Arobba* et al. *2017*); both operations provided accurate stratigraphic control and recording.

Within Maggi's 1997–2002 sector, Impressa was found in two successive units (US10 and 10A with four SLS-dates under US.9Bbase with one SLS-date) and predating the Cardial deposits (US9B with one SLS-date). Within the 2012 area, R. Maggi, C. Panelli and S. Rossi clustered the ICC deposits into nine sets; among them, Impressa was associated with Phase AC1 at the bottom (from sets 2 to 4 including, US360 at the bottom, US347, US351A and US330 at the top, with four SLS-dates); early Cardial aspects define Phase AC2 (from sets 5 to 7, including US312, with two SLS-dates). In addition, a date has been obtained for the charred remains included in a typical Cardial pot from Phase AC2, with refitted sherds from set 6 and from Layer 26 of Bernabò Brea's excavations (*Arobba* et al. *2017*).

At San Sebastiano di Perti (western Liguria) in 1992, a deposit preserved on a small terrace produced a sherd set that included diverse types of Impressed wares and charred seeds (*Biagi, Starnini 2016; Capelli* et al. *2006; Starnini, Vicino 1993*). From this unique layer, three SLS-dates are to be considered as distinct events clustered in a single generic set.

Arma dell'Aquila (western Liguria), excavated in 1938–1942 by C. Richard, revealed a set of burials and human remains in a context where diverse Neolithic aspects were identified, which included Impressed wares (*Biagi, Starnini 2016*). Two skull fragments, from a child burial and from Layer 7, respectively, provided SLS-dates, here considered as distinct events included in a single generic phase.

Pendimoun (eastern Provence) is a large rock-shelter whose stratigraphy recorded a large part of the Neolithic period. Taking advantage of the preliminary results obtained in 1985–1992 (*Binder* et al. *1993*), more extended excavations were organised in 1998–2006 in both the northern and southern sectors, separated by the trench dug in the 1950s (*Battentier* et al. *2015; Binder, Sénépart 2010*).

Within the northern sector, the Impressa set encompasses several stratigraphic units and features of small size (including nine SLS-dates from five events: US2067, 41678, 47800 and 47801) which predate early Cardial units (including 10 SLS-dates from seven events: burials F1 and H2, US18364, 19 000, 19 001 and 42 370); US47799 is a technical unit situated at the interface between Impressa (#47 889) and Cardial (#48 256) phases. Within the southern sector, the Impressa set also contains several units (including four SLS-dates from four events: US5711, 28 889, 29 203 and base of US28 781#28 905) which also predate the early Cardial units (including two SLS-dates from two events: burial F1 and the top of US28 781#28 898). Current research is focused on the correlation of both sectors, since Impressa pottery assemblages differ slightly from one to another.

Pont de Roque-Haute (Mediterranean Languedoc) is a small open-air settlement with ten pits of different shapes. The consistent pottery assemblage is considered as mono-phase and, on the basis of its parallels with Le Secche, linked to the south-eastern Italian tradition (*Guilaine* et al. *2007*). A set of five SLS-dates from pit F1, which is the richest, is here clustered into two successive events (two from F1 base and three from F1) belonging to a single phase.

Peiro Signado (Mediterranean Languedoc), excavated in 1978 and 1996–1997, yielded the remains of an oval building and a set of adjacent pits (*Briois, Manen 2009; Briois* et al. *2009; Roudil, Soulier 1981*). As yet, the extremely abundant pottery assemblage associated with the archaeological features is considered as belonging to a unique phase. Then the two available SLS-samples are here clustered as distinct events within a single phase.

Modelling results and interpretations

The early southern and central Italian chronology (Tabs. 2, 3 and 4, Fig. 3)

The probability of Favella's beginning to predate Pulo's is very weak (53%). The modelled dates from both sites indicate that the Archaic Impressa stage could have begun during the second half of the 60th century (BMAP: 5918 and 5953 BCE respectively) and slightly post-date the earliest southern Dalmatian Impressa, *e.g.*, from Pokrovnik (BMAP: 5978 BCE).

The two SLS-dates obtained for Terragne-US4-5 (BMAP: 6138 BCE; EMAP: 5804 BCE) are not accurate enough to support a secure Late Mesolithic attribution.

The single Impressa date from Sidari-5cd (event_HPD: 6191–5885 BCE) could be placed over these boundaries, as the previous Monochrome phase Sidari-4 seems so far to have developed until the end of the 7th millennium (event_HPD: 6557–6019 BCE).

Trasano 1 and Coppa Nevigata settlements seem to have begun a century later (BMAP: 5823 and 5810 BCE, respectively). The whole dataset indicates that the archaic phase could have lasted three centuries, until the very beginning of the 57th century (EMAP: from 5704 to 5682). These results give us an idea of an internal periodisation of the archaic stage. Furthermore, the marked differences observed between Trasano 1, where tool impressions predominate (*c.* 65%), and Favella, where finger and nail impressions predominate (42%), support the idea of different stylistic traditions within the archaic stage. Nevertheless, as already suggested by Elena Natali and Vincenzo Tiné (*Tiné 2009*), our modelling does not support the idea of an internal evolution from one sector of the site to the other.

New modelled dates of Ripatetta confirm that the evolved Impressa, *i.e.* the Guadone style, clearly overlap the second part of the archaic phase (BMAP: 5841 BCE). The precocity of the Guadone aspect at Ripatteta illustrates the huge variability of pottery production during the 59th and 58th centuries in a rather small area; this raises new issues on the social origin of such discrepancies and, moreover, the increasing role of crafts and workshops. The single event dated at Sant'Angelo and its debated pottery assemblage providing both archaic and evolved aspects could have taken place in such a context.

The modelled dates highlight the very good seriation of archaic, evolved and recent stages of the Impressa in the Basilicata, at Trasano, during three centuries, until the end of the 56th (EMAP: 5588 BCE). Here the evolved and recent phases seem brief, approximately one century. Nevertheless, the earliest

Event (n-dates)	e_HPD (95%)	e_MAP	Event (n-dates)	e_HPD (95%)	e_MAP
Terragne_US4-5#2 (1)	[–6132; –5510]	–5803	Trasano_B_II3 (1)	[–5823; –5649]	–5721
Terragne_US4-5#1 (1)	[–6398; –5857]	–6137	Trasano_A_IIC (1)	[–5756; –5633]	–5691
Sidari_Fo4 (1)	[–6557; –6019]	–6250	Trasano_B_II4 (1)	[–6006; –5705]	–5821
Sidari_Hearth5b-5c (1)	[–6191; –5885]	–6033	Trasano_A_IIinf (1)	[–5884; –5665]	–5733
Pulo_II_US49 (1)	[–5695; –5424]	–5579	Trasanello_US3sup (1)	[–5431; –5083]	–5269
Pulo_Isup_US46 (1)	[–5824; –5554]	–5682	Trasanello_US3inf (1)	[–5585; –5368]	–5510
Pulo_Iinf_US10 (2)	[–6078; –5790]	–5953	Trasanello_US5_Foss (1)	[–5711; –5461]	–5578
S. Angelo_T6-7 (1)	[–5729; –5242]	–5502	Trasanello_US5_C4 (1)	[–5716; –5473]	–5587
S. Angelo_T9 (1)	[–6151; –5599]	–5861	Trasanello_US5_B3 (1)	[–5757; –5495]	–5607
Ripatetta_Acciottolato_C9 (1)	[–6049; –5521]	–5769	Trasanello_US5_cv (1)	[–5722; –5477]	–5585
Ripatetta_Acciottolato_IM30 (2)	[–5949; –5715]	–5812	Favella_StrE_FoT-US3 (1)	[–5963; –5435]	–5755
Coppa Nevigata_II-III_#A (1)	[–6083; –5458]	–5740	Favella_StrG-Fo10-US3-VI (1)	[–6150; –5625]	–5889
Coppa Nevigata_II-III_#B (1)	[–6124; –5425]	–5767	Favella_StrD-FoY-US4-II (1)	[–5790; –5568]	–5680
Trasano_B_II1 (1)	[–5718; –5489]	–5638	Favella_StrA-FoZ-US4-VI (1)	[–6070; –5549]	–5793
Trasano_A_I (1)	[–5683; –5464]	–5620	Favella_StrE-Fo30-US4-II (1)	[–6080; –5652]	–5823
Trasano_B_II2 (1)	[–5743; –5591]	–5663	Favella_StdD-FoY-US4-XIII (1)	[–6004; –5682]	–5820
Trasano_A_IIo (1)	[–5713; –5575]	–5646	Colle-S.Stefano_17 (2)	[–5750; –5616]	–5683

Tab. 2. Modelled events (from Table 1) of southern and central Italian ICC. The number of associated dates for each event is indicated in brackets: e_HPD (95%), i.e. ***the event's highest posterior density interval at 95% confidence; e_MAP, event's posterior mode.***

deposits from Trasanello 1 (BMAP: 5629 BCE; EMAP: 5542 BCE), attributed to the final phase and predating the development of Red Painted Wares, slightly overlap Trasano 3, which raises questions about possible old-wood effect.

The place occupied by the Stentinello aspects is still challenging due to the lack of SLS-dates and stratigraphic seriations, in Sicily and Calabria as well. The single date from Piana di Curinga was obtained from an excellent context on a pole from the wattle-and-daub house H, but with a possible old-wood effect (*Ammerman* et al. *1988*).

Thanks to a single event dated at Colle Santo Stefano (e_HPD: 5750–5616 BCE), the modelling confirms that Neolithic diffusion towards Central Italy is rather late, between the mid-58th and the very end of the 57th century, contemporary with the end of Ripatetta's evolved Impressa and the beginning of evolved Impressa aspects at Trasano 2. However, additional SLS-dates from the successive phases recorded at Colle Santo Stefano are necessary for a better understanding of the regional trend and the transition to the latest aspects of Medio-Adriatic Impressa during the second part of the 6th millennium.

Phase (n–events, n–dates)	D_HPD (95%)	D_MAP	B_HPD (95%)	B_MAP	E_HPD (95%)	E_MAP
Terragne_Late Mesolithic ? (2, 2)	[1; 626]	327	[–6398; –5875]	–6138	[–6108; –5530]	–5804
Pulo–1_Archaic–Imp (2, 3)	[50; 441]	257	[–6078; –5790]	–5953	[–5824; –5554]	–5682
Favella_Archaic–Imp (6, 6)	[87; 705]	248	[–6205; –5792]	–5918	[–5776; –5383]	–5669
Favella_2_Archaic–Imp (2, 2)	[0; 505]	107	[–6123; –5685]	–5890	[–5930; –5428]	–5753
Favella_1_Archaic–Imp (4, 4)	[33; 570]	201	[–6189; –5737]	–5872	[–5788; –5523]	–5679
Trasano–1_Archaic–Imp (4, 2)	[18; 348]	138	[–6024; –5722]	–5823	[–5740; –5633]	–5686
Coppa–Nevigata_Archaic–Imp (2, 2)	[0; 511]	56	[–6141; –5607]	–5810	[–5935; –5399]	–5704
Ripatetta_Evolved–Imp (2, 3)	[0; 312]	40	[–6005; –5726]	–5841	[–5901; –5566]	–5771
Trasano–2_Evolved–Imp (2, 2)	[1; 115]	15	[–5738; –5622]	–5671	[–5695; –5567]	–5641
Trasano–3_Recent–Imp (2, 2)	[0; 207]	23	[–5701; –5561]	–5637	[–5664; –5413]	–5588
Trasanello–1_Late–Imp (4, 4)	[1; 304]	87	[–5850; –5552]	–5629	[–5611; –5470]	–5542
Trasanello–2_Bande Rosse (2, 2)	[16; 396]	221	[–5585; –5368]	–5510	[–5431; –5083]	–5269

Tab. 3. Modelled phases of southern and central Italian ICC. The number of associated events and dates for each phase is indicated in brackets: D_HPD (95%), highest posterior density interval at 95% confidence of phase duration; D_MAP, posterior mode of phase duration; B_HPD (95%), highest posterior density interval at 95% confidence of phase beginning; B_MAP, posterior mode of phase beginning; E_HPD (95%), highest posterior density interval at 95% confidence of phase's end; E_MAP, posterior mode of phase's end.

The Impressa spread towards the North-West and its evolutionary trends (Tabs. 5–7, Fig. 4)

Compared to Abruzzo, which offers the earliest available dates for Central Italy, the first evidence of Neolithic settlement is very early, at least one century earlier, in the North-West and at the latest during the transition between the 59th and 58th centuries, at least two centuries before the Iberian Peninsula (*Isern* et al. *2017; Zilhão 2001*).

For the North-Western Mediterranean, the modelled dates indicate a rather good seriation of the sites and

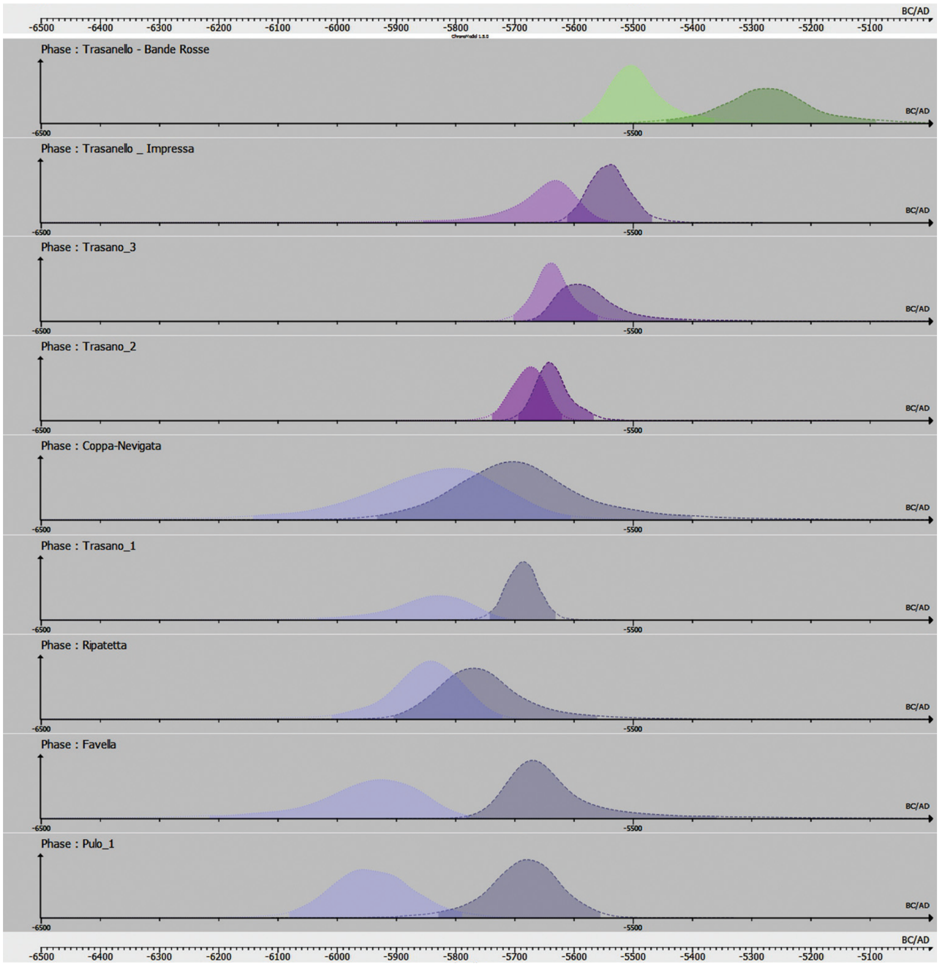


Fig. 3. Posterior density distribution of all south-eastern Italian Impressa phases. The density region of the beginnings are the oldest. The areas below the curves represent the 95% highest posterior densities.

	FAVELLA	PULO_1	RIPATETTA	TRASANO_1	COPPA-NEVIGATA	TRASANO_2	TRASANELLO_1	TRASANO_3	TRASANELLO_2
FAVELLA		52,7	82,3	82,5	77,7	100,0	97,5	100,0	100,0
PULO_1	47,3		81,1	81,2	76,4	99,9	97,2	100,0	100,0
RIPATETTA	17,7	18,9		52,9	55,4	99,7	94,9	100,0	100,0
TRASANO_1	17,5	18,8	47,1		53,6	100,0	94,6	100,0	100,0
COPPA-NEVIGATA	22,3	23,6	44,6	46,4		92,8	90,2	97,0	99,8
TRASANO_2	0,0	0,1	0,3	0,0	7,2		66,5	100,0	100,0
TRASANELLO_1	2,5	2,8	5,1	5,4	9,8	33,5		59,4	100,0
TRASANO_3	0,0	0,0	0,0	0,0	3,0	0,0	40,6		99,2
TRASANELLO_2	0,0	0,0	0,0	0,0	0,2	0,0	0,0	0,8	

Tab. 4. Anteriority probabilities of phase beginnings for the southern and central Italian ICC (expressed in percentages). The higher the probability, the greater the distance.

of the main pottery styles, although many questions remain unsolved.

Obviously, the pottery style of Peiro Signado (BMAP: 5826 BCE) and Arene Candide (BMAP: 5786 BCE), characterised by the predominance of stab-and-drag decoration, is currently the marker of the first Neolithic impact in the North-West, although its links with the South-East are weak, since almost no direct stylistic comparison can be established with either the archaic or the Guadone style, both contemporary. Some comparisons are still to be sought in Sicily and Calabria, within Stentinello *sensu lato* (*Bernabò Brea 1950; Scarcella 2011*).

The beginnings of the Pont de Roque-Haute aspects (BMAP: 5767 BCE) cannot be distinguished from Peiro Signado and Arene Candide, although they could be more clearly linked to the archaic style of the South-East, for instance Trasano 1, via Giglio in the Tuscan archipelago. Unfortunately, the dates from Giglio are not a great help: they appear to be rather late (BMAP: 5674 BCE) compared to the earliest dispersal, and their reliability to one or another style present within the pottery assemblage is weak. The shared use of obsidian from Palmarola and Sardinia adds to the general consistency of these earliest northern styles, which at the moment have to be kept in the same set.

The deposits and pottery production of Pendimoun cover a wide range, more than two centuries, starting at the very end of the 58th century in the southern sector (BMAP: 5715 BCE). It has virtually no stylistic connections with Arene Candide 1A, which is definitely earlier, and more consistent with Arene Candide 1B (event_HPD: 5704–5489). Surprisingly strong comparisons can be made with the archaic aspect of Favella that could have ended in the middle of the 57th century, with a similar proportion of finger and nail impressions. Later assemblages from the northern sector of Pendimoun (BMAP: 5608 BCE) can be connected with several sites in Liguria, including Arma dell'Aquila (BMAP: 5619 BCE), which offers some stylistic parallels, *e.g.*, small curvilinear impressions. All these aspects predate with a high probability the Cardial phases at Pendimoun (BMAP: 5503 and 5445 BCE) and Arene Candide 2 (BMAP: 5467 BCE).

Dispersal routes and speed, and the endless question of origins

Regarding the distance, approx. 1500km of coastline, the spread from the South to the North-West occurred at a record speed, as the difference of BMAP between the earliest southern sites (Pulo di Molfetta or Favella) and the earliest northern one (Peiro Signado) is in the order of one century (Figs. 5–6). This confirms and specifies previous considerations that were based on a smaller set of less accurate radio-

Event (n-dates)	e_HPD (95%)	e_MAP
Giglio-Secche_#3 (1)	[–5706; –5186]	–5450
Giglio-Secche_#1 (1)	[–5742; –5409]	–5579
Giglio-Secche_#2 (1)	[–5820; –5534]	–5669
Arene-Candide_US9B (1)	[–5544; –5155]	–5351
Arene-Candide_Cardial pot (1)	[–5590; –5234]	–5417
Arene-Candide_US312 (2)	[–5620; –5196]	–5291
Arene-Candide_US9Bbase (1)	[–5704; –5489]	–5625
Arene-Candide_US330 (1)	[–5747; –5467]	–5657
Arene-Candide_US10 (1)	[–5776; –5616]	–5704
Arene-Candide_US347 (1)	[–5772; –5592]	–5685
Arene-Candide_US351A (1)	[–5809; –5628]	–5712
Arene-Candide_US10A (2)	[–5842; –5686]	–5748
Arene-Candide_US360 (1)	[–5972; –5676]	–5771
S. Sebastiano Perti_#1 (1)	[–5730; –5472]	–5586
S. Sebastiano Perti_#2 (1)	[–5813; –5517]	–5664
S. Sebastiano Perti_#3 (1)	[–5800; –5537]	–5672
Aquila_#1 (1)	[–5731; –5471]	–5587
Aquila_#2 (1)	[–5730; –5464]	–5584
Pendimoun_N_US.18364 (2)	[–5400; –5146]	–5326
Pendimoun_N_US.19000 (1)	[–5415; –5224]	–5342
Pendimoun_N_US.42370 (2)	[–5427; –5262]	–5359
Pendimoun_N_SEP.H2 (1)	[–5455; –5305]	–5383
Pendimoun_N_SEP.F2 (1)	[–5506; –5336]	–5431
Pendimoun_N_US.19001 (2)	[–5478; –5326]	–5413
Pendimoun_S_SEP.F1 (1)	[–5549; –5265]	–5413
Pendimoun_S_US28781A_sup (1)	[–5572; –5201]	–5377
Pendimoun_N_US.47799A_sup (1)	[–5609; –5411]	–5502
Pendimoun_N_US.47799B_inf (1)	[–5742; –5492]	–5601
Pendimoun_N_US.47800 (2)	[–5544; –5383]	–5471
Pendimoun_N_US.47801 (2)	[–5618; –5454]	–5519
Pendimoun_N_US.41678 (2)	[–5641; –5484]	–5559
Pendimoun_N_US.2067 (2)	[–5609; –5434]	–5505
Pendimoun_S_US29203 (1)	[–5792; –5507]	–5654
Pendimoun_S_US.28889 (2)	[–5695; –5521]	–5618
Pendimoun_S_US.28781B_inf (1)	[–5834; –5546]	–5690
Pendimoun_S_US.5711 (2)	[–5835; –5539]	–5682
Peiro Signado_#1 (1)	[–5983; –5597]	–5780
Peiro Signado_#2 (1)	[–6034; –5591]	–5798
Pont de Roque-Haute_F1 (3)	[–5805; –5677]	–5739
Pont de Roque-Haute_F1base (2)	[–5857; –5711]	–5767

Tab. 5. Modelled events (from Table 1) of the north-western Mediterranean ICC. The number of associated dates is for each event indicated in brackets: e_HPD (95%), **i.e.** ***event's highest posterior density interval at 95% confidence; e_MAP, event's posterior mode.***

Phase (n-events, n-dates)	D_HPD (95%)	D_MAP	B_HPD (95%)	B_MAP	E_HPD (95%)	E_MAP
PeiroSignado (2, 2)	[1; 329]	38	[–6034; –5703]	–5826	[–5895; –5562]	–5763
Arene-Candide-1A_Impressa (6, 7)	[40; 410]	154	[–5963; –5707]	–5786	[–5726; –5473]	–5653
Pont-de-Roque-Haute (2, 5)	[0; 109]	12	[–5857; –5711]	–5767	[–5805; –5677]	–5739
Pendimoun-S_Impressa (4, 6)	[18; 315]	121	[–5881; –5633]	–5715	[–5671; –5499]	–5611
S. Sebastiano Perti_Impressa/Cardial (3, 3)	[2; 293]	103	[–5841; –5609]	–5697	[–5682; –5458]	–5581
Giglio_Impressa/Cardial (3, 3)	[34; 498]	210	[–5837; –5544]	–5674	[–5627; –5237]	–5456
Aquila_Impressa (2, 2)	[1; 204]	23	[–5739; –5528]	–5619	[–5654; –5447]	–5571
Pendimoun-N_Impressa (5, 9)	[50; 299]	147	[–5737; –5532]	–5608	[–5516; –5387]	–5470
Pendimoun-N_Cardial (7, 10)	[77; 385]	189	[–5609; –5424]	–5503	[–5400; –5146]	–5326
Arene-Candide-2_Cardial (3, 4)	[13; 376]	149	[–5625; –5332]	–5467	[–5458; –5131]	–5298
Pendimoun-S_Cardial (2, 2)	[1; 237]	26	[–5599; –5323]	–5445	[–5487; –5196]	–5364

Tab. 6. Modelled phases of the north-western Mediterranean ICC. The number of associated events and dates for each event is indicated in brackets: D_HPD (95%), highest posterior density interval at 95% confidence of phase duration; D_MAP, posterior mode of phase duration; B_HPD (95%), highest posterior density interval at 95% confidence of phase beginning; B_MAP, posterior mode of phase beginning; E_HPD (95%), highest posterior density interval at 95% confidence of phase's end; E_MAP, posterior mode of phase's end.

carbon dates (*Binder, Guilaine 1999; Zilhão 2001*). Our results contribute to moderating, and even to changing, the idea of a strong contrast between a fast continental farming dispersal following rivers (*i.e.* trans-Balkans routes) and a slow one following maritime itineraries (*i.e.* Adriatic routes) (*Biagi* et al. *2005*). Indeed, the dispersal from southern Italy towards Liguria and France appears seven or eight times faster than for reaching Abruzzo.

Within this Ulyssean world, voyagers faced many hazards, depending on their own sailing skills. Surface currents could have been a compelling factor limiting voyaging capacities, and this could partly explain the apparent discontinuity of the north-western spread and the lack of early sites in several regions (*e.g.*, Lazio, Tuscany or Sardinia on the western slope of the Apennine, or Molise, Umbria, Abruzzo, Emilia *etc*. on the eastern slope).

In the Alps, the Tosco-Emilian Apennine and the Po plain, a significant network of Late Mesolithic settlements is observed (*Ferrari 2010; Franco 2011; Marchand, Perrin 2017*) which is not the case everywhere in the North-Western Mediterranean and especially in places where the farmers first settled (Western Liguria, Eastern Provence, Mediterranean Languedoc). Although the Castelnovian chronology is still poorly known in general terms, late Mesolithic sites, contemporary with the first evidence of farmer settlement, are documented in the Rhône Valley and in the Tosco-Emilian Apennine (*Binder* et al. *2017; Dini, Fioravanti 2011; Marchand, Perrin 2017*). This has sometimes been considered to be

	PEIRO SIGNADO	ARENE CANDIDE 1A Impressa	PONT-DE-ROQUE-HAUTE	PENDIMOUN-SOUTH Impressa	ARMA DEL-L'AQUILA	PENDIMOUN-NORTH Impressa	PENDIMOUN-NORTH Cardial	ARENE CANDIDE 2 Cardial	PENDIMOUN-SOUTH Cardial
PEIRO SIGNADO		63,9	79,7	88,4	98,1	98,1	100,0	99,5	100,0
ARENE CANDIDE 1A Impressa	36,1		68,0	84,3	97,8	97,8	100,0	99,4	100,0
PONT-DE-ROQUE-HAUTE	20,3	32,1		77,5	97,0	97,1	100,0	99,3	100,0
PENDIMOUN-SOUTH Impressa	11,6	15,7	22,5		93,5	93,6	99,9	99,0	100,0
ARMA DELL'AQUILA	1,9	2,2	3,0	6,5		52,9	96,3	94,3	98,4
PENDIMOUN-NORTH Impressa	1,9	2,2	2,9	6,4	47,1		100,0	94,1	98,4
PENDIMOUN-NORTH Cardial	0,0	0,0	0,0	0,1	3,7	0,0		64,3	83,5
ARENE CANDIDE 2 Cardial	0,5	0,6	0,7	1,0	5,7	5,9	35,7		65,2
PENDIMOUN-SOUTH Cardial	0,0	0,0	0,0	0,0	1,6	1,6	16,6	34,8	

Tab. 7. Anteriority probabilities of phase beginnings for the north-western Mediterranean ICC (expressed in percentages). The higher the probability, the greater the distance.

at the origin of a lock for the ICC dispersion (*Binder 2000; 2013*).

As yet, the absence of Mesolithic data prevents a discussion of such a hypothesis for the eastern slopes of the central Apennine. Thus the question of a blocking situation of the Neolithic spread on the western side of the Adriatic remains wide open, unlike what is observed on the eastern shore (*Biagi* et al. *2005*).

The diversity observed in the earliest ICC from the northern Mediterranean reflects parts of the diversity observed in the South-East. This could have resulted from the diffusion of small culturally diverse

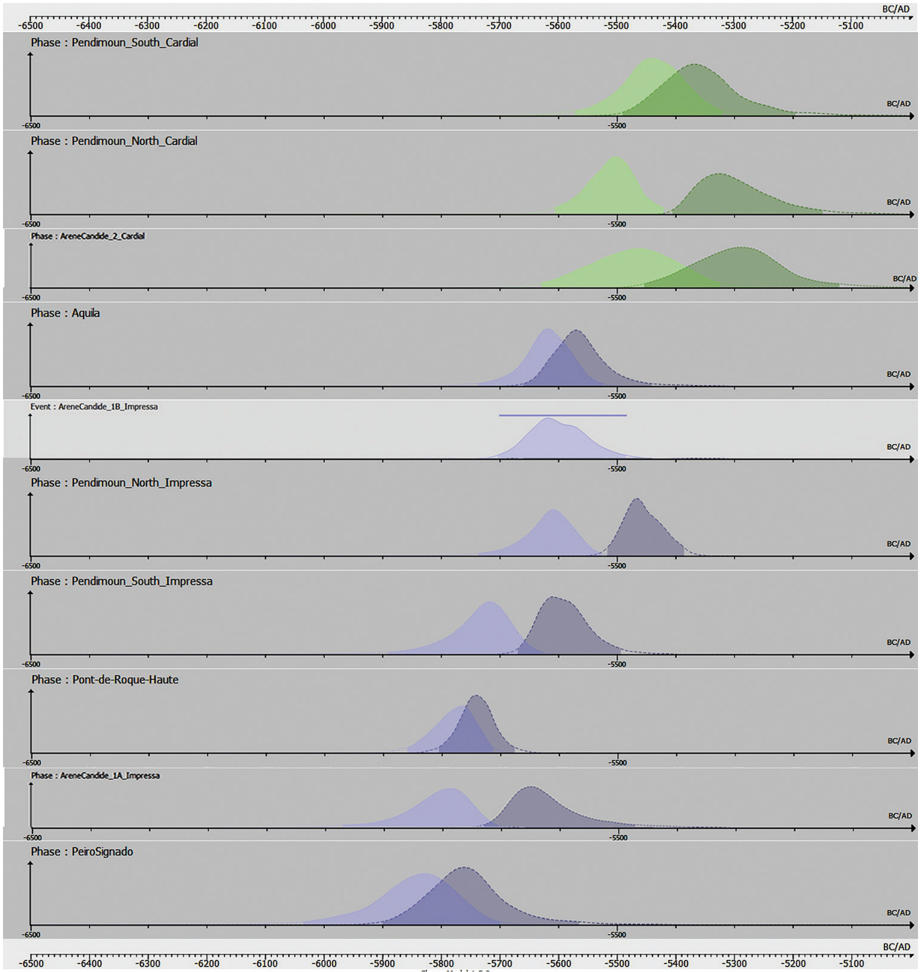
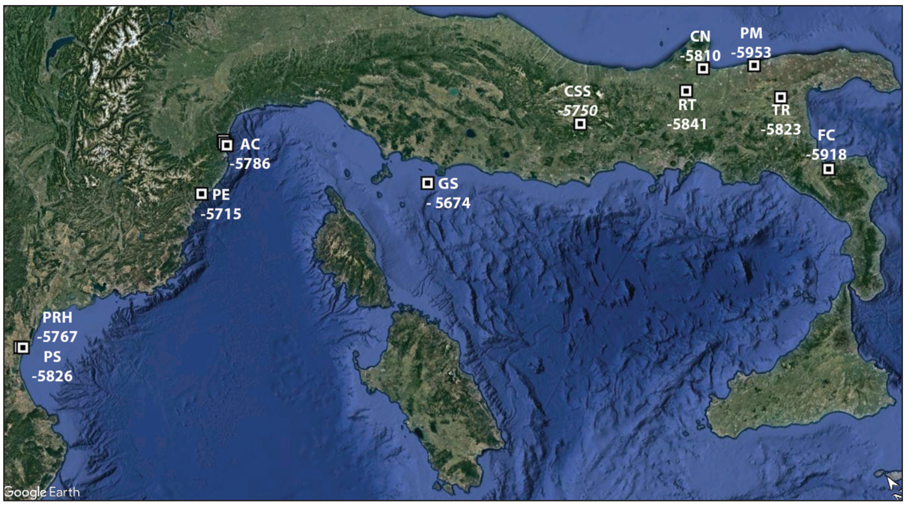


Fig. 4. Posterior density distribution of all north-western Impressa phases. The density region of the beginnings are the oldest. The areas below the curves represent the 95% highest posterior densities.

Fig. 5. Representation of the earliest Italian and northwestern Mediterranean ICC settlements using the Mode a posteriori of Phases beginning (BMAP): AC Arene Candide; CN Coppa Nevigata; CSS Colle Santo Stefano; FC Favella della Corte; GS Giglio Le Secche; PE Pendimoun; PM Pulo di Molfetta; PRH Pont de Roque-Haute; PS Peiro Signado; RT Ripatetta; TR Trasano.



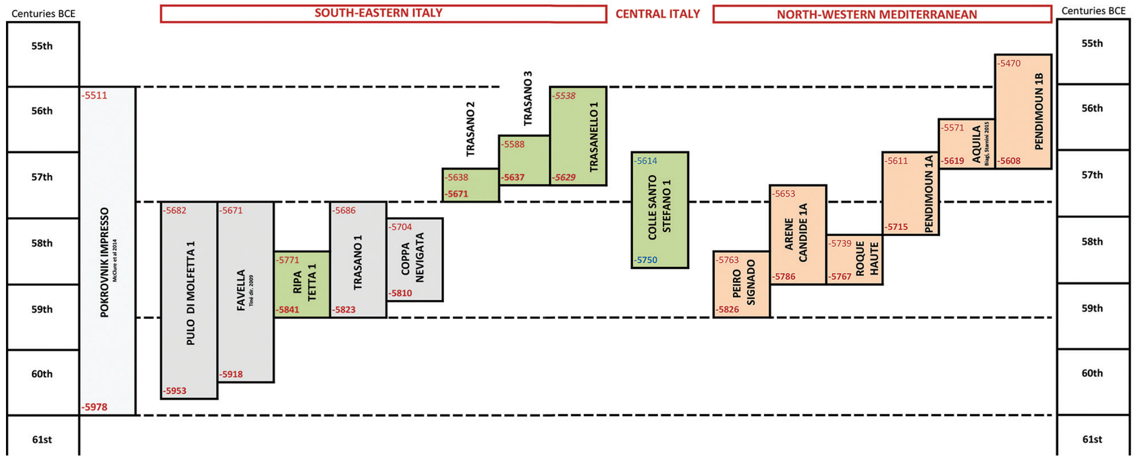


Fig. 6. Periodisation diagram of the Impressa aspects from the Central and Western Mediterranean.

groups. Indeed, some of the north-western pottery assemblages share more characteristics with the distant Apulian and Calabrian settlements than with their closest neighbours.

To date, the early north-western dispersal has been shown to have occurred from about the 59th century, a period during which diversification is observed within the material cultures in south-eastern Italy, *i.e.* the early emergence of Guadone. Nevertheless, north-western material cultures do not provide evidence of the evolved Guadone patterns, and they globally remain closer to the archaic patterns. Likewise, the origins of the Arene Candide – Peiro Signado style remains unsolved, even if some connections were highlighted on Corfu (Sidari) and Sicily (Kronio) (*Guilaine* et al. *2016*). New work on pottery technology now demonstrates a disconnection between north-western ICC, with a singular Spiral Patchwork technology, and the evolved assemblages from Ripatetta and Colle Santo Stefano, with a standard pan-European coiling technology (*Gomart* et al. *2017 in press*). This reinforces the hypothesis of cultural drift and questions the origin of both communities of practices. In this framework, Sicily still constitutes a priority target.

ACKNOWLEDGEMENTS

This study was undertaken within the framework of the CIMO Project (ANR-14-CE31-009) with the support of the CEPAM, and the partnership of the PROCOME Project (ANR-13-CULT-0001-01).
New cultural, stratigraphic and radiocarbon data have been provided by L. Angeli, J. Guilaine, I. M. Muntoni, G. Radi and C. Tozzi for the southern sites and by D. Binder, M. Brandaglia, F. Briois, L. Gomart, J. Guilaine, R. Maggi, C. Manen, C. Panelli and S. Rossi for the north-western sites.
Regarding the new dates published here, botanical samples were identified thanks to J. Battentier, L. Bouby, A. Carré, C. Delhon, P. Marinval, R. Nisbet and S. Thiébault, and zoological samples thanks to L. Gourichon, S. Massala and P. Rowley-Conwy.
D. Binder ran the Bayesian modelling and wrote the paper with the collaboration of P. Lanos, who specified the ChronoModel rules and ran an anteriority probability calculus. All the authors discussed the results and interpretations before submission.

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Appendix

Tab. 1. Conventional radiocarbon dates and samples of Central and Western Mediterranean ICC considered in this article.

Region (district)		Site	^{14}C_lab_label	Mean	StE	Sample
Ionian islands (Corfu)	Corfu	Sidari	Ly-5633 (SacA-13393)	7170	40	Cerealia charred seeds
Ionian islands (Corfu)	Corfu	Sidari	Ly-3172 (SacA-4513)	7370	80	*Quercus* sp. charcoal
Apulia (Bari)	Molfetta	Pulo di Molfetta	LTL-141A	6651	50	*Ovis* vel *Capra*, bone collagen
Apulia (Bari)	Molfetta	Pulo di Molfetta	LTL-3810A	6764	60	*Ovis* vel *Capra*, bone collagen
Apulia (Bari)	Molfetta	Pulo di Molfetta	LTL-4536A	6983	50	*Ovis* vel *Capra*, bone collagen
Apulia (Bari)	Molfetta	Pulo di Molfetta	LTL-142A	7134	60	*Ovis* vel *Capra*, bone collagen
Apulia (Brindisi)	Ostuni	Sant'Angelo	Gif-6722	6530	70	Cerealia charred seeds
Apulia (Brindisi)	Ostuni	Sant'Angelo	Gif-6724	6980	70	*Triticum* sp. charred seeds
Apulia (Foggia)	Lucera	Rippa Tetta	Beta-47808	6890	60	Cerealia charred seeds
Apulia (Foggia)	Lucera	Rippa Tetta	LTL-16676A	6910	40	Cerealia charred seeds fragments
Apulia (Foggia)	Lucera	Rippa Tetta	LTL-16677A	6988	45	Cerealia charred seeds fragments
Apulia (Foggia)	Manfredonia	Coppa Nevigata	OxA-1474	6850	80	Cerealia charred seeds
Apulia (Foggia)	Manfredonia	Coppa Nevigata	OxA-1475	6880	90	*Hordeum* sp. charred seeds
Apulia (Tarente)	Manduria	Terragne	Beta-59934	6930	70	*Cervus* sp, bone collagen
Apulia (Tarente)	Manduria	Terragne	Beta-67093	7260	60	*Bos primigenius* bone collagen
Basilicate (Matera)	Matera	Trasano	Ly -3951 (OxA)	6840	35	Cerealia charred seeds
Basilicate (Matera)	Matera	Trasano	Ly -3949 (OxA)	6730	40	Cerealia charred seeds
Basilicate (Matera)	Matera	Trasano	Ly -3950 (OxA)	6810	35	Cerealia charred seeds
Basilicate (Matera)	Matera	Trasano	Ly -3948 (OxA)	6710	35	Cerealia charred seeds
Basilicate (Matera)	Matera	Trasano	Ly -3952 (OxA)	6760	40	Cerealia charred seeds
Basilicate (Matera)	Matera	Trasano	Ly -3953 (OxA)	6730	40	Cerealia charred seeds
Basilicate (Matera)	Matera	Trasano	Ly -3954(OxA)	6835	40	Cerealia charred seeds
Basilicate (Matera)	Matera	Trasano	Ly -3955(OxA)	6935	40	Cerealia charred seeds
Basilicate (Matera)	Matera	Trasanello	LTL-12139A	6301	45	Unspecified charcoal
Basilicate (Matera)	Matera	Trasanello	LTL-12146A	6614	45	Unspecified charcoal
Basilicate (Matera)	Matera	Trasanello	LTL-12142A	6644	45	Unspecified charcoal
Basilicate (Matera)	Matera	Trasanello	LTL-12143A	6683	45	Unspecified charcoal
Basilicate (Matera)	Matera	Trasanello	LTL-12144A	6632	45	Unspecified charcoal
Basilicate (Matera)	Matera	Trasanello	LTL-12145A	6612	45	Unspecified charcoal
Calabria (Cosenza)	Corigliano Calabro	Favella della Corte	Beta-165482	6940	40	Cerealia charred seeds
Calabria (Cosenza)	Corigliano Calabro	Favella della Corte	Beta-71633	6910	60	Cerealia charred seeds
Calabria (Cosenza)	Corigliano Calabro	Favella della Corte	LTL-202A	6956	75	Cerealia charred seeds
Calabria (Cosenza)	Corigliano Calabro	Favella della Corte	LTL-203A	6890	50	Cerealia charred seeds
Calabria (Cosenza)	Corigliano Calabro	Favella della Corte	LTL-204A	6793	40	Bone collagen
Calabria (Cosenza)	Corigliano Calabro	Favella della Corte	LTL-778A	7003	55	Bone collagen
Abruzzi (L'Aquila)	Ortucchio	Colle Santo Stefano	LTL-15952A	6809	45	Triticum dicoccum charred seed
Abruzzi (L'Aquila)	Ortucchio	Colle Santo Stefano	LTL-15953A	6770	45	Triticum cf. dicoccum charred seed
Tuscany (Grossetto)	Isola del Giglio	Le Secche	LTL-16671A	6637	45	*Erica* sp. charcoal
Tuscany (Grossetto)	Isola del Giglio	Le Secche	LTL-16672A	6769	45	*Erica* sp. charcoal
Tuscany (Grossetto)	Isola del Giglio	Le Secche	LTL-16673A	6492	65	Erica sp. charcoal

Identification	Field_label	Cultural attibution	Referneces
_	Hearth 5b-5c	Archaic Impressa	*Berger* et al. *2014*
S. Thiébault	Pit 4	End of the Monochrome phase	*Berger* et al. *2014*
S. Massala	Phase II, US49	Archaic Impressa	Unpublished, I. Muntoni
S. Massala	Phase Isup, US46	Archaic Impressa	Unpublished, I. Muntoni
S. Massala	Phase I, US10	Archaic Impressa	Unpublished, I. Muntoni
S. Massala	Phase I, US10	Archaic Impressa	*Fiorentino* et al. *2013*
L. Costantini	Level 6-7	Red painted wares	*Coppola 2001*
L. Costantini	Level 9	Evolved Impressa (Guadone)	*Coppola 2001*
L. Costantini	Cobble paved area (C9)	Evolved Impressa (Guadone)	*Costantini, Stancanelli 1994*
L. Bouby	Cobble paved area, TG1B (I-M30), #B	Evolved Impressa (Guadone)	Unpublished, CIMO project
L. Bouby	Cobble paved area, TG1B (I-M30), #A	Evolved Impressa (Guadone)	Unpublished, CIMO project
L. Costantini	Phase II-III	Archaic Impressa	*Skeates 1994*
L. Costantini	Phase II-III	Archaic Impressa	*Skeates 1994*
C. Corridi	US4-5	Late Mesolithic ?	*Gorgoglione* et al. *1995*
C. Corridi	US4-5	Late Mesolithic ?	*Gorgoglione* et al. *1995*
P. Marinval	Sector A (T44), C2inf	Archaic Impressa	Unpublished, J. Guilaine
P. Marinval	Sector A (U48), C2.0	Evolved Impressa	Unpublished, J. Guilaine
P. Marinval	Sector A (U48), C2c	Archaic Impressa	Unpublished, J. Guilaine
P. Marinval	Sector A (U48-49), C1	Recent Impressa	Unpublished, J. Guilaine
P. Marinval	Sector B (AB46), C2.1	Recent Impressa	Unpublished, J. Guilaine
P. Marinval	Sector B (AB42), C2.2	Evolved Impressa	Unpublished, J. Guilaine
P. Marinval	Sector B (AA44), C2.3	Archaic Impressa	Unpublished, J. Guilaine
P. Marinval	Sector B (AA-AB south), C2.4	Archaic Impressa	Unpublished, J. Guilaine
_	Trench 11, US3sup, internal ditch edge	Red painted wares	Unpublished, L. Angeli
_	Trench 11, US3inf, internal ditch edge (F4)	Red painted wares	Unpublished, L. Angeli
_	Trench 11, US5, sherd concentration	Late Impressa	Unpublished, L. Angeli
_	Trench 11, US5 (B3)	Late Impressa	Unpublished, L. Angeli
_	Trench 11, US5 (C4)	Late Impressa	Unpublished, L. Angeli
_	Trench 11, US5, ditch filing	Late Impressa	Unpublished, L. Angeli
S. Coubray	Structure D, Pit Y, US4_XIII	Archaic Impressa	*Tiné 2009*
S. Coubray	Structure A, Pit Z, US4_VI	Archaic Impressa	*Tiné 2009*
S. Coubray	Structure E, Pit T, US3	Archaic Impressa	*Tiné 2009*
S. Coubray	Structure E, Pit 30, US4_II	Archaic Impressa	*Tiné 2009*
S. Coubray	Structure D, Pit Y, US4_II	Archaic Impressa	*Tiné 2009*
S. Coubray	Structure G, Pit 10, US3_VI	Archaic Impressa	*Tiné 2009*
L. Bouby	Cobble paved area (H20), US17, #A	Evolved Impressa (Guadone)	Unpublished, CIMO project
L. Bouby	Cobble paved area (H20), US17, #B	Evolved Impressa (Guadone)	Unpublished, CIMO project
C. Delhon	Grey sediment #1	Impressa / Cardial	Unpublished, CIMO project
C. Delhon	Brown sediment #2	Impressa / Cardial	Unpublished, CIMO project
C. Delhon	Brown sediment #3	Impressa / Cardial	Unpublished, CIMO project

Region (district)		Site	14C_lab_label	Mean	StE	Sample
Liguria (Savona)	Finale-Ligure	Arene Candide	LTL-15943A	6834	45	*Ovis aries* bone collagen
Liguria (Savona)	Finale-Ligure	Arene Candide	LTL-15944A	6864	45	*Ovis aries* bone collagen
Liguria (Savona)	Finale-Ligure	Arene Candide	LTL-15946A	6750	45	*Vitis vinifera* ssp. *sylvestris* charred seed
Liguria (Savona)	Finale-Ligure	Arene Candide	LTL-15947A	6861	45	*Ovis aries* bone collagen
Liguria (Savona)	Finale-Ligure	Arene Candide	LTL-16680A	6271	40	*Capra hircus* bone collagen
Liguria (Savona)	Finale-Ligure	Arene Candide	LTL-16681A	6623	45	*Bos taurus* bone collagen
Liguria (Savona)	Finale-Ligure	Arene Candide	LTL-16678A	6751	45	*Capra hircus* bone collagen
Liguria (Savona)	Finale-Ligure	Arene Candide	LTL-6004A	6446	45	*Triticum monococcum* charred spikelet and fork
Liguria (Savona)	Finale-Ligure	Arene Candide	Beta-66552	6150	70	*Phillyrea* sp. charcoal
Liguria (Savona)	Finale-Ligure	Arene Candide	Beta-66553	6880	60	*Pistachia terebinthus* charcoal
Liguria (Savona)	Finale-Ligure	Arene Candide	Beta-170557	6870	40	*Triticum monococcum* charred seeds
Liguria (Savona)	Finale-Ligure	Arene Candide	Beta-170558	6860	40	*Cornus* sp. charred seed
Liguria (Savona)	Finale-Ligure	Arene Candide	OxA-23072	6778	39	*Triticum dicoccum* charred seeds
Liguria (Savona)	Finale-Ligure	Arene Candide	Beta-110542	6830	40	*Hordeum* sp. charred seeds
Liguria (Savona)	Finale-Ligure	Arene Candide	Beta-170555	6700	40	*Euphorbia* sp. charcoal
Liguria (Savona)	Finale-Ligure	Arene Candide	Beta-109619	6370	50	*Rhamnus alaternus* charcoal
Liguria (Savona)	Finale-Ligure	San Sebastiano di Perti	GrA-25715	6760	45	*Hordeum* sp. charred seeds
Liguria (Savona)	Finale-Ligure	San Sebastiano di Perti	OxA-21359	6767	39	*Triticum dicoccum* charred seeds
Liguria (Savona)	Finale-Ligure	San Sebastiano di Perti	OxA-19734	6675	33	*Triticum vulgare*
Liguria (Savona)	Orco Feglino	Arma dell'Aquila	OxA-V-2365-31	6678	33	Human bone collagen
Liguria (Savona)	Orco Feglino	Arma dell'Aquila	OxA-V-2365-50	6669	34	Human bone collagen
Provence (Alpes-Maritimes)	Castellar	Pendimoun	GrA-26893	6445	40	Human bone collagen
Provence (Alpes-Maritimes)	Castellar	Pendimoun	LTL-15940A	6399	45	Cerealia charred seeds
Provence (Alpes-Maritimes)	Castellar	Pendimoun	LTL-15941A	6803	45	*Arbutus unedo* charcoal
Provence (Alpes-Maritimes)	Castellar	Pendimoun	GrA-29528	6650	45	Cerealia charred seeds
Provence (Alpes-Maritimes)	Castellar	Pendimoun	GrA-29403	6725	45	Cerealia charred seeds
Provence (Alpes-Maritimes)	Castellar	Pendimoun	LTL-15942A	6745	45	Maloideae charcoal
Provence (Alpes-Maritimes)	Castellar	Pendimoun	Lyon-1713 (GrA-20195)	6790	50	Pomoideae charcoal
Provence (Alpes-Maritimes)	Castellar	Pendimoun	LTL-8012A	6499	45	*Quercus* sp. charred seeds
Provence (Alpes-Maritimes)	Castellar	Pendimoun	LTL-8011A	6507	45	*Quercus* sp. charred seeds
Provence (Alpes-Maritimes)	Castellar	Pendimoun	LTL-14104A	6466	40	*Corylus avellana* charcoal
Provence (Alpes-Maritimes)	Castellar	Pendimoun	LTL-8007A	6170	45	*Quercus* sp. charred seeds
Provence (Alpes-Maritimes)	Castellar	Pendimoun	LTL-8008A	6337	45	*Quercus* sp. charred seeds
Provence (Alpes-Maritimes)	Castellar	Pendimoun	LTL-8009A	6241	45	*Corylus avellana* charred fruit
Provence (Alpes-Maritimes)	Castellar	Pendimoun	LTL-8010A	6328	45	*Quercus* sp. charred seeds
Provence (Alpes-Maritimes)	Castellar	Pendimoun	GrA-32061	6450	40	Human bone collagen

Identification	Field_label	Cultural attibution	Referneces
P. Rowley-Conwy	Phase AC1, US347	Impressa	Unpublished, CIMO project
P. Rowley-Conwy	Phase AC1, US360	Impressa	Unpublished, CIMO project
R. Nisbet	Phase AC1, US351A	Impressa	Unpublished, CIMO project
P. Rowley-Conwy	Phase AC2, US330 (anatomical connection)	Impressa	Unpublished, CIMO project
P. Rowley-Conwy	Phase AC3, US312, #A	Cardial	Unpublished, CIMO project
P. Rowley-Conwy	Phase AC3, US312, #B	Cardial	Unpublished, CIMO project
P. Rowley-Conwy	Phase AC3, US306, #B	Cardial	Unpublished, CIMO project
D. Arobba	Cf. Phase AC3, US26, #Cardial pot	Cardial	*Arobba* et al. *2017*
R. Nisbet	Cf. Phase AC4/, US27C	Impressa / Cardial	*Maggi 1997b*
R. Nisbet	Cf. Phase AC1/, US27G	Impressa / Cardial	*Maggi 1997b*
R. Nisbet	Phase AC1, US10A	Impressa	Unpublished, R. Maggi
R. Nisbet	Phase AC1, US10A	Impressa	Unpublished, R. Maggi
R. Nisbet	Phase AC1, US10	Impressa	*Biagi, Starnini 2016*
R. Nisbet	Phase AC1, US10	Impressa	Unpublished, R. Maggi
R. Nisbet	Phase AC2, US9Bbase	Impressa	Unpublished, R. Maggi
R. Nisbet	Phase AC3, US9B	Cardial	Unpublished, R. Maggi
D. Arobba	Unique layer	Impressa	*Biagi, Starnini 2016*
D. Arobba	Unique layer	Impressa	*Biagi, Starnini 2016*
D. Arobba	Unique layer	Impressa	*Biagi, Starnini 2016*
_	Child burial	Impressa	*Biagi, Starnini 2016*
_	Layer 7	Impressa	*Biagi, Starnini 2016*
H. Duday, G. Goude	Sector South, Burial F1, #N16_606	Cardial	*Binder, Sénépart 2010*
L. Bouby, A. Carré	Sector South, US28781-sup, #28898	Cardial	Unpublished, CIMO project
J. Battentier	Sector South, Pit, US28781-inf, #28905	Impressa	Unpublished, CIMO project
L. Bouby, A. Carré	Sector South, Pit, US28889, #28941	Impressa	*Binder, Sénépart 2010*
L. Bouby, A. Carré	Sector South, US28889, #28938	Impressa	*Binder, Sénépart 2010*
J. Battentier	Sector South, Pit, US29203, #29223	Impressa	Unpublished, CIMO project
S. Thiébault	Sector South, US5711, #5720	Impressa	Unpublished, D. Binder
L. Bouby, A. Carré	Sector North, US18364, #18512	Cardial	Unpublished, D. Binder
L. Bouby, A. Carré	Sector North, US18364, #18365	Cardial	Unpublished, D. Binder
J. Battentier	Sector North, US19000, #41859	Cardial	Unpublished, D. Binder
L. Bouby, A. Carré	Sector North, US19001, #44387	Cardial	Unpublished, D. Binder
L. Bouby, A. Carré	Sector North, US19001, #44473	Cardial	Unpublished, D. Binder
L. Bouby, A. Carré	Sector North, US42370, #42861	Cardial	Unpublished, D. Binder
L. Bouby, A. Carré	Sector North, US42370, #44077	Cardial	Unpublished, D. Binder
H. Duday, G. Goude	Sector North, Burial H2, US43000, #43220	Cardial	*Binder, Sénépart 2010*

Region (district)		Site	14C_lab_label	Mean	StE	Sample
Provence (Alpes-Maritimes)	Castellar	Pendimoun	GrA-26894	6440	40	Human bone collagen
Provence (Alpes-Maritimes)	Castellar	Pendimoun	LTL-13788A	6547	45	*Bryonia* sp. charred seeds
Provence (Alpes-Maritimes)	Castellar	Pendimoun	LTL-13787A	6666	45	*Bryonia* sp. charred seeds
Provence (Alpes-Maritimes)	Castellar	Pendimoun	LTL-8005A	6599	45	*Triticum dicoccum* charred seeds
Provence (Alpes-Maritimes)	Castellar	Pendimoun	LTL-8006A	6649	45	*Triticum dicoccum* charred seeds
Provence (Alpes-Maritimes)	Castellar	Pendimoun	LTL-8003A	6452	45	*Quercus* sp. charred seeds
Provence (Alpes-Maritimes)	Castellar	Pendimoun	LTL-8004A	6507	45	*Quercus* sp. charred seeds
Provence (Alpes-Maritimes)	Castellar	Pendimoun	LTL-8002A	6539	45	*Quercus* sp. charred seeds
Provence (Alpes-Maritimes)	Castellar	Pendimoun	LTL-8001A	6600	45	*Triticum* sp. charred seeds
Provence (Alpes-Maritimes)	Castellar	Pendimoun	GrA-26897	6500	40	*Quercus* sp. charred seeds
Provence (Alpes-Maritimes)	Castellar	Pendimoun	GrA-26895	6605	40	*Quercus* sp. charred seeds
Occitanie (Hérault)	Portiragnes	Peiro-Signado	Ly-5688	6910	40	Cerealia charred seeds
Occitanie (Hérault)	Portiragnes	Peiro-Signado	Ly-5689	6925	45	Cerealia charred seeds
Occitanie (Hérault)	Portiragnes	Pont de Roque-Haute	Beta-398950	6920	30	*Triticum dicoccum* charred seeds
Occitanie (Hérault)	Portiragnes	Pont de Roque-Haute	Beta-398951	6870	30	*Triticum dicoccum* charred seeds
Occitanie (Hérault)	Portiragnes	Pont de Roque-Haute	Ly-9879 (SacA-32046)	7010	60	*Triticum dicoccum* charred seeds
Occitanie (Hérault)	Portiragnes	Pont de Roque-Haute	Beta-398952	6910	30	*Triticum dicoccum* charred seeds
Occitanie (Hérault)	Portiragnes	Pont de Roque-Haute	Ly-9878 (SaA-32045)	6820	35	*Triticum dicoccum* charred seeds

Identification	Field_label	Cultural attibution	Referneces
H. Duday, G. Goude	Sector North, Burial F2, #K16_603	Cardial	*Binder, Sénépart 2010*
L. Bouby, A. Carré	Sector North, US47799-sup, #48256	Cardial	Unpublished, D. Binder
L. Bouby, A. Carré	Sector North, US47799-inf, #47889	Impressa	Unpublished, D. Binder
L. Bouby, A. Carré	Sector North, US41678, #47328	Impressa	*Binder* et al. *2014*
L. Bouby, A. Carré	Sector North, US41678, #47292	Impressa	*Binder* et al. *2014*
L. Bouby, A. Carré	Sector North, US47800, #47783	Impressa	Unpublished, D. Binder
L. Bouby, A. Carré	Sector North, US47800, #47915	Impressa	Unpublished, D. Binder
L. Bouby, A. Carré	Sector North, US47801, #48150	Impressa	Unpublished, D. Binder
L. Bouby, A. Carré	Sector North, US47801, #48041	Impressa	Unpublished, D. Binder
L. Bouby, A. Carré	Sector North, US2067, #2070	Impressa	*Binder, Sénépart 2010*
L. Bouby, A. Carré	Sector North, US2067, #2066	Impressa	*Binder, Sénépart 2010*
P. Marinval	Unique layer	Impressa	Unpublished, F. Briois
P. Marinval	Unique layer	Impressa	Unpublished, F. Briois
L. Bouby	Pit F1_base	Impressa	Unpublished, PROCOME project
L. Bouby	Pit F1_base	Impressa	Unpublished, PROCOME project
L. Bouby	Pit F1	Impressa	Unpublished, L. Bouby
L. Bouby	Pit F1	Impressa	Unpublished, L. Bouby
L. Bouby	Pit F1	Impressa	*Guilaine* et al. *2007*

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