TO THE VICINITY AND BEYOND! PRODUCTION, DISTRIBUTION AND TRADE OF COOKING GREYWARES IN MEDIEVAL CATALONIA, SPAIN

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ABSTRACT

Utilitarian greyware ceramics are one of the most abundant artefacts at rural sites in Medieval Catalonia, Spain and were manufactured by numerous long-lived production centres. The stylistic homogeneity of this class of pottery has traditionally restricted its contribution to the archaeological interpretation of the region. However, recent scientific analyses of excavated kiln sites are offering new perspectives via the establishment of compositional reference groups for greyware ceramics. Using one such dataset, from the large workshop of Cabrera d'Anoia, this paper examines the distribution and consumption of utilitarian grey pottery at 25 Medieval sites across Catalonia. The study reveals a pattern of several regional production centres distributing their goods to small villages within the surrounding countryside and in some cases competing for rural markets. This is interpreted in terms of the mechanisms by which greyware pottery was distributed, as well as the socio-political and religious influences on its supply and demand in Medieval Catalonia.

KEYWORDS: Medieval Pottery, Petrography, Geochemistry, Production, Distribution, Catalonia, Spain

INTRODUCTION

Greyware cooking pottery is a common find at Medieval sites across northern Spain (Bohigas and Gutiérrez 1989), southern France (Bonhoure 1992; Bonhoure and Marchesi 1993; Pelletier and Bérard 1996; Leenhardt et al. 1996) and Italy (Brogiolo and Gelichi 1986; 1997; Milanese 2007). These coarse, reduced and usually undecorated ceramics (Fig. 1) are particularly abundant in Catalonia (González 1997; Riu 1984a), dominating pottery assemblages at rural sites from the 8th–13th centuries. Several kiln-sites and workshops manufacturing greyware pottery have been excavated (Riu 1990a; Travé and Padilla 2013), while others are known only from written sources (Fig. 2). Greyware production had a very persistent tradition in the area with some potteries lasting until the late twentieth century (Guerrero 1988).

Given the abundance and widespread occurrence of utilitarian greyware ceramics in Catalonia, this vernacular pottery type holds potential for studying interaction between the Medieval communities that produced and consumed it. Indeed, typological studies on greywares from the sites in present day shire of Anoia (López and Beltrán 2008; 2009) (Fig. 2) have indicated the presence of pottery from local as well as more distant production centres. This seems to suggest that regional trade in greywares took place via active rural markets, which may have been an important element for socialisation and cultural exchange in Medieval Catalonia (Batlle 2004). Patterns of pottery production and trade are also likely to have been influenced by the complex administrative, political and religious configuration of the region, which was divided into numerous counties and split between fluctuating Christian and Muslim domains (Bonnassie 1975) (Fig. 3).

While traditional studies of greyware pottery from kiln sites and consumption contexts have hinted at possible source areas and the influence of specific major pottery producing centres in their surrounding landscape, the macroscopic homogeneity of this class of pottery over Catalonia has hindered the accurate reconstruction of distribution patterns. The dominant form of greyware vessel is a basic round-bottomed boiling pot referred to as an 'olla', which was mostly undecorated (Fig.1). This means that confidently distinguishing between the products of different kiln sites is difficult on metric and stylistic criteria alone.

Scientific data has also been brought to bear on the topic of greyware production and circulation with promising results. Important early studies include (Pradell et al. 1991; Vendrell et al. 1997a; 1997b), which applied thin section petrography and instrumental geochemistry to sherds from several consumption contexts and detected compositional groups that might represent the products of different centres. Unfortunately, a lack of comparative data from kilns sites at the time meant that the location of these sources could not be accurately determined. The subsequent excavation of Cabrera d'Anoia (Leenhardt et al. 1995; Padilla and Vila 1998) offered the opportunity to characterise the largest Medieval greyware production site known in Catalonia. Integrated petrographic and geochemical analysis of 100 sherds from different phases of this workshop resulted in the establishment of several well-defined compositional groups that seem to reflect changes in the extraction of local raw materials for pottery production, concomitant with the development of Cabrera d'Anoia over several centuries (Travé et al. 2014).

In the present paper, we utilise these 'reference groups' (Fillieres et al. 1983) as starting point with which to detect patterns of trade and exchange between rural Medieval communities. Several hundred greyware sherds from numerous consumption sites across central and northern Catalonia are analysed and compared to the compositional data from Cabrera d'Anoia in order to define the size and geographic extent of the market of this large workshop. In a second step,

greyware sherds that are compositionally distinct from those of Cabrera d'Anoia are attributed to potential sources based on their distribution, their petrographic relationship to surface geology and the occurrence of other known or suspected kiln sites in different parts of the region.

The pattern which emerges from this two stage approach is that of several regional production centres (Cabrera d'Anoia, Casampons, Piera, Quart, Santa Creu d'Ollers, Sant Fost de Campsentelles and Verdú) distributing their goods to small villages within a radius of between 10-40 km. Significant overlap exists between the distribution of the products of certain adjacent workshops, indicating that they may have competed for rural markets. Rare cases of possible long distance transport of greywares over distances of 80 km or more have also been detected, providing evidence for broader networks for pottery trade or exchange.

These findings are interpreted in terms of the mechanisms by which pottery from Cabrera d'Anoia and other greyware production sites were distributed, as well as the market forces driving the supply and demand of utilitarian pottery in Medieval Catalonia and its relationship to the changing socio-political and administrative structure of the area.

SITES AND SAMPLES

A total of 330 greyware pottery sherds were selected from consumption contexts at 25 Medieval sites across a wide area of central and northern Catalonia (Fig. 2) (Table 1). Nearly half of the samples come from 11 sites within the modern shire of Anoia. These were chosen based on the macroscopic observations of López and Beltran (2008; 2009), in order to detect the products of Cabrera d'Anoia in the surrounding landscape. In addition, sherds were selected from several other suspected production areas within the shires of Berguedà, Osona and Maresme, that were suggested by the study of Vendrell et al. (1997a).

The analysed sites include churches, sacraria, necropolises, castles and habitation structures. The samples from Anoia come mainly from Romanesque churches that were the neuralgic centres of small villages. These include Santa María de Rubió (López 2007), Sant Miquel de Veciana (Solé 1991), Sant Jaume Sesoliveres (López et al. 1996) and Santa Càndia d'Orpí (González 1989) (Fig. 2). In northern Catalonia, the church of Sant Feliu (Chamorro 2000, 2007) in Girona, and the medieval monastery of Sant Sebastià del Sull (Riu 1984b), in Berguedà, were also sampled.

Sacred spaces or sacraria were often associated with Medieval churches. Here countrymen could receive protection from feudal violence and were allowed to store goods. Sherds were sampled from a silo within the 13th Century sacraria of the church of Sant Andreu d'Òrrius, in Maresme (Padilla and Balaguer 1983). Greyware ceramics can also be found within Medieval necropolises, such as that of Sant Pere Màrtir (Enrich and Enrich 1974) or La Creueta, dated from 13th–14th Centuries.

Castles and towers were an important element for landscape control and organisation in Medieval Catalonia. They were particularly common in Central and Western Catalonia, where the border with Muslim lands was active for a long period of time (Fig. 3). Some ceramics have been selected among the artefatcs found at these military structures, including Castell de Boixadors (López 2008), the Castle of Saldes (Segret and Riu 1986; Cascante 2004) and Sant Miquel de la Vall (Riu 1985; Padilla 1986) (Fig. 2).

Greywares are common in habitation structures in Catalonia, especially in small villages formed by few households situated around a church or castle. Roc de Palomera (Riu 1990b), L'Esquerda (Ollich and Rocafiguera 1990) and Caulers (Riu 1976) are good examples of these settlements (Fig. 2). The isolated household of Mas B in Vilosiu (Bolós et al. 1996) was also included in the sample set. This type of settlement was not uncommon in Medieval times.

All samples can be confidently attributed to the 10th–15th centuries AD, according to the published documentary evidence of each site. The sherds all derive from spherical boiling pots or ollas (Fig. 1), which were by far the most common form of Medieval greyware vessel used in rural areas, accounting for as much as 95% at some production sites (Travé et al. 2014).

ANALYTICAL METHODS

The 330 selected greyware pottery samples were characterised and classified using a combination of thin section petrography and instrumental geochemistry. These techniques were performed independently before comparing the results with one another, as well as with the accompanying archaeological information on the ceramics. Standard 30 μm thin sections of all sherds were visually grouped into petrographic fabrics under the polarising light microscope based upon the nature of their inclusions, clay matrix and voids (Quinn 2013, 73-79). Each fabric was then interpreted in terms of its raw materials and manufacturing technology.

Geochemical characterisation was carried out at the Material Culture and Archaeological Science (MCAS) laboratories, Institute of Archaeology, University College London, using a Specro X-Lab 2000 energy dispersive X-ray fluorescence spectrometer (ED-XRF). Subsamples of c. 5 g in weight were taken from each sherd for the purpose of ED-XRF analysis. The surface layer of each subsample was removed with a tungsten carbide abrasive tool and the remaining material was then ground to a fine powder and oven dried at 110°C for 12 hours. The dried powder was pressed as pellets, using 4 g of sample and 0.9 g of binding wax. A total of eight major elements (Na_2O, MgO, Al_2O_3, SiO_2, K_2O, CaO, TiO_2, Fe_2O_3) and two minor elements (P_2O_5, MnO) were measured as percentage weight (%wt) oxides, and 20 trace elements (S, V, Cr, Co, Ni, Cu, Zn, Ga, Rb, Sr, Y, Zr, Nb, Ba, La, Ce, Hf, Ta, Pb and Th) were recorded as parts per million (ppm). The accuracy of the ED-XRF analysis was monitored using certified reference materials SARM69 'Ceramic-1'

and NBS679 'Brick Clay'. The elements Ag, As, Br, Bi, Cd, Cl, Cs, G, Hg, I, In, Mo, Se, Sb, Sn,Te, Tl, U and W had concentrations below the limits of detection of the ED-XRF so were disregarded. The remaining elemental data was then normalised to 100% and subjected the multivariate statistical analysis via principal components analysis (PCA) in order to identify compositional patterning and the existence of geochemical groups.

The petrographic thin sections from the 25 sites were directly compared under the microscope with those analysed from Cabrera d'Anoia by Travé et al. (2014) in order to identify possible matches. The geochemical reference groups from this published study were also classified statistically with the 330 greyware sherds via PCA and compared via scatterplots of specific pairs of elements. The possible sources of raw materials for the production of those sherds that could not have come from Cabrera d'Anoia were identified using geological maps of Catalonia (Institut Cartogràfic i Geològic de Catalunya) as well as the geographic distribution of these fabrics in the dataset.

IDENTIFICATION AND DISTRIBUTION OF POTTERY FROM CABRERA DE ANOIA

Petrographic classification of the 330 pottery sherds in thin section revealed the existence of 28 distinctive coarse-grained fabrics (Table 2) (Figs. 4 and 7). A total of 43 sherds exhibit a close petrographic match with the previously described Coarse Granitic Fabric (Fig. 4a-b), which occurs as wasters at the kiln site of Cabrera d'Anoia (Travé et al. 2014). The sherds belonging to this fabric come from settlements within the shire of Anoia and neighbouring Bages, where they constitute the largest proportion of the analysed samples (Fig. 5a). The Coarse Granitic Fabric was not detected among the sherds analysed from other Catalonian sites in this study. Samples that correlate well with the Coarse Granitic with Clay Pellets Fabric, the Coarse Granitic with Calcite Fabric and the Fine Granitic Fabric of Travé et al. (2014) were also found at sites in the Anoia region (Fig. 5b-d).

Statistical classification of the geochemical data from the 330 greyware sherds and the 100 Cabrera d'Anoia control samples via PCA accounts for c. 50% of the total variance in the dataset. This is lower than the recommended value of 60% (Baxter 2003) due to the compositional diversity and large size of the dataset. A scatterplot of principal component 1, which is strong affected by Al_2O_3, Ga, Nb, Th, TiO_2 and Y versus principal component 2, which is strongly affected by CuO, Ni, Pb and Zn (Figs. 6 and 9) reveals the presence of several compositional groups (A, B, C, D and E), that were identified visually and corroborated by independent hierarchical cluster analysis and the petrographic data on the same samples. By highlighting the samples belonging to the three published geochemical reference groups from Cabrera d'Anoia (Travé et al. 2014), it can be seen that they mostly plot in chemical groups A and B along with numerous greyware samples analysed from the consumption sites (Fig. 6b). Cabrera d'Anoia reference groups 1 and 2 appear in group A with most of the aforementioned samples of the Coarse Granitic Fabric (Fig. 6c). A close geochemical match is also visible between the sherds belonging to the Fine Granitic Fabric and Cabrera d'Anoia reference group 3 (Fig. 6c), both of which plot in group B in the PCA scatter plot. Interestingly, the sherds that match the other Cabrera d'Anoia fabrics occur mainly in group B and therefore do not correlate well with reference group 2 (Fig. 6d), as is the case in production material from Cabrera d'Anoia (Travé et al. 2014).

Notwithstanding the above mismatch, the petrographic and geochemical correlations between greyware sherds analysed from several of the studied sites and the previously analysed wasters from Cabrera d'Anoia, suggests that we are able to positively identify the products of this kiln site in the surrounding landscape (table 2). These occur at all sites within the shire of Anoia, where they account for up to 95% of studied assemblages, as well as at two sites just across the border in the neighbouring shires of Bages and Segarra (Fig. 5). In our analysis, the products of Cabrera d'Anoia occur in a range of consumption contexts dated to the 10^{th}–14^{th} Centuries.

IDENTIFICATION OF GREYWARE CERAMICS FROM OTHER SOURCES

Some 80% of the greyware sherds analysed from the 20 sites did not correspond petrographically with the production groups established at Cabrera d'Anoia by Travé et al. (2014). These ceramics, which account for groups C, D and E in the geochemical classification of the 330 samples (Fig. 6), are likely to have been produced at one or more other Medieval kiln sites in Catalonia, or further afar. While the locations of several other greyware production sites are known from archaeological or written evidence (e.g. Casampons, Quart or Verdú), few have been excavated and studied in detail. In the absence of petrographic or geochemical control groups for the ceramics produced at these sites, we can speculate about the origins of the other greyware sherds in the present study by using the petrographic information that they contain in thin section (Fig. 7). The geological diversity of Catalonia means that different parts of the region are characterised by distinct rock and sediment types (Fig. 8). Matching the particulate inclusions within the remaining 25 petrographic fabrics to occurrences of compatible raw materials provides us with a good general guide to their probable geological sources (Quinn 2013, 117-119). This can be compared to the distribution of known and suspected Medieval kilns in order to infer the probable centres that produced the ceramics of each fabric. The following discussion is restricted to those fabrics that are most significant in terms of the identification of additional greyware production sites and the reconstruction of markets and trade. The detailed compositional classification of the remaining fabrics is presented in table 2.

Sherds with characteristic phyllite and/or slate inclusions that have been classified as the Coarse Metamorphic Fabric (Fig. 7a) and plot mainly in chemical group B (Fig. 9a), occur at several sites in the shire of Anoia (Fig. 10a). These samples exhibit coarse, poorly-sorted, angular mica-rich inclusions together with quartz and feldspar. This composition was not detected among the greyware sherds analysed from the kiln site of Cabrera d'Anoia by Travé et al. (2014). However, low grade metamorphic rocks including slate and phyllite occur around Piera, a distance of 4 km away (Fig. 8). There are written records of Medieval pottery manufacture in the village of Piera (Fig. 1) and it is therefore possible

that the ceramics of the Coarse Metamorphic Fabric represent the products of an as yet undiscovered kiln site that once operated in this area.

A final greyware composition that occurs at sites within the province of Anoia is the Coarse Quartz and Marl Fabric (Fig. 7c), a sandy variant of which also occurs at Sant Miquel de la Vall in Pallars (Fig. 7b; Fig 10b). This fabric contains frequent sub-rounded to angular calcareous inclusions as well as angular quartz and feldspar. These ceramics, which plot in or close to chemical group B (Fig. 9a), may have originated from the kiln site of Verdú (Fig. 1). This workshop produced greyware ceramics from Medieval times until to the late 20th century and is located in an area of sedimentary geology that contains several marly units.

Three related petrographic fabrics were identified at the four sites studied within the shire Berguedà (Fig. 7d-f). The most common of these is the Coarse Quartz, Altered Feldspar and Rock Fragments Fabric, which is characterised by inclusions of quartz, weathered alkali feldspar and rare sedimentary and very low-grade metamorphic rock fragments (Fig. 7d). Ceramics of this fabric were not detected elsewhere in Catalonia in our sample set (Fig. 10c), suggesting that it was produced somewhere within Berguedà. This interpretation is corroborated by the surface geology of the area, which is dominated by sedimentary rock units (Fig. 8). Possible production locations include the excavated kiln sites of Casampons (Padilla 1984) and Santa Creu d'Ollers (Riu 1972) (Fig. 1). Chemically, samples of the Coarse Quartz, Altered Feldspar and Rock Fragments Fabric are included in groups A and B and those of a finer related fabric (Fig. 7e) plot in groups B and E (Fig. 9b). Some of the group A samples are chemically indistinguishable from the Cabrera d'Anoia reference groups via PCA. However, they are petrographically distinct under the microscope due to clear differences in mineralogy and texture. Previous research on the ceramics of Casampons has suggested that this greyware workshop was operated during two different phases that can be distinguished by a slight variation in recipe (Vendrell et al. 1997a, 266-267; Padilla et al. 1989). This may explain the existence of chemical variation within these fabrics.

Ceramics of the Coarse Sand Fabric (Fig. 7g) constitute c. 60% of the samples analysed from the two sites studied in the shire of Girona (Fig. 10d). These are characterised by well-sorted, rounded, quartz and phyllite sand temper added to very fine base clay. Ceramics of this fabric fired in either a strongly oxidising or a uniformly reducing atmosphere. Both versions plot in chemical group C in the PCA scatterplot in Fig. 9c. The quartz sand inclusions are not particularly indicative of provenance, but could have possibly been obtained from alluvium of the river Onyar (Fig. 1). Greyware production is thought to have taken place in the village of Quart on the banks of the river in central Girona in Medieval times (Guerrero 1988, 194). As such this might be a candidate for the source of the ceramics of the Coarse Sand Fabric (Travé et al. 2013a).

The Calcite, Opaques and Fine Quartz Fabric (Fig. 7h) occurs within the ceramics analysed from the sites of Sant Miquel de la Vall (Pallars) and Sant Feliu de Girona (Girona), which are located some 150 km apart (Fig. 10e). The sherds at both sites are characterised by fine sand-sized quartz, calcite, shell and opaque inclusions within a calcareous clay matrix. Whilst fossiliferous limestone is common in many parts of Catalonia and the adjacent Pyrenees, it worth noting that carbonate rocks occur more commonly in the shire of Pallars than in Girona (Fig. 8).

The remaining ceramic compositions, such as the Acidic/Intermediate Igneous Rock Fragments Fabric (Fig. 7i), which accounts for all of the sherds analysed from Sant Andreu d'Òrrius in the shire of Maresme (Fig. 10f), seem to represent examples of local production that occurred at sites in the immediate area of a workshop. The Acidic/Intermediate Igneous Rock Fragments Fabric contains coarse angular rock fragments composed of quartz, plagioclase, epidote and biotite, and constitutes the bulk of geochemical group D (Fig. 9d). Sant Andreu d'Òrrius is located on a large granite and granodiorite outcrop (Fig. 8), perhaps confirming that the ceramics from this site were locally produced. A possible source might be the workshop of Sant Fost de Campsentelles (Fig. 1).

Within the shire of Osona, only the site of L'Esquerda was sampled in this study. Its ceramic assemblage contained sherds classified within three distinct petrographic fabrics, each accounting for c. 30% of the sample, that are geochemically related to one another (Fig. 9d). The presence of arkose and acidic igneous rock inclusions in thin section suggests that the greyware ceramics at L'Esquerda could have had been locally produced within the shire. Possible sources could include the unexcavated workshops of Sant Julià de Vilatorta and Sant Romà de Sau (Fig. 1) (Travé et al. 2013b).

DISCUSSION: GREYWARE DISTRIBUTION, MARKETS AND TRADE

Our compositional characterisation of the 330 Medieval greyware sherds and its comparison with the reference groups of Travé et al. (2014) as well as published geological and archaeological data has revealed the existence of several pottery workshops operating in Catalonia and distributing their products within the surrounding landscape. Four of these production centres have already been excavated (Cabrera d'Anoia, Casampons, Santa Creu d'Ollers, Sant Fost de Campsentelles), three are known from written sources only (Piera, Verdú, Quart), whereas several others, in the shires of Pallars and Osona, are yet to be discovered.

Pottery from the major workshop of Cabrera d'Anoia has been be identified at all consumption sites analysed from the shire of Anoia, as well as at two sites in the neighbouring shires of Bages and Segarra (Fig. 5). This implies that its market covered an area of at least 40 km within the surrounding landscape. Greyware pottery is likely to have been exported from the workshop along the River Anoia.

While the products of Cabrera d'Anoia account for up to 95% of the studied ceramics at specific sites in the shire of Anoia, a second large workshop, probably located in Piera, also distributed greyware pottery in an overlapping territory. The two kiln sites, which are separated by a distance of 10 km, account for all sherds that have been analysed from sites

within a 30 km radius. This could be interpreted in terms of direct competition for a similar market, or perhaps the existence of two workshops working in tandem to meet the needs of the surrounding villages (Fig. 11).

In the northern shire of Berguedà the workshops of Casampons or Santa Creu d'Ollers seem to have monopolised the market within a radius of 10-15 km for several centuries. The products of one or other of these kiln sites reached villages located further afar (e.g. El Sull and the Castle of Saldes), however, they shared the market with or competed directly against other, as yet unidentified centres in this area. The River Llobregat is likely to have acted as the main conduit along which greyware ceramics were distributed within Berguedà in Medieval times. The river continues beyond Berguedà, into the shire of Bages, and may also have facilitated the distribution of greyware from the excavated workshop of Cal Ticó further south.

East of the River Llobregat, the pattern of Medieval greyware pottery production and distribution appears to have differed considerably from the western part of Catalonia. Both our compositional data and the existing archaeological data point towards the existence of a larger number of smaller, perhaps household workshops, supplying local communities within a reduced market area. For example, ceramics produced in the region of Osona does not seem to have reached sites in Girona and vice-versa, perhaps due to the regional organisation of the Medieval Counties of Besalú and Girona.

These differences in greyware pottery production and distribution may be related to the changing Muslim border to the west and the resulting expansion of Christian lands (Fig. 3). Large workshops such as Cabrera d'Anoia, Piera and Casampons could have served to strengthen the Llobregat basin as a barrier against nobility revolts distributing their goods in local markets (Riera 2004, Soler 2004). Both Cabrera d'Anoia and Piera are located close to the Castle of Cabrera, from which the Counts and Viscounts of Barcelona could have controlled Medieval production and trade in the area, as well as forest exploitation (Py 2001, 199) and travelling routes (Vives 2007, 778-780). The comparatively calm conditions in the east of Catalonia would have enabled small households industries to prevail, serving the needs of villages in their local area with relatively minor competition. Records show that local markets existed in the Counties of Empordà, Besalú and Girona (fig. 3) in eastern Catalonia between 11th–12th Centuries, for example on the banks of the river Onyar (fig. 11) (Alberch et al. 1983, 22-24).

The occurrence of compositionally related sherds at sites up to 150 km apart might provide evidence broader scale networks of greyware pottery distribution in the region in Medieval times. Long distance trade via middlemen or 'marxants' is not uncommon from the 16th–17th Centuries onwards (Torras 1994, Vilar 1966). It therefore is tempting to propose that these regular trade routes started earlier, in the 14th–15th Century. However, the small number of cases of long distance movement of ceramics contrasts with the general pattern in our dataset (Fig. 11).

Unravelling the details of Medieval greyware production and distribution in Catalonia and the economic, political and cultural driving forces behind these is likely to be challenging endeavour. Data from additional sites, as well as the establishment of further compositional control groups from other workshops, for example Casampons, will enable us to better capture the underlying patterns of pottery consumption, of which we have provided an initial glimpse in this paper. The analysis of stratified and dated sites within the shifting border zone in particular, could be used to test the above theory about the relationships between pottery industries and the gradual expansion of Christian territory throughout the Medieval period. These are important goals and directions for our on-going and future research on this topic.

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FIGURES

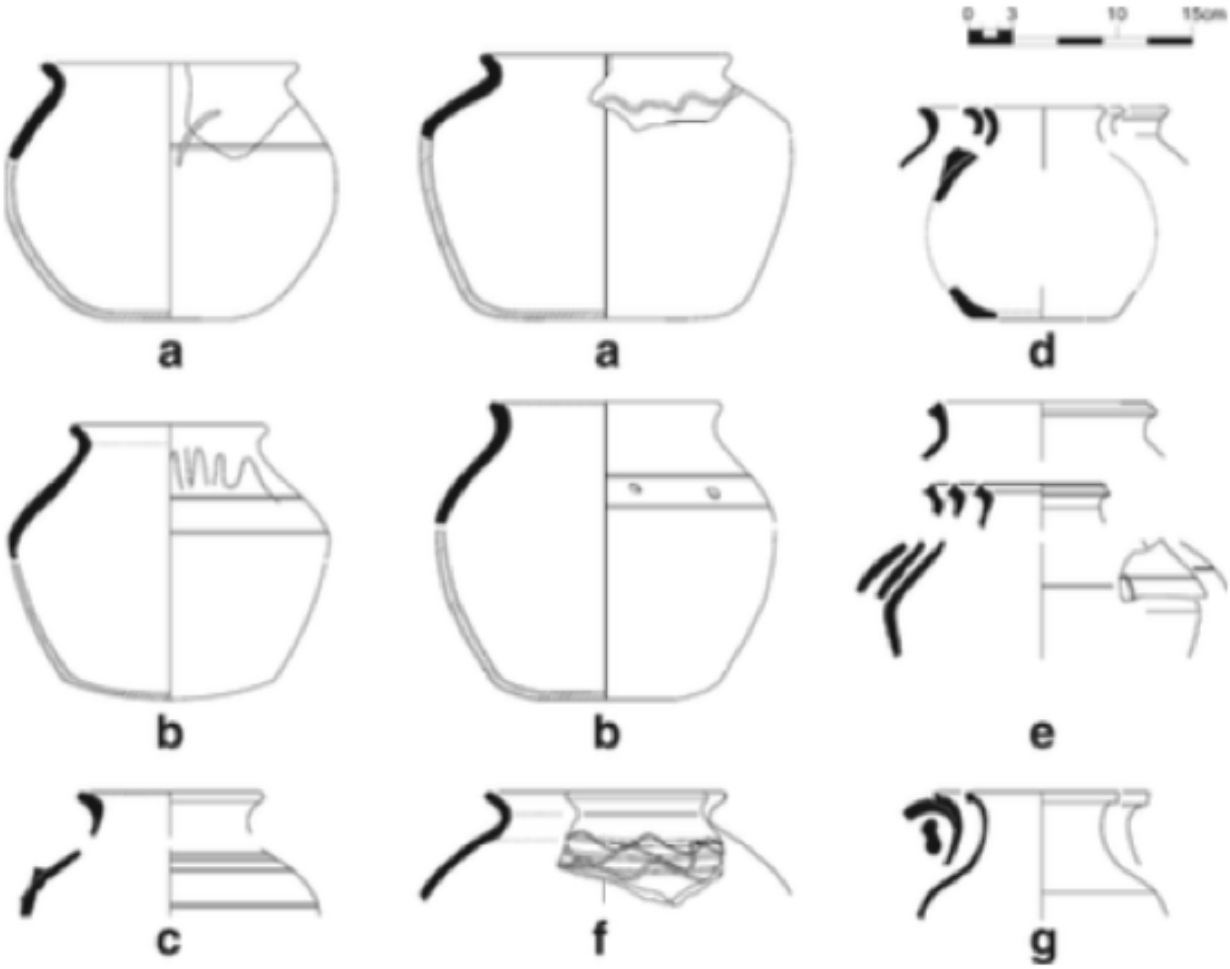
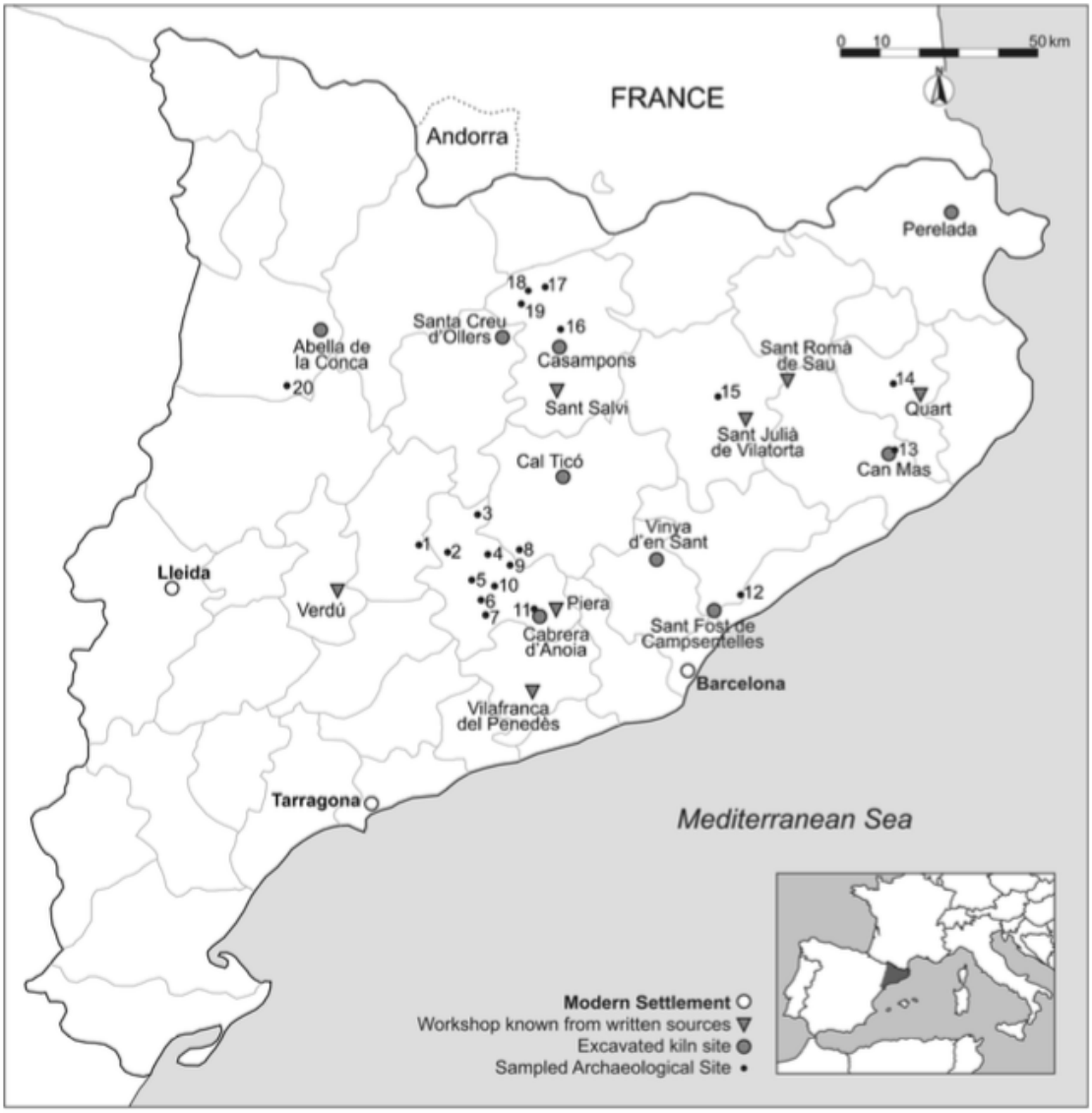


Fig. 1. Illustrations of greyware boiling pots or ‘ollas’ from the Medieval kiln sites of Casampons (a) and Cabrera d’Anoia (b) and from consumption sites in the shires of Anoia (c), Berguedà (d), Osona (e), Maresme (f) and Girona (g).



SAMPLED ARCHAEOLOGICAL SITES: (1) Santa Maria de Gàver, (2) Sant Miquel de Veciana, (3) Castell de Boixadors, (4) Santa Maria de Rubió, (5) Sant Julia de les Alzinetes and Pla del Magre, (6) Tossa Medieval and Santa Margarida de Montbui, (7) Santa Càndia d'Orpí, (8) Sant Pere del Mont and Torre del Moro, (9) Collet de Sant Pere Màrtir and Torre d'Òdena, (10) Sant Jaume Sesoliveres, (11) La Creueta, (12) Sant Andreu d'Òrrius, (13) Sant Esteve de Caulers, (14) Sant Feliu de Girona, (15) L'Esquerda, (16) Mas B de Vilosiu, (17) Sant Sebastià del Sull, (18) Castell de Saldes, (19) Roc de Palomera, (20) Sant Miquel de la Vall.

Fig. 2. Location of the 25 Medieval Catalonian sites analysed in this study (small black dots) as well as production sites that have been excavated or are known from written sources, including borders of present-day shires.

Fig. 3 : Map of Catalan Counties from 8th to 12th Centuries AD with changing border between Christian and Muslim domains.

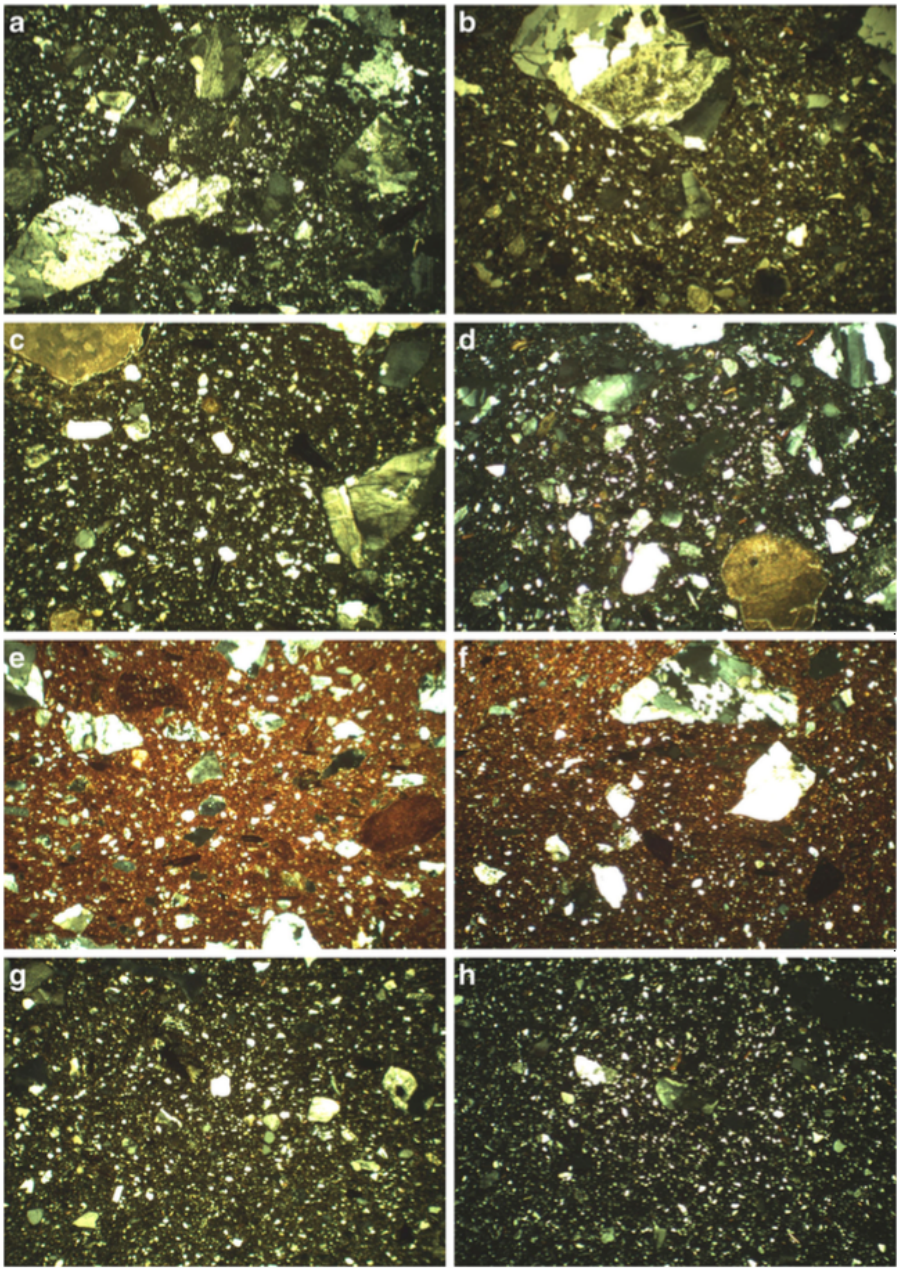


Fig. 4. Photomicrographs of petrographic reference groups from the Medieval kiln site of Cabrera d'Anoia (Travé et al. 2014) (left column) and compositonal matches within the 330 greyware ceramics from consumption sites analysed in this study (right column). Coarse Granitic Fabric (a-b); Coarse Granitic with Calcite Fabric (c-d); Coarse Granitic with Clay Pellets Fabric (e-f) and Fine Granitic Fabric (g-h). All images captured in crossed polars. Image width = 5 mm.

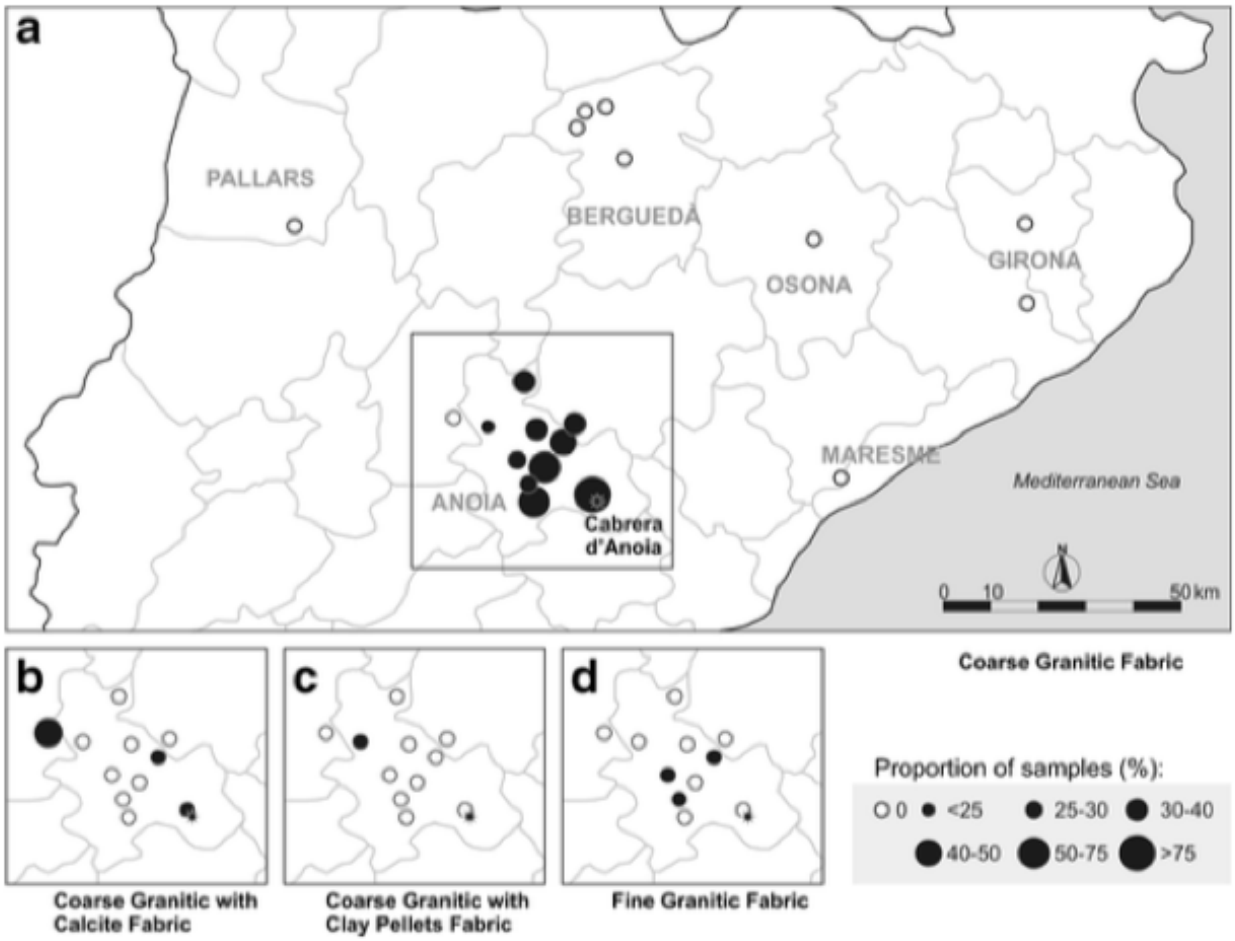


Fig. 5. Distribution of Medieval greyware ceramics corresponding to petrographic reference groups from the Medieval kiln site of Cabrera d'Anoia (Travé et al. 2014). Coarse Granitic Fabric (a). Coarse Granitic with Calcite Fabric (b). Coarse Granitic with Clay Pellets (c). Fine Granitic Fabric (d).

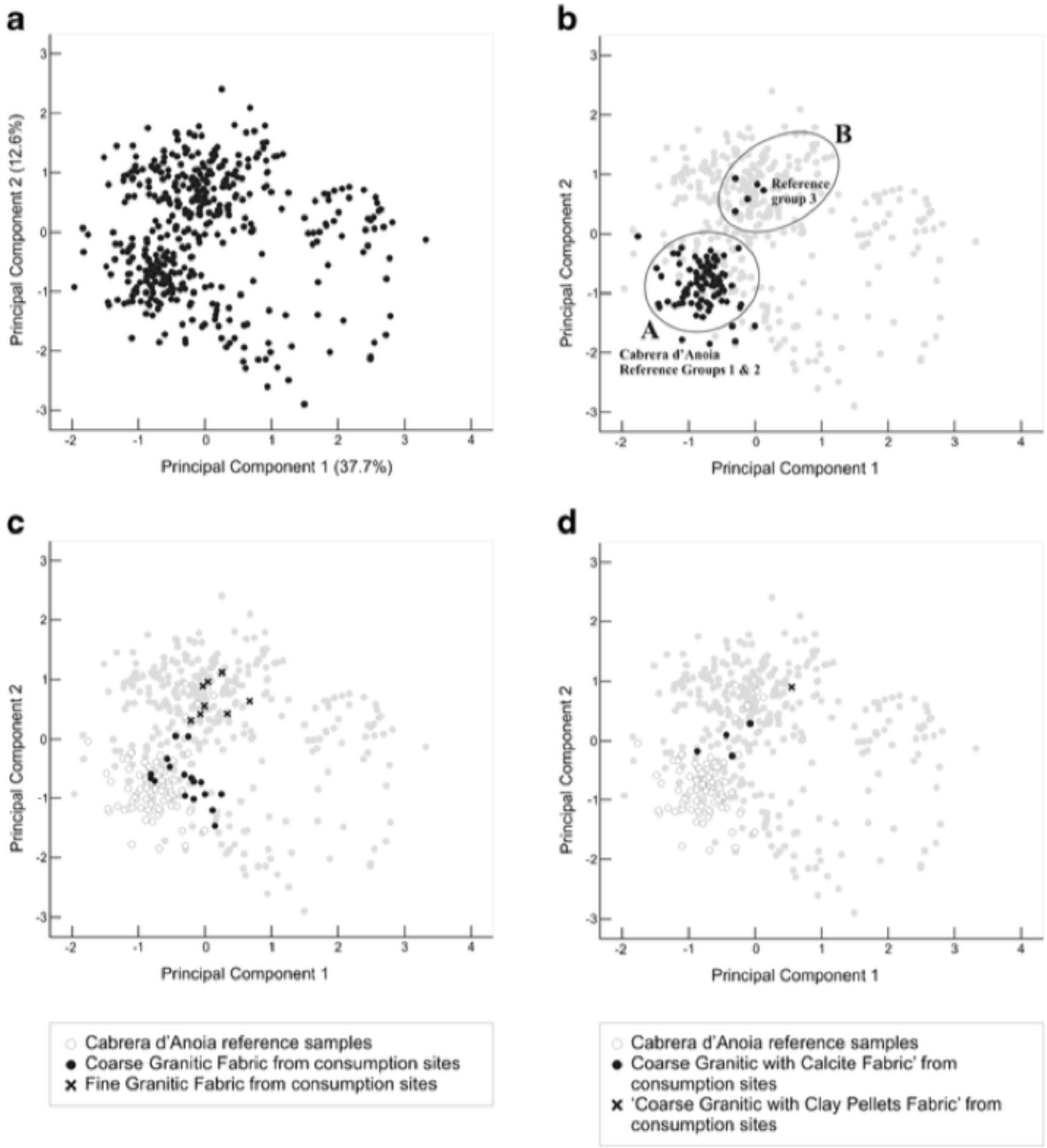


Fig. 6. Principal components analysis scatterplots of the multivariate geochemical data from 330 Medieval greyware pottery sherds analysed in this study combined with 100 reference sherds from the kiln site of Cabrera d'Anoia (Travé et al. 2014). Scatterplot of principal component 1 versus principal component 2 (a). Scatterplot with the geochemical reference groups from Cabrera d'Anoia highlighted (b). Geochemical comparison between the 100 Cabrera d'Anoia samples and sherds in this study matching the Coarse Granitic Fabric and Fine Granitic Fabric (c). Comparison between the Cabrera d'Anoia reference samples and sherds matching the Coarse Granitic Fabric with Calcite and Coarse Granitic Fabric with Clay Pellets Fabric (d).

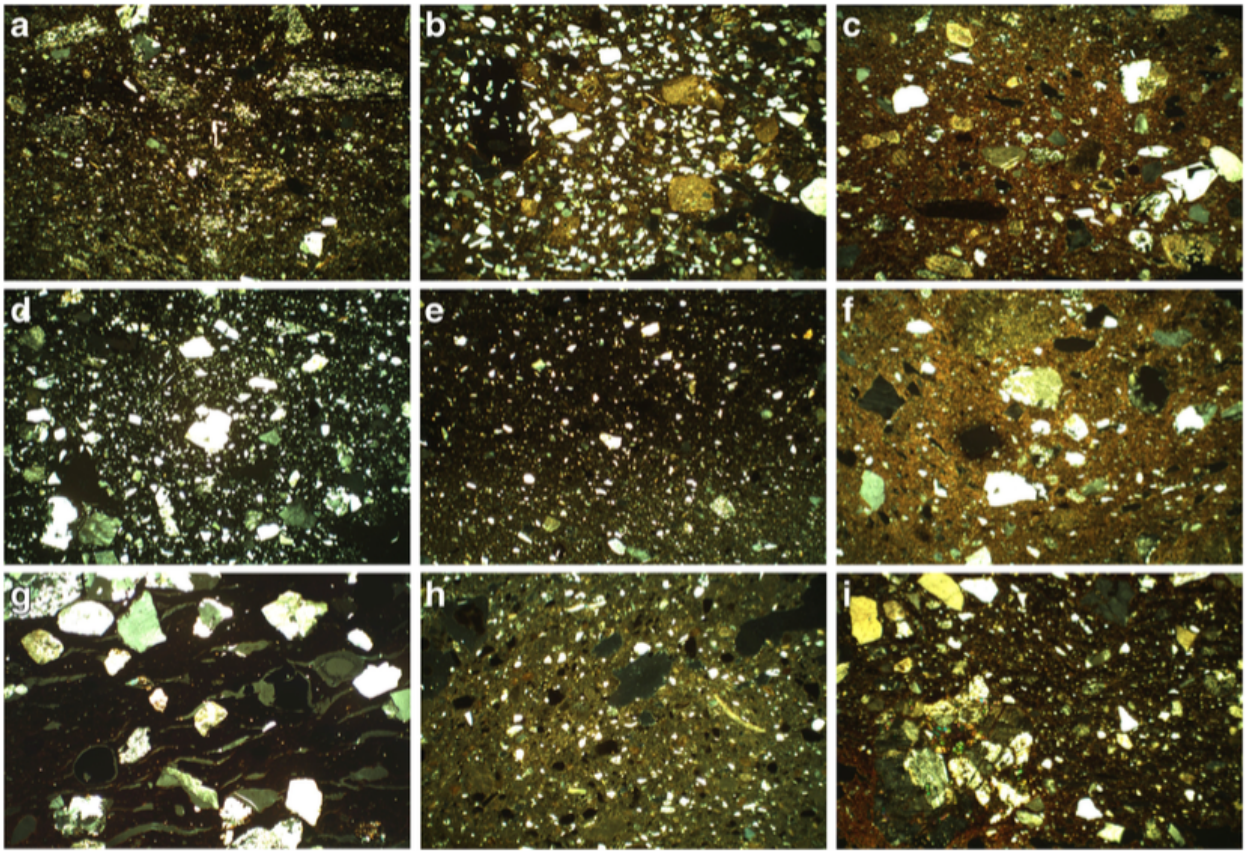


Fig. 7. Photomicrographs of selected petrographic fabrics detected within the 330 Medieval greyware pottery sherds analysed in this study, that cannot be ascribed to the production site of Cabrera d'Anoia. Coarse Metamorphic Fabric (a), Coarse Quartz and Sandy Marl Fabric (b), Coarse Quartz and Marl Fabric (c), Coarse Quartz, Altered Feldspar and Rock Fragments Fabric (d), Fine Quartz, Altered Feldspar and Rock Fragments Fabric Fabric (e), Very Fine Clay, Quartz and Rock Fragments Fabric (f), Reduced Coarse Sand Fabric (g), Calcite, Opaques and Fine Quartz Fabric (h), and Acidic/Intermediate Igneous Rock Fragments Fabric (i). All images captured in crossed polars. Image width = 6 mm.

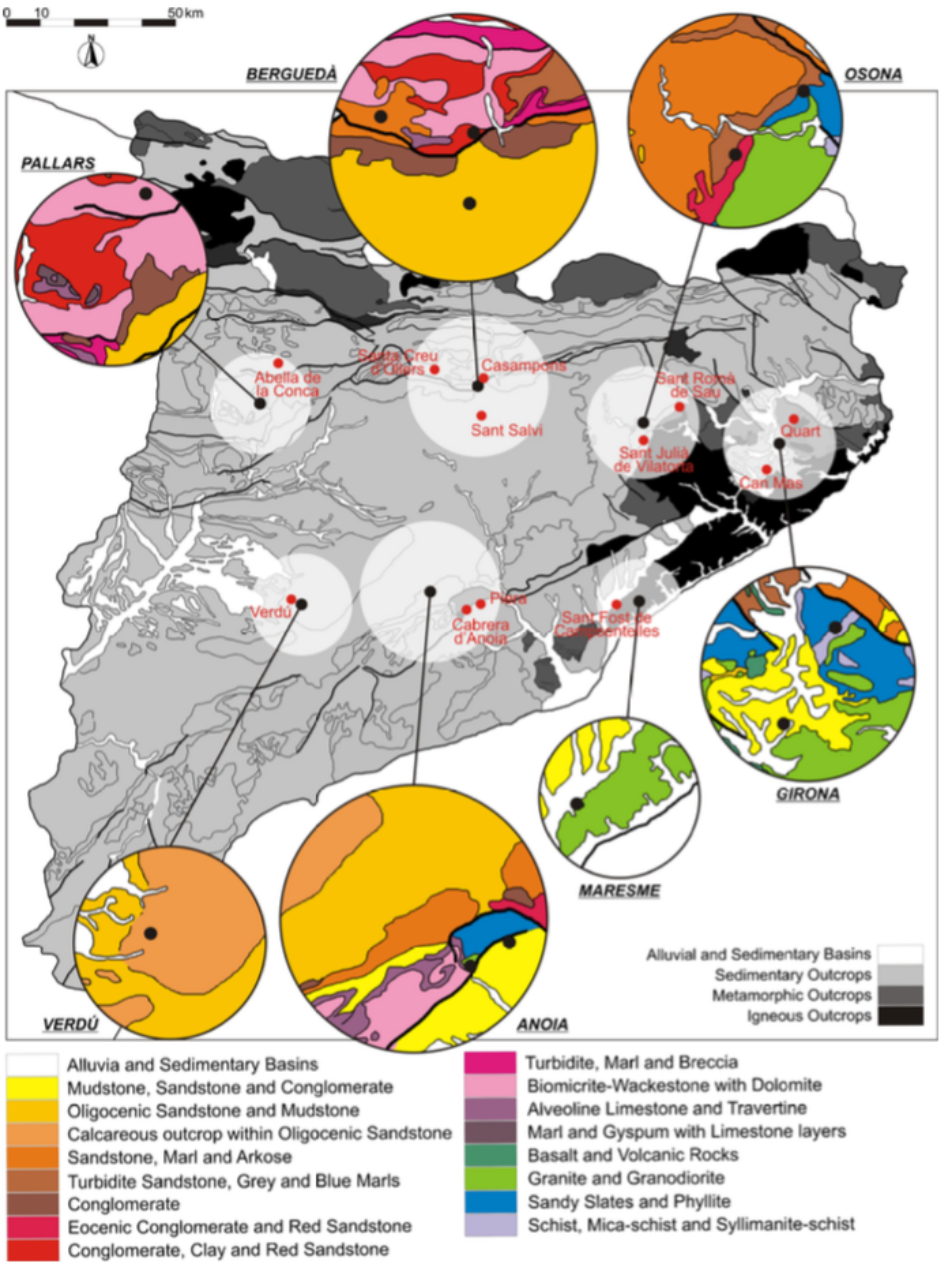


Fig. 8. Geological map of Catalonia with details of the bedrock in selected areas mentioned in the text and the location of specific kilns sites excavated or known from written sources.

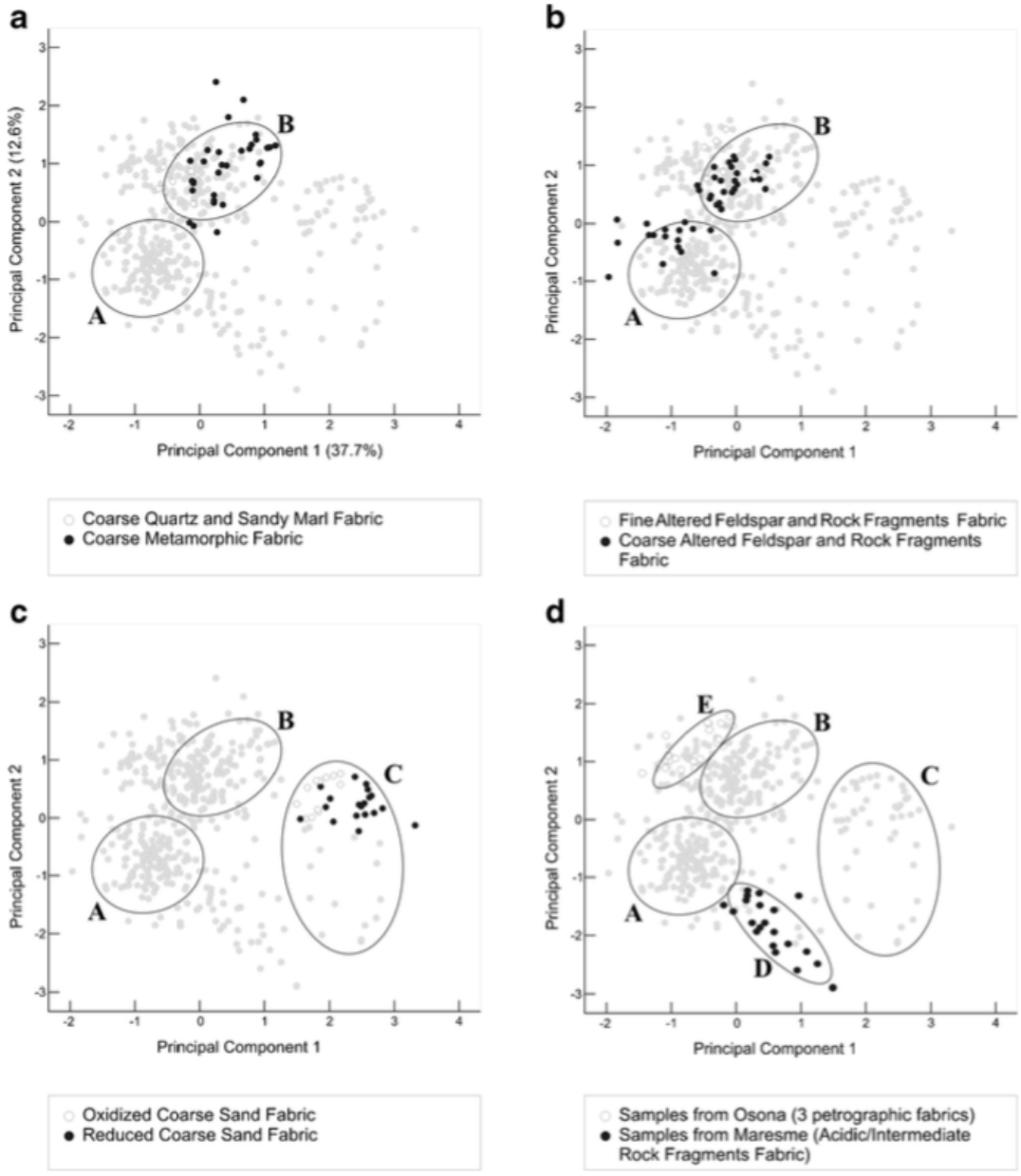


Fig. 9. Principal components analysis scatterplots of the multivariate geochemical data from the 330 Medieval greyware pottery sherds analysed in this study indicating the location of sherds ascribed to selected petrographic fabrics illustrated in Fig. 7 above. Coarse Metamorphic Fabric and Coarse Quartz and Sandy Marl Fabric (a). Coarse Quartz, Altered Feldspar Rock Fragments Fabric and Fine Quartz, Altered Feldspar Rock Fragments Fabric (b). Oxidised Coarse Sand Fabric and Reduced Coarse Sand Fabric (c). Acidic/Intermediate Igneous Rock Fragments Fabric and samples found at the shire of Osona.

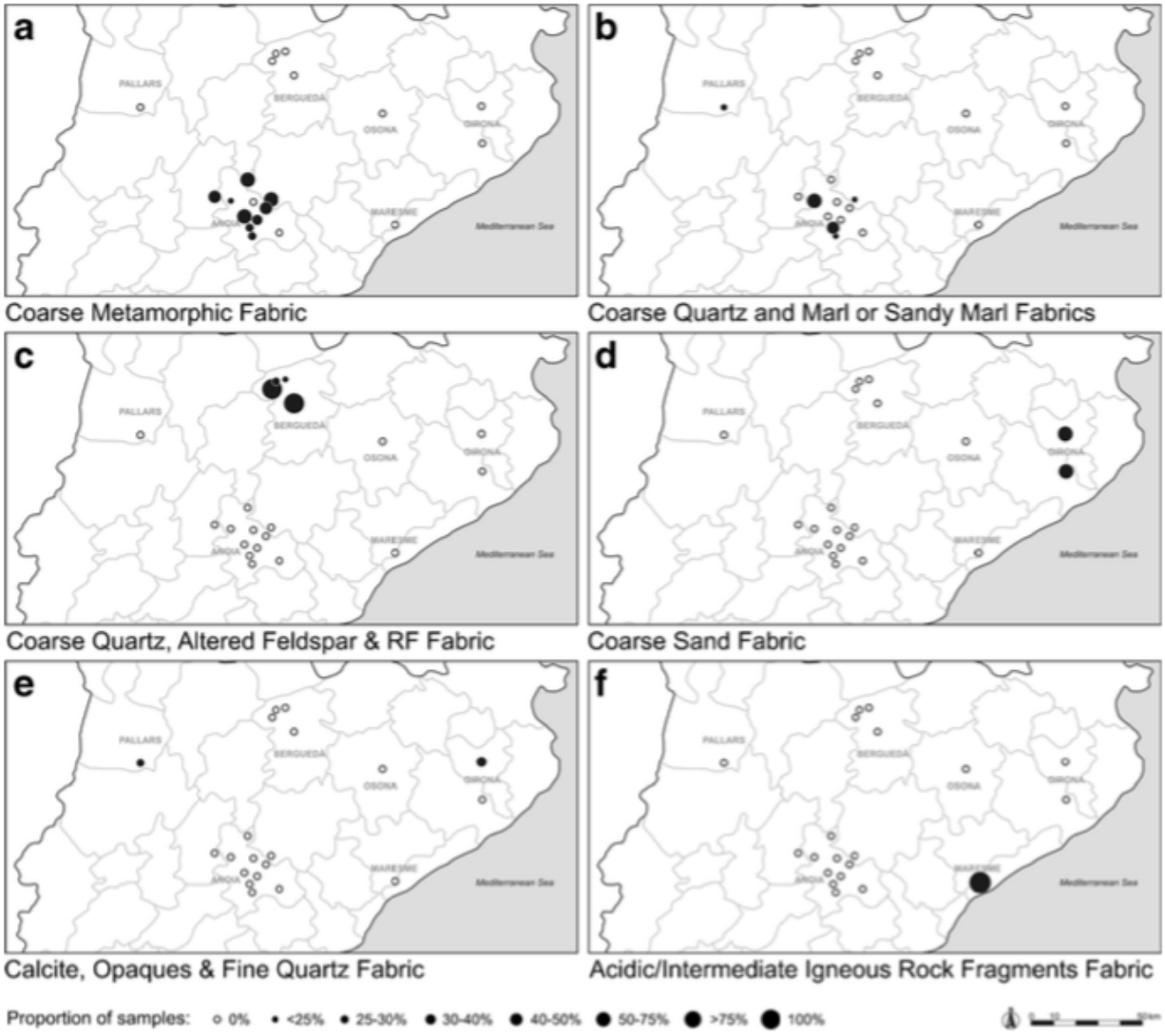


Fig. 10. Distribution of Medieval greyware ceramics belonging to selected petrographic fabrics illustrated in Fig. 7 above. Coarse Metamorphic Fabric (a), Coarse Quartz and Sandy Marl Fabric and Coarse Quartz and Marl Fabric (b), Coarse Quartz, Altered Feldspar Rock Fragments Fabric (c), Oxidised Coarse Sand Fabric and Reduced Coarse Sand Fabric (d), Calcite, Opaques and Fine Quartz Fabric (e), Acidic/Intermediate Igneous Rock Fabric (f).

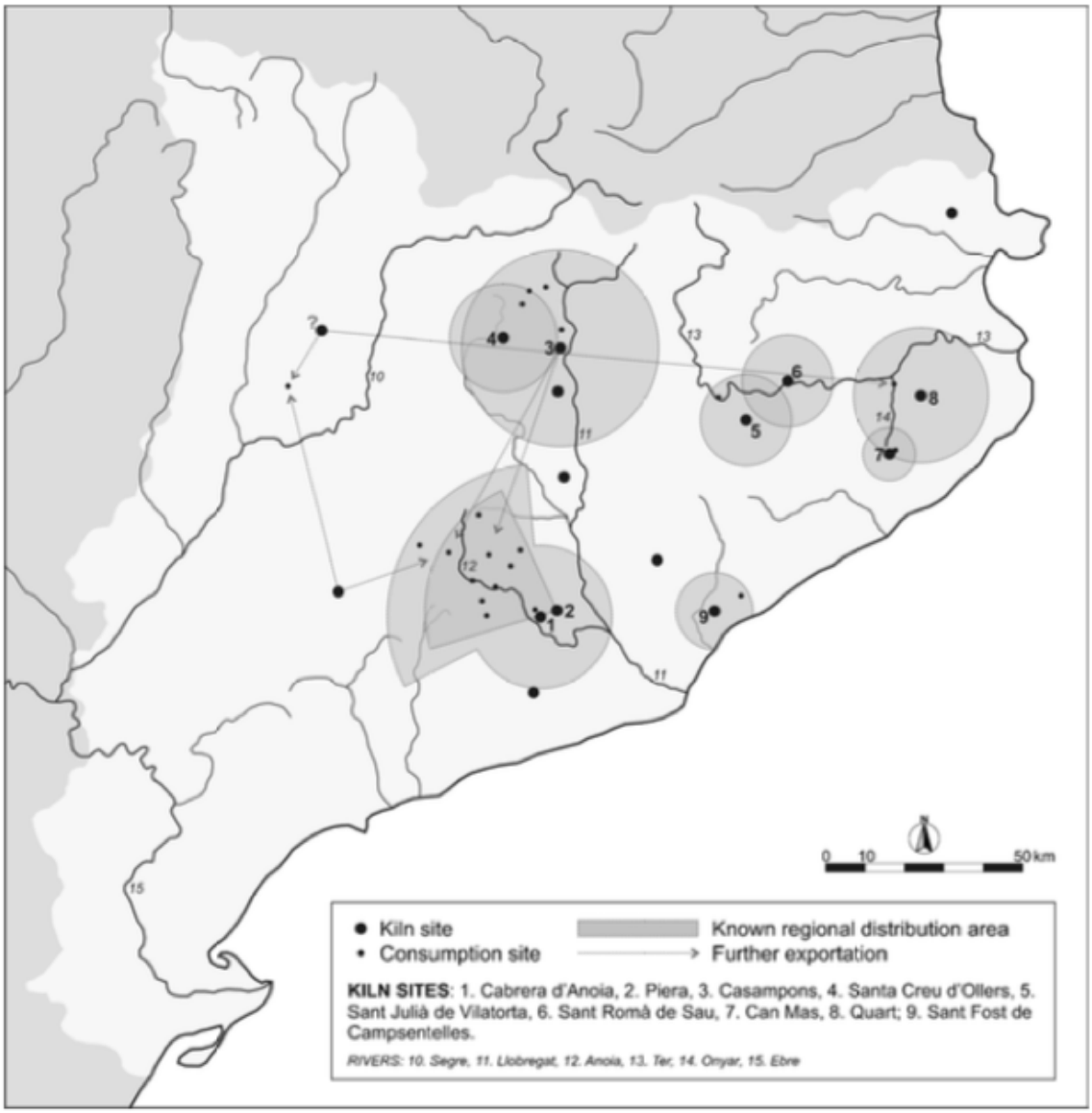


Fig. 11: Interpreted patterns of Medieval greyware pottery distribution in Catalonia and the possible markets of individual workshops discussed in the text.

TABLES

Table 1: Medieval Catalan sites from which greyware ceramics were analysed in this study.

Shire	Archaeological Site	Description	Period	No samples
Anoia	La Creueta	Necropolis	10th - 12th Cent.	16
Anoia	Tossa Medieval	Village	10th Cent. (?)	1
Anoia	Collet de Sant Pere Màrtir	Necropolis	11th - 13th Cent.	19
Anoia	Santa Maria de Rubió	Church	11th - 14th Cent.	8
Anoia	Òdena	Village	12th - 13th Cent. (?)	5
Anoia	Torre d'Òdena	Castle	12th - 14th Cent.	3
Anoia	Santa Margarida de Montbui	Village	12th Cent.	1
Anoia	Santa Margarida de Montbui	Village	12th Cent.	9
Anoia	Pla del Magre	Village	12th Cent. (?)	1
Anoia	Sant Miquel de Veciana	Church	13th - 14th Cent.	26
Anoia	Castell de Boixadors	Castle	14th - 15th Cent.	17
Anoia	Sant Jaume Sesoliveres	Church	14th Cent.	5
Anoia	Santa Càndia d'Orpí	Church	Before 14th Cent.	10
Anoia	Sant Julià de les Alzinetes	Church	Before 1517	11
Bages	Torre del Moro	Castle	10th - 11th Cent.	3
Bages	Sant Pere del Mont	Monastery	11th - 13th Cent.	1
Berguedà	Sant Sebastià del Sull	Monastery	11th - 12th Cent.	35
Berguedà	Roc de Palomera	Village	11th - 14th Cent.	3
Berguedà	Castell de Saldes	Castle	11th Cent.	19
Berguedà	Mas B de Vilosiu	Single household	12th - 14th Cent.	19
Gironès	Sant Feliu de Girona	Church	12th - 14th Cent.	16
Segarra	Santa Maria de Gàver	Church	11th - 12th Cent.	2
La Selva	Sant Esteve de Caulers	Village	12th - 14th Cent.	41
Maresme	Sant Andreu d'Òrrius	Sacraria	13th Cent.	25
Osona	L'Esquerda	Village	12th - 13th Cent.	25
Pallars Jussà	Sant Miquel de la Vall	Castle	11th - 14th Cent.	9

Table 2. Petrographic and geochemical classification of 330 Medieval greyware pottery sherds analysed in this study, including their interpreted origin.

Petrographic fabric	Shires and Sites (sample numbers given in parentheses)	Geochem. group	Interpreted Production Location
Coarse Granitic Fabric	ANOIA: Castell de Boixadors (1, 2, 9, 19, 20), La Creueta (1, 12), Santa Margarida de Montbui (8), Santa Càndia d'Orpí (1, 4, 5, 6, 9, 10), Sant Julià de les Alzinetes (5), Sant Jaume Sesoliveres (5, 10), and Collet de Sant Pere Màrtir (8, 14, 15, 21)	A	Cabrera d'Anoia
	ANOIA: Castell de Boixadors (3, 13, 21), La Creueta (3, 4, 5, 6, 8, 9, 10, 11, 13, 15, 16), Òdena (3), Sant Julià de les Alzinetes (6, 13), Santa Maria de Rubió (3, 4, 6), Sant Miquel de Veciana (3, 10, 15, 18), and Collet de Sant Pere Màrtir (17)	B	Cabrera d'Anoia?
C. G. & Clay Pellets Fabric	ANOIA: Sant Miquel de Veciana (33)	B	Cabrera d'Anoia?
C. G. with Calcite Fabric	ANOIA: La Creueta (2, 7), Santa Maria de Gàver (1), Collet de Sant Pere Màrtir (13, 20)	B	Cabrera d'Anoia?
Fine Granitic Fabric	ANOIA: La Creueta (14), Santa Margarida de Montbui (11), Òdena (1), Santa Càndia d'Orpí (7), Sant Julià de les Alzinetes (1, 11), Collet de Sant Pere Màrtir (9, 18), and Tossa Medieval (1)	B	Cabrera d'Anoia?
Coarse Metamorphic Fabric	ANOIA: Castell de Boixadors (4, 5, 6, 8, 10, 11, 12, 14, 15, 16), Santa Margarida de Montbui (2, 3, 9), Santa Maria de Gàver (2), Òdena (4, 5, 6), Pla del Magre (2), Santa Càndia d'Orpí (2, 8, 11), Sant Julià de les Alzinetes (2, 3, 7, 9, 12), Sant Jaume Sesoliveres (2, 4), Sant Miquel de Veciana (5, 24), Collet de Sant Pere Màrtir (3, 4, 5, 7, 10, 11, 19), Torre del Moro (1, 2, 3), Torre d'Òdena (1)	B	Probably Piera
Fine Quartz Fabric	ANOIA: Collet de Sant Pere Màrtir (2, 12)	B	
Mica & Granite Fabric	ANOIA: Sant Julià de les Alzinetes (4), Sant Miquel de Veciana (7, 35), and Torre d'Òdena (2)	B	
Coarse Granite and Fine Quartz Fabric	ANOIA: Castell de Boixadors (7, 18) and Sant Miquel de Veciana (6, 9, 16, 28)	B	
Very Coarse Slate & Marl Fabric	ANOIA: Torre d'Òdena (3)	B	
Coarse Quartz & Sandy Marl Fabric	ANOIA: Santa Càndia d'Orpí (3) and Sant Miquel de Veciana (1, 2, 4, 8, 11,13, 14, 17) / PALLARS JUSSÀ: Sant Miquel de la Vall (6, 10)	B	Verdú?
Coarse Quartz & Marl Fabric	ANOIA: Santa Margarida de Montbui (1, 4, 5, 6, 10) and Santa Maria de Rubió (1, 2, 7, 9)	B	Verdú (early)
Fine clay with Clay Pellets & Sandy Marl Fabric	ANOIA: Sant Miquel de Veciana (34, 37, 38, 39)	B	Verdú (late)
Coarse Quartz, Altered Feldspar & Rock Fragments Fabric	ANOIA: Santa Maria de Rubió (8) and Sant Miquel de Veciana (25)	outliers	Casampons (phase A)?
	BERGUEDÀ: Castell de Saldes (14, 17, 20, 21, 22), Roc de Palomera (2, 4, 5), Sant Sebastià del Sull (17, 22, 24, 26, 30, 31, 42, and Mas B de Vilosiu (1, 3, 4, 6, 7, 8, 9, 10, 11, 13, 14, 16, 17, 18, 19 20)	B	
	BERGUEDÀ: Castell de Saldes (2, 9, 13, 19) and Sant Sebastià del Sull (1, 3, 4, 15, 21, 23, 27, 28, 29, 32, 35, 38)	A	
	BERGUEDÀ: Castell de Saldes (8, 12, 15), Sant Sebastià del Sull (10, 11, 37, 38) and Mas B de Vilosiu (22)	outliers	
Coarse Quartz, Altered Feldspar & RF Fabric (Qz rich)	BERGUEDÀ: Sant Sebastià del Sull (25, 33, 36, 46)	outliers	
Fine Quartz, Altered Feldspar & RF Fabric	BERGUEDÀ: Castell de Saldes (4, 5, 10, 16, 18) and Sant Sebastià del Sull (5, 14, 16, 18, 41)	B/E	Casampons (phase B)?
Very Fine Clay, Quartz & Rock Fragments Fabric	BERGUEDÀ: Castell de Saldes (1, 11) and Sant Sebastià del Sull (2, 9, 44)	B	
Coarse Sand (Oxidized) Fabric	LA SELVA: Sant Esteve de Caulers (14, 32, 33, 34, 36, 37, 38, 39, 40, 41, 42, 43)	C	Quart

Coarse Sand (Oxidized-Reduced) Fabric	LA SELVA: Sant Esteve de Caulers (1, 2, 9, 12, 15, 17, 21, 24, 25, 28) GIRONÈS: Sant Feliu de Girona (3, 7, 8, 14, 16, 17)	C	Quart
Coarse Sand (Reduced) Fabric	GIRONÈS: Sant Feliu de Girona (1, 2, 4, 12)	C	Quart
Coarse Quartz & Feldspar Fabric	LA SELVA: Sant Esteve de Caulers (3, 6, 18, 19, 22, 23, 27, 20, 30, 31, 35)	C	
Fine Quartz, Feldspar & Clay Pellets Fabric	LA SELVA: Sant Esteve de Caulers (4, 5, 7, 10, 11, 13, 16, 26)	C	
Mica-schist Fabric	GIRONÈS: Sant Feliu de Girona (13, 15)	C	
Calcite, Opaques & Fine Quartz Fabric	GIRONÈS: Sant Feliu de Girona (5, 6, 8, 10) PALLARS JUSSÀ: Sant Miquel de la Vall (1, 9)	C	Pyrenees
Acidic/Intermediate Igneous Rock Fragments Fabric	MARESME: Sant Andreu d'Òrrius (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 26)	D	Maresme
Coarse Qz-Fds Rock Fragments & Clay Pellets Fabric	OSONA: L'Esquerda (2, 7, 9, 10, 15, 21, 27, 28, 30, 32)	E	
Coarse Acidic Igneous Rock Fragments Fabric	OSONA: L'Esquerda (5, 20, 26, 29, 31, 34, 41,46)	E	
Fine Quartz & Arkose Fabric	OSONA: L'Esquerda (11, 19, 22, 25, 38, 44, 45)	E	
Micrite & Fine Quartz Fabric	PALLARS JUSSÀ: Sant Miquel de la Vall (2, 4, 5, 7, 8)	E	