Archaeometric study of glass working indicators of Altare (Italy) in the Middle Ages : preliminary data

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This communication briefly describes three important Ligurian sites linked to the discovery of glassy finds (**fig. 1**). First of all Altare (SV), which is inserted *ex novo* into the panorama of archaeological studies thanks to the dig held at the Lascito Balestra, a house located in the historical centre. Knowing Altare from the point of view of the production archeology is particularly important because the Altaresi masters worked *in loco* but also in many European countries, including France (Maitte 2005), to which the migration (begun in the 15th century) was very substantial. The marriage between Ludovico Gonzaga (owner of the feud of Altare) and Enrichetta of Nevers in 1568 greatly facilitated the migration of Altaresi artisans towards the French Duchy, where glassmakers produced «à la façon de Venise», but also experimented new techniques : this is what happened with the famous Altarese glassmaker Bernardo Perrotto, who worked in Nevers and in 1665 obtained from the Duke Philippe d'Orléans the permission to build a furnace in the town. This migration process underlines the ability of the Altaresi glassmakers and emphasizes the lack of information regarding the glass production in the place of origin of these artisans. So, the excavation campaigns carried out in 2017-2018 (still in progress in 2019) can be a real tresure of information to reconstruct the know-how of the Altaresi glassmakers and to reconstruct the events of the glass productive centre.
Another fundamental production site in Liguria is Monte Lecco (GE), where excavations carried out in the 1970s by the researchers Fossati and Mannoni as part of a «programma per l'archeologia di superficie del genovesato» (Fossati, Mannoni 1975, 34) in an area called «cian da veeja» led to the discovery of a furnace. The third site is the Priamàr (SV), which was characterized by a religious frequentation (due to the medieval Cathedral of S. Maria di Castello) and became military in the XVI century, with the construction of the Fortress. Comparing these sites and studying the glassy findings with archaeometric analysis will allow us to focus research on Ligurian (and not only) glass production.

Production contexts : Altare and Monte Lecco

The archaeological excavation in Altare started in 2017, by initiative of Prof. Carlo Varaldo (Università degli Studi di Genova – DAFIST) and Dott.ssa Rita Lavagna (I.I.S.L.) with concession of the Soprintendenza Archeologia, Belle Arti e Paesaggio per la città metropolitana di Genova e le province di Imperia, La Spezia e Savona – funzionaria Dott. ssa Silvana Gavagnin.
This excavation (**fig. 2**) shown traces of frequentation since the Middle Ages. The most ancient archaeological levels investigated in the 2017-2018 campaigns are pertinent to the middle of the 14th-15th centuries and they consist in a natural layer linked to a sudden overflow of one or more rivers existent in the past near the place of the current building. In the path, water must have encountered anthropically frequented areas, probably damaging one or more productive structures, incorporating and transporting parts of them elsewhere. Between the 16th-17th centuries soil fertility led to cultivation or perhaps to a meadow, on which it was built between the 17th-18th centuries a water well in stones, pottery and bricks, with floor and a drainage channel. These structures were de-functionalized, covered by building actions and by a floor in mortar between 1888 and 1895, when the building was expanded (this last remained in use until the end of 1900s). As for the glass finds that emerged in the excavation of Altare, among the most significant findings there are very small fragments of finished glass (sometimes with decorations) and scraps (including, for example, masses and drops).
In Monte Lecco, the activity concerned various areas (zones A, B, C). The first allowed the identification of a room with a furnace (**fig. 3**) with a diameter of about 2.20 m. It had two remains of planes (probably used to support the crucibles) and a channel with two glassy masses (Fossati, Mannoni 1975, 38). One level (layer II) was on the whole area with an important quantity of finds. In area A layer II was characterized by a succession of almost sterile red earth levels and black earth rich in charcoals and glassy material. Layer II was covered by «layer I» consisting of humus, which returned various indicators of glass

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production and it was located on layer III, a sterile clay from disintegration of the rocky substrate (Fossati, Mannoni 1975, 41).
In this excavation a big amount of glass finds came to light. Among them, not only are there fragments of finished glass but also scraps. In the first group there were lot of findings, such as bottoms, bottle necks and bottle shoulders, stamps, edges of glasses and bottles (the finished finds were sometimes decorated).
Fragments of slabs were also found during the excavations. The second group consisted mainly in waste, (such as masses, slags, collars).

The context of use : Savona
The digs carried out by Università degli Studi di Genova – DAFIST (prof. Carlo Varaldo and prof. Fabrizio Benente) and by Istituto Internazionale di Studi Liguri (dott. ssa Rita Lavagna) at St. Maria di Castello, has allowed us to investigate the area of the cloister of the cathedral. From this area two important complexes of glass came to light ; the oldest one (mostly used for service) consists in glasses, lamps and bottles dating back to the 14th century, identified above a masonry burial (Lavagna, Varaldo, Cagno, Brondi 2019, 205-213). Among these, a bottle with a globular body and a high neck, characterized by a ring-shaped foot (**fig. 4**).
The most recent complex (end 16th-early 17th centuries) comes from a structure pertinent to the life of the Genovese Fortress, that is a black well of waste water (located above the old cloister of the cathedral) connected by a drainage channel to the nearby Casa dei Colonnelli. This complex consists above all in tableware from the military garrison stationed at the fortress : bottles, lamps, goblets, glasses.

Preliminary archaeometric data
Finds have been studied at the macroscopic level to describe their shape and, when possible, their function. Some archaeological finds were prepared for analyses following standard metallographic procedures for microstructural and microchemical examination. Microstructural and chemical analyses were accomplished through reflected light petrographic microscope (OM) and scanning electron microscopy (SEM) equipped with an EDX. Geochemical data (trace e minor element) was performed by LA-ICP-MS.

At the Altare glasshouse different types of glass were processed : the Na-Ca-glass up to the K-Ca glass. The fluxes were mainly derived from the plant-ashes. In Figure 6, the compositions with high values of MgO and/or K2O refer to glasses present in the crucibles ; the group of artifacts with an average content of K2O (between 7 and 8.5 wt%) are drops and drippings.
The chemical comparison of glass-work indicators of Monte Lecco glasshouse shows an overlapping of the compositional characters of the production of Altare (**fig. 5 A** and **fig. 6**). Even the minor and traces elements do not seem to distinguish the two productions. Only the contents of Rb and Sr seem to distinguish the production of Altare from that of Monte Lecco (**fig. 5 B**). This aspect will be explored in further studies.

The glass finds of the Savona excavation are of Ligurian production (Lavagna, Varaldo, Cagno, Brondi 2019). On the basis of the contents of Rb and Sr, they seem more similar to the production of Altare glasshouse than to the produ ction of Monte Lecco glasshouse (**fig. 5 B**). This evidence is also supported by the types studies of the objects returned by the respective archaeological excavations.

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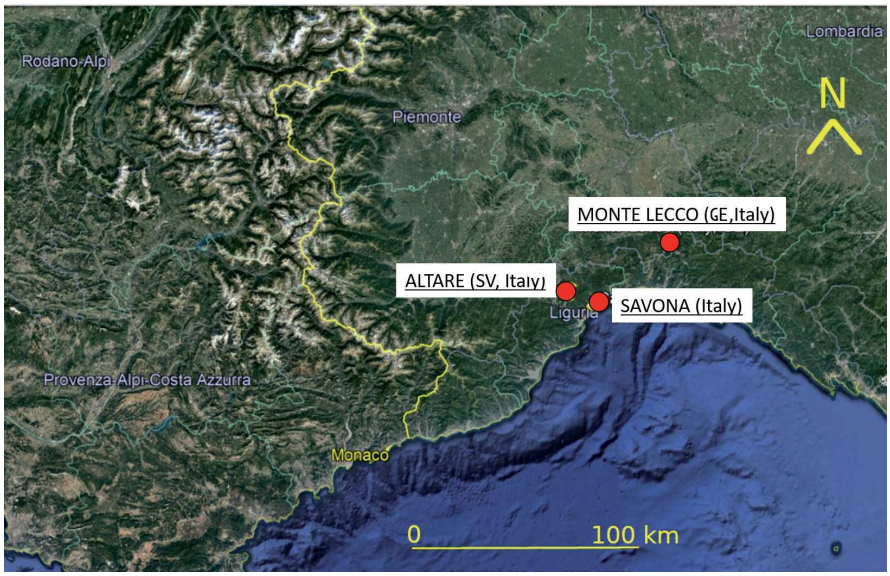

Fig. 1 Location of Altare, Savona, Monte Lecco (*from Google Earth*).

Fig. 2 Site of Altare (© *M. Bagnasco, copyright of I.I.S.L.*).

Fig. 3 Site of Monte Lecco (d'après Fossati, Mannoni 1975, 124).

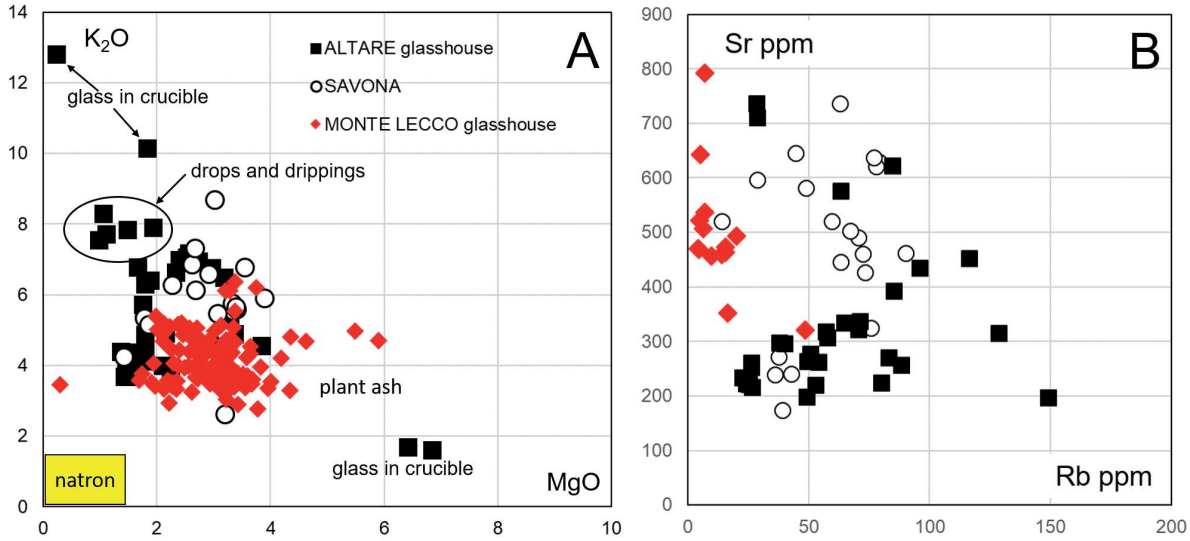

Fig. 5 Some compositional features of the analyzed artifacts.
A : MgO/K_2O binary diagram, classifying by flux type;
B: Rb/Sr in the in archaeological finds (*graphic by Prof.ssa Maria Pia Riccardi, copyright of University of Pavia*).

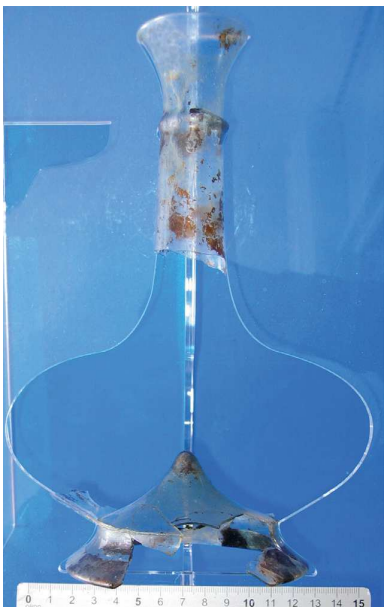

Fig. 4 Bottle from Savona (© *C.Varaldo, copyright of I.I.S.L.*).

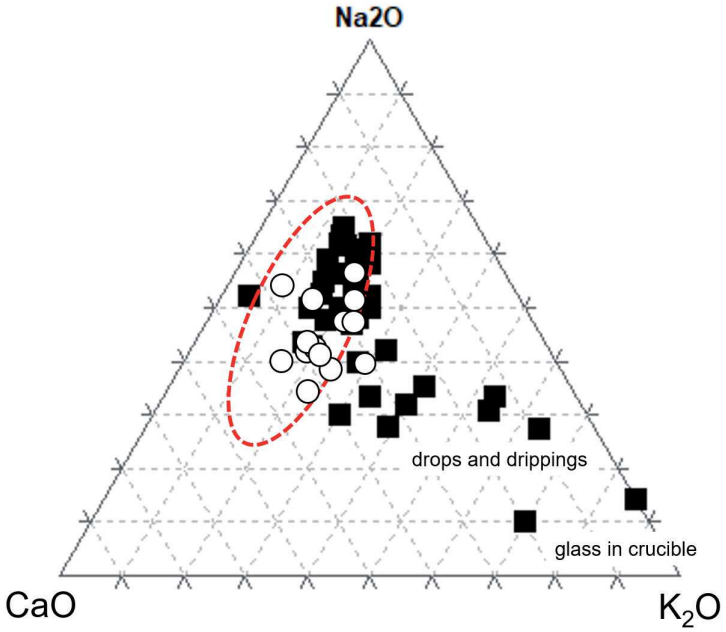

Fig. 6 $CaO/Na_2O/K_2O$ ternary diagram. The diagram shows a partial overlap of the chemical composition of the glass-indicators of the Monte Lecco glasshouse and the Altare glasshouse (*graphic by Prof.ssa Maria Pia Riccardi, copyright of University of Pavia*).