ESRF	**Experiment title: Characterization and firing history determination of an ancient pottery unearthed at the Capitolium of Cumae (ITALY)**	**Experiment number**: HG190
Beamline: ID22	**Date of experiment**: from: 10/10/2022 to: 11/10/2022	**Date of report**: 27/02/2023
Shifts: 3	**Local contact(s)**: Prof. Andy Fitch, Dr. Catherine Dejoie	*Received at ESRF:*

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Report:

To investigate the pottery production technique and the firing conditions used in the ancient colony of Cumae, 12 pottery shards were examined on the high resolution powder diffraction beamline ID22. The colony of Cumae was founded in the 8th century BC and is recognised as the first Greek settlement on the European continent and was well known for the quality of the pottery production.

The shards were positioned on a sample holder and measured in transmission mode (Figure 1). Several patterns were acquired from different spots for each sample, for a total of 86 diffraction patterns. All the measurements were performed with λ= 0.4000378(9) Å. Despite the thickness of the measured samples, we were able to get high quality X-ray diffraction patterns that allow us to characterise the mineral composition (Table 1).

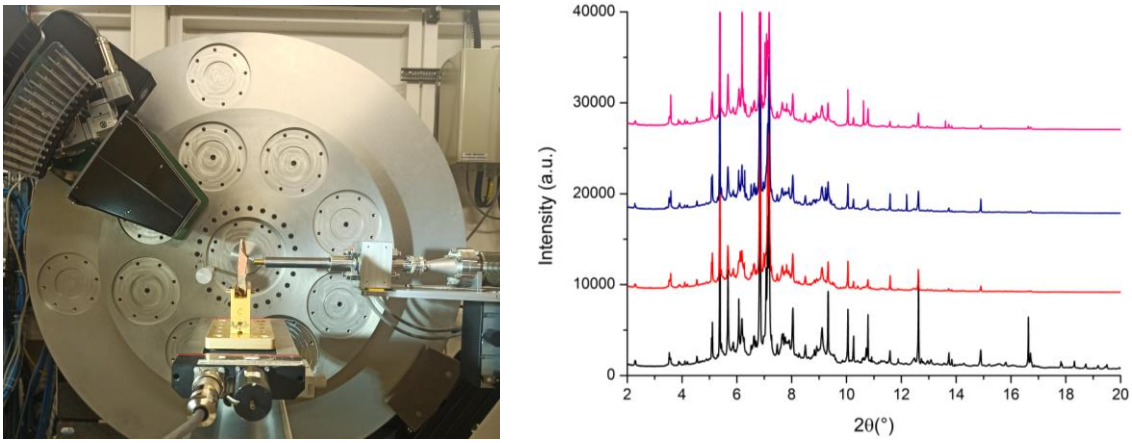
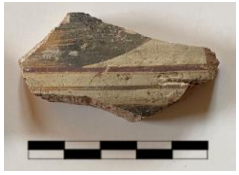


Figure 1. Experimental set-up and collected diffraction patterns for sample **4** from different spots.

The software Qualx2[1] was used to perform a qualitative phase analysis on all of the collected diffraction patterns. These preliminary studies demonstrate that the mineral composition of the various samples is quite similar, with the exception of samples **6** and **10**, which show no signs of pyroxenes. Furthermore, with the exception of sample **7**, all of the samples contain hematite, indicating an oxidising environment during the firing. Given the mineral composition, a firing temperature greater than 900 °C might be estimated for all the samples. Sample **5**, a kitchen pottery shard, caught our attention since its peculiar mineral composition suggests a firing temperature higher than 1100 °C.

Table 1. Measured samples and their mineral composition.[a]

Sample	Photo	Dating	Mineral phases	Environment	Firing temperature
1		VII BC	quartz, pyroxenes, feldspars, hematite, muscovite	oxidizing	900° C
2		VII BC	quartz, feldspars, gehlenite, hematite	oxidizing	1000° C
3		VII-VI BC	quartz, feldspars, pyroxenes, hematite	oxidizing	>950° C
4		VII-VI BC	quartz, feldspars, pyroxenes, hematite	oxidizing	>950° C
5		VII-VI BC	quartz, feldspars, pyroxenes, mullite, muscovite, hematite	oxidizing	>1100° C
6		VI BC	quartz, feldspars, gehlenite, muscovite, hematite	oxidizing	1000° C
7		VI BC	quartz, feldspars, pyroxenes, feldspars, gehlenite	no evidence	>950° C
8		VI BC	quartz, pyroxenes, feldspars, hematite	oxidizing	>950° C
9		VI BC	quartz, feldspars, pyroxenes, muscovite, hematite	oxidizing	>950° C
10		VIII BC	quartz, feldspars, hematite	oxidizing	900° C
11		VIII-VII BC	quartz, feldspars, pyroxenes, hematite	oxidizing	900° C
12		VIII-VII BC	quartz, feldspars, pyroxenes, muscovite, hematite	oxidizing	900° C

[a] *For space reasons we decided to show only a few representative samples.*

References

[1] A. Altomare, N. Corriero, C. Cuocci, A. Falcicchio, A. Moliterni and R. Rizzi, *J. Appl. Cryst.*, 2015, **48**, 598-603.