4th-3rd Millennium BCE Medium Coarse and Polychrome Fine Pottery From Baluchistan, Pakistan: First Archaeometric Analysis

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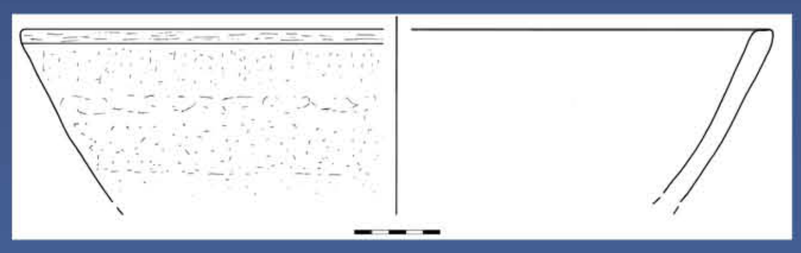
INTRODUCTION: AIMS AND METHODS OF THE RESEARCH

The aim of the research is to investigate clays and pigments used in Baluchistan during 4th - 3rd millennium BCE in order to gain a better understanding of technological evolution and diffusion of ceramic techniques. The focus will be on material from the land of central Baluchistan, Pakistan. Petrographic analysis on thin and polished sections was carried out, using polarizing and binocular microscopes. XR Fluorescence and SEM were employed to obtain semi-quantitative chemical results from investigations on pigments.

The results here presented were obtained by the first archaeometric analysis carried out in the laboratories of the Istituto Centrale per il Restauro in Rome.
I would like to thank my supervisors: Dr. M. Vidale, archaeologist, Dr. G. Guida, chemist and Dr. P.L. Bianchetti, geologist.

SAMPLE 939_005, A MEDIUM COARSE GRITTY ORANGE POTSHERD, 4th MILLENNIUM BCE

Sample 939_005



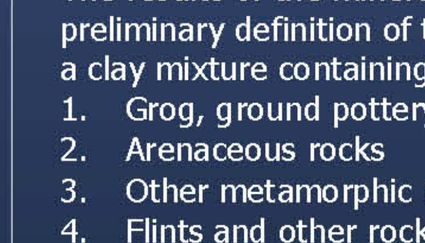
Sample 939_005. Possible reconstruction of the original shape

A darker line covering the outer surface are remains of a slip. The lighter band underneath might suggest a migration of salt crystals during drying and/or firing.

The core shows incomplete oxidizing conditions suggested by the lighter color.

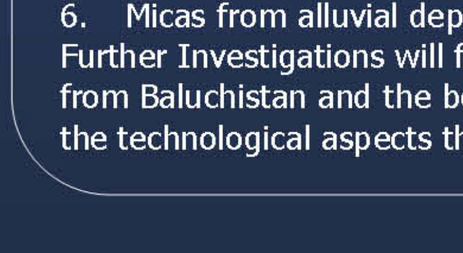
At the bottom, interior surface: a dark, 3 mm thick layer shows that the vessel was fired in oxidizing conditions (hematite Fe_2O_3). Was the vessel fired upside down?

Sample 939_005. Stratigraphy of section.
Binocular microscope with magnification 6,3 x



General view. Bright white quartz particles, weakly oriented in the brown clay matrix

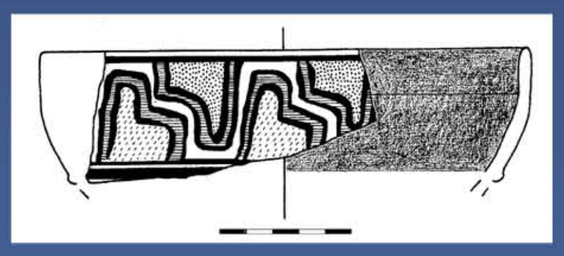
Sample 939_005. Mineralogical characterization of paste.
Polarizing microscope with magnification 5x



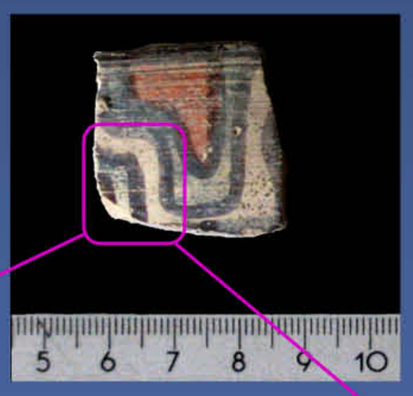
Rounded grog inclusion. As the orientation of the dark particles inside the grog piece is clearly different, it is evident that its fabric comes from another potsherd

Sample 939_005. Mineralogical characterization of paste.
Polarizing microscope with magnification 5x

SAMPLE 914 SA_008, A FINE BUFF POTSHERD, 3rd MILLENNIUM BCE



Sample 914 SA_008. Possible reconstruction of the original shape



Sample 914 SA_008

As copper (Cu) is totally absent from blue pigment, this excludes azurite as a possible mineral source for the pigment.

The high value of sodium (Na) and traces of sulfur (S) point to a lazurite and a lapis lazuli origin

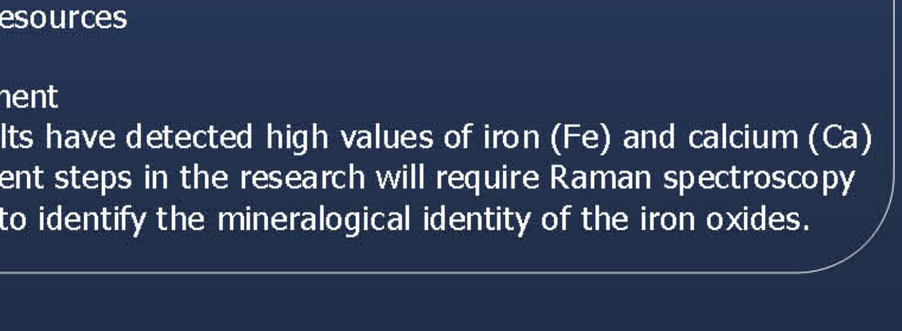
Sample 914 SA_008. SEM back scattering electron image with locations of spots detected

	O	Si	Ti	Al	Fe	Mn	Mg	Ca	Na	K	P	S	Cl	TOT
1 Blue	47,25	17,53	0,30	4,29	5,21	0,23	2,00	8,30	5,10	2,19	0,37	0,81	6,43	100,00
6 Black	48,34	17,25	0,40	4,73	9,13	2,76	2,02	8,29	1,77	2,62	0,33	0,63	1,73	100,00
2 Biscuit	47,67	16,39	0,39	5,29	12,52	3,45	1,97	8,12	1,15	1,72	0,23	0,67	0,43	100,00

Sample 914 SA_008. Semi-quantitative chemical determination of blue, black pigments and clay matrix

High concentration of iron (Fe).

Presence of calcium (Ca) strontium (Sr), rubidium (Rb) and manganese (Mn) are commonly found in ceramic matrix and soil



Sample 914 SA_008. Graph of X-ray fluorescence (XRF) showing peaks of semi-quantitative chemical determination of red pigment

CONCLUSIONS: PETROGRAPHIC ANALYSIS

The results of the mineralogical characterization of this sample point to a preliminary definition of the raw material used by potters for this fabric: a clay mixture containing

1. Grog, ground pottery
2. Arenaceous rocks
3. Other metamorphic rocks
4. Flints and other rocks subjected to heat and pressure
5. Coarse sands
6. Micas from alluvial deposits

Further Investigations will focus on comparisons with other fabrics from Baluchistan and the borderlands to gain a deeper insight into the technological aspects that characterize the ceramic production.

CONCLUSIONS: SEMI-QUANTITATIVE CHEMICAL DETERMINATION FOR BLUE AND RED PIGMENTS

1) Blue Pigment

a) The results concerning sodium (Na) and sulfur (S) point to a lapis lazuli origin for the blue pigment

b) Further research will focus on tracing distinctive element such as barium (Ba) to understand which areas were exploited for natural resources

2) Red Pigment

a) The results have detected high values of iron (Fe) and calcium (Ca)

b) Subsequent steps in the research will require Raman spectroscopy analysis to identify the mineralogical identity of the iron oxides.