ANTIQUE AUTHENTICATION

COMMENTS ON PORTABLE XRF INSTRUMENTS

XRF is a surface analysis, which means the material is analyzed from the surface. This means the patina and the material is analyzed, but there is no way of knowing the proportion of each (50% patina and 50% material? Or 70% patina and 30% material?).

For metal analysis, if aluminum is detected, does it come from the material? In which case it would indicate the object is a fake. Or does it come from the superficial patina? Earth, clay and sediment naturally contain aluminum. So, it is not possible to conclude about the antiquity or the modernity.

Scratching and scraping the surface of the metal would remove surface deposits. But, in this case, the interest of a non-destructive technique is lost. Finally, if it was possible to remove the surface deposits without any damage and the composition was "good", is it enough to determine its antiquity? No, in order to draw definitive conclusions about its antiquity or modernity analysis on the corrosion processes and their origin must also be studied and analyzed.

For porcelain analysis, the limits of XRF are technical. XRF works in air, which induces the decrease of sensitivity. Because of this decrease in sensitivity, it is not possible for XRF to detect fluorine, sodium, magnesium and aluminum. XRF gives an incomplete composition, which is insufficient and non-relevant to claim the antiquity or the modernity of a porcelain.

Additionally, when a faker wants to artificially patinate glass or porcelain, hydrofluoric acid (unique acid that can dissolve glass and porcelain) is used. It is not possible to detect fluorine with XRF, so it would not be possible to identify fakes.

Furthermore, the composition of a porcelain cannot be considered as formal proof of antiquity. If chromium or zinc (evidence of modernity) is not detected, it does not mean the object is ancient.

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The only way to really authenticate a porcelain is to thermoluminescence (TL) test it. So XRF analysis is very limited in the field of scientific authentication.

XRF Device:

Negative Points

- The various models proposed are each optimized for a certain material to be analyzed, and thus for specific elements to be identified. Therefore it is not advisable to employ the same instrument (model) for different applications, as it will not maintain the same efficiency of acquisition and detection.
- The target in Silver of the X-ray tube may not be appropriate for some applications, when e.g. the artwork that will wan under analysis presents this element in the composition.
-The acquisition times are fixed (maximum 30 seconds) and are less than what is generally advisable for art artifacts (which require at least 100 seconds), as we are looking for trace elements. If the times are shorter, they are most likely not sufficient to accumulate enough counts for the lighter elements especially if immersed in heavy matrices. This could lead to an acquisition of a noisy spectrum and, for some matrices, mainly paintings, a meaningless one. The technical specs of the model for applications on minerals reports that the detection sensitivity comprises magnesium up to uranium, but this is probably only true in cases where the magnesium (or other elements with low atomic number) is present with high concentrations. In order to increase the detection capability for light elements, they propose as an optional element that the system is used flushing with helium.

Positive Points

- Lightweight, portable, it does not need a PC, and it is easy to use for the layman, as the results are provided "ready to use" for standard situations, regular geometries and homogeneous surfaces. However, the results will probably not be reliable for problems posed by heterogeneous mixtures or complex pictorial stratigraphy as in the case of paintings.
- It has a good spectral resolution (139 eV), thus allowing to discriminate peaks of emission values of energy (keV) very close to each other.