ANALYZING STRATIGRAPHY WITH A DUAL XRD/ XRF INSTRUMENT

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Non-invasive portable instruments have become increasingly adapted to cultural heritage research. In-situ analysis of objects that cannot be moved has become possible. The risk of accidental damage is greatly reduced, together with insurance costs. Handheld XRF devices give the elemental composition, but not how atoms are bonded. Recently, new portable XRD/XRF devices have been developed (1,2) quite varying in design. The Getty Conservation Institute's XRD/XRF (DUETTO) (3,4) developed together with Philippe Sarrazin, is totally portable (in 2 sturdy cases) and battery operated. Based on reflection geometry, it works on flat or convex surfaces, without touching them. The sample to instrument distance is 2mm, a compromise between X-rays intensity and safety of the object. The optimized geometry is particularly stable (no moving parts). The XRD range is limited to 20-50^{o} 2θ. A high resolution camera takes pictures of the spot and helps the exact positioning on the focal plane with a specially designed laser system. A complete technical description of DUETTO is found in (4). Examples of pigment analysis of manuscripts, easel paintings (Rembrandt, Degas), Roman bronze statues and mural paintings (Tutankhamen tomb) will be given.

STRATIGRAPHY: If the sample is not in the focal plane a shift in 2θ results. For portable instruments, the position of the sample, or layers of it, depends on the object itself. One can exploit this feature to determine the depth of the diffracting layer, in a noninvasive way. A good linear calibration curve has been obtained for our instrument, plotting the displacement from the focal plane vs. the peak shift from the zero position. The estimated depths agree with those measured in cross sections.

QUANTIFICATION: Binary metal alloys (brass, bronzes) are common. The ratio *Cu/Zn* or *Cu/Sn* can be obtained using the curve obtained by plotting the cell volume calculated from XRD peak vs. the Zn content for several standards. The linear correlation permits noninvasive quantification of Zn in a brass (Tin in a bronze) by measuring one peak, even for more than one alloy.

References:

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