High Speed, Simultaneous XRD-XRF Mapping of Geological Specimens with the Color X-ray Camera

Jeffrey M. Davis[1,*], Julia Schmidt[1], Martin Huth[1], Robert Hartmann[2], Heike Soltau[1], Lothar Strüder[2]

[1.] PNDetector GmbH, Otto-Hahn-Ring 6, 81739 München, Germany
[2.] PNSensor GmbH, Otto-Hahn-Ring 6, 81739 München, Germany

The Color X-ray Camera (CXC) [1] is a unique imaging spectrometer capable of recording both the position and energy of each X-ray event on the detector. This enables the simultaneous collection and analytical separation of both X-ray fluorescence and X-ray diffraction [2]. When combined with a micro focused X-ray source, the CXC can create X-ray maps of heterogeneous materials with mapping dwell times as low as 10 ms per point. In this relatively short measurement time, a full X-ray spectrum with an energy resolution of 145 eV at Mn Kα is recorded along with a diffraction pattern with an angular range of approximately 150° 2θ. Figure 1 shows the results from the analysis of a polished sample of Ocean Jasper. Geological specimens, particularly silica calcedonies like Ocean Jasper, pose a major challenge for ED-XRF mapping because of the presence of multiple crystalline phases and an abundance of so-called "Bragg Peaks". In this experiment, a 100 µm X-ray beam (created by the XOS fleX-Beam system) was scanned over the sample with a dwell time of 2 s per point. The data recorded by the CXC contained significant diffraction, some of which overlapped with the Fe K α peak. Without correction, a user may falsely identify iron rich regions in the sample, but with correction, this problem can be eliminated.

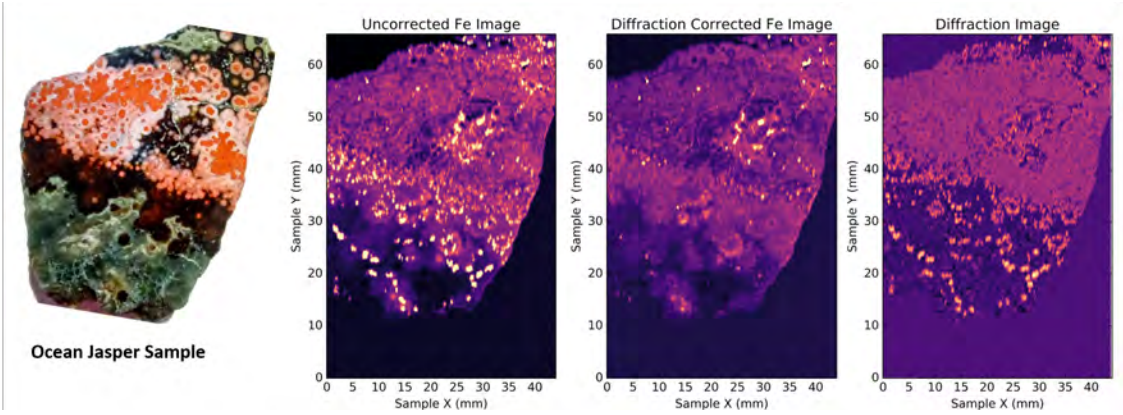

Figure 1: (Left) An optical image of a polished sample of Ocean Jasper. (Middle) The uncorrected Fe image, created by setting an energy window around the expected position of the Fe Kα peak. (Right two images) When the diffraction from the sample is corrected, these bright spots disappear in the fluorescence image and are correctly associated with silica diffraction.

References:
[1] Scharf, O., Ihle, S., Ordavo, I., *et al*, Compact pnCCD-based X-ray camera with high spatial and energy resolution: A color X-ray camera, Analytical Chemistry, **83** (2011), p. 2532:2538.
[2] Leitenberger, W., Hartmann, R., Pietsch, U., *et al*, Application of a pnCCD in X-ray diffraction: a three-dimensional X-ray detector, Journal of Synchrotron Radiation, **15** (2008), p. 449:457.