MACRO-, TO MICRO- TO NANOSCALE ADVANCED SEM/EDS ANALYSIS USING STAGE CONTROL AND AN ANNULAR FOUR-CHANNEL SILICON DRIFT DETECTOR: APPLICATIONS IN IMPACT STUDIES.

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Introduction: Imaging of ever smaller structures, in situ within large samples, requires low electron beam energy to enhance spatial resolution, and therefore also use of low energy X-ray lines for elemental analysis. To separate significant overlapping peaks e.g. N-K (392 eV) and Ti-L_l (395 eV) [1], the incorporation of line deconvolution algorithms [2] in energy dispersive X-ray (EDX) software is of crucial importance. In this paper we describe applications of a new system to impact studies.

Methods: Without adequate X-ray count statistics, deconvolution is unlikely to be effective. We therefore used an annular Silicon Drift Detector (SDD), the Bruker XFlash 5060F. This has parallel processing of data from four channels, giving an output count rate of 1.1 Mcps. It is placed between the pole piece and sample, covering a very large solid angle of X-ray collection, rapidly acquiring sufficient data even on beam sensitive samples. High take-off angle and collection of X-rays from four different directions allow data collection across samples with substantial surface topography. Automated stage control and spectrum imaging (an entire EDS spectrum is collected at each pixel) allow large data sets to be acquired within a short time.

Examples of applications: (A) Large area, high resolution mapping (with tiling or stitching of neighboring areas) is useful for understanding processes in the formation of tektites [3], revealing flow textures and layering, without destructive section preparation. Coalescence textures formed during the transition from melt to solid are seen, with surface pitting produced by micro-impact collisions in the impact plume, and surface etching by chemical attack in the impact plume, or later weathering.

(B) Large area, high resolution spectrum imaging of the matrix at impact melt breccia of the Chicxulub impact crater (Yax-1 borehole, Unit 5 861.72 m) [3] reveals the distribution of unusual, resorbed andradite garnets. Analysis at low accelerating voltage reveals secondary mineral formation, such as <500 nm NaCl and <150 nm Fe-Ti-oxides associated with garnet resorption, indicating a complex history of matrix genesis during the fluid evolution of high temperature seawater-derived brine.

(C) Complex topographic surfaces, such as the interior of experimental Stardust foil craters, can be imaged very rapidly and in detail in order to locate projectile residues [4] without loss of data due to 'shadowing' of any area at depth.

References: [1] Salge et al. 2010. Abstract #I6.4 *17th International Microscopy Congress.* [2] Aßmann A. and Wendt M. 2003. *Spectrochim. Acta* 58:711–716. [3] Howard K.T. 2011. *Geological Society of London*: 573-591. [3] Salge T. and Newsom H. 2010. Abstract #5337. *73rd Annual Meeting of the Meteoritical Society*. [4] Kearsley et al. 2011. submitted to *74rd Annual Meeting of the Meteoritical Society.*