High speed characterisation of Earth and planetary science samples using a CMOS-based EBSD detector

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EBSD has been routinely applied to geological materials for over 2 decades [1], with many applications in the fields of structural, metamorphic and igneous geology. Increasingly the technique is also being applied to planetary sciences, with a number of recent TKD and EBSD applications to meteorite samples [e.g. 2]. However, there exists a common belief that successful EBSD analyses of complex, polymineralic rock samples require high resolution patterns and long acquisition times.

Here we investigate the potential for rapid characterisation of geological samples using a new CMOS-based EBSD detector. This technology shift allows the collection of sufficient resolution EBSPs (e.g. 156 x 128 pixels or higher) at high speeds (300-1500 patterns per second (pps)) without requiring exceptional beam currents (i.e. <35 nA).

We present examples from a range of geological and planetary samples, including nanoscale measurements of the Allende meteorite (at speeds up to 1200 pps with resolutions down to 80 nm), deformed quartzo-feldspathic samples and overview scans of whole polished blocks. One such example is shown in figure 1 - this is an orientation map of a deformed ocean gabbro sample, collected with a step size of 3 um at 400 pps (using 20 nA). The analysis area contains at least 11 phases and took a total of 10 hours to collect, complete with full chemical information using energy dispersive X-ray spectrometry and electron images.

We discuss the potential for routine, high resolution scanning of large areas of rock samples as well as some of the challenges for data processing and presentation, and will look at new fields of geosciences research that this approach may benefit.

References

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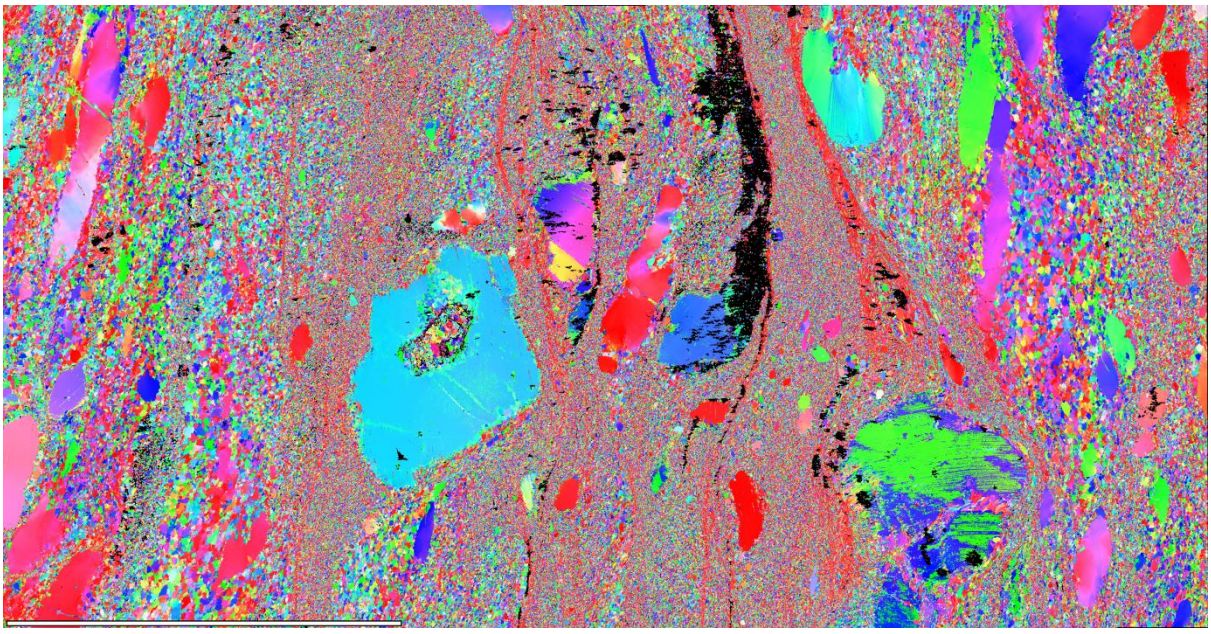

Figure 1. Orientation map (IPF-Y direction) of a deformed gabbro sample, containing 11 phases and over 13 million analysis points. The scale bar marks 5 mm.