

Automated Fabric Analyser system for hexagonal minerals

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<http://www.earthsci.unimelb.edu.au/facilities/analyser>



Figure 1. Set up for data collection in coarse grained material.

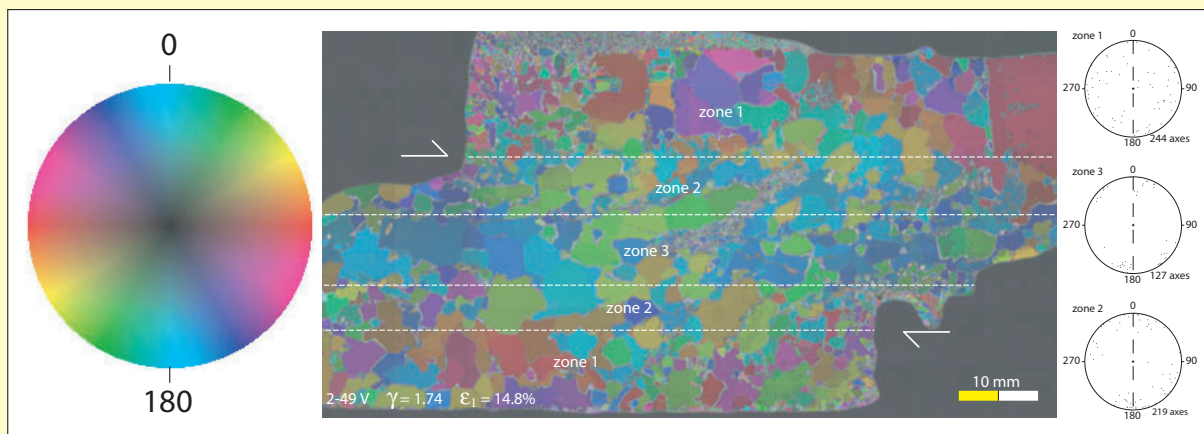
A new fully automated data acquisition system that can be used for the collection of c-axis crystallographic fabric data in hexagonal mineral systems in coarse grained (Fig. 1) and fine grained rocks (eg. mylonites Fig. 2) has been developed. The analysis process works in two stages: 1) The analytical instrument scans the thin section and collects and processes image data. 2) The section data acquired from the analytical instrument is loaded into a separate analysis software (called INVESTIGATOR) that allows the operator to examine individual crystallographic variation across individual grains. Unlike traditional texture analysis the information allows considerable interactive data processing, using INVESTIGATOR, as the link between microstructure and individual c-axis orientations.



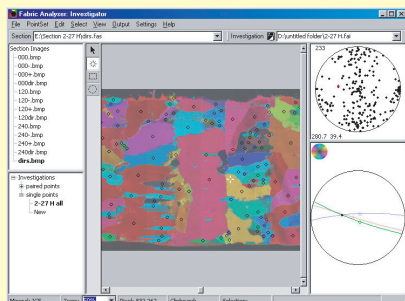
Figure 2. Example of apparatus for analysis of fine grained rocks.

This is a portable acquisition system that is controlled from a laptop computer. All microstructural images were acquired using three CCD digital cameras. The computer-controlled fabric analyser uses three imaging axes to simultaneously capture crossed-polar images of the thin-section material. The polarizers and retarder plate are directly mounted on high-resolution geared motors, and high intensity light-emitting diodes provide the light source. The real-time analysis of images is obtained from a Firewire camera as the polars are rotated, with and without the retarder plate, which provides the information necessary to reconstruct the individual c-axis orientation for each 3µm to 0.2µm pixel in the section image.

The stage can accommodate thin sections of up to 100 x 100 mm (in the coarse grained fabric analyser) with motors controlling translations in the X and Y directions to 1 µm resolution. No tilting of the thin section is required for the analysis. The software system on the computer controls the stage and captures images directly from the cameras. Composite optical images of the total thin section are then used for the analysis of the c-axis at any particular point.



Twelve images that are typically on the order of 2000 x 2000 pixels are decomposed and reprocessed as axial-distribution diagrams or AVA diagrams (Achsverteilungsanalysis) or as scatter diagrams of individual grain c-axis orientation plotted on an equal area stereographic net. A standard colour code is used to identify the c-axis directions as azimuths and dips in the micrographs. In this scheme, north trending axes are in blue, east trending axes are in orange, axes normal to the plane of the thin section are in black and gradational shades represent angular differences between neighbouring pixels. A change in colour intensity to the centre of the colour circle (black) corresponds to c-axes increasing in plunge from horizontal, on the periphery, to vertical at the centre of the net. This is an easy method of measuring grain orientations and large data-sets can be collected quickly (e.g. in the above analysis of 600 grains, these were measured and analysed in 30 minutes; the capture of the images used to make the AVA took 40 minutes).



Use of INVESTIGATOR software

The process yields spatial information describing individual grains and their orientation within a sample. Each c-axis is recorded with its XY position, orientation and relationship within the captured sequence. The results can then be analysed using a variety of discriminators to sort and select different collections of candidate grains to prepare fabric diagrams or analyse nearest neighbour grain relationships.

¥ 12 section images are used to create AVA

¥ Areas where c-axes are required are selected using a cursor

¥ Clicking on an individual grain identifies the plunge of the individual c-axis and is displayed on stereonet

¥ Data can be saved as EXCEL file and as a cumulative stereonet

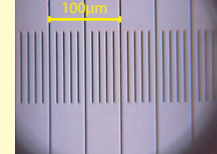
¥ Misorientation relationships can be analysed to calculate neighbour-pair misorientation from c-axes on either side of a grain boundary. Random-pair misorientation relationships are calculated from the existing neighbour-pair datas using EXCEL macros.



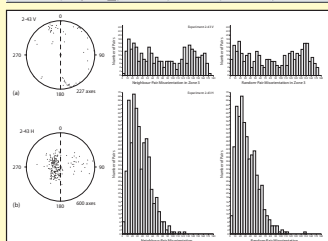
Starting material



Deformed material



Fine grained Quartzite.



For purchase of instrument - contact Chris Wilson (cjw@unimelb.edu.au)

We are prepared to build instruments on a collaborative basis to meet the requirements of any individual researcher. Coarse grained minerals such as ice of metamorphic quartzites will need a demagnifying imaging system. On the other hand, quartz mylonites will require magnification (³100X lens) and a special substage illumination system built into a Zeiss Axioskop microscope.