DATA REPOSITORY 1

We have analyzed the fracture-bound blocks produced by fracture sets, in addition to the fractures themselves, in order to more completely understand 'block-controlled' cataclastic flow. Natural fracture networks have complex patterns due to material heterogeneities and variable deformation of different fracture sets. Because of this, the fracture-bound blocks formed from the outcrop-scale fracture sets are not easily envisaged in the field. It is critical to understand the shape, size and orientation of these fracture bound blocks for two main reasons. First, in order to unravel the amount of work required by cataclastic flow, the surface areas and the volumes of these blocks need to be known. Second, the behavior (i.e. reactivation, healing) of the fractures/cataclasite zones bounding these blocks can be understood by reconstructing the interaction of the blocks. This can only be done if the blocks' morphological characteristics are known. Replica fracture bound blocks were constructed by using a combination of the information obtained from stereograms (which provide fracture orientations) and field observations (which provide spacing and density information).

Surface Area/Volume (SA/V) ratios were determined for a total of 17 sites throughout the CR syncline; 5 sites are in the PCc quartzites along strike in the west limb to document variations in fracture fabric with different fold shapes, while 12 sites are in a transect across the syncline to document the variation in the PCc, PCm, Ct and Cp quartzites (see Fig. 4a,b for site locations) (Fig. DR1). For each site, a scaled 10 cm^3 block of clay was cut according to the spacing and orientations of the active fracture sets at that site (Fig. DR2a). The resulting fracture bound blocks were oriented and dried (Fig. DR2b). Blocks that contained any portion of one or more of the cubes' six faces were discarded, to avoid 'edge-effect' complications.

The following steps were used to measure the surface area (SA) of the blocks: (1) Each of the blocks was painted with acrylic paint and then dried (Fig. DR2c). (2) Several of the blocks' edges were cut with a knife and the paint was carefully peeled off (Fig. DR2d). (3) The paint peel, representing the SA of the block, was glued onto a sheet of paper (Fig. DR2d) and its area was measured using a semi-automated image capture analysis system. The volume (V) of the clay blocks was determined by water displacement, after the blocks were waterproofed with clear acrylic spray. Although the size of the clay blocks at each site may vary slightly, their SA/V ratios are very similar, as illustrated by the small error bars (Fig. DR1).

DATA REPOSITORY 2

Quantitative stereology is used to numerically characterize geometrical aspects (typically viewed in two-dimensions) at any scale, e.g. analysis of microstructures from a thin section. Chord length analysis is one of the many methods used in stereologicaly. This method evaluates size distributions from measured chord lengths of features in transects across samples. The derivation for chord length analysis developed by Spektor (Spektor, 1950) is most commonly used; the formulas employed are straightforward and easy to understand, and have wide ranging applicability. This method of analysis is commonly referred to as 'Spektor-chord' analysis.

1. Micro-scale grain size analysis and % volume

We measured 49 thin sections, with 4-6 transects across each thin section, from the PCc, PCm, Ct and Cp quartzites throughout the CR thrust sheet. Chord lengths were measured for the following categories: unfractured grains, overgrowths, iron-oxide, calcite, cataclasized quartzite and cataclasized iron-oxide (both further subdivided into two cross-cutting stages). For each category, the chord lengths were subdivided into size classes of convenient length, ÷. The number of particles of a particular size class is given by:

$(N_V)_j = (4/\phi÷^2) * [((n_L)_j/(2j-1)) – ((n_L)_{j+1}/(2j+1))]$ (DR1)

where $(N_V)_j$ is the number of particles per unit volume in a particular j-size and $(n_L)_j$ is the number of chords per unit length of the transect in a particular j-size (Underwood, 1970).

The volume percent for each category was averaged from all transects across one thin section and was determined by dividing the total chord length of that category by the combined lengths of the transects across the thin section. In this paper, we focus on the volume percent of the cataclasized quartzites; stage 1 and stage 2 cataclasites were combined.

2. Micro-scale surface area/volume ratio

Spektor chord analysis also provides the total grain boundary per unit volume, S_V where

$S_V = 2P_L$. (DR2)

We know that P_L (the number of point intersections per unit test line) equals N_L (number of intersections of features per unit length of test line) for space filling grains. Also, it has been shown that $N_L = n_L$, the total number of chords per transect (Underwood, 1970). Therefore, equation (A2) can be rewritten as

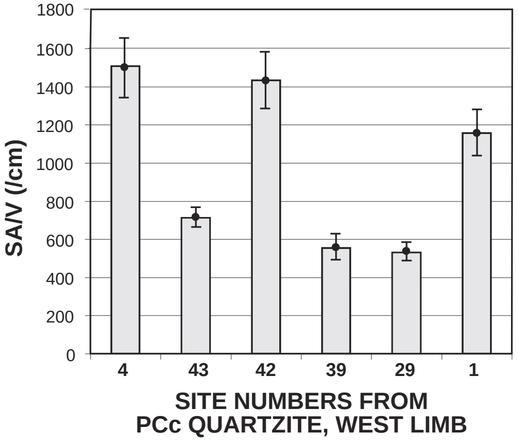
$S_V = 2n_L$ (DR3)

where the S_V values for each category within each thin section are the averages from all transects through that sample.

Figure DR1. Surface Area/Volume (SA/V) ratios for fracture bound blocks from (a) the Proterozoic Caddy Canyon (PCc) quartzite of the west limb and (b) a transect across the syncline from the northern transverse-zone bound segment. See figure 4 a,b for site locations. Results from both the east and west limb for the PCc, Mutual (PCm), Tintic (Ct) and Pioche (Cp) quartzites are shown in part (b). Error bars indicate the standard deviation specific to each site.

Figure DR2. The last stage fractures are used to reconstruct the fracture-bound blocks from clay models. The following steps are used to determine the SA of the fracture bound blocks. (a) Fracture orientations are drawn on a scaled 10 cm^3 block of clay and cuts are made along these planes. (b) Small fracture-bound blocks are removed from only the middle of the cube (thereby avoiding edge effects). Clay blocks are oriented and dried. (c) The blocks are painted (with acrylic paint). (d) The paint is peeled and the area measured using an image analysis system to obtain the surface area of each block.

A



B

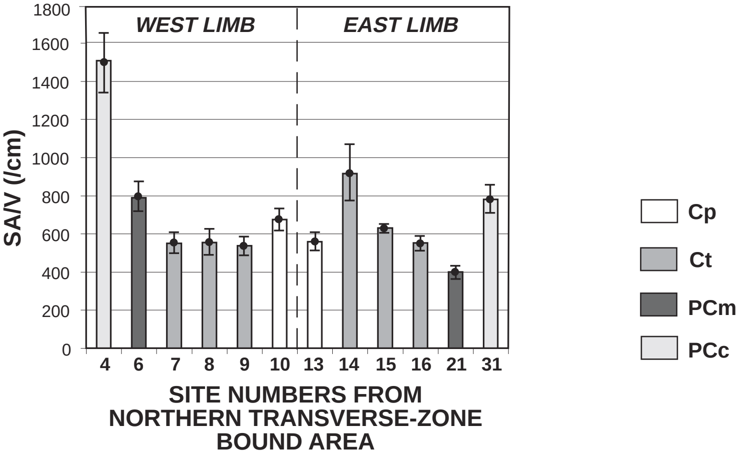


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Fig. DR1a,b

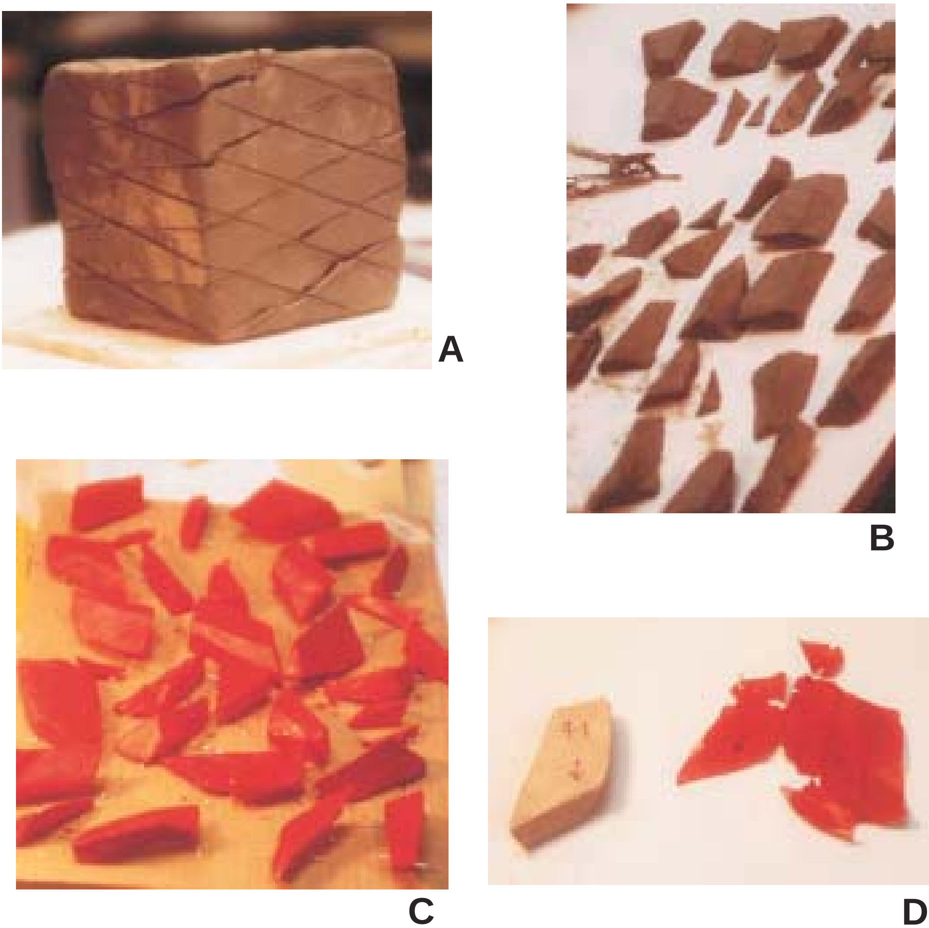

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Fig. DR2