Substructure Dynamics: In-situ Experiments coupled with Numerical Modelling

What do I want to do with Elle?

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Why Important?

- Understanding subtructural changes → deciphering tectonic history
- Examining microstructures can allow – interpretation of deformation processes and estimation of conditions
- We are viewing final stage → difficult to interpret what has taken place

About substructures

- During deformation strain energy stored - point defects and dislocations
- Recovery – point defects and dislocations of the opposite sign annihilated
- Dislocations of similar sign align to form boundaries
- As more dislocations added misorientation of boundary increases
- In this study – interested in Low angle boundaries (LABs) - <15degs

Experiments

- In-situ heating experiments in the SEM – provide info on dynamic changes occuring with annealing
- Rocksalt chosen – good analogue for silicate materials
- Samples heated a number of times and Electron Backscatter Diffraction (EBSD) maps taken to collect info about crystallographic orientation

The Problem

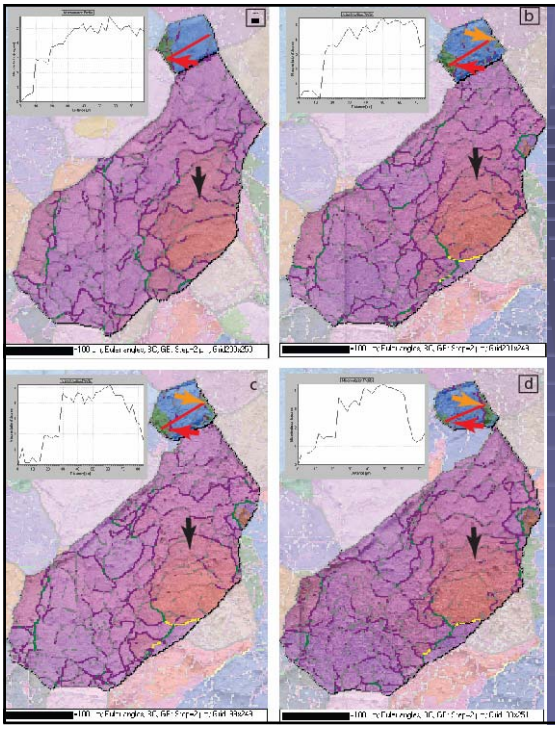
- Substructures inherently complex
- Not doing what they should do according to current models – should remain fairly fixed with subgrains increasing in size
- This does not happen – have observed during heating - substructures are mobile – rearranging, dissipating, increasing or decreasing in misorientation

Results

- Results have shown a number of interesting features including:

  → **intragranular** - substructures rearranging in response to a change in the Euler angle orientation of the grain

  → **intergranular** - related to the substructure density of the grain – including dictating how much change and whether it will engulf grains around



Changes in Euler Angle Orientation

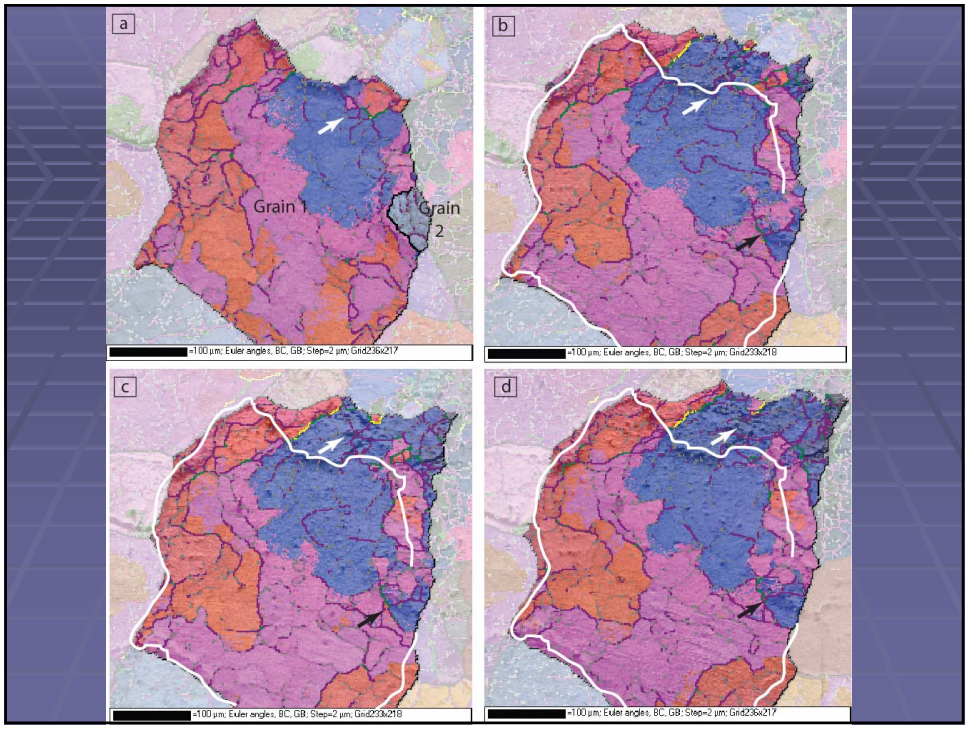
- Substructures:
  - → rearranging
  - → dissipating
  - → forming

More Results

→ the increase and decrease of substructure density with regard to HAGB migration

→ the inheritance of substructures from engulfed grains by the growing grain

→ a comparison of misorientation angle distributions → growing grains vs non-growing grains



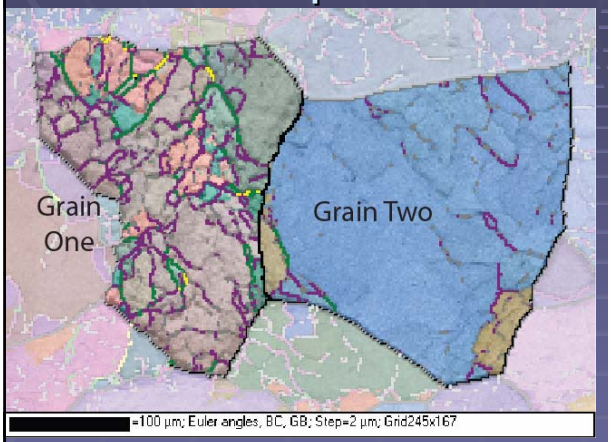
Numerical Modelling

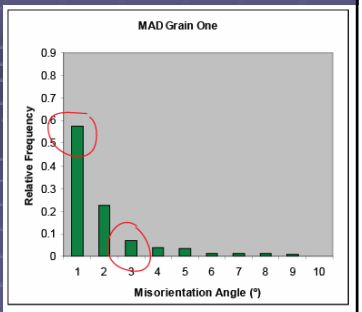
- Lots of weird things happening that need to be explained
- Can examine the effect of various processes and their theoretical foundations by varying parameters
- Combining in-situ heating experiments with numerical modelling – we can compare results and refine
- Focus first on substructures within single grain – then expand to include HAGB migration

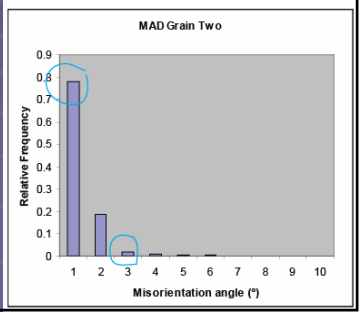
Conclusions

- In-situ heating experiments allow us to observes dynamic changes in substructures
- Results show that substructures are not behaving as expected
- Beneficial to conduct more in-situ heating experiments coupled with numerical modelling using the Elle program

Misorientation Angle Distribution Comparisons







(i) non-growing grains which have >65% 1° LABs and <5% 3° LABs, and

(ii) growing grains which have <65% 1° LABs and >5% 3° LABs