Grain Growth Microstructures as Indicators of Sample Evolution

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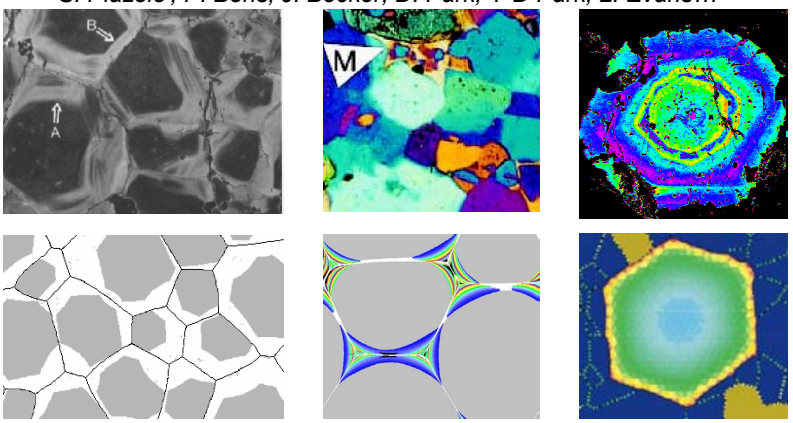
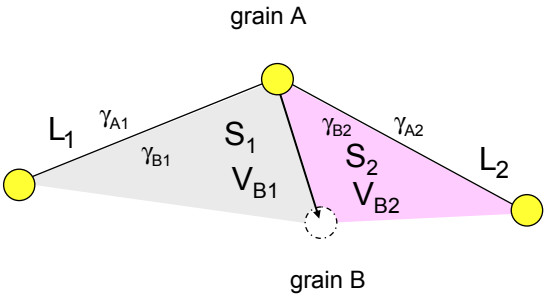


Grain/Phase Boundary Migration



γ= surface energies of 'half-boundaries'
L=boundary lengths
V=volume energies
S=area swept by boundaries

$$E_{total} = E_s + E_v$$

$$E_s \propto \gamma_{A1}L_1 + \gamma_{B1}L_1 + \gamma_{A2}L_2 + \gamma_{B2}L_2$$

$$E_v \propto S_1V_{B1} + S_2V_{B2}$$

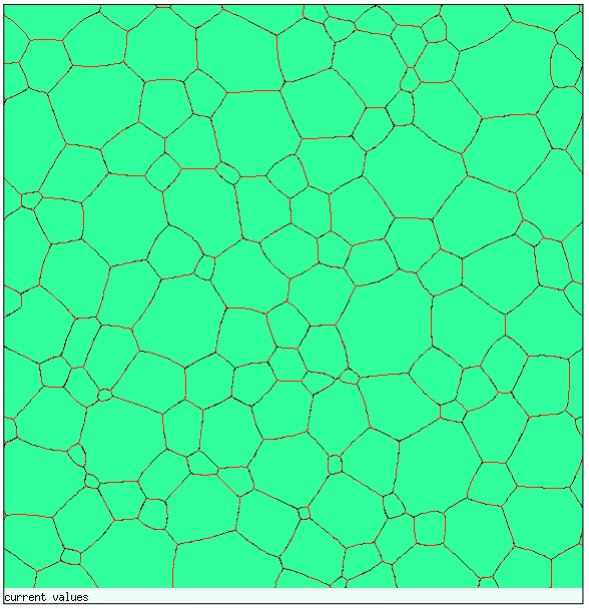
Grain boundary network and unswept cores

Grain boundary

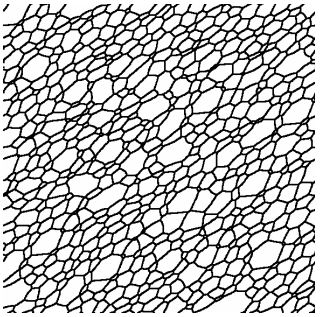
Swept zones

Unswept cores

Surface energy driven normal grain growth

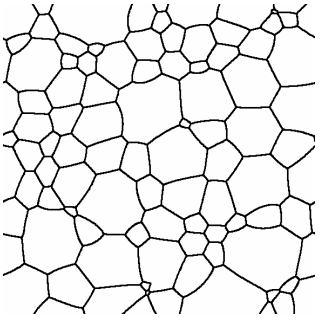


Initial grain boundary alignment



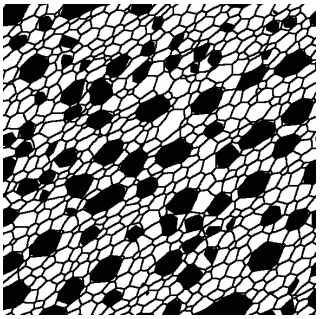
Grain boundary network

t=0



Grain boundary network

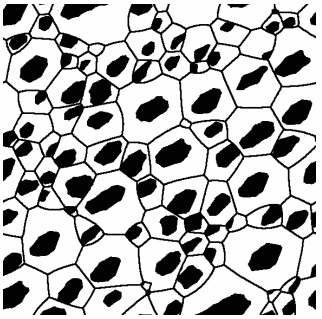
t=800



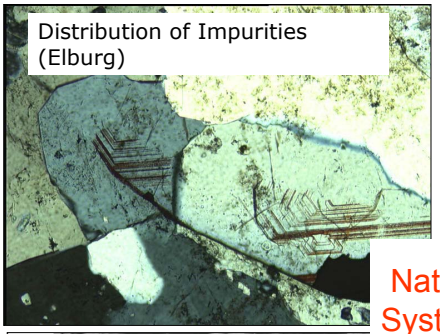
t=0

Unswept cores

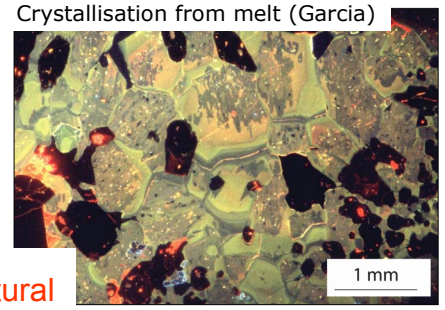
Swept zones



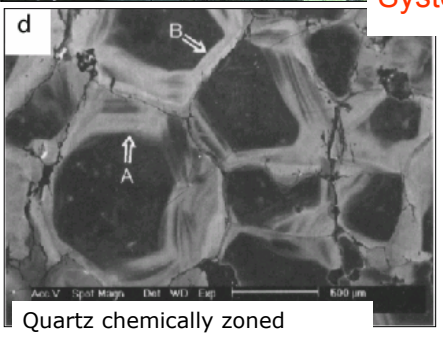
t=800



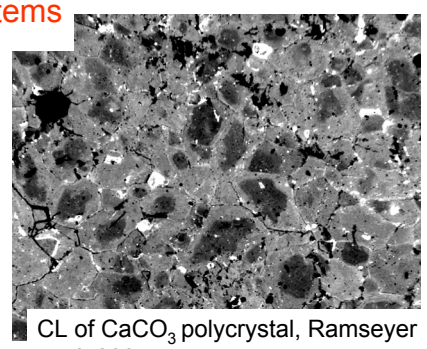
Crystallisation from melt (Garcia)



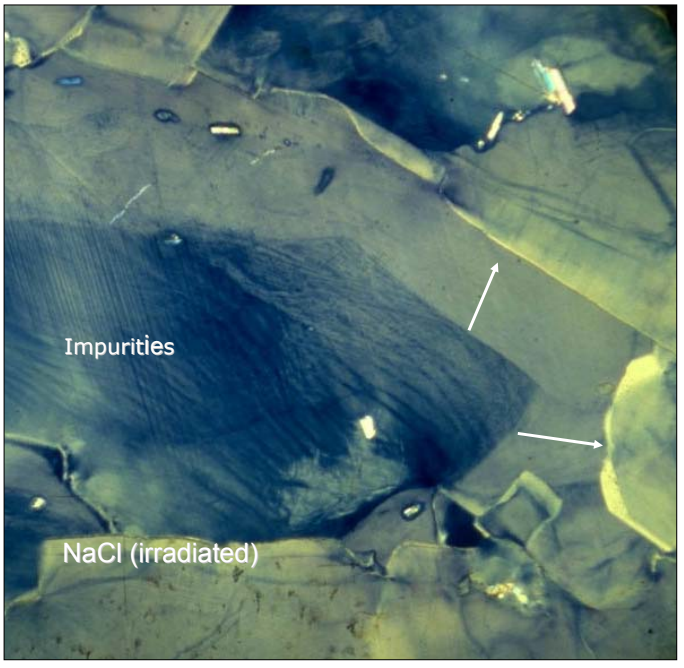
Natural Systems



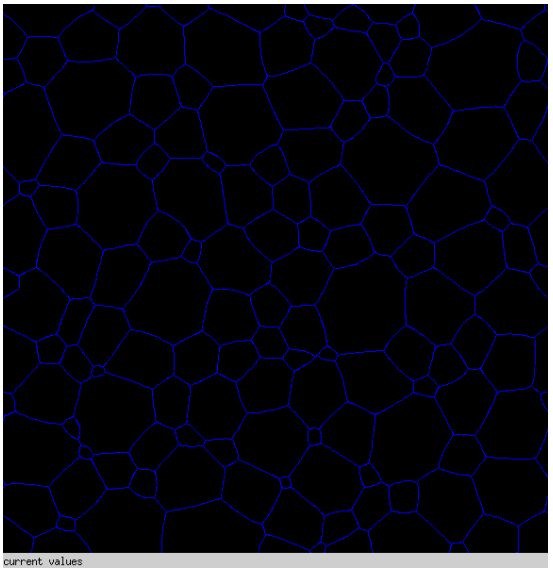
Quartz chemically zoned
(CL, Holness)



CL of $CaCO_3$ polycrystal, Ramseyer et al. 2004



Distribution of Impurities (Urai)



Volume energy driven grain boundary migration

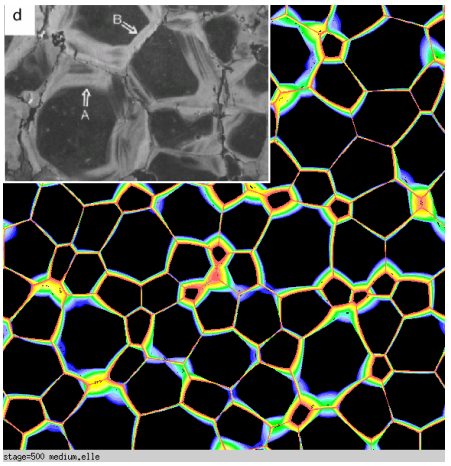
Volume energies randomly assigned at start

gb colours vary with time

GBM zones

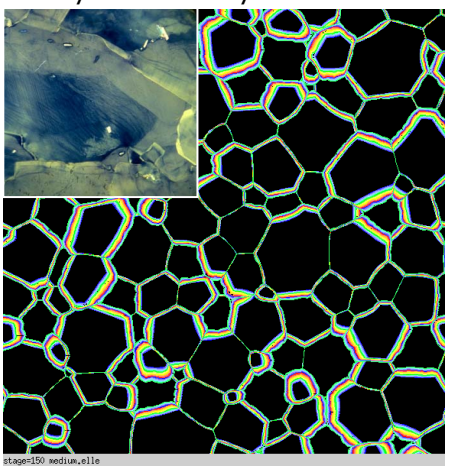
Oscillatory zoning and predicted by cyclical grain boundary chemistry variations during grain boundary migration

Grain Growth



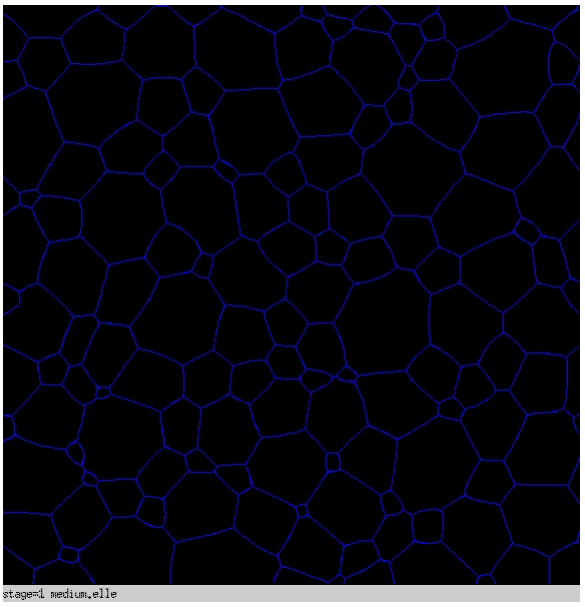
Not concentric, Widest at triple junctions

Dynamic Recrystallisation



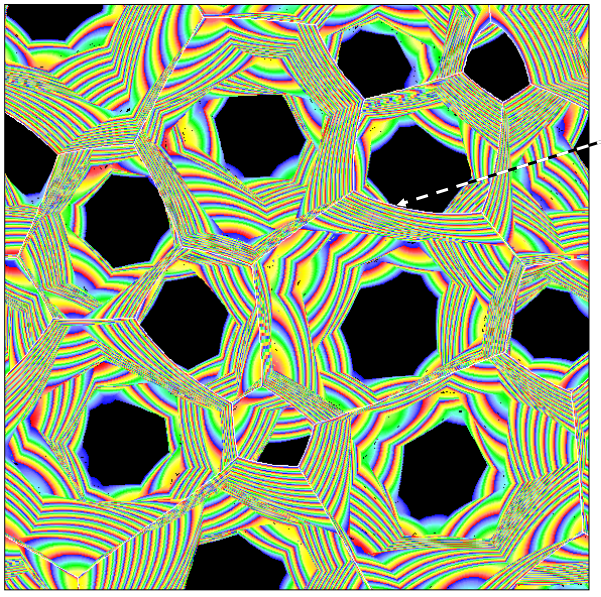
Not concentric, Uniform width zones

Normal Grain growth patterns



Cyclic variation in grain boundary chemistry reflected in lattice behind migrating boundary

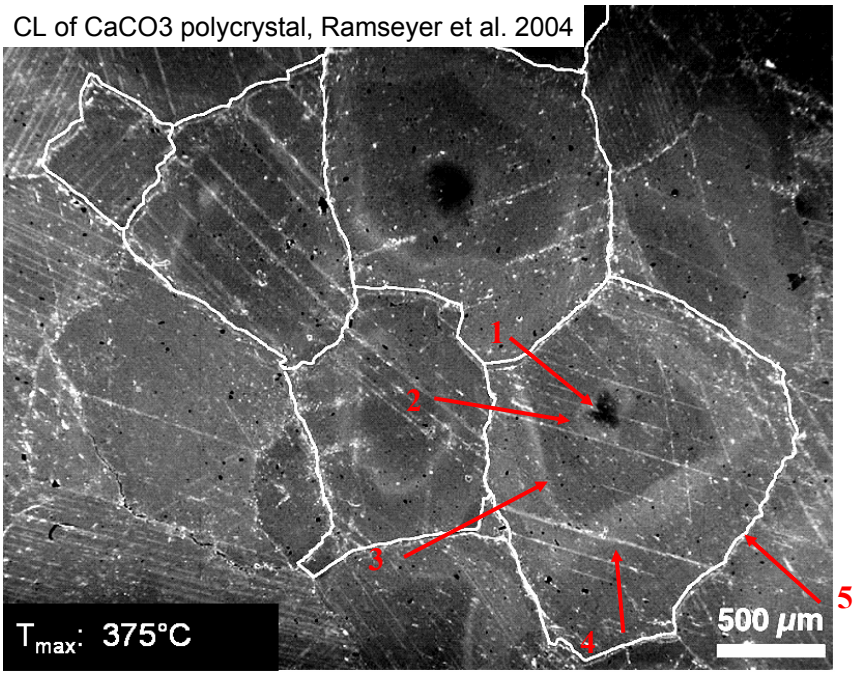
Normal Grain growth patterns

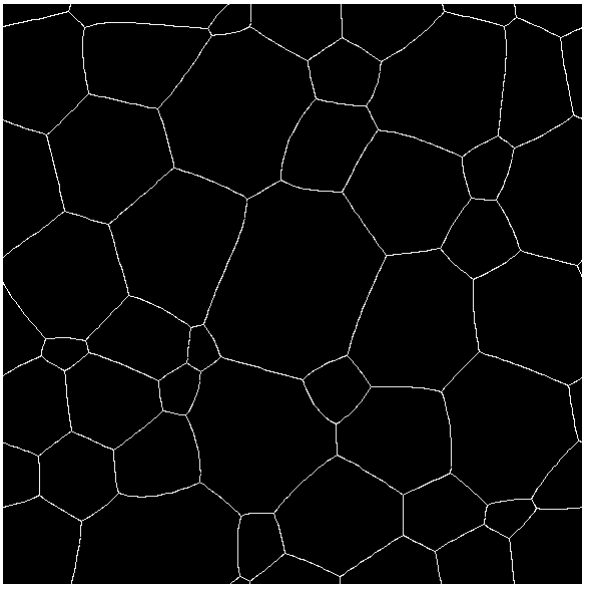


Continuous growth, but truncations and rapid changes in grain boundary velocity

Possibility to sample grain boundary chemistry as a function of time

CL of CaCO3 polycrystal, Ramseyer et al. 2004

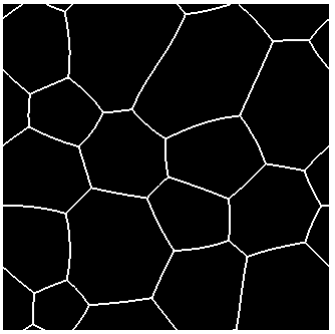




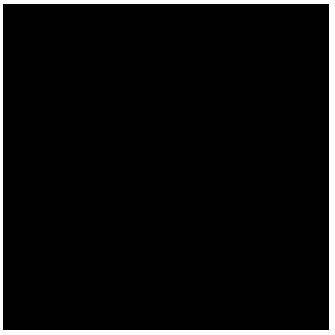
Triple junction trails tracking tj positions with time

Possible if material in tj does not wet boundaries

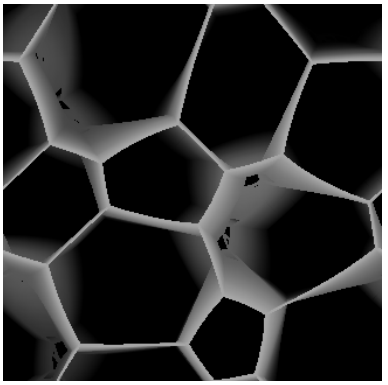
Grain Boundary Migration Textures



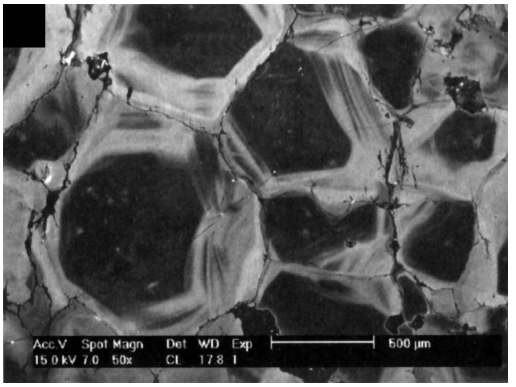
Grain Boundary Migration Textures



Grain Boundary Migration Textures



Jessell et al 2003



Holness & Watt 2000