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Grain growth experiment on organic polycrystals as a rock analogue

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Physical and chemical properties of mantle and crustal rocks are often determined by their grain size. For example, grain size can control the creep and diffusion properties of the rocks. The size can change with time, so called grain growth. To find out how grain size changes with time and temperature, we carried out grain growth experiments using borneol ($C_{10}H_{18}O$) organic polycrystal. Advantage of using the borneol as a rock analogue is that the experiment does not require high temperature condition (more than 1000C), which is necessary for grain growth of mineral aggregates.

We ball-milled the borneol powder under temperature condition of -20~-40 C. Then the powder was pressed and sintered at room temperature to obtain pore-free aggregates with grain size of ~2 micron. After the measurement of initial grain size, the aggregated was heated in the oven at certain temperature to produce grain growth. We found the grain growth relationship of $d^n - d_0^n = kt$, n = 2.6 (grain size d, initial grain size d_0, and time t). Based on the relationship of k as a function of exp(-Q/RT), we obtain Q = 127 (kJ/mol). Consequently, the grain growth of borneol follows $d^{2.6}$ - d_0$^{2.6}$ =5.2*10^21*exp(-127000 /RT) t.