**1 Introduction**

A relationship between differential stress and dynamically recrystallized grain-size has been established experimentally for quartz, olivine, calcite, orthopyroxene, and various metals and salts. As yet, there is no overarching theory that explains the stress-grain-size relationship.

Current explanations are inconsistent with observational data, and basic physical laws. Here I show that the relationship between subgrain size and stress, which has a physical basis, leads to an understanding of the grain-size piezometer in terms of recrystallization processes.

**2 Mechanisms of Dynamic Recrystallization**

Grain-boundary migration is an essential part of dynamic recrystallization. It is a thermally activated process involving diffusion across the boundary. It may be driven by lattice strain energy ($\gamma_{\text{GBM}}$) or by surface energy ($\gamma_{\text{BLG}}$). These processes produce very different microstructures.

Grain-boundary bulging (BLG) is driven by dislocations, whereas subgrain rotation recrystallization (SGR) is a process involving diffusion across the boundary. It may be driven by lattice strain energy ($\gamma_{\text{GBM}}$) or by surface energy ($\gamma_{\text{BLG}}$). These processes produce very different microstructures.

**3 Stress during Dislocation Creep**

The experimentally determined grain-size parameter is $\phi$ or $G_{\text{GBM}}$, which is the surface area of the grain and $G_{\text{BLG}}$, which is the bulk modulus. Its position is determined by the intersection of the two lines, which indicates the value of $\phi$ and stress conditions.

**4 Subgrains are Key**

Thermally activated recovery occurs when a stress is applied to a grain in the orientation of surfaces that lower the elastic strain energy. These surfaces are unstable, and the crystal will transform from the unstable orientation into one of lower energy. The stress field below the critical stress is a region of instability.

In terms of grain-size piezometer, when $\phi_{\text{BLG}}$ is dominant, the stress is $\phi_{\text{BLG}}$. When $\phi_{\text{GBM}}$ is dominant, the stress is $\phi_{\text{GBM}}$.