diagrams of the four deformation mechanisms are shown in Figure 1.8.

The total rate of deformation in ice I is expressed as the sum of strain rates due to the four individual creep mechanisms,

$$\dot{\varepsilon}_{total} = \dot{\varepsilon}_{diff} + \dot{\varepsilon}_{disl} + \left(\frac{1}{\dot{\varepsilon}_{GBS}} + \frac{1}{\dot{\varepsilon}_{bs}}\right)^{-1}, \tag{1.4}$$

where *(diff)* represents diffusional flow, *(disl)* represents dislocation creep, *(bs)* represents basal slip, and *GBS* represents grain boundary sliding. Grain boundary sliding and basal slip (collectively, grain-size-sensitive creep, or GSS creep) are dependent mechanisms, and both must operate simultaneously to permit deformation (*Durham and Stern*, 2001).

The strain rate for each deformation mechanism is described by

$$\dot{\varepsilon} = A\frac{\sigma^n}{d^p}\exp\left(\frac{-Q^*}{RT}\right), \tag{1.5}$$

where $\dot{\varepsilon}$ is the strain rate, A is the pre-exponential parameter, σ is stress, n is the stress exponent, d is the ice grain size, p is the grain size exponent and Q^* is the activation energy, R is the gas constant, and T is temperature. Rheological parameters from the experiments of *Goldsby and Kohlstedt* (2001) used in our models are summarized in Table A.2.

For ice near its melting point, *Goldsby and Kohlstedt* (2001) present an alternate set of creep parameters to describe large creep rates and low viscosities observed in ice near its melting point in terrestrial ice cores and laboratory samples. The enhancement of creep rates in ice near its melting point is attributed to premelting along grain boundaries and edges. High temperature creep enhancement is not included in the models presented in this thesis, but the possible implications of including such a term, are discussed when relevant, in Chapters 2, 3, 4, and 6.

The deformation mechanism that yields the highest strain rate for a given temperature and differential stress is judged to dominate flow at that temperature and