the apparent lack of correlation between axial stress–strain behaviour and nature of deformation pointed to by GRIGGS and HANDIN [23].

It is not clear why, as observed above, barrelling appears more pronounced when the specimen dilates during deformation than when it compacts and further observations are needed to test whether this correlation is a general effect. Dilation contributes an additional lateral expansion which will tend to exaggerate the barrelling due to end-constraint but this is a minor effect. Otherwise, the explanation may involve a more far-reaching influence of the end-constraints in a dilating specimen.

Application

The main aim of this study has been the better understanding of fundamental mechanisms of rock deformation rather than immediate practical application and only some suggestions regarding applications can be made here. Points of relevance to solid-medium high-pressure apparatus have been discussed elsewhere [14]. Applications in engineering rock mechanics are likely to arise especially when pore fluids are present since dilatancy or compaction will lead to decrease or increase, respectively, in the pore pressure if the rates of strain relative to the permeability of the rock are such that a condition of 'incomplete draining' exists and this will influence any phenomena dependent on pore pressure. Also, roles of dilatancy in metamorphism, the generation of magma and the occurrence of earthquakes have been proposed by earlier writers [18, 38].

Application to geology is made difficult by lack of knowledge of the influence of higher temperature or slower strain rate, either of which will tend to reduce the role of cataclastic flow and dilatancy under geological conditions. However, they may still be present under low-grade conditions where the available crystallographic glide systems are inadequate for full intracrystalline plasticity and diffusion-dependent alternative processes are still relatively slow, or even under higher-grade conditions when the pore pressure is high. In such cases, inelastic volume changes of either sign may have important consequences. Dilatancy may facilitate movement of fluid phases in a rock of initially low permeability, thereby accelerating metasomatic or other metamorphic processes; this could be one of the most important ways in which mineralogical reactions are accelerated in deforming regions. The alternative effect of deformation in accelerating compaction in porous rock may be relevant in the compaction of sedimentary rocks.

It is possible that a dilatancy associated with deformation under upper crustal conditions occurs in the vicinity of active faults, for example, near the San Andreas Fault [39]. Such an association would imply that the straining in the vicinity of the fault is not a steady state process; it may be an aspect of episodic behaviour at the fault. A possible consequence, if the ratio of strain rate to permeability is appropriate, is a decrease in pore pressure at the fault, thereby inhibiting slippage on the fault itself and allowing a general build-up in stress levels.

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