

to occur readily parallel to the layering. Such slip can, at most, only contribute two independent slip systems and so additional deformation mechanisms are needed for the polycrystalline bodies. Kinking can meet some of the additional requirement but probably not all (Paterson, 1969). However, crystallographic slip on non-basal planes may be difficult to achieve. In this case, in the absence of effective diffusion mechanisms at room temperature, it can be expected that cataclastic mechanisms, that is, fracturing or grain boundary parting and relative movement of grains, will also be involved in the deformation. Because of the friction and volume changes associated with cataclastic flow (c.f. soils) this will introduce substantial pressure sensitivity in the stress-strain curve. The observation of higher pressure sensitivity of flow stress in these materials can probably therefore be taken as evidence for some cataclasis being involved (Edmond and Paterson, 1971 a). However, in the case of talc at the higher pressures used here, the pressure sensitivity is only marginally higher than for fully plastic behaviour in materials such as copper, which suggests that nonbasal slip systems may then be contributing to the deformation.

Application to Solid Pressure Media

1. Strength of the Media

The capacity of the medium in a piston-cylinder apparatus to support a shear stress affects its practical application in several ways. Thus, error is introduced in calculating pressure from the piston load and cross-sectional area. Also, the specimen is subjected to non-hydrostatic stress. Further, the conditions tend to be affected by relaxation during the experiment and by variations in details of technique such as whether the pressure is approached from above or from below. We shall now discuss these factors in the light of the present experimental results.

Extrapolation to higher pressures of the stress differences supportable by the various media at room temperature involves uncertainties because of the non-linear dependence on pressure, but for moderate extrapolation, say to 25 kb, fairly firm limits can be estimated. A lower limit is set by assuming no further increase with pressure beyond 8 or 10 kb (actually, the flow stress is more likely to be raised at least in the same proportion as are the elastic constants). An upper limit is set by assuming a rate of increase with pressure equal to that at the upper end of the present range of observation. These two limits are given in the first and third columns of Table for a pressure of 25 kb and 10 percent strain.

Except in the case of talc, all the measurements have been done at room temperature but they should still give a useful guide to behaviour in a high-temperature apparatus because much of the pressure medium in such an apparatus is at a much lower temperature than the specimen. In a typical apparatus with specimen temperature around 1000° C, the temperature near the outer diameter, in the region making up the larger part of the cross-sectional area, is probably not above 200–400° C. In the case of talc and pyrophyllite, the measurements on talc (Fig. 3) indicate that at such temperatures, the stress difference supported by the medium will not be substantially below what it is at room temperature. The strengths of graphite and boron nitride are likely to be little affected even by the furnace

Table. *Extrapolated strength limits at 25 kb (10 percent strain)*

Material	Flow stress at 10% strain at 8 kb ^a = lower limit	Tan ψ at 10% strain at 8 kb ^a	Extrapolation to 25 kb using tan ψ at left = upper limit
Three Springs Talc	2.4 kb	0.08	3.6 kb
Pyrophyllite	4.0	0.21	7.5
Silver Chloride	0.5	0.01	0.7
Sodium Chloride	0.9	<0.01	1.0
Boron Nitride	2.6	0.10	4.3
Graphite	2.2	0.06	3.3

^a 10 kb for talc.

temperature because of their extremely high melting points (at atmospheric pressure, graphite actually increases in short-term strength up to 2500° C; Riley, 1967). On the other hand, silver chloride and sodium chloride, having relatively low melting points, can be expected to show appreciable weakening at 200–400° C and so the room-temperature figures could give a substantial over-estimate of their strengths in a high-temperature apparatus.

2. Nominal Pressure Correction

As mentioned in the Introduction, most workers using piston and cylinder apparatus of the Boyd and England (1960a) type determine the pressure at the sample by applying a correction, often called the "friction correction", to the nominal pressure (load divided by piston area). It is generally agreed that several factors contribute to this correction and it is convenient for discussion to distinguish the following (c.f. Tamayama and Eyring, 1967):

(a) *Stress Gradient in the Sample Region.* This mainly concerns the sample itself and any other medium inside the graphite furnace. Since the dimensions of this region are generally small relative to the overall dimensions of the high pressure volume, stress gradients within it can probably be neglected for the nominal pressure correction, especially at high temperatures where the strengths are low.

(b) *Stress Gradient in the Pressure Media.* Here we consider the contents of the high pressure cylinder apart from the sample region, that is, in the simplest case, the graphite furnace and surrounding medium such as talc. The ability of these materials to support shear stress allows the axial stress component to differ from the radial stress component adjacent to the sample region. Moreover, the radial and, therefore, the axial stress can increase or decrease at larger radii, depending on the loading history and boundary conditions, analogously as in a thickwalled tube under external or internal pressure. Thus, averaging the axial stress gives a nominal pressure that differs from the pressure in the sample region, the latter being given by the radial stress at the boundary of the sample region. It is very difficult to calculate precisely the stress distribution in the pressure cell because of the non-linear stress-strain properties of the media, the volume changes that occur during their deformation, the difference in properties of the components