

The results quoted are from one block; measurements on specimens from another block gave results approximately 20 percent higher.

(b) *Other Talc*. C and E refer to small blocks of talc supplied by Professor D. Griggs from different batches of commercially obtained supplies used in his laboratory. Two pairs of mutually perpendicular specimens were cored from each block. Some preferred orientation of grains was evident in thin sections and measurements on block E with the X-ray texture goniometer showed the preferred orientation to be quite strong in it.

2. *Pyrophyllite*

These specimens were cored from a block of "Grade A Lava" supplied by the American Lava Corporation. No obvious preferred orientation was seen in thin section and any anisotropy of strength was barely detectable in measurements on orthogonal specimens. The density (2.69 gm cm^{-3}) was approximately 95 percent theoretical.

3. *Silver Chloride*

Specimens were cast and machined from a commercially pure grade supplied by Townson and Mercer Pty. Ltd. (Australia). After deformation, the specimens were melted, re-cast, remachined and used again. Their density was approximately 97 percent theoretical.

4. *Sodium Chloride*

Specimens were formed in a piston and cylinder device from Analar analytical reagent grade material. They were not annealed before testing. The density was approximately 99.5 percent theoretical.

5. *Boron Nitride*

Specimens were machined to shape, all in the same orientation, from a block supplied by Union Carbide (Australia) Ltd. X-ray texture goniometer measurements showed moderate preferred orientation, about twice as many basal planes being parallel to the specimen axes as perpendicular to it. The density was approximately 91 percent theoretical.

6. *Graphite*

Specimens were machined from rods of "Electrographite Grade EY 9" supplied by Morganite Carbon Ltd. (Australia). X-ray texture goniometer measurements showed a strong preferred orientation of the graphite crystals, there being about three times as many with basal planes parallel to the specimen axis as perpendicular to it. The density was approximately 77 percent theoretical.

Results

1. *Talc*

(a) *Three Springs Talc*. The stress-strain curves at room temperature are shown in Fig. 1. The change from falling to rising curves corresponded with the transition

from brittle to ductile behaviour. It is seen that the level of the stress-strain curves rises with increasing pressure but at a reducing rate. This effect is illustrated by plotting the stress at 10 percent strain against confining pressure (Fig. 2). The gradient, $\tan \psi$, of this plot can be taken as a measure of the pressure sensitivity of the stress-strain curve at the given strain and confining pressure (Paterson, 1967) and used in extrapolating to higher pressures (Table, p. 152).

The weakening of the talc at higher temperatures is illustrated in Fig. 3, in which the maximum stress in tests at 4 kb confining pressure is plotted against temperature; also a selection of the stress-strain curves from which Fig. 3 is derived are plotted in Fig. 4 to show the effect of temperature on their shape. Using X-ray powder diffractometry, decomposition could only be detected after the 900° C experiments; in these, some talc remained but a large part had been converted to quartz, enstatite and anthophyllite¹. No detectable decomposition had occurred in the 1/2 hour heating period at 800° C, possibly because of sluggishness of reaction since the dehydration temperature at 4 kb pressure appears to be slightly below 800° C (Kitahara, Takanouchi and Kennedy, 1966).

Unexpectedly, sealed specimens of talc did not show an abrupt weakening and embrittlement at 800–900° C associated with dehydration, such as was observed in serpentinite (Raleigh and Paterson, 1965). Instead, there is a more nearly steady rate of fall of strength with increase in temperature. Also in the tests at 400 to 800° C, the talc behaved in a fairly brittle manner; there was a sharp drop in the stress-strain curve after a few percent strain and the specimens showed single shear fractures. Another discrepancy with the observations on serpentinite is the absence, above the dehydration temperature, of any marked effect on the strength resulting from venting one end of the specimen to atmosphere. The venting was done by using a hollow piston of 1.5 mm bore but, in order to avoid extrusion of the talc, a 1.5 mm thick molybdenum alloy disk with four 0.4 mm diameter holes was interposed between the specimen and the hollow piston. Probably the venting has not been fully effective in eliminating pore pressure, either because of low initial permeability or because of reduction of permeability due to collapse of pores in the weak talc matrix as water is removed. Two other factors that may be involved in the discrepancy in behaviour between talc and serpentinite are, first, that talc is much weaker than serpentinite and, second, that the amount of water involved in dehydration of talc is much less than for serpentinite (namely, 4.8 percent by weight for the reaction talc \rightarrow enstatite + quartz + water compared with 11.7 percent for serpentinite \rightarrow forsterite + talc + water).

Further tests suggest that adsorbed water remaining after air-drying may also be important in the behaviour of the talc (the serpentinite specimens of Raleigh and Paterson had been oven-dried). Heating for an hour or so above 100° C leads to about 0.4 percent weight loss in the air-dried specimens. Tests at 600° C after this showed significantly higher strength (Fig. 3) although the specimens still developed a shear fracture after a few percent strain. This increase in strength is found even though both sets of specimens were vented using the arrangement

¹ The presence of anthophyllite is inferred from clearly-defined diffractometer peaks additional to those of talc, quartz and enstatite, for spacings of 8.30, 3.66, 3.06, 2.75, 1.73 and 1.62 Å, all of which are important reflections for anthophyllite.