IMPLICATIONS OF ELASTIC WAVE VELOCITIES MEASURED FOR APOLLO 17 ROCK POWDERS; P. Talwani, Dept. of Geology, University of South Carolina, Columbia, South Carolina 29208, and A. Nur and R. L. Kovach, Dept. of Geophysics, Stanford University, Stanford, California 94305

The seismic velocity in the upper several kilometers of the Moon is known to increase with depth at a rate of 2 km/sec per km. Rocks in the near surface of the Moon are so jointed and broken that their granular nature cannot be neglected. However, little is known about their mechanical behavior at elevated pressures corresponding to moderate depths of burial. One suggestion is that increasing compaction with depth in a rock powder can provide the necessary increase in velocity with depth which has been observed in the Moon.

We have measured the elastic wave velocities of four lunar rock powders 170051, 172161, 172701 and 175081 subjected to hydrostatic confining pressures ranging from 1 atmosphere to 2.5 kilobars. The elastic wave velocities are reversible with pressure cycling, as has been noted for terrestrial rock powders. The results for the compressional and shear wave velocities are shown in Figures 1, 2 and 3.

Velocity-depth gradients of 0.4 to 0.8 km/sec per km are observed but these gradients only persist to a pressure of 50 bars or so (depth $\approx$ 1 km in Moon). At higher pressures the velocity gradient decreases to values some 10 to 20 times less than the gradient at low pressures. The increase of seismic velocity with depth in the shallow lunar interior is much too great to be due simply to cold self-compaction of rock powder.

Our measurements would argue against the idea of cold accretion without extensive heating and it follows that temperature may have a larger effect on the seismic velocity in the lunar crust than heretofore believed. Preliminary experiments on terrestrial rock powders show that it is possible to achieve equivalence with solid rock velocities at relatively low temperatures (Table 1).

TABLE 1

Compressional Velocity in Volcanic Ash Samples After Various P-T Cycling. Measurements at Room Conditions.

Pressure History	Temperature/time History	Compressional Velocity
2.5 kb	room temp.	.77 km/s
10.0 kb	room temp.	1.10 km/s
2 kb	~200°C/~1 hrs	1.90 km/s
2 kb	300°C/5 hrs	4.00 km/s

ELASTIC WAVE VELOCITIES

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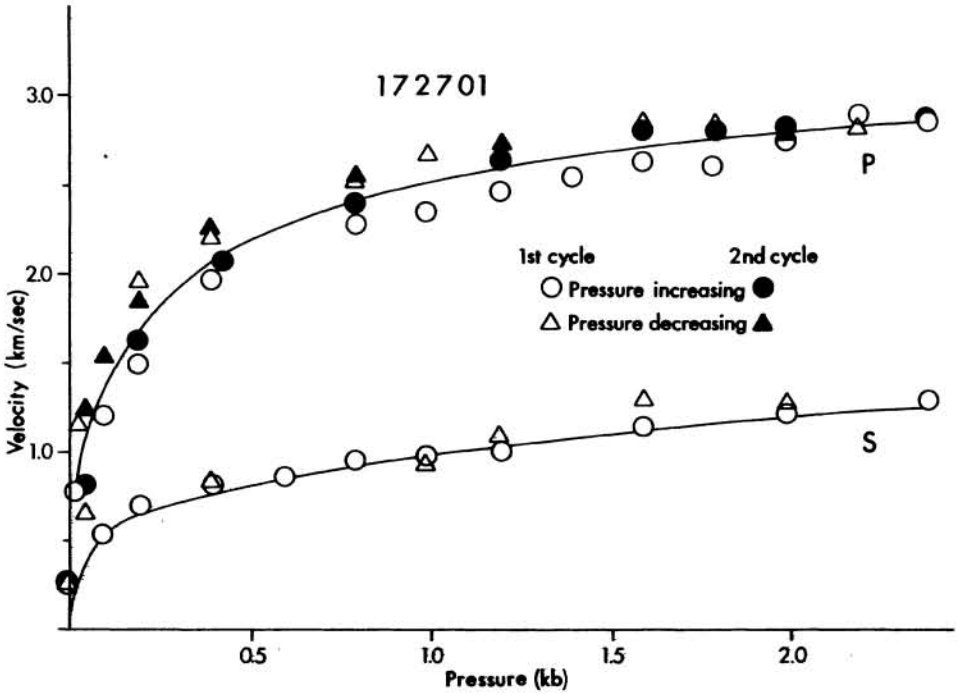

Fig. 1

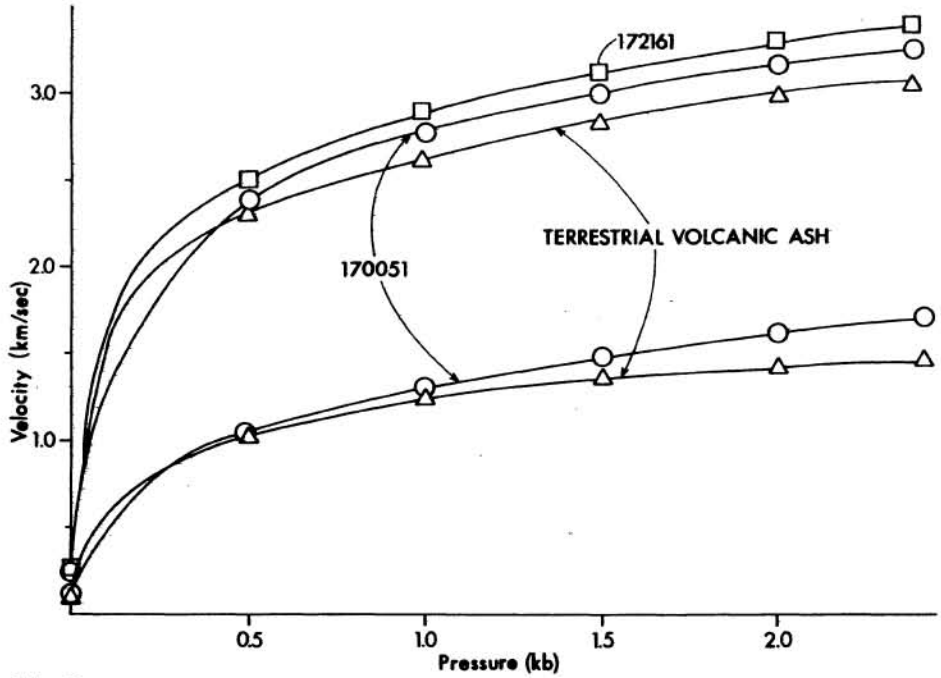

Fig. 2

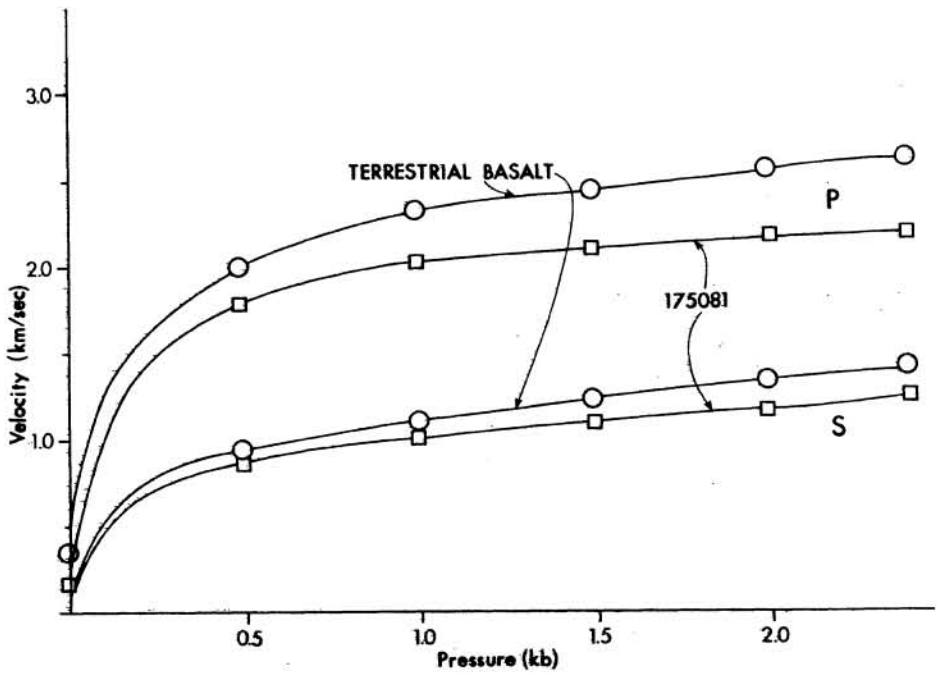

Fig. 3

FIGURE CAPTIONS

Fig. 1. Compressional (P) and shear (S) velocities in sample 172701 as a function of confining pressure. Both P and S are reversible with pressure.

Fig. 2. The P and S-wave velocities in samples 170051 and 172161 as a function of confining pressure compared with values measured on a terrestrial volcanic ash.

Fig. 3. P and S-wave velocities for sample 175081 compared to values measured on a terrestrial finely ground basalt.

REFERENCES

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