greater than the value previously used, and it gradually increases with pressure and temperature. Overall, the two elastic constants are not greatly different from those given by *Stacey* [1969] for the earth at equivalent depths.

Calculations are given below for the total strain release energy available for seismic radiation according to the revised failure model (Figure 11). Three confining pressures are considered: 20, 40, and 100 kbar. Equivalent terrestrial depths are 60, 125, and 300 km, respectively. Calculations are made for both a high-magnitude hypothetical earthquake having failure surface dimensions of $L = 1.5 \times 10^6$ cm and $h = 3 \times 10^5$ cm and a low-magnitude earthquake with $L = 1 \times 10^4$ cm and $h = 2 \times 10^3$ cm. The values used for the several constants and parameters are summarized in Table 4.

If a complete stress relief over the surface undergoing catastrophic failure is assumed, the calculated strain release energies available for generating seismic waves are as follows:

For a high-magnitude earthquake at $P = 20$ kbar ($D = 60$ km), (2) yields

$$E_s = 1 \times 10^{-1}(3 \times 10^5)60.8 \times 10^{18} = 1.8 \times 10^{24} \text{ ergs}$$

Similarly, at $P = 40$ kbar, or $D = 125$ km,

$$E_s = 0.98 \times 10^{-1}(3 \times 10^5)75.7 \times 10^{18} = 2.2 \times 10^{24} \text{ ergs}$$

and at $D = 300$ km

$$E_s = 0.9 \times 10^{-1}(3 \times 10^5)110 \times 10^{18} = 3 \times 10^{24} \text{ ergs}$$

For a low-magnitude earthquake at $D = 60$ km

$$E_s = 1.35 \times 10^{-5}(2 \times 10^3)60.8 \times 10^{18} = 1.6 \times 10^{18} \text{ ergs}$$

Similarly, at a depth of 125 km

$$E_s = 1.3 \times 10^{-5}(2 \times 10^3)75.7 \times 10^{18} = 2 \times 10^{18} \text{ ergs}$$

and at 300 km of depth

$$E_s = 1.2 \times 10^{-5}(2 \times 10^3)110 \times 10^{18} = 2.6 \times 10^{18} \text{ ergs}$$

The above energies are in good agreement with the values of 10^{24} and 10^{18} ergs calculated for magnitude 8.5 and 4 earthquakes, respectively, by means of the Gutenberg-Richter equation (1). The significant reason for the agreement is, of course, the dimensions chosen for the respective surfaces of catastrophic failure. It remains to be seen whether earthquakes are in fact due to limited surfaces that undergo total strain relief by catastrophic shear failure as designated by the failure model.

SUMMARY

It should be noted that the nature of high-pressure torsional experimentation is such that uncertainties exist concerning the stress environment to which samples are subjected and in the interpretation of the results obtained. Strength values should be considered as being no better than semiquantitative. The microstructural observations cited and their interpretation are only qualitative. Equations that have been used in relation to the failure model are based on assumptions that may not be rigorously applicable to the problem to which

TABLE 4. Values of Elastic Constants and Other Parameters Used for Calculating Total Strain Release Energy Available for Generating Seismic Waves Upon Castastrophic Failure of Rock According to Revised Failure Model

Confining Pressure, kbar	Earth Depth, km	Maximum Shear Stress, kbar	Modulus of Rigidity, kbar	Poisson's Ratio	High-Magnitude Earthquake: Failure Surface Width, km	High-Magnitude Earthquake: Failure Surface Length, km	Low-Magnitude Earthquake: Failure Surface Width, km	Low-Magnitude Earthquake: Failure Surface Length, km
20	60	7.8	572	0.254	3	15	0.02	0.1
40	125	8.7	575	0.26	3	15	0.02	0.1
100	300	10.5	594	0.27	3	15	0.02	0.1