rings. The rock sample was surrounded by a 0.6 mm pyrophyllite ring and then placed into the die. The piston, which served as one of the electrodes, was insulated from the die, which served as the other electrode, by a layer of mica. The pressure was transmitted from the piston to the sample as well as to the pyrophyllite ring, so that the resulting nonuniform triaxial compression was nearly hydrostatic. The whole equipment was put between the rams of a 30-ton press, which was thermally and electrically insulated from the bases of the pressure vessel by asbestos and mica plates. The resulting pressure was calculated from the ratio of the load and the cross-section of the piston and calibrated against *Bi I–Bi II* transition at room temperature. The calculated values are accurate to about ± 4 percent at the upper limit of the pressure range, with increasing accuracy toward low pressures.

For the purpose of the experiment the pressure vessel was placed in a vertical furnace. Temperature was recorded by means of a *Pt/Pt-Rh* (10 percent) thermocouple fixed in the die near the sample. The large masses of the supporting rings and the die guarantee homogeneous heating of the sample. Moreover, after the required temperature was reached, we waited for 10 to 15 minutes before taking a resistivity reading. Fluctuations in temperature during the pressure cycle, which took 35 to 45 minutes, were smaller than ± 2.5°C. The measurements were taken at constant temperature and at pressures to 20 kb in about 2-kb intervals. No reading was taken in the first pressure run, and only values of the second and third runs were considered. After each set of pressure runs was completed the temperature was raised by 50°C and the whole procedure repeated. All samples were pre-dried at 150 to 200°C for 6 to 8 hours before being placed in the apparatus.

The dc resistances were measured by means of a terra-ohmmeter in two polarities immediately after switching the meter on in an attempt to minimize the effect of polarization. An average of these two readings was used for the resistivity value. Additional measurements at a frequency of 1 khz were made with an ac bridge method described previously (Valeyev and Parkhomenko, 1965).

The whole set of specimens used was collected at different locations in the U.S.S.R. (the exact locations were not known to the author) and consisted of six different samples of dunite, two of peridotite, and two of olivinite, being thus a set of samples the main constituent of which was olivine. The physical state of the samples may be described as follows. With all the dunites a substantial amount of olivine was altered by serpentinization (more than 35 percent). One of the peridotites (no. 6871) was altered to a high degree (over 60 percent), while the other was almost unaffected by hydration (3 to 7 percent). Both olivinite samples were altered only weakly (less than 10 percent).

Direct readings of resistance of the sample together with known dimensions were used to calculate the electrical conductivity values at given pressure and temperature conditions. No corrections were made for the compressibility, and/or thermal expansion of the samples. Errors arising from leakage currents through the sample holder (pyrophyllite ring) and the pressure vessel might be quite substantial at room temperatures as conductivities of both the pyrophyllite and the samples were of comparable value. At elevated temperatures (over about 200°C), however, the conductivities of the measured rocks were found to be much higher than that of pyrophyllite, and, therefore, no corrections were made for effects arising from the experimental arrangement.

From the conductivity values, graphs of $\log\sigma$ versus pressure were constructed, as illustrated for several samples in Figure 1. Data obtained at pressures greater than 6 to 8 kb can be represented quite reasonably by straight lines. For reasons which will be discussed later, these plots were extrapolated and used to obtain $\log\sigma$ versus $1/T$ graphs for 0 and 20 kb.

Results

The electrical conductivity of the investigated rocks exhibits several types of dependence upon pressure P. In some specimens, usually at temperatures below 300–380°C, conductivity decreases with increasing pressure, while in others, it stays almost constant throughout the whole pressure range. With some samples conductivity increases with pressure as with the first two groups at elevated temperatures exceeding, in general, 500°C. For pressures up to 6 to 8 kb there is a difference between the measured values of conductivity and the values obtained by linear extrapolation of the high-pressure data (Figure 1). This behavior is probably due to the fact that at ordinary pressures pores and cracks are open and their influence upon many physical properties

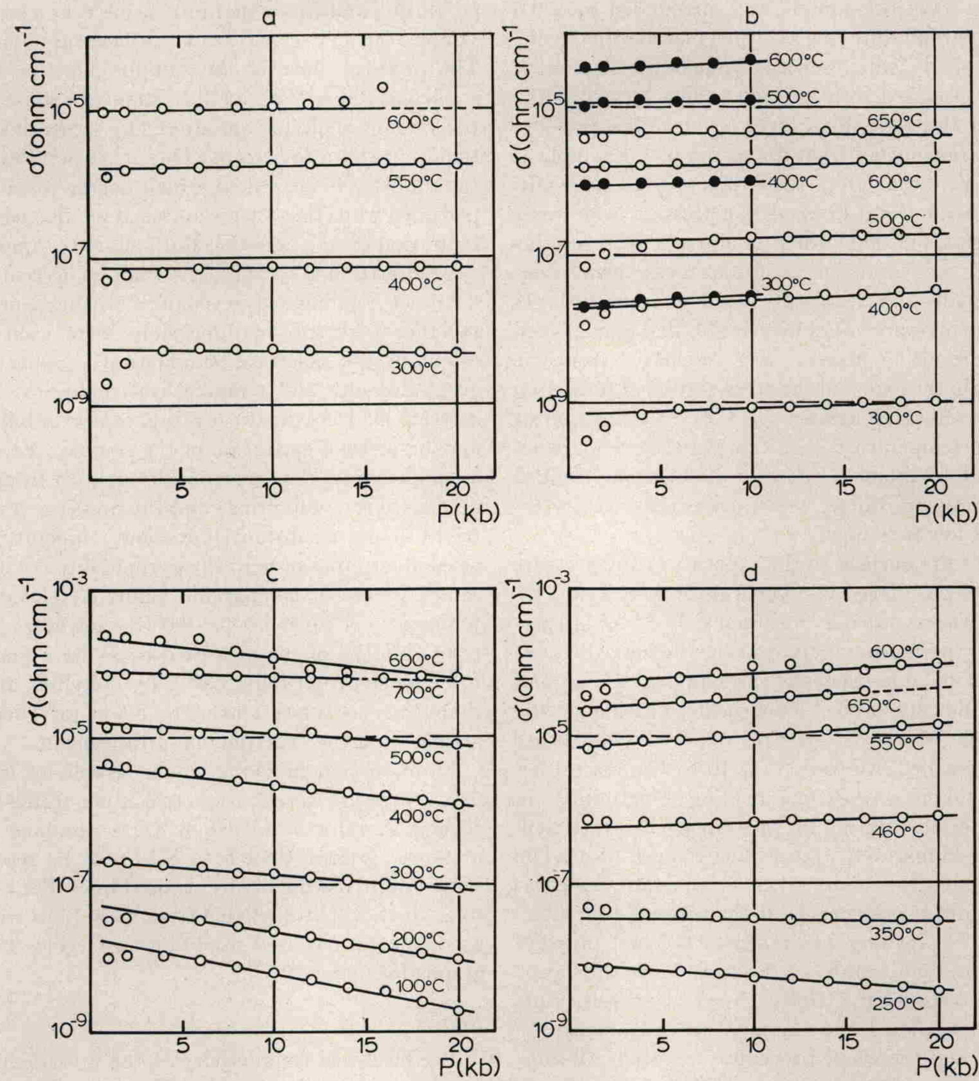

FIG. 1. Variations of conductivity with pressure of several samples as a function of T: *a*—olivinite 6013; *b*—peridotite 5373 (open circles) with values taken during repeated heating on the same sample (full circles); *c*—dunite 4825; *d*—dunite 7198.

is very pronounced (Brace, 1965). As pressure is increased, most pores and cracks close, and their effect is largely eliminated, perhaps through the improved contact between grains (Parkhomenko, 1967, p. 173). After some pressure limit is reached, the behavior of rock can be regarded as "intrinsic" (Birch, 1969; Brace, 1965). Thus, values at ordinary pressure may differ many times from those at a few kilobars (Volarovich and Bondarenko, 1960; Lebedev and Khitarov, 1964).

When the pressure was lowered to the starting value (1 kb), a hysteresis was established in accordance with our previous measurements (Dvořák and Parkhomenko, 1967), the general trend of the relationship being preserved. According to Parkhomenko and Bondarenko (1963), such numerical differences between the first and second pressure cycle are probably caused by contact effects and changes in the dimensions of the sample. The ac conductivities taken at a frequency of