cm^{-1} to be reached at about 750–800°C. For the peridotite mantle material, the conductivity was found to be about $6.7\times10^{-5}-1.3\times10^{-4}$ ohm^{-1} cm^{-1}, leading, thus, by using our data on peridotites, to temperatures between 620 and 800°C.

Comments on depth distribution of σ as deduced from laboratory measurements

In the past, many attempts were made to use results of laboratory measurements of the electrical conductivity to deduce the depth distribution of σ within the earth. Suppose a mechanism of conductivity represented by an equation of type (1) exists, then by taking the logarithm of σ and differentiating, we get

$$\partial \log\sigma/\partial P = \partial \log\sigma_0/\partial P - 1/(kT)\, \partial A/\partial P. \quad (2)$$

Suppose

$$\partial \log\sigma_0/\partial P \ll 1/(kT)\, \partial A/\partial P, \quad \text{and} \quad (3)$$

$$\partial A/\partial P = A\, \partial \log A/\partial \log V\, \partial \log V/\partial P, \quad (4)$$

where V is the volume per unit mass. Then, using $(1/V)(\partial V/\partial P) = -\beta$ for the compressibility, and denoting $\partial \log A/\partial \log V = \gamma$, it follows from (4) that

$$A_p = A_0 \exp(-\gamma\beta P), \quad (5)$$

A_0 being the value of A at $P=0$. From (2),

$$\partial \log\sigma/\partial P = \gamma\beta A/(kT). \quad (6)$$

For $\gamma\beta$ being taken independent of pressure, we get

$$\sigma_p = \sigma^0 \exp\left\{-\frac{A_0}{kT}\left[\exp(-\gamma\beta P) - 1\right]\right\}, \quad (7)$$

σ^0 now being the value of σ at $P=0$.

Such a procedure, however promising, would, according to the present results, lead to incorrect values. The assumption made in (3) does not seem to be justified, if $\partial \log\sigma/\partial P$ and $\partial \log\sigma_0/\partial P$, to a first approximation expressed by the differences $\Delta\log\sigma/\Delta P$ and $\Delta\log\sigma_0/\Delta P$, are of comparable value (Table 1 and Table 2). Also, introducing values of A_0 and σ^0 as obtained from room pressure measurements into (7), leads to an incorrect result. The values one would look for should be found through high-pressure experiment only. When extrapolating high-pressure data to zero pressure and plotting these as a function of $1/T$, one should obtain A_0 and σ^0 describing the "intrinsic" behavior of the material under investigation. Finally, the assumption that $\gamma\beta$ is independent of pressure, would give rise to additional errors.

ACKNOWLEDGMENTS

I am indebted to Dr. E. I. Parkhomenko from the Institute of Physics of the Earth of the Soviet Academy of Sciences in Moscow, where the experimental part of the work was done, for supplying me with specimens, for the use of the equipment of the Department of High Pressures and Physical Properties of Rocks, and for her kind assistance and advice during measurements.

I am also grateful to Dr. H. H. Schloessin and Dr. A. E. Beck from the Department of Geophysics of the University of Western Ontario, London, Canada, for reading the manuscript, and for their comments and discussion of the matter of the paper.

REFERENCES

Birch, F., 1969, Density and composition of the upper mantle: First approximation as an olivine layer, *in* The earth's crust and upper mantle, edited by P. J. Hart: Geophys. Monogr. 13, Washington, D. C., AGU, p. 18–36.

Brace, W. F., 1965, Relation of elastic properties of rocks to fabric: J. Geophys. Res., v. 70, p. 5657–5667.

Bradley, R. S., Jamil, A. K., and Munro, D. C., 1964, The electrical conductivity of olivine at high temperatures and pressures: Geochim. Cosmochim. Acta, v. 28, p. 1669–1678.

Brindley, G. W., 1963, Crystallographic aspects of some decomposition and recrystallization reactions, *in* Progress in ceramic science, v. 3, edited by J. E. Burke: New York, Pergamon Press, p. 1–55.

Brindley, G. W., and Zussman, J., 1957, A structural study of the thermal transformation of serpentine minerals to forsterite: Amer. Mineral., v. 42, p. 461–474.

Duba, A., 1972, Electrical conductivity of olivine: J. Geophys. Res., v. 77, p. 2483–2495.

Dvořák, Z., 1967, The temperature dependence of electric conductivity of some basic and ultrabasic rocks of the Bohemian Massif: Geofys. Sb. 1967, No. 284, Academia, Praha 1968, p. 451–468.

Dvořák, Z., and Parkhomenko, E. I., 1967, Pressure and temperature dependence of electric conductivity of some basic and ultrabasic rocks: Geofys. Sb. 1967, No 285, Academia, Praha 1968, p. 469–481.

Dvořák, Z., and Parkhomenko, E. I., 1971, Temperature and frequency dependence of electric parameters of igneous rocks: Stud. Geophys. Geod., v. 15, p. 86–91.

Dvořák, Z., and Schloessin, H. H., 1972, On the anisotropic electrical conductivity of enstatite as a function of pressure and temperature: Geophysics, this issue

Hatch, F. H., Wells, A. K., and Wells, M. K., 1952, The petrology of the igneous rocks, 11th edition: London, Thomas Murby and Co., p. 340.

Hermance, J. F., and Grillot, L. R., 1970, Correlation of magnetotelluric, seismic, and temperature data from southwest Iceland: J. Geophys. Res., v. 75, p. 6582–6591.

Ioffe, A. F., 1960, Physics of semiconductors: New York, Academic Press, translated from Russian, p. 15, 71.
Kiyoura, R., and Ito, Y., 1954, Thermal transformation of synthetic and natural serpentines, especially exothermic reactions: J. Ceram. Ass. Jap., 1953, v. 61, p. 525–528, Chem. Abstr., v. 48, p. 4194.
Kobayashi, K., 1962, Differential thermal analysis of olivine mineral products in Japan: Imono, 1960, v. 32, p. 125–129, Chem. Abstr: v. 57, p. 5649.
Lebedev, E. B., and Khitarov, N. I., 1964, Dependence of the beginning of melting of granite and the electrical conductivity of its melt on high water vapour pressure: Geochem. Int., v. 1, p. 193–197.
Lidiard, A. B., 1957, Ionic conductivity, *in* Encyclopaedia of physics, v 20, Electrical conductivity, II: New York, Springer Verlag, p 246–349
Lubimova, E. A., and Feldman, I. S., 1970, Heat flow, temperature, and electrical conductivity of the crust and upper mantle in the U.S.S.R.: Tectonophysics, v. 10, p. 245–281.
Noritomi, K., 1961, The electrical conductivity of rocks and the determination of the electrical conductivity of the earth's interior: J. Mining Coll., Akita Univ., ser. A, v. 1, p. 27–59.
Parkhomenko, E. I., 1967, Electrical properties of rocks: New York, Plenum Press.
Parkhomenko, E. I., and Bondarenko, A. T., 1963, An investigation of the electric resistivity of rocks at pressures up to 40,000 kg/cm² and temperatures up to 400°C: Izv. Akad. Nauk SSSR, ser. geofiz., p. 1823–1832.
Rikitake, T., and Whitham, K., 1964, Interpretation of the Alert anomaly in geomagnetic variations: Can. J. Earth Sci., v. 1, p. 35–62.
Ringwood, A. E., 1966, Mineralogy of the mantle, *in* Advances in earth science, edited by P. M. Hurley: Cambridge, M.I.T. Press, p. 359–399.
——— 1969, Composition of the crust and upper mantle, *in* The earth's crust and upper mantle: P J Hart, editor, Geophys. Monogr. 13, Washington, D. C., AGU, p. 1–17.
Schober, M., 1971, The electrical conductivity of some samples of natural olivine at high temperatures and pressures: Z. f. Geophysik, v. 37, p. 283–292.
Uyeda, S., and Rikitake, T., 1970, Electrical conductivity anomaly and terrestrial heat flow: J. Geomagn. Geoelec., v. 22, p. 75–90.
Valeyev, K. A., and Parkhomenko, E. I., 1965, Electrical properties of rocks in constant and variable electric fields: Izv. Akad. Nauk SSSR, Fizika Zemli, no. 12, p. 45–52.
Volarovich, M. P., and Bondarenko, A. T., 1960, Investigation of the resistivity of rock samples under hydrostatic pressure up to 1000 kg/cm²: Izv. Akad. Nauk SSSR, ser. geofiz., p. 946–953.
Watanabe, H., 1970, Measurements of electrical conductivity of basalt at temperatures up to 1500°C and pressures to about 20 kilobars: Spec. Contributions, Geophys. Inst., Kyoto Univ., no. 10, p. 159–170.