an order of magnitude, on the σ of olivine in the temperature region below 1000°C. This band is delimited by the Fa 7.7 olivine for low conductivity and the Fa 26.4 olivine for high conductivity. Besides the higher temperature measurements of the Bonin Island olivine, which have slopes similar to the Red Sea peridot, the slopes in this temperature region are similar ($A_x \cong 0.7$ ev). This similarity indicates a common mechanism of conductivity that is probably due to ferric-iron content. The steeper slopes represented by the low- temperature portions of the synthetic forsterite, Red Sea peridot, and intermediate-temperature portion of the Bonin and Sado olivines may be the result of extrinsic ionic conductivities [*Shankland*, 1969]. The mechanism of conductivity for the highest-temperature portion may be due to ionic or intrinsic electronic conductivity.

Figures 4 and 5 compare the variation of A_x and σ_x with pressure for all samples studied with literature values. Only the (001) direction for the Fa 8.2 A_x has been plotted, because all three directions are almost the same in both sign and magnitude of the variation. The pressure derivatives of σ_x for the Fa 9.4 and the Fa 0 show a significantly larger pressure effect than the other samples. Except for the Fa 8.2, all single crystals studied have derivatives that are opposite those reported for powders. One could attribute this marked variation between single crystals and powders to compaction and grain-boundary effects in the powders. However, the Fa 8.2 has derivatives in the same sense as the powders, unlike the four other compositions studied.

It is obvious from an inspection of Figure 2 that something other than pressure affected the conductivity pressure derivatives. In this figure the triangles represent low-temperature conductivity measurements made after a crystal had been at the highest temperature. In every sample but the Fa 8.2 the low-temperature data points fall at conductivities higher than those noted on the measurements made before the highest temperature was achieved. This change is in the same direction as the 'pressure effect' and could be the result of the deterioration of the thermocouple, the annealing of dislocations, the diffusion of oxygen into the crystals, or some artifact of the coating procedure, because, as noted above, the Fa 8.2 olivine was platinum-plated

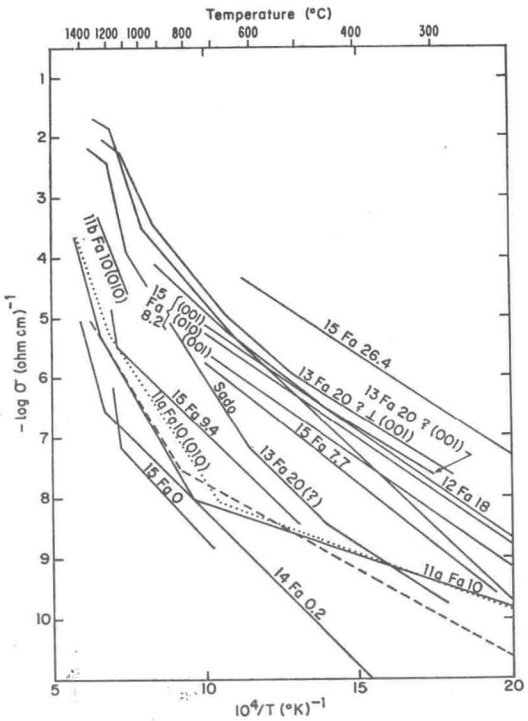

Fig. 3. Conductivity of olivine single crystals as determined by this and other studies. Composition is indicated above the line. Question mark means that the composition of olivine was not reported by the author. Numbers in parentheses give the direction in which σ measurement was made. First number above the line refers to one of the following investigators: 11*a*, *Hughes* [1953]; 11*b*, *Hughes* [1955]; 12, Mizutani and Kanamori [1967]; 13, *Noritomi* [1961]; 14, *Shankland* [1969].

in air at 600°C, whereas the other samples were plated in a vacuum at 800°C. It seems likely that a combination of the last two possibilities is the most probable cause of the variation. It is proposed that the Fa 8.2 came to equilibrium with an oxygen atmosphere during plating (however, no color change was noted in the thin uncoated plates of the sample that were present during the plating process), whereas all other samples were subjected to an oxygen-rich atmosphere only during actual measurement of conductivity.

The results of the experiments reported above can be summarized as follows:

1. Although an increase in iron content generally increases the σ of olivine, olivines with small differences in iron content may differ by

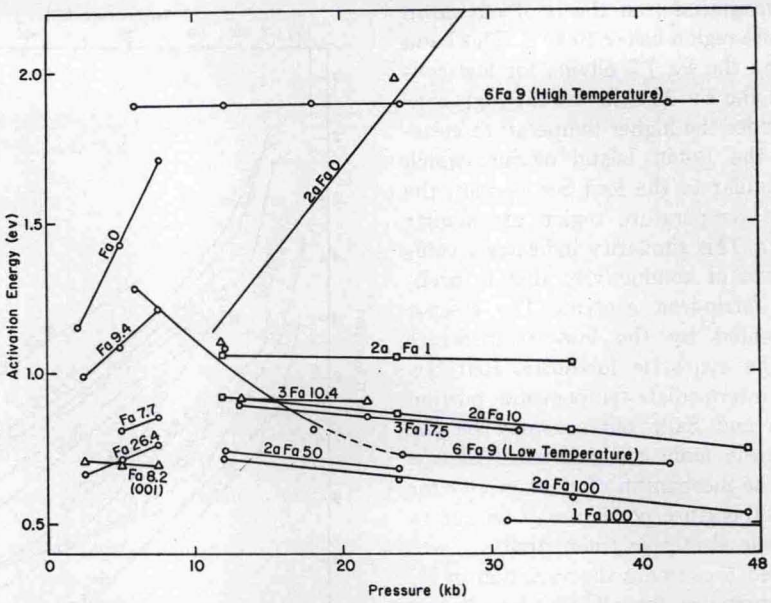

Fig. 4. Activation energy as a function of pressure, as reported for olivine powders and as determined in this study for olivine single crystals. Composition is indicated above the line. A line intersecting a boundary indicates that the data are off-scale. Numbers above the line refer to the following investigators: 1, *Akimoto and Fujisawa* [1965]; 2a, *Bradley et al.* [1964]; 3, *Hamilton* [1965]; 6, *Schult and Schober* [1969].

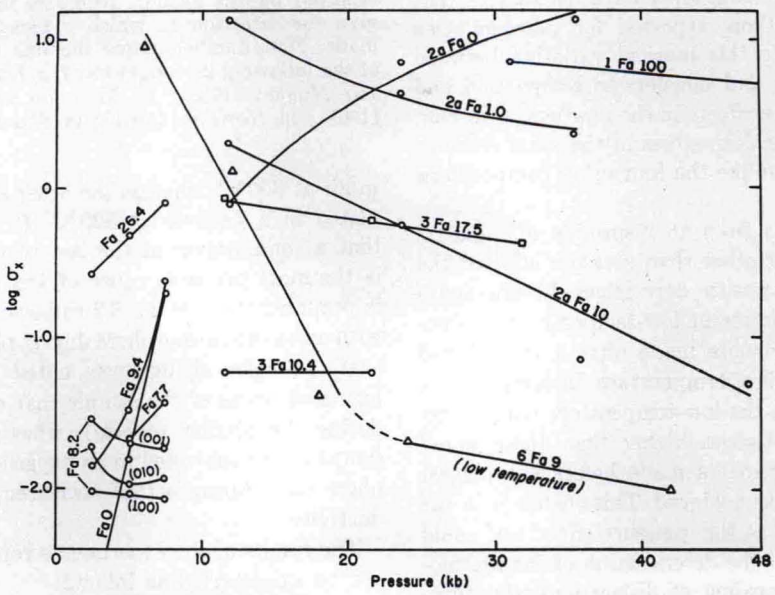

Fig. 5. Log σ_x as a function of pressure, as reported for olivine powders and as determined in this study for olivine single crystals. Composition is indicated above the line. A line intersecting a boundary indicates that the data are off-scale. Numbers above the line refer to the investigators listed in Figure 4.