

TABLE 3. Continued

Sample	Composition	Crystal Direction	Pressure, kb	Temperature Range, $10^4/T$ ( $^{\circ}\text{K}$ ) <sup>-1</sup>	$\log \sigma_x$	$A/k$	Stand. Deviation	$A_x$ , ev
St. John's Island	Fa 9.4							
35*		(010)	7.50	15 to 11	-0.6245	0.6097	0.01383	1.2097
35*		(010)	5.00	15 to 11	-1.471	0.5405	0.007261	1.0724
35*		(010)	2.50	15 to 7.3	-1.859	0.4986	0.02002	0.9893
35*		(010)	2.50	7.05 to 6.9	+20.056	3.587	2 points only	7.117
Crater Elegante	Fa 26.4							
36*			7.50	20 to 11	-0.1012	0.3855	0.009410	0.7649
36*			5.0	21 to 12	-0.3204	0.3518	0.008379	0.6980
36*			2.5	21 to 10	-0.5887	0.3349	0.01016	0.6645
Synthetic	Fa 0							
38*			7.5	9.5 to 7.2	-0.7139	0.8573	0.01300	1.701
38*			5.0	10.1 to 7.3	-1.810	0.7165	0.01213	1.422
38*			2.5	10.0 to 7.5	-2.932	0.5796	0.03838	1.150
38*§			2.5	7.15 to 6.8	+21.972	4.0284	0.23937	7.993

\*Data used in Figure 6.

†Experiment repeated 2 weeks later to check reproducibility.

§Three data points used in this calculation.

TABLE 4. Results of Spectrographic, Electron-Microprobe, and Wet Chemical Analyses of Olivine Samples (Composition of synthetic forsterite given in Table 1.)

Oxide	Wet Chemical Analyses, wt %			Crater Elegante Microprobe Analysis, ¶ wt %
	San Carlos*	Red Sea†	Mt. Leura§	
SiO <sub>2</sub>	40.7	40.5	41.0	37.8
Al <sub>2</sub> O <sub>3</sub>	0.2	0.3	0.1	<0.2
Cr <sub>2</sub> O <sub>3</sub>	0.05	0.00x	0.02	
Fe <sub>2</sub> O <sub>3</sub>	0.41		0.34	} 24.2
FeO	7.94	9.16	7.5	
MnO	0.12	0.14	0.11	<0.2
MgO	50.1	49.3	50.7	37.7
CoO	0.02	0.01	0.01	
NiO	0.38	0.38	0.34	<0.2
CuO	0.02	0.00x	0.01	
CaO	0.07	0.01	0.04	<0.1
ZnO	0.01	0.005	0.01	
Na <sub>2</sub> O	0.01	0.02	0.01	
K <sub>2</sub> O	0.00	0.01	0.00	
Total	100.03	99.83	100.19	

\*8.2 mole % fayalite; spectrographic trace elements Ti, Ba, Be, Sc.

†9.4 mole % fayalite; spectrographic trace elements Ti, Ba, Ag, Sc.

§7.7 mole % fayalite; spectrographic trace elements Ti, Ba, Ag, Sc.

¶26.4 mole % fayalite; spectrographic trace elements Ti, Ba, Ag, Sc.

|| Present but small ( $\leq 0.2\%$ ).

500° and 1100°C in the Fa 9.4 and between 700° and 1100°C in the Fa 0 indicate that only one  $\sigma$  mechanism is operating in these olivines in these temperature regions. It is possible that some other  $\sigma$  mechanism is effective at lower temperatures, but the larger leakage conductance of the sample holder masks these regions. Above about 1150°C the two olivines exhibit a large reversible increase in  $\sigma$ . Because of the deterioration of the chromel-alumel thermocouple, the data were collected over a small region of reciprocal temperature space and are of poor precision. However, despite large differences in initial conductivity, both samples indicate an  $A_x$  of 7–8 eV and a  $\sigma_x$  of  $10^{21}$ – $10^{22}$ . Although the poor precision does not allow more than a qualitative assessment of the nature of the difference in  $A_x$ , it would appear that the synthetic Fa 0 requires the larger  $A_x$  (8 eV) vis a vis the Fa 9.4 (7.1 eV).

Table 3 summarizes the coefficients and stand-

ard deviations of the linear-regression analysis of the data for various compositions, pressures, crystal directions, and temperature ranges. For the linear-regression analysis  $\log \sigma$  was treated as the dependent variable, and  $10^4/T$  ( $^\circ K$ )<sup>-1</sup> was treated as the independent variable.  $\log \sigma_x$  is the log pre-exponential term of (1) and is negative for all samples studied, except samples 38 and 35 from the high-temperature region, where  $\log \sigma_x$  is 22 and 21, respectively. The term  $A_x/k$  from (1) is the slope of this 'best-fit' line, and from this term the activation energy  $E$  may be calculated. However,  $A_x$  is listed in Table 3 because its use involves no interpretation of conduction mode, as would a listing of activation energies.

Figure 3 compares the data of Figure 2 with available literature data for single crystals of olivine. With the notable exceptions of the Red Sea peridot, Sado olivine, and synthetic forsterite, there is a wide band of agreement, within