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# The influence of oxidation state on the electrical conductivity of olivine

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### Abstract

The electrical conductivity of a single crystal of San Carlos olivine ( $\text{Fo}_{92}$ , 0.16 wt.%  $\text{Fe}_2\text{O}_3$ ) has been measured as a function of temperature and oxygen fugacity ( $f\text{O}_2$ ). After heating to  $1338^\circ\text{C}$  at  $f\text{O}_2 = 10^{\hat{1}2}$  atm., the conductivity at  $950^\circ\text{C}$  was  $10^{\hat{5}}$  ( $\text{ohm}\cdot\text{m}$ ) $^{\hat{1}}$ , almost 3 orders of magnitude less than that measured in air. This decrease is due to the reduction of  $\text{Fe}^{3+}$  to  $\text{Fe}^{2+}$ . Further heating to  $1500^\circ\text{C}$  at  $f\text{O}_2 = 10^{\hat{1}4}$  atm., decreased the electrical conductivity at  $950^\circ\text{C}$  to  $10^{\hat{6}}$  ( $\text{ohm}\cdot\text{m}$ ) $^{\hat{1}}$ . When recovered at room temperature, the specimen had  $\text{Fo}_{96}$  composition and contained small, opaque blebs distributed throughout the crystal. Derivations of temperature profiles for the earth's mantle from conductivity-depth models must take account of the important role played by iron oxidation state in the electrical conductivity of olivine.



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