

1100°C is controlled by Fe³⁺ content. Activation energies ≤ 1.0 eV are associated with Fe₂O₃ > 0.05 wt%. Most likely, the mechanism is extrinsic semi-conduction due to Fe³⁺ doping. Oxidation and reduction of the iron in natural olivine during σ studies to test the validity of this hypothesis have been performed and are discussed elsewhere [19].

4. Geophysical application

When calculating temperature profiles from electrical conductivity-depth distributions, the oxidation state of the iron in the olivine of the mantle has to be considered. This is not a trivial problem since the equilibrium Fe³⁺ content of mantle olivine will be controlled by both the oxidation state of the mantle and the distribution of Fe³⁺ among the phases in the mantle.

The results of Drickamer et al. [18] may be applicable to this problem. They have shown that Fe³⁺ → Fe²⁺ with increasing pressure according to the rule

$$\frac{C_{II}}{C_{III}} = K = A (P/P_0)^B, \quad (2)$$

in which A and B are constants, C_{II} and C_{III} the fraction of sites occupied by Fe²⁺ and Fe³⁺ and $P_0 = 1$ kb for the values of B quoted in ref. [18].

We have plotted the 27 values for A and B given in [18] and have discovered a linear relationship between $\ln A$ and B :

$$A = \exp(-4B), \quad (3)$$

where B varies from ~0 to 4 while A ranges from ~0.3 to 10⁻⁷. While some of the A , B values are for temperatures other than 295°K, omission of these points does not change eq. (3) significantly. For $B = 0$, $A = 1$ and for $A > 1$ (i.e. $C_{II} > C_{III}$), B is forced to be negative and eq. (2) predicts that pressure will cause the formation of more ferric iron rather than less. Since Drickamer et al. studied substances with $A < 1$ the validity of eqs. (2) and (3) in the region $A > 1$ is unproven. Hence, regardless of its attractiveness for geophysical applications in studies of the oxidation state of iron compounds at elevated pres-

ures, in the case of small amounts of ferric iron being present in a basically ferrous compound, the theory is ambivalent or inapplicable.

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