

CRITICAL EVALUATION OF THE RECENT MINERAL-PHYSICS DATA AND THE COMPOSITION OF EARTH'S MANTLE

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I WILL CRITICALLY EVALUATE THE FOLLOWING INFORMATION AND DISCUSS THE COMPOSITIONAL HETEROGENEITY AND EVOLUTION OF EARTH'S MANTLE. 1. THE INNER CORE IS LESS DENSE THAN IRON OR IRON AND NICKEL AT THE CORE PRESSURES AND TEMPERATURES. RECENT PRESSURE-TEMPERATURE-VOLUME DATA ON IRON TEND TO SHOW THAT THE IRON DENSITY MAY BE ONLY LITTLE DIFFERENT FROM THE PREM MODEL DENSITY. 2. PEROVSKITE IS NOT THE MOST STABLE SILICATE IN THE LOWER MANTLE. 3. THE SECOND MINERAL, WHICH IS THOUGHT TO COEXIST WITH PEROVSKITE IN THE MANTLE, THE MAGNESIOWUSTITE SOLID SOLUTION COULD BREAK DOWN TO TWO PHASES ONE RICH IN MGO AND THE OTHER IN FEO AT ABOUT 70 GPA BECAUSE OF A STRUCTURAL CHANGE IN FEO. 4. AFTER MANY YEARS OF DEBATE, A CONSENSUS IS EMERGING AMONG THE GEOPHYSICISTS THAT IRON MELTS AT ULTRA-HIGH PRESSURES AT A SIGNIFICANTLY LOWER TEMPERATURE THAN THAT FOUND IN SOME OF THE SHOCK-WAVE STUDIES. 5. IRON AT SUB-SOLIDUS TEMPERATURES IS EMERGING TO BE A SUBSTANCE WITH ADDITIONAL PHASE TRANSITIONS NOT KNOWN BEFORE. 6. THERE IS NEW DATA AND THERMODYNAMIC EVALUATION OF THE IRON-OXYGEN BINARY, WHICH TENDS TO SUPPORT AN EXTENSIVE SOLUTION OF FEO IN IRON MELT. 7. RECENT DATA ON FE-FES CONTINUE TO SUPPORT FES AS A COMPONENT OF THE OUTER CORE. 8. ALTHOUGH DEFINITE THERMODYNAMIC DATA ARE LACKING ON THE FE-C SYSTEM, INCLUSION OF CARBON IN THE CORE IS VIABLE. 9. AT A MODEST PRESSURE OF 7.5 GPA, IRON HYDRIDE IS STABLE AND MAY BE CONSIDERED AS A POSSIBLE COMPONENT OF THE CORE.