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Preface

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On 25–26 January 1995 the Royal Society held a Discussion Meeting entitled 'Developments in high-pressure, high-temperature research and the study of the Earth's deep interior'. This London meeting brought together speakers in the fields of experimental high-P–T research (mineral physics), geochemistry, seismology and geodynamics. The goal was to highlight the current state of experimental achievements in the context of other mainstream research on the nature of the Earth's interior. This collection of fourteen papers and discussion comments were derived from four sessions with the following themes: (i) central-Earth temperatures and melting; (ii) experiments at high pressures and temperatures; (iii) seismology and dynamics; and (iv) mantle and core chemistry.

Papers in the first session discuss the thermodynamics of iron, shock temperature measurements, review methods and developments in laser-heated diamond-anvil cell technology and the implications for core temperatures.

The second session papers cover a variety of high-P–T measurements including light and X-ray scattering in the diamond-anvil cell, the crossing of melting curves expected with pressure, and DC electrical conductivity measurements under varying oxygen partial-pressure. Constraints on the equation of state of perovskite obtained by diffraction in a cubic-anvil apparatus to near 30 GPa and 2000 K are presented with the implications for lower-mantle composition.

The seismology and dynamics session topics include a new model of shear velocity structure in the mantle derived from a combined fit to several datasets. The seismic model shows no distinct change in structure at the 660 km discontinuity which contrasts with a review of model calculations of thermal convection in the mantle in which mass transfer across 660 km is inhibited and episodic. A further paper discusses numerical calculations of magnetoconvection in the Earth's core in the presence of inhomogeneous boundary conditions, as are likely to result from a convecting mantle.

The final session on broader chemical issues in the deep Earth covers crystal-chemical compression mechanisms and first-principles calculations on selected materials showing the change in character of chemical bonding that takes place under pressure. Chondrite models of the composition of the mantle and core are briefly revisited and the collection closes with a review of the constraints on, and implications for, water and carbon in the Earth's mantle.

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