Preface

Diamond-bearing upper mantle eclogite rock has been found in 1897 at South African kimberlitic pipe. It is now appreciated that this eclogite represents the first natural sample wherein diamonds have been combined with the genetically associated mineral phases. Later on, the diamond-associated phases were discovered as primary solid, hardened liquid and volatile inclusions of the great diversity. Several tens of years of a purposeful and intensive analytic investigation of the diamond-hosted mineral phases will allow the evidence of the multicomponent multiphase composition of natural parental media for diamonds and associated phases at 150–800 km depths of the Earth's mantle. And only in the last decade an understanding has arrived that a progress of the genetic mineralogy of diamonds and associated phases can be solely provided by a methodology of physicochemical experimental study of the relevant multicomponent heterogeneous diamond-producing mineral systems. The actual PT conditions at the upper mantle, transition zone and lower mantle depths are bound to be reproduced in the experimental research.

This book has the academic directionality and deals with the present state of genetic mineralogy of diamond and associated phases. Contents of the book may be referred to three main divisions. First, the analytic mineralogical data of evident genetic interest have been briefly characterized. Second part of the book is focused on high-pressure experimental studies of diamond-parental multicomponent mineral systems. Therewith their boundary compositions are specified having regard to the natural chemistry of diamond-hosted inclusions from the depths of the upper mantle, transition zone and lower mantle. Experimental physicochemical results allows to substantiate the completely miscible silicate-(±oxide)-carbonatite melts with dissolved carbon as the parental media for diamonds and associated mineral phases over the all mantle depths. Experimental melting phase diagrams are lively presentative for the syngenesis relations of diamonds and minerals associated in their primary inclusions. The melting phase relations have made a direct determination of the physicochemical mechanism of diamond nucleation in carbon-oversaturated melts–solutions. Moreover, the melting diagrams offer a clearer view of how the joint crystallization of diamonds and paragenetic minerals may originate.

The combined physicochemical experimental and mineralogical data provide a means for substantiation of the mantle-carbonatite theory of genesis of diamonds and associated phases at the Earth mantle depths of 150–800 km. In the conclusive part, all the variety of mineral inclusions in diamonds of the upper mantle, transition zone and lower mantle is genetically classified. Along with this, partition coefficients of trace and scattered elements between minerals-in-inclusions and diamond-parental melts are first experimentally determined. The results of physicochemical experiments provide for investigation of mechanisms of fractional ultrabasic–basic evolution of diamond-parental melts which are responsible for paragenetic transitions in the course of the genetic processes for diamonds and associated phases under the upper and lower mantle conditions. Physicochemical experimental and analytical mineralogical data are compatible with the concept that the reservoirs–chambers of silicate-(±oxide)-carbonatite-carbon melts–solutions, parental for diamonds and associated phases, had been generated within the enclosing Earth's mantle rocks.

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