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# How deep (and hot) is a diamond?

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A good understanding of the distribution of diamond in Earth's mantle provides constraints for the evaluation of diamond potential of economic targets and for the assessment of the deep carbon cycle in ancient Earth. Much of what we know about the depth distribution of diamond is derived from the study of rare mineral inclusions that are amenable to conventional two-phase thermobarometry. However, non-touching inclusions were not necessarily in equilibrium at their encapsulation time, whereas touching inclusions could re-equilibrate after entrapment. Moreover, since diamonds are stable under a wide range of redox conditions, the unknown $Fe^{3+}/Fe_{tot}$ ratios in the inclusions may lead to large uncertainties on T estimates based on Fe–Mg exchange thermometry and, in turn, on P estimates. The development of single-mineral thermobarometers that are relatively independent on redox conditions and are applicable to isolated inclusions has in part overcome these issues. However, as yet only chromian clinopyroxene allows to estimate both P and T with a precision comparable, *if* appropriate analytical conditions are used *and* specific compositional limitations are met, to that of conventional two-phase methods, thus restricting the applicability to a limited proportion of lherzolitic diamonds. An additional problem arises if the inclusions represent passively captured pre-existing material, as possible incomplete chemical resetting during diamond growth may prevent determination of the conditions of diamond formation. When dealing with large sample populations, the errors due to the above issues will most probably tend to average out. On this basis, presently available thermobarometric data for inclusion-bearing diamonds worldwide provide reasonably robust evidence that lithospheric diamonds may form at any depth below the graphite–diamond transition. Nonetheless, recognition of subtle inhomogeneity in the vertical distribution of diamond (or of specific diamond populations) remains challenging. Very limited data from individual localities suggests a non uniform vertical distribution for peridotitic diamonds, with potential relationships with the vertical distribution of different mantle lithologies, and a possible link with ascending constructive fluid-metasomatic fronts and destructive melt-metasomatic fronts. Further development of conventional and non-conventional thermobarometric methods may allow to increase the statistical significance of the diamond P-T record and may eventually contribute to refine models of diamond formation in the sub-cratonic mantle.

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