Oldest diamond crystallisation on Earth: a metal-driven Hadean growth model related to core formation.

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When hot liquid metal drained towards the core during and shortly after Earth accretion, exceptional conditions may have led to the first global crystallisation of diamond. Newly reported metallic iron trapped in large mantle diamond invites comparison between commercial Fe-Ni-Co "HPHT" diamond growth and natural environments. We evaluate possible conditions for Hadean diamond crystallisation from liquid iron-rich metal where thermal and compositional gradients influence diamond crystallization. The solubility of up to 6% carbon has little effect on the phase transitions of the metallic iron phase diagram and carbon generally decreases with increasing pressure in solid iron based on calculated enthalpies. Models for core differentiation provide two scenarios (i) from an accumulated metal "pond" (ii) from massive downward mobile metal diapirs. A refinement arises from a parameterization of self-propagating downward fractures filled by turbulent liquid iron as proposed by Stephenson to send a transponder to the core; negatively buoyant diamond crystals would float. Experiments show that diamond growth under these conditions is fast (~1 carat per hour) and micro-textures of natural diamond with metallic inclusions retain substantial isotopic heterogeneities. We speculate that if the oldest diamond trapped metallic iron on its way to form the core, such "stranded core" might be recognized by trace element compositions, and could retain anomalous isotopic signatures of W and Hf.