

Deep Carbon. Jun 2019. Prof. Adrian Jones, UCL

Adrian introduced the topic by summarising evidence for carbon being plentiful in the deep Mantle, notably through diamonds in kimberlite pipes and dykes, and from carbonatite magmas. But where could all this carbon have originated? At high pressure/temperature Carbon has different forms (e.g. graphite and diamond) and it is known that diamond would be stable even at the centre of the Earth! Diamond from the Mantle is always around 3Ga in age, so this raises the question as to whether diamond formed only at a single event in the Earth's history, but also whether diamond crystallised throughout the Mantle or only in select places i.e. can it move?

Research shows growth zoning in diamond but it seems to be episodic rather than steady growth i.e. short but rapid growth spurts. Do these relate to specific, perhaps, catastrophic events in the Earth's history such as large asteroid impacts which contribute carbon as well as providing energy for short term diamond growth? Diamond is stable at 150+ km so any impacts would have been truly catastrophic to cause diamond growth.

A UCL researcher has found that the growth zones alternate between cubic and hexagonal symmetry, in either a regular pattern or completely random pattern. Comparing mantle diamond with known impact diamonds, there are different structures which appear to reflect these two origins. And yet the isotopic composition of Carbon is remarkably consistent over vastly different diamond age range.

The only known UK occurrence of diamond is perhaps surprisingly on the Isle of Wight, where it has been recorded from a 2cm thick diamictite (tillite) deposit, which raises the question of whether the last ice age ended because of a large impact.

Samples of grey, polycrystalline diamond from S Africa contain small garnets, while others contain ringwoodite (HP version of olivine) and it is known from experiments that diamond can nucleate on a range of materials.

The delivery system for transporting diamonds to the Earth's surface from at least ~150km are the kimberlites, small diameter pipes of highly energetic, heterogenous, gas rich, broken rocks, but the age of the diamonds at around 3Ga is considerably older than the kimberlites – usually Cretaceous. Moreover, the kimberlites seem to be restricted to the 2-5Ga cratons, albeit that cratons do not have sharp boundaries.

Carbonatites from volcanoes near the African rift are clearly melts and there are Ca or Mg rich varieties, while kimberlites are clearly cooler. Are the two related?

The available evidence suggests that there may be several percent of Carbon in the deep crust.

There followed a lively discussion which perhaps inevitably moved from Carbon in the deep crust to current concerns about carbon in the atmosphere.

John Bennett