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Towards the bulk carbon content of Earth; new metal carbide geobarometer in high pressure diamond.

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Formation of the metallic core in Earth (and other terrestrial planets) is not thought to have completely removed metallic iron from the lower mantle, where metallic iron might therefore be expected to occur as a widespread minor component [1]. We provide a new interpretation of metallic carbide inclusions in some diamond, which support a very high pressure origin from the lower mantle. Unlike rare carbides reported from diamonds previously without silicon [2], some diamonds from Jagersfontein coexist with iron-rich carbides which do contain significant silicon and oxygen, including in some cases their partial exsolution products. Based on an experimental calibration for liquid iron coexisting with lower mantle perovskite [3], we are able to show that some carbides were likely derived from pressures of approximately 45 GPa, or depths of $>$1100 km. This potential geobarometer has not been corrected for the behaviour of carbon in the liquid iron system, which might be an important experimental goal. The recognition of this independent carbide geobarometer offers an important new tool to confirm the superdeep origin of some diamond. The carbide-bearing diamonds are from a group whose charcteristics have recently been described [5]. Their distinctive light carbon isotopic signature ($^{13}\delta$C $\sim$ 17 ‰) coupled with evidence for very low contents nitrogen which is nonetheless highly aggregated, might be interpreted as indicative of subducted carbon. However, we are also open to the possibility that the bulk carbon isotopic composition of the Earth might also be different from the normal mantle value ($^{13}\delta$C $\sim$ 6 ‰), in which case the potential 0.4 wt% C in the Earth's core could also be isotopically very light, as suggested by Grady et al [6].

References

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