Isotopically light carbon in diamonds from some kimberlite pipes in Lesotho

THIS study of the isotopic composition of carbon has been carried out on six diamond crystals from kimberlite pipes in Lesotho. One crystal came from the Kao pipe, one from the Liqhobong and four from the Kolo pipe. We consider here how their colour and location are related to their isotopic composition.

The Kao and Liqhobong kimberlite pipes are located in the highlands of the northern Lesotho where they cut through the thick basaltic lavas of the Drakensberg Beds[1,2]. The Kolo pipe is situated in the lowlands of western Lesotho and it cuts through the shales and sandstones of the Beaufort series and the Karoo dolerites. Diamonds from these deposits are characterised by a large quantity of fragments and angular forms (up to 65% for the Kao pipe and 80% for the Liqhobong and Kolo pipes).

Generally among the crystals, rounded dodecahedra prevail[3,4] but a tendency towards an increase of octahedral forms in the Liqhobong–Kao–Kolo direction is noticeable.

Table 1 A brief description of the diamonds and analytical results of isotopic composition of carbon

No.	Pipe	Brief description	^{13}C‰ PDB
1	Kao	A flattened rounded twin of dodcecahedra, smoky, transparent fissured. Faces 110 are unevenly pitted. The lines of plastic deformation and traces of etching are observed. Weight 40.62 mg.	−4.6
2	Liqhobong	A fragment of a lemon-yellow transparent octahedron with triangular cavities and hillock of irregular or rounded shape on the relics of faces III. Weight 30.5 mg.	−20.5; −10.6
3	Kolo	An irregular intergrowth of 3 flattened colourless transparent octahedra with development of the curved dodecahedral surfaces. The surfaces are badly etched with cavities. The diamonds have several graphite inclusions. Weight 30.95 mg.	−16.2; −15.9
4	Kolo	A rounded badly elongated on L_3 yellow-transparent dodecahedron with several cavities. Weight 30.95 mg.	−6.9
5	Kolo	A rounded flattened colourless dodecahedron with several graphite inclusions. Faces 110 are roughly pitted with some hillocks. Weight 30.81 mg.	−6.5
6	Kolo	A rounded flattened smoky dodecahedron. The faces are irregularly developed and have deep canals of etching. An inclusion of orange garnet is observed inside the crystal. Weight 50.83 mg.	−14.7; −15.1

Serial no. *	Crystal habit	Colour	^{13}C‰ PDB
1	Twin or rounded dodecahedron	Smoky	−4.6
2	Fragment of octahedron	Lemon-yellow	−20.5; −19.6
3	Intergrows of octahedra	Colourless	−16.2; −15.9
4	Rounded dodecahedron	Yellow	−6.9
5	Rounded dodecahedron	Colourless	−6.5
6	Rounded dodecahedron	Smoky	−14.7; −15.1

* The diamonds are described in the same succession as in the text.

Many of the stones are of different colours and varying intensity: for the Liqhobong pipe, yellow is dominant: Kolo diamonds are mostly smoky-grey whereas Kao diamonds are brownish. Most of the diamonds have black inclusions of graphite. A brief description of the diamonds which have been analysed is given in Table 1.

Analysis of the isotopic composition of carbon of the diamonds has been done by oxidation in a stream of oxygen on copper oxide. The relative contents of isotopes of carbon have been measured by a mass spectrometer (Varian MAT −230) with precision of ±0.01% (±0.1‰). Analytical data in Table 1 are in values of ^{13}C (±0.1‰). Analytical data in Table 1 are in values of ^{13}C (‰) which are deviations in ‰ of $^{13}C/^{12}C$ of samples with respect to $^{13}C/^{12}C$ of the PDB standard.

Table 1 shows that three of the six diamonds (nos. 2, 3 and 6) are characterised by somewhat light intermediate composition of carbon (group B of the Galimov *et al.*[5] classification). Note that the analysis of these diamonds has been done twice and the data obtained have been rechecked.

Diamonds with a similar carbon isotope composition have not been reported either in kimberlite rocks of Africa[6,7] or in Yakutia[5,8]. Therefore, it had been thought until recently that the ratio ^{13}C in kimberlites is rather constant and is characterised by a value $^{13}C = -4$ to -9‰ PDB the value assumed for mantle carbon carbonatites as also fall in this range[9]. The only exception were carbonados of Brazil with $^{13}C = -27$ to -30‰ PDB[5,10] as well as some coloured diamonds from placers of the northern Yakutia[11]. However, it has been established recently that among the diamonds from the placers of the Urals, Sayans, Ukraine and from other areas of the USSR there are monocrystals with light $^{13}C = -20$ to -25% PBD) and intermediate $^{13}C = -10$ to -20‰ PBD) isotopic composition of carbon[5]. Kaminsky *et al.*[12] have even suggested that such diamonds are of non-kimberlitic origin. In this connection, the discovery of isotopically light diamonds in Lesotho kimberlites is very significant. From these descriptions of the diamonds and from Table 1, neither the habitat of the stones nor their colours are related to a particular isotopic composition. Among the isotopically light diamonds there are rounded dodecahedra and octahedra which are colourless or have a yellow or smoky colour. This isotopic composition of diamonds probably depends on their genetic peculiarities but further study on this is required.

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