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Genesis of diamond: A mantle saga—A reply

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The preceding comments and criticism by Harte (1986) are most welcome as they allow me to expand on an important topic that received minor attention in Meyer (1985)—namely, kimberlite and its genesis.

Kimberlite (Skinner and Clement, 1979; Clement et al., 1984; Mitchell, 1986) is the name given to a rock that is observed at the Earth's surface and is considered by most petrologists familiar with kimberlite to have formed from a magma (Dawson, 1980; Shee, 1984; Apter et al., 1984). However, from whence the magma came and for how long it existed prior to its intrusion into the crustal layers is unknown. Furthermore, the magmatic line of descent that gave rise to the final kimberlite at the surface is also unknown, although models based on experimental and mineralogical studies have been proposed (e.g., Wyllie, 1979, 1980; Eggler and Wendlandt, 1979; Dawson, 1983a, 1983b).

One of the major problems confronting the kimberlite researcher is determining this line of descent and the relation of one or more derivative magmas to the primary one and to the final consolidated kimberlite. Some (e.g., Mitchell, 1973; Nixon et al., 1981) have referred to early kimberlitic magmas in the upper mantle as "proto-kimberlites." This is a useful term as it implies the magma will eventually undergo some change into a second type, although the mechanism and evolution are unknown. More importantly it specifies that the magma is not to be confused with a later one that resulted in the final emplaced kimberlite rock.

The origin of magmas that resulted in kimberlite is also open to question. Mitchell (1986) has reviewed the various hypotheses (hybridization, zone refining, fractional crystallization, and partial melting) and has concluded that some variant of partial melting is the most popular process at this time.

In view of the foregoing I would suggest that Harte (1986) was incorrect when he stated "his [Meyer's] apparent general view of '*the* kimberlite magma' as a simple magmatic system." It has never been my view that kimberlite is the product of a simple system, and in Meyer (1979), for example, I have noted various problems concerned with the genesis of kimberlite that reflect on its complexity.

In Meyer (1985) there is no reference relating "phenocrystal diamond" to *erupting* kimberlite as is suggested by Harte (1986). As Harte has correctly stated in his criticism, I wrote "Gurney et al. (1979) and Harte et al. (1980) maintain that diamonds are genetically related to *early crystallization products of kimberlite within the upper mantle* and are thus phenocrysts" (italics added).

I believe the above statement is in agreement with the italicized comment by Harte (1986), "*the kimberlitic melt they were discussing was not necessarily to be correlated with the erupting kimberlite,*" since Harte and coworkers have considered the diamonds to have crystallized from the kimberlitic melt that they were discussing and presumably this took place in the upper mantle. In Harte et al. (1980, p. 188) is the comment "Diamonds appear to crystallize from a magma of kimberlitic type." This statement, I presume, means that diamonds are liquidus phases, and hence phenocrysts in a kimberlitic (type) magma.

It would appear that there is a serious problem with regard to semantics. When should one call a magma kimberlitic? I would suggest that to most geologists who are not conversant with kimberlite and diamond geology, and to whom the article (Meyer, 1985) was directed, the term "kimberlite magma" means the magma from which the kimberlite rock immediately formed. In this sense it is highly unlikely that a diamond having a model age of 3000 Ma has formed from a magma that solidified in the crust about 90 Ma. However, as pointed out above, I specifically stated in reference to Harte et al. (1980) that they considered diamond to be formed from a kimberlitic magma in the upper mantle. I apologize here to Richardson et al., whose article was published in *Nature,* not *Science* as I quoted in my note added in press (Meyer, 1985).

My interpretation of what was written by Harte et al. (1980) regarding diamonds as phenocrysts is also similar to that of Dawson (1980, p. 219), and incidentally this paper (Harte et al., 1980) was the only one to which Dawson made specific reference when discussing the "phenocrystal theory." One wonders why Harte did not object to Dawson in 1980 as he has done to Meyer in 1985?

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