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Origins of diamond-forming fluids: An isotopic and trace element study of diamonds and silicates from diamondiferous xenoliths

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While there is increasing understanding of the age of formation and nature of “gem” diamonds, significant debate revolves around the nature of the fluids/melts from which they form. Stable C and N isotopes have been shown to be highly variable and yet the role of subduction-related fluids remains strongly debated. Recent studies on fibrous diamonds have yielded new trace and major element data (e.g., Weiss et al., 2009) that, together with new radiogenic isotope data (Klein BenDavid et al., 2010) indicate such diamonds grow from fluids that comprise mixtures of hydrous silicic, hydrous saline and carbonatitic fluids, derived from different source components of asthenospheric and lithospheric origin. However, until now such data has been lacking from gem diamonds. Using a new laser-based technique (McNeill et al., 2009), we have analysed a suite of diamonds plus co-existing host silicates from several diamondiferous xenoliths (6 harzburgites, 1 eclogite) from the Finsch and Newlands kimberlites in order to try to understand the fluid compositions that produce gem diamonds and better understand their effects of their mantle wall rocks. Diamonds from the xenoliths show a wide variety of trace element enrichment levels. While the eclogitic diamond shows similar trace element systematics to some of the harzburgitic diamonds there are significant differences within the harzburgitic diamonds from different xenoliths, with those from Finsch being significantly enriched in Ba, Sr and Pb relative to other elements. Nd isotope data on the host silicates is variable and dominantly unradiogenic, indicative of long-term enrichment typically associated with the source of some diamond-forming fluids. We will present Sr isotopic data on host silicates and diamond fluids to constrain whether the “gem” diamonds require the complex sources of fluids that characterise the growth of fibrous diamonds.

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