

RELEASE OF NOBLE GASES DURING PYROLYSIS OF METEORITIC AND SYNTHETIC DIAMONDS: A NEW APPROACH

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Introduction: Thermal release patterns of noble gases during pyrolysis of meteoritic diamonds provide information on the different components of noble gases and on the history of presolar grains [1]. However, the ordinary procedure of stepped heating (100°C steps as a rule) does not allow resolving the fine structure of thermal patterns. We report the first results of continuous measurements of noble gas release during linear heating of the samples in vacuum.

Experimental: The diamond samples (0.2-0.8 mg) were heated at a rate 7°C/min up to 1600°C in vacuum. A Ti-getter removed active gases during heating. The released noble gases were measured using a quadrupole mass spectrometer pumped at very low rate through a calibrated orifice. Three types of diamond grains were studied: presolar grains extracted from Murchison meteorite [2], ultradispersed detonation diamonds (UDD) and micro-sized synthetic diamonds both implanted with a noble gas ion mixture [3].

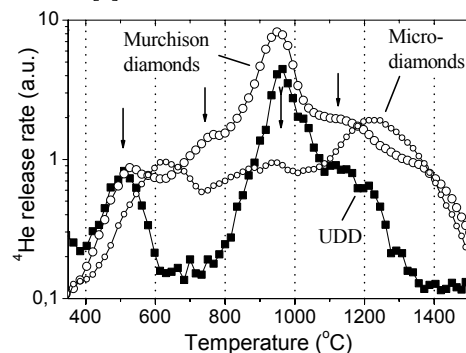


Fig. 1. Thermal release of helium from diamond samples.

Results and Discussion: Due to low sample weight, for Murchison diamonds only helium could be measured. The main release peak was at 950°C, with other small peaks near 520, 760 and 1120°C (Fig.1). Most of these features were also observed for ion-implanted UDD, but not for microdiamonds. Kr and Xe were observed in the case of the ion implanted diamonds, with the temperature profiles strongly dependent on the size of diamond grains. For UDD the high-temperature (1200-1500°C) release of Kr and Xe was similar to observations in stepped pyrolysis of meteoritic diamonds [1] and ion implanted UDD [3]. The method developed allows an express analysis of thermal release patterns of noble gases (one day instead of ~2 weeks) with very high temperature resolution. Moreover, release of noble and active gases can be studied simultaneously, which may allow obtaining information on possible mechanisms of noble gas release. Effects on the release profiles of high-temperature annealing of nano-diamonds prior to implantation will also be discussed.

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References: [1] Huss G. R and Lewis R. S. 1994. *Meteoritics* 29:791-810. [2] Merchel S. et al. 2003. *Geochimica et Cosmochimica Acta* 67:4949-4960. [3] Koscheev A. P. et al. 2001. *Nature* 412:615-617.