

The atmospheric component in diamonds: post-eruption contamination or subduction-related ?

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Mantle-derived fibrous, mono- and polycrystalline diamonds contains noble gases that isotopically are the result of mixing between three sources: the mantle, lithospheric and eventually the primordial one [1]; the crust; and the atmosphere. This last component has been often related to post-eruptive contamination [2]. Yet, the ratios of $^4\text{He}/^i\text{X}$ (where ^iX is the primordial isotopes ^{20}Ne , ^{36}Ar , ^{84}Kr and ^{130}Xe) are roughly from 50 to 125 times the present-day atmosphere values. During eons these ratios should have not changed dramatically. Primordial noble gas amounts in the atmosphere were fixed during early catastrophic degassing episode(s). Contrarily to the radiogenic $^{40}\text{Ar}^*$, the ^4He – even if abundantly produced in the terrestrial crust – is transient in the atmosphere at equilibrium between crustal production and atmospheric escape. If we assume recent incorporation of air by diffusion – following the classical Graham's Law – expected enrichments for the $^4\text{He}/^i\text{X}$ ratios will be 1-2 order of magnitude lower than the observed ones. However, seawater – possibly re-gassed in the mantle by subduction and partitioned by solubility at disequilibrium with carbonatitic or silicic melts – could explain most enrichment patterns. This hypothesis would imply that the so-called “subduction barrier” is quasi inexistent for all noble gases, even the lighter ones such as ^4He , and that mantle feeding diamonds is recording past subduction.

[1] Broadley, Kagi, Burgess, Zedgenizov, Mikhail, Almayrac & Sumino (2018). *Geochem. Perspect. Lett.* 8, 26-30.

[2] Basu, Jones, Verchovsky, Kelley & Stuart (2013). *Earth-science Rev.* 126, 235-249.