SIMULTANEOUS NANODIAMOND SYNTHESIS AND Xe-HL FORMATION IN THE SHOCK WAVES OF SUPERNOVA EXPLOSIONS.

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Introduction: Apart from the isotopically normal Xe-P_3 component, the anomalous Xe-*HL* component in nanodiamonds is about twice enriched with the light neutron-deficient, as well as with the heavy neutron-rich isotopes [1]. Since the Xe-*HL* component is observed only in nanodiamonds and it is absent in other presolar relics of meteorites, it is natural to suppose that this component was formed under the same conditions, in which the nanodiamond was synthesized, in particular, under the conditions of shock-wave reprocessing of the matter at the supernova explosions. Hence, it seems logical that just the regularities of fractionation and peculiarities of change of the noble gas isotopic relations during the propagation of strong shock waves [2] represented the cause of the exotic isotopic composition of Xe-*HL*.

Shock Wave Isotopic Effects: At the front of shock waves, the enhancement of the rigidity of a power-law energy spectrum $F(>E_0) \sim E^{-\gamma}$ ($\gamma \rightarrow 1$) of nuclear-active particles [3] and its enrichment with heavier ions [4] take place. There is a comparison in the table below: by how many times the isotopic ratios in Xe-HL are higher than in Xe-P_3 (* according to [1]), and by how many times the isotopic ratios of cosmogenic xenon generated at the front of shock waves (at γ~1) are higher than those in the case of calm medium (γ=3) [5]. The best agreement is for light neutron-deficient isotopes, which are mostly produced in spallation reactions and other ones with protons (*p*-process). It serves as a natural evidence of genesis of the light Xe-*L* component just in the rigid radiation conditions of the pre-fronts of the explosive shock waves. In its turn, these transient local regions of pre-fronts of the explosive shock waves are the most enriched reservoirs of heavy neutron-rich isotopes of xenon [2, 4, 5], supplementing the formation of the heavy component Xe-*H*.

Ratios	$\frac{\text{Xe-HL*}}{\text{Xe-P}_3}$	$\frac{\text{Xe}(\gamma\sim1)}{\text{Xe}(\gamma=3)}$
$^{124}Xe/^{132}Xe$	1.86	1.87
$^{126}Xe/^{132}Xe$	1.43	1.53
$^{128}Xe/^{132}Xe$	1.12	1.17
$^{129}Xe/^{132}Xe$	1.02	0.94
$^{130}Xe/^{132}Xe$	0.97	1.09
$^{131}Xe/^{132}Xe$	1.03	0.92
$^{134}Xe/^{132}Xe$	1.85	1.38
$^{136}Xe/^{132}Xe$	2.26	1.44

Nanodiamond synthesis: The high compression of matter in the pre-front range (which is the unlimited function of the Mach number) and the strong fall of temperature behind the front could be considered as ideal conditions for rapid nanodiamond synthesis, which might be possible in the extreme *PT*-conditions of the pre-front range, as well as due to nucleation in the underpressure range behind the shock front and due to irradiation of the carbonaceous grains with high-energy particles. The Xe-P_3 could be trapped too, but, most likely, that component was implanted later under the homogeneous mixing of the matter by supersonic turbulence, and this implantation continued up to the accretion of the meteorite parent bodies.

References: [1] Huss G. R. and Lewis R. S. 1995. *Geochim. Cosmochim. Acta* 59: 115-160. [2] Ustinova G. K. 2007. *Solar System Research* 41: 231-255. [3] Ellison D. C. and Eichler D. 1984. *Astrophys.J.* 256: 691-701. [4] Eichler D. and Hainebach K. 1981. *Phys. Rev. Lett.* 47 : 1560-1563. [5] Ustinova G. K. 2009. Abstract #1007. 40th Lunar & Planetary Science Conference.