Characterization of the noble gases and CRE age of the D'Orbigny angrite

Conference or Workshop Item

CHARACTERIZATION OF THE NOBLE GASES AND CRE AGE OF THE D'ORBIGNY ANGRITE. O. Eugster[1], H. Busemann[1], G. Kurat[2], S. Lorenzetti[1], and M. E. Varela[3], [1]Physikalisches Institut, University of Bern, 3012 Bern, Switzerland (eugster@phim.unibe.ch), [2]Naturhistorisches Museum, Postfach 417, A-1014 Vienna, Austria, [3]Dept. de Geologia, Universidad Nacional de Sur, 8000 Bahia Blanca, Argentina.

Introduction: The D'Orbigny angrite, a 16.55 kg stone, was found 1979 in Argentina [1]. Mineralogy and chemistry of this meteorite were characterized in detail [2-6]. A Pb-U-Th age of 4.559 Ga was obtained for pyroxenes by Jagoutz et al. [7]. Here we report results on the noble gas isotopic composition and, in particular, on the cosmic-ray exposure (CRE) age of D'Orbigny.

Cosmogenic component: The nuclides ^{3}He, ^{21}Ne, ^{38}Ar, ^{83}Kr, and ^{126}Xe are mainly of cosmogenic origin. CRE ages were calculated from the stable isotopes mentioned above, using production rates from Eugster and Michel [8]; the shielding was corrected as for eucrites. The ^{81}Kr-Kr age was derived using a mean life τ_{81}=0.33 Ma [9] and P_{81}/P_{83} = $0.44[(^{80}Kr/^{83}Kr)_c+(^{82}Kr/^{83}Kr)_c]$ [10]. The results are given in Table 1. The average CRE age is 12.3±0.9 Ma. It differs from that of the other five angrites: Angra dos Reis (55.5±1.2 Ma [11]), LEW 86010 (17.6±1.0 Ma [12])], LEW 87051 (≥0.2 Ma [12]), Asuka 881371 (5.4±0.7 Ma [13]), and Sahara 99555 (6.6±0.8 Ma [14]). These differing ejection ages suggest that at least five different sites of the parent body were sampled.

Table 1. CRE ages (Ma) of the D'Orbigny angrite. The average age is 12.3±0.9 Ma.

	T_3	T_{21}	T_{38}	T_{83}	T_{126}	T_{81}
Bulk 1 (23.24 mg)	12.0	13.7	11.8			
Bulk 2 (27.04 mg)	11.4	13.8	11.0			
Bulk 3 (379 mg)				10.4	12.5	14.3

Experimental errors (2 σ) of individual ages are ~20 %.

Fissiogenic component: We obtain a concentration of $^{136}Xe_f$ = 11.4x10^{-12}cm^{3}STP/g (> 80 % of total ^{136}Xe is fissiogenic). The ratio $(^{134}Xe/^{136}Xe)_f$ is 0.928 that is close to that for ^{244}Pu fission (0.939 [15]), but differs from that for spontaneous fission of ^{238}U (0.818 [16]). Our bulk sample contains 0.08 ppm U. Adopting a Xe retention age of 4.56 Ga we calculate 0.3x10^{-12}cm^{3}STP/g $^{136}Xe_f$ from ^{238}U. The high concentration of Xe from short-lived ^{244}Pu is typical for angrites [11, 12] and reflects a relatively short interval between the end of nucleosynthesis and formation of the D'Orbigny material.

Trapped component: D'Orbigny contains no solar noble gases, that is, its material was never exposed on the surface of its parent asteroid. The trapped Kr and Xe is dominated by the cosmogenic and fissiogenic components. Therefore, its type can not be determined.

Acknowledgements: This work was supported by the Swiss National Science Foundation.

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