COSMOGENIC AND TRAPPED NOBLE GASES OF CSÁTALJA H4-5 CHONDRITE.

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Introduction: A single piece (15 kg) of a stony meteorite was found in August 2012 near the small town of Csátalja in Southern Hungary, and has been classified as an ordinary chondrite of type H4-5 [1]. The texture of chondrules and Raman studies on forsterite minerals [1, 2] indicate that the meteorite was exposed to moderate shock pressure, ranging between 10 and 15 GPa (stage S2). The low degree of terrestrial weathering (W1) suggests a short terrestrial residence (<2500 yrs) for this find [1]. Further, the parent body of Csátalja has been linked to S type asteroids of the inner belt: Koronis, Agnia, or Merxia [1]. Here we report the first noble gas data and estimate the cosmic ray exposure (CRE) age.

Sample and experimental procedure: Two clean specimens, Csátalja-1 (82.79 mg) and Csátalja-2 (17.6 mg) were analysed for all the noble gases, extracted in three temperature steps at 600 ˚C, 1000 ˚C and 1800˚C. Sample preparation, noble gas extraction, blank and interference correction followed standard procedures (for details see [3]). Concentrations and isotopic ratios of noble gases were measured with a MAP 215-50 mass spectrometer at the Institute for Nuclear Research Hungarian Academy of Sciences in Debrecen. The instrument was installed in the fall of 2015 and the lab devoted the first study to the investigation of Csátalja.

Results and discussion: Cosmogenic He, Ne, and Ar, and trapped Ar, Kr and Xe abundances are listed in Table 1. The bulk of He and Ne is of cosmogenic and (in the case of ^{4}He) radiogenic origin, while heavy noble gases are dominated by trapped components, with cosmogenic components mostly extracted at the highest temperature steps. In case of Csátalja-2, there is an unusually large amount of trapped ^{132}Xe released in the 600 ˚C extraction step, with excess ^{129}Xe. In addition, the trapped $^{84}Kr_{tr}/^{132}Xe_{tr}$ ratio is high (~17) at 1000 ˚C and low (~0.8) at 1800 ˚C. Based on the bulk trapped ^{132}Xe content of the larger Csátalja-1 sample (lower than $3.5x10^{-10}$ cc STP/g) we argue that Csátalja falls into the H5 petrological group [4].

Cosmogenic $^{3}He/^{21}Ne$ and $^{22}Ne/^{21}Ne$ ratios are 3.09 and 1.108 for Csátalja-1, and 2.67 and 1.11 for Csátalja-2, respectively. Both specimens plot below the chondritic correlation of $^{3}He/^{21}Ne$ and $^{22}Ne/^{21}Ne$ [5], indicating loss of cosmogenic He. The CRE ages presented in Table 1 have been determined using the method of [5] as modified for ^{38}Ar by [6], using average H chondrite abundances from [7]. CRE ages of the two specimens calculated from cosmogenic ^{21}Ne (T_{21}) are consistent with each other, while CRE ages based on ^{3}He (T_3) are variable, and are systematically lower than T_{21} due to preferential He loss. The small difference between T_{38} and T_{21} ages may be attributable to a slightly lower Ca abundance than average H chondrites [7]. Most importantly, estimated T_{21} ages belong to the lower end of the dominant peak of the exposure age distribution of H chondrites compiled by [8].

Assuming Th, U and K contents typical of H chondrites [4] and no trapped ^{4}He and ^{40}Ar, the measured radiogenic ^{4}He (Csátalja-1: $8.03x10^{-6}$ cc STP/g, Csátalja-2: $7.32x10^{-6}$ cc STP/g) and ^{40}Ar abundances (Csátalja-1: $2.85x10^{-5}$ cc STP/g; Csátalja-2: $4.31x10^{-5}$ cc STP/g) indicate old He (2.48 and 2.31 Gyrs) and Ar (3.94 and 3.3 Gyrs) retention ages.

Table 1. Cosmogenic and trapped noble gas abundances (10^{-8} cc STP/g) and estimated CRE ages (Myrs). $^{129}Xe_{ex}$ is the concentration of excess ^{129}Xe from ^{129}I decay.

specimen	$^{3}He_c$	T_3	$^{21}Ne_c$	T_{21}	$^{38}Ar_c$	T_{38}	$^{36}Ar_{tr}$	$^{84}Kr_{tr}$	$^{132}Xe_{tr}$	$^{129}Xe_{ex}$
Csátalja-1	6.45	4.12	2.09	6.61	0.24	5.44	1.41	0.046	0.021	0.0028
Csátalja-2	5.40	3.43	2.02	6.5	0.24	5.57	0.9	0.041	0.068	0.0018

References: [1] Kovács J. et al. 2015. *Planetary and Space Science* 105:94–100. [2] Kereszturi Á. et al. 2016. submitted to *Spectrochimica Acta*. [3] Schwenzer S. P. et al. 2007. *Meteoritics & Planetary Science* 42:387–412. [4] Marti K. 1967. *Earth and Planetary Sciences* 2:193–196. [5] Eugster O. 1988. *Geochimica et Cosmochimica Acta* 52:1649–1662. [6] Schultz L. et al. 1991. *Geochimica et Cosmochimica Acta* 55:59–66. [7] Wasson J. T. and Kallemeyn G. W. 1988. *Philosophical Transactions of the Royal Society of London* 325:535–544. [8] Graf T. and Marti K. 1995. *Journal of Geophysical Research* 100:21247–21263.