MEAN ATOMIC WEIGHT AND GRAIN DENSITY OF KOŠICE CHONDRITE.

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Introduction: Košice meteorite is a typical H5 chondrite, moderately shocked (S3) which fell in 2010 in Slovakia [1,2]. Mean atomic weight is important to characterize minerals, rocks, planets, moons and asteroids, and is important to classify meteorites. The aim of the paper was to determine mean atomic weight and mean atomic number of the Košice meteorite, and to verify grain density of the chondrite.

Results and discussion: Bulk elemental composition of the meteorite [1] has been used to calculate mean atomic weight *Amean* and mean atomic number *Zmean* using the following formulas:

$$Amean = \sum wi / \sum (wi/Ai), \quad (1)$$

$$Zmean = \sum wi / \sum (wi/Zi), \quad (2)$$

where *wi*(wt%) is the mass fraction of i*th* element and i*th* oxide, *Ai* is atomic weight of i*th* element and i*th* oxide, and *Zi* is atomic number of i*th* element and i*th* oxide. Apart from the bulk composition data [1], also *Fe/Si* ratio, grain density *dgrain* [2], and magnetic susceptibility χ [2] were used to predict *Amean* values using *Amean(Fe/Si)*, *Amean(dgrain)*, and *Amean(logχ)* relationships, established by Szurgot (e.g. [3-7]):

$$Amean(Fe/Si) = 5.72 \cdot Fe/Si + 20.25, \quad (3)$$

$$Amean(dgrain) = 7.51 \cdot dgrain - 2.74, \quad (4)$$

$$Amean(log\chi) = 1.49 \cdot log\chi + 16.6, \quad (5)$$

$$A(Fe/Si, dgrain, \chi) = (Amean(Fe/Si) + Amean(dgrain) + Amean(log\chi))/3. \quad (6)$$

Grain density was calculated using two relationships, discovered by the author [4,7]:

$$dgrain(Amean) = 0.133 \cdot Amean + 0.37, \quad (7)$$

$$dgrain(Fe/Si) = 0.765 \cdot Fe/Si + 3.11. \quad (8)$$

Table 1 compiles values of *Amean*, *Zmean* and *Amean/Zmean* ratios calculated for Košice and Pultusk meteorites, and average values for H5 chondrites. Data concern falls, and composition of meteorites does not include H_2O.

Table 1. Mean atomic weight *Amean*, mean atomic number *Zmean*, *Amean/Zmean* ratio, and *Fe/Si* atomic ratio of Košice, Pultusk and mean for H5 chondrites.

Meteorite	*Amean (Bulk composition)*	*Zmean*	*Amean/Zmean*	*Fe/Si atomic ratio*
Košice H5	**24.98**	**12.33**	**2.026**	**0.879**
Pultusk H5	25.04 [3]	12.33	2.030	0.802 [3]
H5 Average[#]	25.05 ± 0.20 [3]	12.34	2.030 ± 0.005	0.801 ± 0.044 [3]
H5 *Range*[#]	*24.7 - 25.5* [3]	*12.2-12.6*	*2.015 - 2.042*	*0.75 - 0.89*

Table 2 *Amean* values of Košice determined by bulk composition (eq.(1)), and by relationships (eqs (3) - (6)).

Amean (Bulk composition)	*Amean(Fe/Si)*	*Amean(dgrain)*	*Amean(logχ)*	*A (Fe/Si, dgrain, χ)*
24.98	**25.28***	**25.72***	**24.57***	**25.19 ± 0.58**

*Košice *Fe/Si* = 0.879, *dgrain* = 3.79 ± 0.07 g/cm^3 [2], and *logχ* = 5.35 ± 0.08 [2]. [#] Data for fourteen H5 chondrites.

Tables 1 and 2 show that Košice *Amean* = 24.98 is close to the mean atomic weight of H5 chondrite falls (average: 25.05 ± 0.20, range: 24.7-25.5), and is also close to individual H5 chondrites: Pultusk: 25.04, Ashmore: 25.04, Ehole: 24.99, Ipiranga: 24.99, and Macau: 24.97 [3]. Košice *Fe/Si* atomic ratio (0.879) is within the H5 falls range: 0.75 - 0.89 (avg 0.80 ± 0.04) [3]. In addition, Košice *Amean/Zmean* ratio (2.026) is close to the average *Amean/Zmean* H5 ratio: 2.030. *dgrain(Amean)* relationship (eq.(7)) predicts grain density: 3.69 ± 0.07 g/cm^3, and *dgrain(Fe/Si)* relationship (eq.(8)) predicts grain density: 3.78 ± 0.07 g/cm^3 for the whole rock of Košice chondrite.

Conclusions: Mean atomic weight, mean atomic number, *Amean/Zmean* ratio, and *Fe/Si* ratio indicate that Košice belongs to H5 chondrites, as previously established. *Fe/Si* atomic ratio satisfactorily predicts mean atomic weight and grain density of Košice meteorite.

References: [1] Ozdin D. et al. 2015. *Meteoritics & Planetary Scence* 50:864-879. [2] Kohout T. et al. 2014. *Planetary and Space Science* 93-94:96-100. [3] Szurgot M. 2015. *Meteoritics & Planet. Sci.*, 50(S1), #5013.pdf. [4] Szurgot M. (2015) *LPSC XLVI*, Abstract #1536. [5] Szurgot M. (2017) *LPS XLVIII*, Abstract #1130. [6] Szurgot M. (2018) *LPSC XLIX*, Abstract #1039. [7] Szurgot M. 2017. *Meteoritics & Planet. Sci.*, 52(S1), #6008.pdf.