

MEAN ATOMIC WEIGHT, GRAIN DENSITY, AND POROSITY OF CAVEZZO CHONDRITE.

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Introduction: Mean atomic weight, bulk and grain densities, and porosity are physical properties important to characterize minerals, rocks, planets, moons and asteroids, and are important to classify meteorites. Recently interrelationships between mean atomic weight (A_{mean}), grain density (dgr), and iron to silicon ratio for planetary materials were revealed and applied for predicting and verifying mean atomic weight, Fe/Si atomic ratio, and grain density of ordinary and enstatite chondrites, Earth, Venus, Mars, Mercury, Moon, and Vesta [1-6]. The aim of the paper was to determine mean atomic weight, grain density and porosity of Cavezzo chondrite. Cavezzo meteorite fell on January 1, 2020 in Italy, and has been classified as an anomalous L5, S2, W0 ordinary chondrite [7, 8].

Literature data on chemical composition of Cavezzo meteorite, its mineral and modal composition [8], and bulk density (db) [7] were used to calculate A_{mean} , dgr , and porosity (P) values for the whole rock of meteorite and its silicates. $A_{mean}(Fe/Si)$ relationship for chondrites was used to predict/verify mean atomic weight. Grain density was predicted using three relationships: $dgr(Fe/Si)$, $dgr(A_{mean})$, and $dgr(Modal\ composition)$. Porosity was calculated applying relation $P = 1 - db/dgr$.

Results and discussion: The following values of mean atomic weight of Cavezzo chondrite were obtained: $A_{mean}(Modal\ composition) = 23.07$, $A_{mean}(Bulk\ composition) = 22.59$, and $A_{mean}(Fe/Si) = 22.50$, and 22.65 . This means that the range of A_{mean} values is between 22.50 and 23.07 , and the average value of mean atomic weight of Cavezzo is 22.70 ± 0.25 . The iron to silicon atomic ratio for the whole rock of Cavezzo meteorite is equal to $Fe/Si = 0.394$ (Table 1). Cavezzo A_{mean} and Fe/Si values are smaller than A_{mean} and Fe/Si mean values established for L chondrite falls: $A_{mean} = 23.67$, $Fe/Si = 0.594$ [4, 11].

Cavezzo silicates shown the values: $A_{meanSi}(Modal\ composition) = 21.60$, $A_{meanSi}(Bulk\ composition) = 21.96$, $A_{meanSi}(Fe/Si) = 21.99$, and 22.09 ; and $(Fe/Si)Si = 0.304$. Average value of mean atomic weight of Cavezzo silicates: 21.91 ± 0.21 , and the range of A_{meanSi} values: $21.60-22.09$ (Table 1).

It was established that the relationship $dgr(A_{mean})$ leads to the grain density values: 3.39 ± 0.03 g/cm³ for Cavezzo chondrite, and 3.28 ± 0.03 g/cm³ for silicates. Dependences $dgr(Fe/Si)$ predict the similar values of grain density for the whole rock of Cavezzo chondrite: 3.39 , and 3.41 g/cm³; and to somewhat higher values: 3.31 , and 3.34 g/cm³ for silicates. The modal composition leads to the $dgr(Modal\ composition)$ values: 3.37 g/cm³ for the whole rock, and 3.23 g/cm³ for the silicates. All the predictions lead to the average value of grain density for zero weathering degree W0: 3.39 ± 0.02 g/cm³ for the whole rock, and 3.29 ± 0.05 g/cm³ for the silicates (Table 1). Mean grain density of the whole rock of Cavezzo meteorite is lower than established for L chondrites falls, typically $3.56-3.58$ g/cm³ [9], and for Braunschweig L6 chondrite: 3.553 g/cm³ [10]. On the other hand, grain density of Cavezzo silicates is comparable with the grain density of silicates of other ordinary chondrites. For L'Aigle L6 chondrite, for example, it was predicted that grain densities for the whole rock is equal to 3.59 g/cm³, and 3.33 g/cm³ for the silicates [11].

Measured bulk density of Cavezzo meteorite $db = 3.322$ g/cm³ [7], and predicted average grain density $dgr = 3.39 \pm 0.02$ g/cm³ lead to the value of porosity $P = 2.0 \pm 0.6\%$ for the whole rock. For this value of porosity we can expect that bulk density of Cavezzo silicates is equal to 3.22 ± 0.03 g/cm³ (Table 1).

Table 1. Average values of mean atomic weight A_{mean} , Fe/Si atomic ratio, grain density dgr (g/cm³), bulk density db (g/cm³), and porosity P (%) of Cavezzo chondrite and its silicate fraction.

Meteorite/ fraction	A_{mean}	(A_{mean} -range)	Fe/Si	dgr (g/cm ³)	(dgr -range)	db (g/cm ³)	P (%)
Cavezzo L5	22.70 ± 0.25	(22.50-23.07)	0.394	3.39 ± 0.02	(3.37-3.44)	3.322 [7]	2.0 ± 0.6
Silicates	21.91 ± 0.21	(21.60-22.09)	0.304	3.29 ± 0.05	(3.23-3.34)	3.22 ± 0.03	2.0 ± 0.6

Conclusion: Mean atomic weight, grain density, and porosity predicted for the whole rock of anomalous Cavezzo L5 chondrite are smaller than those established earlier for other L chondrites falls, and Cavezzo silicates A_{mean} and dgr values are typical of H, L, and LL ordinary chondrites falls.

References: [1] Szurgot M. (2015) *LPSC 46*, Abstract #1536. [2] Szurgot M. (2015) *Comparative Tectonics and Geodynamics*, Abstract #5001. [3] Szurgot M. (2016) *Annual Meeting of the Meteoritical Society 79*, Abstract #6005. [4] Szurgot M. (2019) *Acta Societatis Meteoriticae Polonorum* 10:140-159. [5] Szurgot M. (2019) *LPSC 50*, Abstract #1165. [6] Szurgot M. et al. (2020) *LPSC 51*, Abstract #1287. [7] Gardiol D. et al. (2020) *MNRAS* 501:1215-1257. [8] Moggi V et al. *Meteoritical Bulletin Database* 30 III 2021. [9] Macke R. J. (2010) *PhD Thesis*, Univ. Central Florida, Orlando. [10] Bartoschewitz R. et al. (2017) *Chemie der Erde* 77:207-224. [11] Szurgot M. (2018) *Annual Meeting of the Meteoritical Society 81*, Abstract #6001.