Mean Atomic Weight and Thermophysical Properties of Sariçiçek Howardite

Marian Szurgot¹, Radosław A. Wach², Ozan Unsalan², Cisem Altunayar-Unsalan⁴

¹Lodz University of Technology, Center of Mathematics and Physics, Al. Politechniki 11, 90 924 Lodz, Poland, (mszurgot@p.lodz.pl)
²Lodz University of Technology, Institute of Applied Radiation Chemistry, Wróblewskiego 15, 93-590 Lodz, Poland (wach@mitr.p.lodz.pl)
³Ege University, Faculty of Science, Department of Physics, 35100, Bornova, Izmir, Turkey (physicistozan@gmail.com)
⁴Ege University, Central Research Testing and Analysis Laboratory Research and Application Center, 35100, Bornova Izmir, Turkey (cisemaltunyar@gmail.com)

INTRODUCTION

Mean atomic weight and thermophysical properties are important to characterize minerals, rocks, planets, moons and asteroids, and are important to classify meteorites [1-6].

Sariçiçek meteorite fell on September 2, 2015 in Turkey, and have been classified as an eucrite-rich howardite [6]. The aim of the paper was to determine mean atomic weight (Amean) and to predict and measure of heat capacity (Cp), predict thermal conductivity, and thermal diffusivity, and mean atomic heat of Sariçiçek howardite.

Bulk elemental composition of the meteorite determined by Unsalan and co-workers [6] and composition of various HED meteorites [7] were used to calculate Amean and Fe/Si values and to establish Amean(Fe/Si) relationship for howardites. Relationship between specific heat and bulk density (Cp(dbulk)) [8] was used to predict specific heat capacity, and relationship between thermal conductivity and porosity (K(porosity)) [9] was used to predict K values.

RESULTS

Mean atomic weight and Fe/Si Ratio of Sariçiçek and HED’s

Collected data indicate that there exists empirical Amean(Fe/Si) dependence describing howardite matter expressed by the equation:

\[ Amean(Fe/Si) = 7.67\cdot Fe/Si + 20.08, \]

(1)

for which R² = 0.74, and RMSE = 0.14.

Iron to silicon atomic ratio for the Sariçiçek Fe/Si = 0.30±0.01 is close to the mean value of Fe/Si for howardites (0.33, range: 0.26-0.39).

Equation (1) predicts for Sariçiçek

\[ Amean(Fe/Si) = 22.37±0.14 = 22.4±0.1, \]

and predicts the average value for howardites

\[ Amean(Fe/Si)_{Howardites} = 22.61±0.14 = 22.6±0.1. \]

Bulk elemental composition leads to

\[ Amean = 22.56±0.13 = 22.6±0.1 \]

for the Sariçiçek meteorite,

and bulk elemental composition of seventy howardites [7] to the average value:

\[ Amean = 22.4±0.2, \]

and to the Amean range: 22.0 - 22.8 [7] for most howardites.

Diogenites bulk composition reveals Amean range: 21.4-22.3,

and average \[ Amean = 21.8. \]

Eucrites bulk composition reveals \[ Amean range: 22.1-23.3, \]

and average \[ Amean = 22.7 [7]. \]

Average Amean values follow the inequality:

\[ Amean_{Diogenites}(21.8) < Amean_{Howardites}(22.4) < Amean_{Sariçiçek}(22.6) < Amean_{Eucrites}(22.7). \]

CONCLUSIONS

1. Mean atomic weight of Sariçiçek meteorite confirms its classification as an eucrite-rich howardite, as previously established [6].

2. Amean (Fe/Si) relationship discovered for howardites (equation (1)) satisfactorily predict Amean value of Sariçiçek and HED meteorites.

3. New Amean data for HED meteorites and protoplanet Vesta confirm the presence and the contribution of metallic core to the global mean atomic weight of Vesta [2].

4. Specific heat capacity of Sariçiçek meteorite at RT has been satisfactorily predicted by Cp(dbulk) dependence.

Acknowledgements

This work was supported by Ege University Scientific Research Projects Coordination Unit. Project Number: 17-FEN-050.

REFERENCES