Meteoritics & Planetary Science 39, Nr 11, 1889–1890 (2004)
Abstract available online at http://meteoritics.org

Helium, neon, and argon in meteorites: A data collection

L. SCHULTZ* and L. FRANKE

Max-Planck-Institut für Chemie, Abteilung Kosmochemie, Mainz, Germany
*Corresponding author. E-mail: schultz@mpch-mainz.mpg.de

(Received 14 June 2004; revision accepted 26 August 2004)

Abstract–Noble gases have been measured in meteorites for more than 100 years. The last 50 years have been especially fruitful, with concentration and isotopic compositional analysis of He, Ne, Ar, Kr, and Xe making important contributions to meteorite research. Differently trapped noble gas components are the basis for understanding planetary atmospheres and even different stages of stellar evolution. Noble gases are a valuable tool to detect pairing of meteorite specimens or even to prove whether a rock is a meteorite or not. Noble gas data, however, are distributed over a large number of publications. Sometimes, only concentrations are given for selected isotopes or just a simple derivative quantity is published. We have tried to collect all available measurements of He, Ne, and Ar in meteorites. Here, we present the data in a form that will help easily calculate isotopic or elemental ratios for selected measurements. The present compilation contains all data available as of March 2004.

INTRODUCTION

Noble gases have been measured in meteorites for more than 100 years. The last 50 years have been especially fruitful, with concentration and isotopic compositional analysis of He, Ne, Ar, Kr, and Xe making important contributions to meteorite research. For example, the existence of cosmogenic He and Ne with very distinct isotopic compositions led to determinations of exposure age, and the detection of ^{129}Xe as the product of the extinct radioactive nuclide ^{129}I opened the way to the calculation of relatively short time sequences in the early solar system. Differently trapped noble gas components are the basis for understanding planetary atmospheres and even different stages of stellar evolution. Underlining the importance, Porcelli et al. (eds.) published a detailed summary titled *Noble gases in geochemistry and cosmochemistry* in 2002. More practically, noble gases are a valuable tool to detect pairing of meteorite specimens or even to prove that a curious rock is a meteorite—or not!

Noble gas data, however, are distributed over a large number of publications. Sometimes, only concentrations are given for selected isotopes or just a simple derivative quantity is published. Therefore, we have tried to collect all available measurements of He, Ne, and Ar in meteorites and present them in a form that will help easily calculate isotopic or elemental ratios for selected measurements. The present compilation contains all data available as of March 2004.

This project started in 1971 and the first compilation was published in 1978 (Schultz and Kruse 1978). In the beginning, about 1600 individual stony meteorite measurements were listed. The next publication (Schultz and Kruse 1989) already listed 4127 analyses of stone, stony-iron, and iron meteorites performed on 1158 individual meteorites; 393 individual references were given, including many private communications. In the following years, we continued to collect all available data and distributed Excel files among interested colleagues every two years. The last edition was that of 2002 (Schultz and Franke 2002). Furthermore, the data are mentioned in the *Catalogue of meteorites* (Grady 2000) and included in a special section of MetBase (Koblitz 2003). Here, we present the new, revised and updated version of 2004 which contains 7420 individual measurements on 2014 different meteorites. The number of references has been increased to 742. Some of these quotations are, again, private communications.

EXPLANATION OF TABLES

The noble gas data are listed in three individual Excel file tables: stony meteorites (chondrites and achondrites), stony-irons, and iron meteorites. The first column contains the name of the meteorite. In many cases, these are abbreviated, especially for the long names given to Antarctic meteorites or meteorites from hot deserts. However, the specimen number has been kept (e.g., Allan Hills A77005 becomes ALH 77005). Table 1 gives a list of abbreviated localities.

Table 1. Abbreviations used for meteorite locations with numbered finds.

Abbreviation	Location	Abbreviation	Location
ALH	Allan Hills	MOUNTP	Mount Prestrup
BATESN	Bates Nunataks	MOUNTWEG	Mount Wegener
BELGIC	Belgica Mountains	MTBAL	Mount Baldr
CAMELDO	Camel Donga	MTHOW	Mount Howe
DARALGA	Dar al Gani	MTWIST	Mount Wisting
DAVIDGL	David Glacier	NULLARB	Nullarbor
ELEPHA	Elephant Moraine	NWAFRICA	Northwest Africa
FRONT	Frontier Mountains	OUTPO	Outpost Nunatak
GRAVESN	Graves Nunataks	PATUX	Patuxent Range
GROSVE	Grosvenor Mountains	PECOR	Pecora Escarpment
GROVEM	Grove Mountains	QUEENA	Queen Alexandra Range
HAMMAD	Hammadah al Hamra	RECKLP	Reckling Peak
JIDDATALH	Jiddat al Harasis	ROOSEVC	Roosevelt County
LAPAZIF	LaPaz Icefield	SAYALUH	Sayh al Uhaymir
LEWISC	Lewis Cliff	SLEEPERC	Sleeper Camp
LONEWN	Lonewolf Nunataks	TANEZR	Tanezrouft
MACAL	MacAlpine Hills	THIELM	Thiel Mountains
METHILL	Meteorite Hills	YAMA	Yamato

The next column gives the chemical group and petrological type of the meteorite. For these classifications, we follow the data given in MetBase 6.0. Column 3 gives, if available, the shock classification and column 4 defines the analyzed material. An "S" stands for "separate," which is described in very short form under "REMARKS." Grain size fractions are also marked with an "S." Samples without the "S" indicate that a bulk sample (sometimes of a very small mass) was analyzed.

The next eight columns contain concentrations of ^{3}He, ^{4}He, ^{20}Ne, ^{21}Ne, ^{22}Ne, ^{36}Ar, ^{38}Ar, and ^{40}Ar, given in units of 10^{-8} cm^3 STP/g. With the exception of the primarily radiogenic isotopes ^{4}He and ^{40}Ar, all data are given with two digits after the decimal indicator. Some concentrations are rounded off, so the isotopic ratios given in the original source may be more precise than the ratio calculated from the list.

The column labelled "REF" gives the first six characters of the first author's name and the year of publication. When there is more than one publication in the same year, a letter (starting with an A) is added. All references are collected in a list arranged in alphabetical order and supplied as a PDF file. The tables (PDF and XLS files) listing noble gases data and the corresponding references are available online to anyone at *MAPS* website http://meteoritics.org/ and to subscribers at Ingenta as part of the online edition of this issue of *MAPS*.

The column "REMARKS" contains the nature of the analyzed material (abbreviated). Samples that have been artificially irradiated with neutrons for ^{39}Ar-^{40}Ar dating are marked with "NI" because part of the Ar isotopes are modified by this irradiation. The next columns contain selected isotopic ratios calculated from the data shown.

Acknowledgments–We thank the many colleagues who have contributed unpublished data or brought to our attention errors in previous compilations. The tables given here were completed during the stay of L. Schultz at Curtin University of Technology, Perth, Western Australia. The hospitality of Drs. John de Laeter, Bob Loss, and Kevin Rosman is greatly appreciated.

Editorial Handling—Dr. A. J. T. Jull

REFERENCES

Grady M. M. 2000. *Catalogue of meteorites,* 5th ed. Cambridge: Cambridge University Press. 696 p.

Koblitz J. 2003. MetBase 6.0. CD-ROM.

Porcelli D., Ballentine C. J., and Wieler R., eds. 2002. *Noble gases in geochemistry and cosmochemistry.* Reviews in mineralogy & geochemistry, vol. 47. Washington, D.C.: Mineralogical Society of America and Geochemical Society. 844 p.

Schultz L. and Franke L. 2002. *Helium, neon, and argon in meteorites: A data collection.* Update 2002. Mainz: Max-Planck-Institut für Chemie. CD-ROM.

Schultz L. and Kruse H. 1978. Light noble gases in stony meteorites: A compilation. *Nuclear Track Detection* 2:65–103.

Schultz L. and Kruse H. 1989. Helium, neon, and argon in meteorites: A data compilation. *Meteoritics* 24:155–172.