

# Meteorite Collection by CHINARE in Antarctica

Xia, Z. P.<sup>1,2</sup> Miao, B. K.<sup>1,2 \*</sup> Zhang, J.<sup>3</sup> Zhao, K. Y.<sup>1,2</sup> Sun, Y. L.<sup>1,2</sup>

1. Key Laboratory of Planetary Geological Evolution at Universities of Guangxi Province, Guilin University of Technology, Guilin 541004, China;
2. Guangxi Scientific Experiment Center of Mining, Metallurgy and Environment, Guilin University of Technology, Guilin 541004, China;
3. Polar Research Institute of China, Shanghai 200136, China

**Abstract:** A total of 12,665 meteorites (field samples) have been collected by Chinese National Antarctic Research Expedition (CHINARE) during seven polar seasons in the Grove Mountains, Antarctica. From 2005, with support from the National Specimen Information Infrastructure under the National Science and Technology Infrastructures Project, a number of scientific organizations started to classify these Antarctic meteorites and to collect digitized information on the meteorite samples. 3,175 GRV meteorites have been classified and also approved by the Meteorite Nomenclature Committee of the Meteoritical Society and published in the *Meteoritical Bulletin*. The data have also been used to produce an online dataset. This dataset consists of two files: a data sheet in XLS format including data on the collection of the meteorite and the laboratory analyses (e.g., the location of the meteorite, the name of the finder, the meteorite type and mass, the degree of weathering, the level of shock metamorphism, and the main mineral and chemical compositions) and geographical data in .kml format. The .kml data can be used to show the geographical location, quality and type of meteorite in Google Earth images. The dataset can be used in the study of Antarctic meteorites and to promote the development of Antarctic research and cosmochemistry in China.

**Keywords:** Antarctica; meteorite; dataset

## 1 Introduction

With the exception of samples brought back to earth by the Apollo program and asteroid missions, meteorites are the only extraterrestrial materials that can be directly analyzed in the laboratory. Meteorites are important in studies of the origin and evolution of Solar System. China has carried out seven meteorite survey programs in the Grove Mountains of Antarctica since 1998 and 12,665 meteorite samples have been collected. These samples provide resources for studies in cosmochemistry and comparative planetology<sup>[1-2]</sup>. With the support of the National Specimen Information Infrastructure, a number of domestic scientific re-

---

**Received:** 21-06-2017; **Accepted:** 05-08-2017; **Published:** 25-09-2017

**Foundation(s):** Ministry of Science and Technology of P. R. China (2005DKA21406); National Natural Science Foundation of China (41173077); Guangxi science and technology program (AD16450001)

\***Corresponding Author:** Miao, B. K. K-2653-2017, Institution of Meteorites and Planetary Materials Research, Guilin University of Technology, miaobk@glut.edu.cn

**Article Citation:** Xia, Z. P., Miao, B. K., Zhao, K. Y., *et al.* Meteorite collection by CHINARE in Antarctica [J]. *Journal of Global Change Data & Discovery*, 2017, 1(3): 331-335. DOI: 10.3974/geodp.2017.03.12.

**Dataset Citation:** Xia, Z. P., Miao, B. K., Zhao, K. Y., *et al.* Meteorite collection by CHINARE in Antarctica [DB/OL]. Global Change Research Data Publishing & Repository, 2017. DOI: 10.3974/geodp.2017.03.05.V1.

search institutes have jointly classified these Antarctic meteorites, collected basic information on the samples, and set up the Antarctic Meteorite Depository<sup>[3–4]</sup>. This paper summarizes the details and management of the Chinese Antarctic meteorite dataset.

## 2 Metadata of Dataset

Meteorite collection by CHINARE in Antarctica<sup>[5]</sup> is based on local information on the meteorites collected from the Grove Mountains, Antarctica, enriched with the petrological and mineralogical characteristics of the meteorites determined in the laboratory. The dataset consists of two parts: .xls data sheet, .shp and .kml geographical data (Table 1). The .xls data sheet includes the name of the meteorite, the date it was found, the name of the discoverer, the latitude and longitude of the site where the meteorite was found, and its mass. The laboratory data in the .xls data sheet includes the research organization that carried out the study, the type of meteorite and the chemical group, the degree of shock metamorphism, the degree of weathering, and the characteristics of the main minerals. The geographical data can be used to accurately show the location and type of meteorite in Google Earth.

**Table 1** Summary of meteorite collection by CHINARE in Antarctica metadata

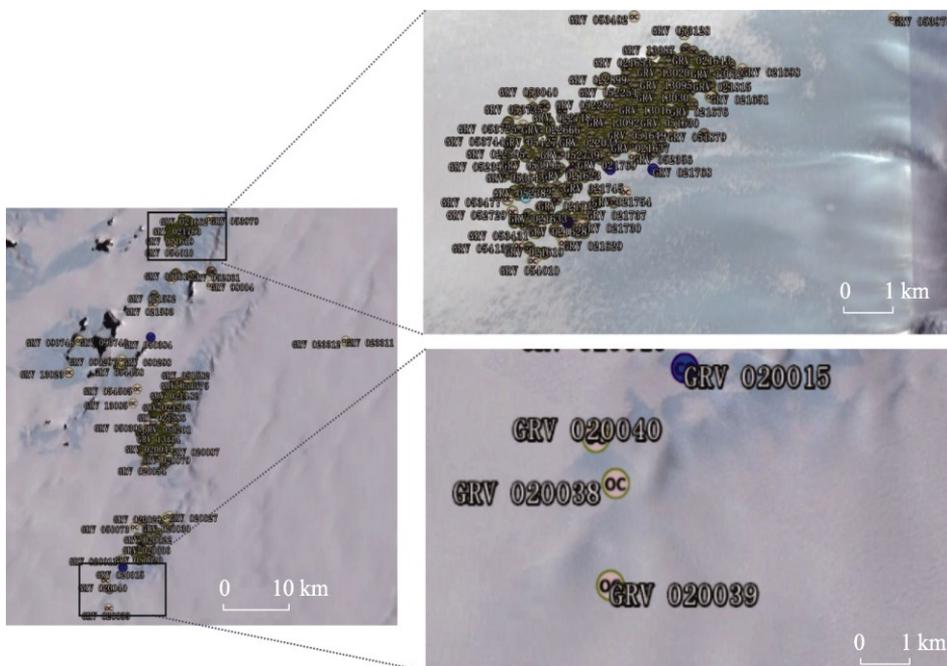
| Items                  | Description   |
|------------------------|---|
| Dataset full name      | Meteorite collection by CHINARE in Antarctica   |
| Dataset short name     | MeteoritesGroveMountainAntarctic  |
| Authors                | Xia, Z. P. K-2472-2017, Guilin university of Technology, xiazhipe@glut.edu.cn<br>Miao, B. K. K-2653-2017, Guilin university of Technology, miaobk@glut.edu.cn<br>Zhang, J. L-4784-2016, Polar Research Institute of China, zhangjie@pric.org.cn<br>Zhao, K. Y. K-2617-2017, Guilin university of Technology, 454887205@qq.com<br>Sun, Y. L. K-2619-2017, Guilin university of Technology, 941823319@qq.com  |
| Geographical region    | 73.67°E–75.67°E, 72.33°S–73.17°S  |
| Research Organizations | Guilin university of Technology; Institute of Geology and Geophysics, Chinese Academy of Sciences; Guangzhou Institute of Geochemistry, Chinese Academy of Sciences; Purple Mountain Observatory, Chinese Academy of Sciences; The National Astronomical Observatories of the Chinese Academy of Sciences; Nanjing university; Beijing Planetarium  |
| Data format            | .xls, .kml, .shp  |
| Data composition       | Information of 3,175 GRV meteorites: the full name, type, mass, collectors, discovery date, latitude, longitude, shock metamorphism, weathering degree, Fa value of olivine, Fs & Wo values of low-Ca pyroxene, identification organization   |
| Date size              | 1.24 MB   |
| Foundation(s)          | Ministry of Science and Technology of P. R. China (2005DKA21406); National Natural Science Foundation of China (41173077); Guangxi science and technology program (AD16450001)  |
| Data publisher         | Global Change Research Data Publishing & Repository, <a href="http://www.geodoi.ac.cn">http://www.geodoi.ac.cn</a>  |
| Address                | No. 11A, Datun Road, Chaoyang District, Beijing 100101, China   |
| Data sharing policy    | <b>Data</b> from the Global Change Research Data Publishing and Repository includes metadata, datasets (data products), and publications (in this case, in the <i>Journal of Global Change Data &amp; Discovery</i> ). Data sharing policy includes: (1) <b>Data</b> are openly available and can be downloaded via the Internet; (2) End users are encouraged to use <b>Data</b> subject to citation; (3) Users, who are by definition also value-added service providers, are welcome to redistribute <b>Data</b> subject to written permission from the GCdataPR Editorial Office and the issuance of a <b>Data</b> redistribution license; and (4) If <b>Data</b> are used to compile new datasets, the ‘ten per cent principal’ should be followed such that <b>Data</b> records utilized should not surpass 10% of the new dataset contents, while sources should be clearly noted in suitable places in the new dataset <sup>[6]</sup> |

### 3 Data Collection

The dataset consists of two parts: (1) data on the collection of the meteorites and their serial numbers; and (2) the experimental results acquired in the laboratory. Table 2 shows the data included in .xls file and Figure 1 shows .kml file opened in Google Earth.

**Table 2** Sub-entries in .xls data sheet

| Field data         | Description                           | Laboratory data              | Description  |
|--------------------|---------------------------------------|------------------------------|--|
| Meteorite name     | International meteorite name          | Research organization        | Scientific research organization carrying out the laboratory analyses        |
| Discovery date     | Date meteorite found                  | Type of meteorite            | Type and chemical group of meteorites reflects the origin of the parent body |
| Name of discoverer | Name of the meteorite’s finder        | Degree of shock metamorphism | Measures the strength of impact and reflects the impact history              |
| Latitude           | Latitude at which meteorite was found | Degree of weathering         | Amount of weathering after the meteorite has fallen to the Earth’s surface   |
| Longitude          | Latitude at which meteorite was found | Fa values of olivine         | Average Fe/(Fe+Mg) content (%) in olivine                                    |
| Mass               | Mass of the meteorite                 | Fs values of low-Ca pyroxene | Average Fe/(Fe+Mg+Ca) content (%) in pyroxene                                |
| Blocks             | Pairing number of meteorite           | Wo values of low-Ca pyroxene | Average Mg/(Fe+Mg+Ca) content (%) in pyroxene                                |



**Figure 1** Visualization of the .kml data file in Google Earth.

Note: screenshot taken directly from Google Earth, with no modification

#### 3.1 Discovery and Collection of Meteorites

The first four discoveries of meteorites in the Grove Mountains occurred during the 15<sup>th</sup> CHINARE in 1998–1999. A further six meteorite surveys were carried out in the Grove Mountains in the 1999–2000, 2002–2003, 2005–2006, 2009–2010, 2013–2014, and 2015–2016 field seasons. The surveys discovered 28, 4,448, 5,354, 1,618, 583, and 630 me-

teorites, respectively. The information on the meteorites provided by the Antarctic Meteorite Expedition is included in.xls data sheet (Table 3).

**Table 3** Investigation of meteorite from Grove Mountain

| Inspection Year | Name of Antarctic expedition                         | Number of Meteorite |
|-----------------|--|---------------------|
| 1998–1999       | The 15 <sup>th</sup> Antarctic scientific expedition | 4                   |
| 1999–2000       | The 16 <sup>th</sup> Antarctic scientific expedition | 28                  |
| 2002–2003       | The 19 <sup>th</sup> Antarctic scientific expedition | 4,448               |
| 2005–2006       | The 22 <sup>th</sup> Antarctic scientific expedition | 5,354               |
| 2009–2010       | The 26 <sup>th</sup> Antarctic scientific expedition | 1,618               |
| 2013–2014       | The 30 <sup>th</sup> Antarctic scientific expedition | 587                 |
| 2015–2016       | The 32 <sup>th</sup> Antarctic scientific expedition | 630                 |
| <b>Total</b>    | 7 times  | 12,665              |

### 3.2 Experimental Data Research

There are some differences among the various organizations in terms of instrument selection and testing methods. The following methods are used to obtain experimental data at the Guilin University of Technology.

1. The samples are cut and sorted to minimize damage to the meteorite. If the sample mass is >20 g, a 1–1.5 g sample is taken. If the sample mass is <20 g, then 5–20% of the total mass of the sample is taken.

2. The samples are made into standard 0.03 mm-thick polished thin sections (PTs).

3. Microscopic observations and microanalysis of the PTs are carried out to determine the petrological and mineralogical characteristics of the meteorite. The techniques include: scanning electron microscopy, electron probe microanalysis and Raman spectroscopy. Electron probe microanalysis is carried out using a JEOL JXA-8230 SuperProbe electron probe microanalyzer with an electric current of 20 nA, a voltage of 15 kV, a beam spot size of 1  $\mu\text{m}$ , and using natural minerals as the standard samples. The Raman spectroscopy is carried out using a Renishaw inVia confocal Raman microscope with a 514 nm Ar<sup>+</sup> laser (power 20 mW, 1–1.5  $\mu\text{m}$  beam spot).

4. The original data are collected and the experimental results summarized. The chemical group and meteorite type are classified according to Wasson<sup>[7]</sup>, the degree of shock metamorphism according to Stöffler, *et al.*<sup>[8]</sup>, and the degree of weathering according to Wlotzka<sup>[9]</sup>.

5. The data are then added to the dataset.

### 4 Verification and Management of Meteorite Samples

All of the meteorite samples in the Grove Mountains, Antarctica were discovered by seven CHINARE teams. The meteorite samples are permanently deposited in the Antarctic Meteorite Depository at the Polar Research Institute of China (PRIC) (Jinqiao Road, Pudong, Shanghai). Figure 2 shows a sample of Meteorite GRV020056, which was in the Antarctic Meteorite Depository at the PRIC. The relevant scientific research institutions submit their research results to the Chinese Antarctic Meteorite Expert Committee after they have analyzed and summarized the experimental data. The Chinese Antarctic Meteorite Expert Committee verify the data and upload it to the Chinese Resource-Sharing Platform of Polar

Samples (<http://birds.chinare.org.cn/>). The data was approved by the Meteorite Nomenclature Committee of the Meteoritical Society and published in the *Meteoritical Bulletin*. The dataset contains information on the Resource-Sharing Platform of Polar Samples and the *Meteoritical Bulletin*.

## 5 Conclusion

This dataset of meteorites from the Grove Mountains is the first comprehensive meteorite data system in China and has been developed by a number of Chinese scientific research institutes. It is verified by the Chinese Antarctic Meteorite Expert Committee and the Meteorite Nomenclature Committee of the Meteoritical Society. The dataset can be used as basic data for cosmochemistry and meteorite research in China.

## Acknowledgments

We thank PRIC for the curation of meteorites and the help of management of meteorite information, and also appreciate Jeff Grossman of the Meteorite Nomenclature Committee for his strong support of data collection.

## References

- [1] Miao, B. K., Lin, Y. T., Wang, D. D., *et al.* Progress of Antarctic meteorite collection in China (2000–2010) [J]. *Bull of Mineralogy, Petrology and Geochemistry*, 2012, 31(6): 566–576.
- [2] Miao, B. K., Ouyang, Z. Y., Lin, Y. T., *et al.* The retrospect and prospect on Antarctic meteorite researches in China [J]. *Geology Sciences and Technology Information*, 2008, 27(1): 13–19.
- [3] Miao, B. K., Wang, D. D. Classification of meteorites from the Grove Mountains and its significance [J]. *Chinese Journal of Polar Research*, 2008, 20(2): 95–104.
- [4] Xia, Z. P., Zhang, J., Miao, B. K., *et al.* Meteorite classification for building the Chinese Antarctic Meteorite depository-introduction of the classification of 500 Grove Mountains meteorites [J]. *Advanced in Polar Science*, 2016, 27: 56–63.
- [5] Xia, Z. P., Miao, B. K., Zhao K. Y., *et al.* Meteorite collection by CHINARE in Antarctica [DB/OL]. Global Change Research Data Publishing & Repository, 2017. DOI: 10.3974/geodb.2017.03.05.V1.
- [6] GCdataPR Editorial Office. GCdataPR Data Sharing Policy [OL]. DOI: 10.3974/dp.policy.2014.05 (Updated 2017).
- [7] Wasson, J. Meteorites: Their Record of Early Solar-system History [M]. New York, WH Freeman and Co., 1985, 274.
- [8] Stöffler, D., Keil, K., Scott, E. R. D. Shock metamorphism of ordinary chondrites [J]. *Geochimica et Cosmochimica Acta*, 1991, 55(12): 3845–3867.
- [9] Wlotzka, F. A weathering scale for the ordinary chondrites [J]. *Meteoritics*, 1993, 28(28): 460.



**Figure 2** Sample of meteorite GRV020056 collected by Antarctic Meteorite Depository of China