

# Meteorite Collection by CHINARE in Antarctica

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**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-

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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

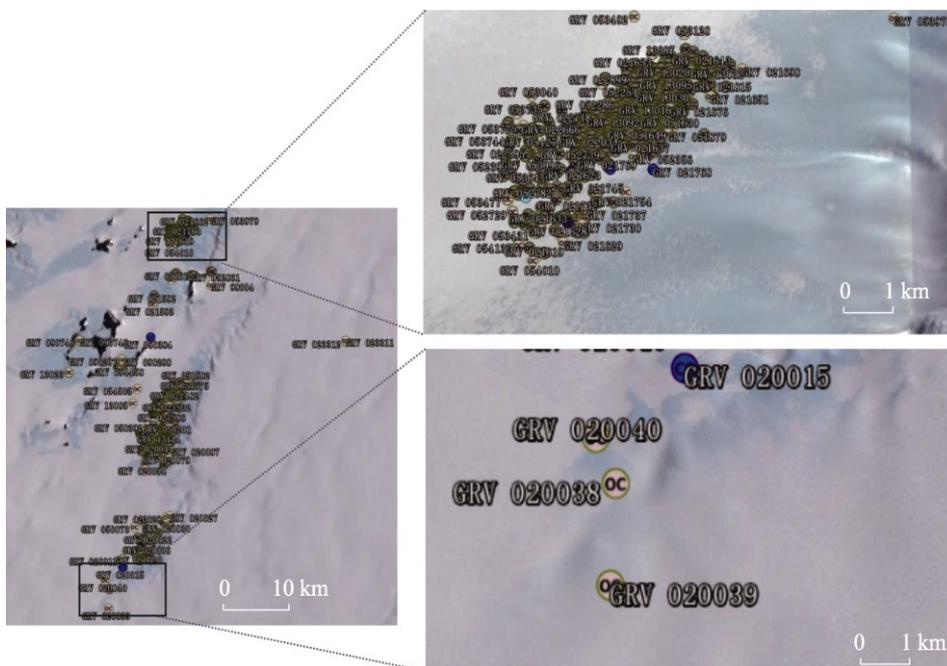
Items	Description
Dataset full name	Meteorite collection by CHINARE in Antarctica
Dataset short name	MeteoritesGroveMountainAntarctic
Authors	Xia, Z. P. K-2472-2017, Guilin university of Technology, xiazhipe@glut.edu.cn Miao, B. K. K-2653-2017, Guilin university of Technology, miaobk@glut.edu.cn Zhang, J. L-4784-2016, Polar Research Institute of China, zhangjie@pric.org.cn Zhao, K. Y. K-2617-2017, Guilin university of Technology, 454887205@qq.com 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.

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