The Use of Geographic Remote Sensing, Mapping, and Aerial Photography to Aid the Recovery of Blue Ice Surficial Meteorites in the Antarctic

A.A. Mardon, Ph.D.

Antarctic Institute of Canada
P.O. Box 1223, Main Post Office
Edmonton, Alberta, Canada
Email: mardon@freenet.edmonton.ab.ca

ABSTRACT

This paper describes the contribution of geography through the use of cartography, remote sensing and aerial photography to the ongoing recovery of meteorites in the Antarctic. It gives details of the first geographer to go on an Antarctic meteorite recovery expedition experiment relating to the aerial detection of meteorites from aerial photography and the ground truth experiment comparing meteorites and other surficial terrestrial rocks. While the results of that experiment were null, the experiment did point to using several criteria to select sites for the recovery of meteorite placers along the Trans-Antarctic mountain range. Meteorites have been estimated in the Antarctic to amount to over 100,000 potentially recoverable specimens over the last 30 years and the next 20 years.

(Key words: field study, expedition, meteorite recovery, GIS, Trans-Antarctic mountain range)

PROBLEM STATEMENT

How to describe the contribution of geography through mapping, remote sensing, and aerial photography to the international Antarctic meteorite recovery effort?

INTRODUCTION

The largest source of extraterrestrial materials has come from the Antarctic, over the last 30 odd years, as meteorites. Our only source of rock samples from Mars comes from the over 10,000 meteorites that have come from the Antarctic meteorite surface placers. The pristine condition of Antarctic meteorites and the varied nature of the sources have meant that the United States of America Antarctic Meteorite Recovery Program (USARP) is a scientific priority.

The first Antarctic meteorite was recovered in the early 20th century by the famous Australian Antarctic explorer Douglas Mawson. Meteorites have been estimated in the Antarctic to amount to over 100,000 potentially recoverable specimens over a 50-year period, spanning the last 30 years and the next 20 years.

Antarctic meteorites have become a major source of materials from Mars, the Moon, from Near-Earth objects and from the Asteroid belt. Topical geography can and has contributed to the recovery of meteorites in the Antarctic thus benefiting the sum of mankind's knowledge of the inner Solar system.

HISTORY OF RESEARCH

The author, in 1986, was the first geographer to go on an Antarctic meteorite recovery expedition. He was a field member for just under two months at the Lewis Cliff Ice Tongue Meteorite Placer Site. The USARP team recovered over 700 meteorites in that locale over the season of 1986-1987.

During that expedition, there was an aerial over flight where photographs of the Lewis Cliff Ice Tongue were taken. In the field, during the season, there were also ground truth images taken.

The first aerial photographs that were taken of the Lewis Cliff Ice Tongue were captured in the

late 1940's in connection with Operation High-Jump, an American expedition. Those images and successive images are archived at the USGS in Reston, Virginia, USA.

The purpose of the research described here was to see if it would be possible to detect meteorites from the air so that later they could be recovered knowing their exact location. Sadly, this experiment was unsuccessful in its stated goals, but in other areas such as exploring sites where meteorites can be recovered based on geographic identifiers through the disciplines of cartography, aerial photography, and remote sensing, useful observations were gathered. Certain areas of the Antarctic seem to be concentration points for meteorites and they are also exposed at these locales. Geographic tools can be used to select these sites for future field reconnaissance.

PURPOSE

At the first stage of selection of a potential field site for meteorite recovery, the researcher must identify the characteristics of an Antarctic meteorite placer area. This will involve the use of over-flights, maps, and extensive examination of aerial photographs, and other remote sensing images.

The majority of meteorites that have been recovered by the United States Antarctic Meteorite Recovery Program are along the Trans-Antarctic Mountains. These meteorites have been concentrated along the edge of this mountain range and are exposed by the ablating process of katabatic winds along this mountain range.

The criteria of selection along this range of blue ice meteorite placers is fairly consistent. Once meteorites are found, coordinates of their exact location are recorded and maps to the meteorite placers are made.

New sites are selected based on the criteria that have been deduced from previous locations where meteorite finds have been discovered. Cartography contributes to the recovery effort by both identifying potential sites and by mapping out the locations of where the meteorites are found in the field.

OBSERVATIONS AND OUTCOMES

The author has examined the techniques that have been taken from the discipline of geography and has examined and contrasted how they have been used to enhance the recovery of meteorites from the Antarctic. Ground truth images were taken in the field and mapping techniques have been utilized throughout the course of these research expeditions. There has been extensive examination of geographic techniques employed. Field mapping was also done of the Lewis Cliff Ice Tongue.

The primary results of these techniques are that thousands of meteorites are being recovered from the Antarctic. Cartography is used to find locales where meteorite placers occur. Maps are made of meteorite placers and the coordinates of meteorites that are found there are located on these maps.

Remote sensing systems are used to find the blue ice placers where meteorites that fall across the interior of Antarctic are located. The size of the meteorites that are recovered cannot be distinguished from photographs taken from airplanes at heights averaging 500 feet.

The criteria for the selection of areas that receive ground reconnaissance involves the use of cartography, aerial photography and remote sensing.

The author has proposed an increase in the number of countries sponsoring Antarctic programs searching for meteorites. Proposals have included expansion of the French and Russian Antarctic programs.

The identification of geographic patterns associated with meteorite recovery can be replicated in other areas of the world such as North America or Russia. Previously glaciated regions of the world might have meteorites that are recoverable. The geology of the placer deposits can also be known to a greater extent, such as the process of deposition of meteorites in Antarctic placers.

CONTRIBUTIONS OF THE AUTHOR

The author has been involved in the description of the methods and process of exploration that are being used to find Antarctic meteorites via

geographic techniques. Geographic techniques have been used from the beginning of Antarctic research when Japanese explorers recovered the first meteorites from this area.

In subsequent works, the author will examine how geography has been used and will be used in the expansion or Antarctic meteorite research.

An example of this is the mapping of meteorite recovery locations within each of the placers such as the Lewis Cliff ice tongue complex. The author has flown in Lewis Cliff Ice Tongue over flights and has examined the last 50 years of aerial photography and remote sensing data from the Lewis Cliff ice tongue. The author was the first geographer to go on an Antarctic meteorite recovery expedition in 1986.

FINAL OBSERVATIONS

The Antarctic meteorite recovery program is a scientific priority because it fills a crucial gap in the retrieval and examination of samples from planets and bodies that have not yet had sample return missions. Currently the only material samples from Mars have been recovered from the Antarctic.

Techniques of exploration that have been used in other locales such as cartography and map reading are useful in the selection of sites for exploration and reconnaissance. After the meteorites are recovered, their location is precisely mapped out. Geography can and has been used to benefit the recovery of the precious meteorites from the Antarctic.

ABOUT THE AUTHOR

Dr. A.A. Mardon earned his BA in Geography from the University of Lethbridge, his MSc in Geography from South Dakota, his MEd in Education from Texas A&M University and his PhD in Geography from Greenwich University. He is presently completing his D.Sc. in Geography at Kharkiv National University in Kharkiv Ukraine. Over the last 17 years Dr. Mardon has authored over 105 scholarly communications in addition to 22 books. Most of the publications have been in the area of space science, historical geography, political history and psycho-social rehabilitation. In 1999 the Canadian Governor General, A. Clarkson, presented him with the Governor General's Caring Canadian Award for his work with the Clubhouse Society. He has also been a member of the Explorer's Club since 1986 and was elected an International Fellow in 1998. Currently he is a member of COSPAR and has been included in several biographical dictionaries including listings in Who's Who in the World, Canadian Who's Who, and the International Biographical Dictionary - IBC.

SUGGESTED CITATION

Mardon, A.A. 2004. The Use of Geographic Remote Sensing, Mapping, and Aerial Photography to Aid the Recovery of Blue Ice Surficial Meteorites in the Antarctic. *Pacific Journal of Science and Technology*. 5(2):83-85.