

THE UNIVERSITY OF ALBERTA METEORITE COLLECTION: APPLICATIONS TO COLLECTED AND RETURNED EXTRATERRESTRIAL SAMPLES. C. D. K. Herd¹, and K. Mallalieu², Department of Earth and Atmospheric Sciences, 1-26 Earth Sciences Building, University of Alberta, Edmonton, AB T6G 2E3, Canada, herd@ualberta.ca, ²University of Alberta Museums, Rutherford Library South, Edmonton, AB T6G 2J4, Canada.

Introduction: The Meteorite Collection at the University of Alberta is actively used in research and teaching, supported and enabled by the associated Meteorite Curation Laboratory, and a centralized museums support unit. Here we provide an overview of the collection, including a brief history of its origin, recent acquisitions and growth, and associated research in curation and handling methods with applications to collected and returned extraterrestrial samples.

History: The first specimens in the collection were five individual fragments of Brenham, purchased by W.F. Ferrier for the fledgling Department of Geology collections in 1915. The Edmonton (Canada) meteorite, which had been plowed up from a farmer's field north of the city in the early 1930s, was identified by Prof. John A. Allan and added to the collection in ~1939. This marked the first of many Alberta meteorites to be acquired, including the falls of Abee (1952), Bruderheim (1960), Peace River (1963), Vilna (1967) and Innisfree (1977). If the names of these meteorites are familiar to meteoriticists and curators, it is likely because of the actions of Dr. Robert E. Folinsbee, professor (1946-1978) and chair (1955-1969) of the Department of Geology, who made specimens of these and other Alberta meteorites available to researchers around the world through loan or trade. Dr. Folinsbee was also instrumental in establishing the Meteorite Observation and Recovery Project (MORP), a network of cameras dedicated to fireball tracking and meteorite recovery that operated from 1971 to 1985 [1]. The orbit of Innisfree was determined based on MORP observations, for only the 3rd time (after Pribram and Lost City), and the meteorite recovered after the fall zone was estimated. A detailed history of meteorites found in Alberta is provided by [2]. The book is highly relevant to the University of Alberta Collection, which houses the main masses or representative specimens of 15 of the 18 meteorites from the province.

Recent acquisitions and growth: Since the start of the tenure of the current curator of the collection in 2003, the collection has grown from ~900 specimens of 130 meteorites to over 2500 specimens of ~420 meteorites. Most of the growth is attributable to the acquisition of meteorite type specimens obtained as part of the classification process. Many of these are iron meteorites, due to the development of methods for trace element analysis via solution ICP-MS, although the analytical facilities required for nearly all classification

types are available within the current Department of Earth and Atmospheric Sciences (with the exception of 3-oxygen isotopic analysis).

Notable acquisitions for the collection in the past two decades include: specimens of the Whitecourt (Alberta) meteorite, thousands of which have been recovered from the site of the 36 m-diameter late Holocene impact crater of the same name [3]; Buzzard Coulee (Saskatchewan), found after a widely observed fireball over Edmonton on November 20, 2008; one of the first specimens of the Tissint (Morocco) martian meteorite; and the type specimen for the 33 g Menisa meteorite in 2023, the result of a probable fall in October 2022 within Edmonton city limits.

The most significant acquisition was 643 g of the pristine specimens of the Tagish Lake (British Columbia) meteorite, which fell on the frozen surface of the eponymous lake on January 18, 2000. These specimens were acquired in 2006 and have been kept frozen (< 0 °C) and under clean conditions since their fall. The specific circumstances of the fall of Tagish Lake necessitate cold and clean curation and handling; for this reason, the Subzero Curation Facility for Astromaterials [4] was developed. This facility is at the heart of the Meteorite Curation Lab, and enables a range of studies relevant to the curation and handling of current and future returned and collected samples.

Research in advanced curation and handling methods: The Subzero Curation Facility consists of an Ar glove box housed within a walk-in freezer. The freezer is maintained at -15 °C. A Class 1000 (ISO6) clean room provides a vestibule for the freezer, as well as a clean environment in which the Meteorite Collection is stored (Figures 1, 2).



Figure 1. Ar glove box within freezer, after [4].



Figure 2. ISO5 clean room as a vestibule for the freezer (freezer door visible in A), and as a storage area for the Meteorite Collection (Lane Cabinets in B).

Since it was commissioned, the Subzero Facility has been used to process Tagish Lake specimens over two dozen times, providing pristine subsamples for numerous studies with collaborators and by external users. Other applications include testing gripper spines for the Asteroid Redirect Mission [5], and investigating the curation and handling of cometary nucleus material [6]. Most recently, the facility was used to process freshly fallen meteorites for organic studies, including Tarda and Aguas Zarcas [7, 8].

A prime example of the application of advanced curation to archival material is a project involving a specimen of Bruderheim that had been sealed inside a custom glass vacuum tube in April 1960 [9], requiring development of the methodology and tools to extract the meteorite while capturing the headspace gas (Figure 3). The meteorite specimen was treated as a returned sample, and our study included steps analogous to Preliminary Examination. Contamination Control was maintained through use of the ISO6 clean room and the glove box, and Contamination Knowledge was provided through collection of swabs and solvent rinses of the meteorite, capsule interior, and curation environment, analysis for organic compounds, and 16s rRNA next generation sequencing to identify microbial contaminants [10]. Analysis of the headspace gas is in progress. The specimen is now in a Teflon jar within the Subzero Facility. This study has provided novel insights into returned sample handling and curation, and could not have been done without the curation infrastructure.

Collections management and support: All of the 30 registered museum collections at the University of Alberta are supported by the University of Alberta Museums Unit, a central leadership team of museum professionals that provides advisory services in all areas of museum practice, administration of the campus-wide museums and collections framework and policy, and maintenance and support of the collections management software (MIMSY XG by Axiell ALM). Museums Unit staff also assist with loans, ensuring compliance with export laws, and maintaining the University of Alberta's

Category A designation by the Canadian Cultural Property Export Review Board. The latter provides advantages, e.g., to donors of meteorite specimens; this designation was instrumental to acquiring Tagish Lake, as well donations of large, regmaglypted Whitecourt specimens.

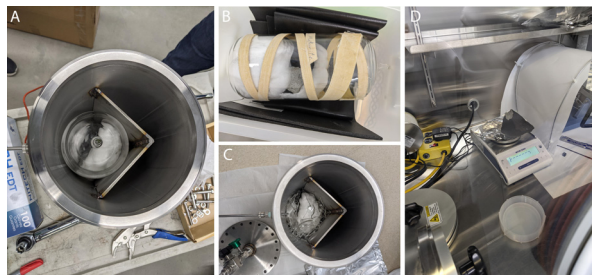


Figure 3. Bruderheim specimen (MET4270/B-195) in its original form (B); in a custom metal vacuum chamber before (A) and after (C) cracking of the glass on Nov. 10, 2021; and (D) after removal and transfer to the glove box. Photos by Patrick Hill.

Museums Unit staff enabled barcoding of all meteorite collection specimens, facilitating tracking of locations and loans. All records (meteorites and other), are searchable (<https://search.museums.ualberta.ca/>). In these ways, the University of Alberta Meteorite Collection is committed to long-term curation.

Current and future research: We maintain the Western Canada arm of the Global Fireball Observatory [11] (informally “MORP 2.0”). Coupled with the advanced curation facilities, we carry out end-to-end research into the best practices for tracking, recovery, transport, handling, and curation of freshly fallen meteorites [12], with a focus on frozen surfaces. If another fall like Tagish Lake happens, we will be ready!

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