2014 Nunavut Research Licence Renewal Application: Wayne Pollard

2013 Scientific Research #02 008 13R-M (multi-year)

Project Title: The permafrost hydrology and environmental significance of perennial springs in the Expedition Fiord area, Axel Heiberg Island

Project Leader: Wayne Pollard, Department of Geography, McGill University,
805 Sherbrooke St. W. Montreal, Quebec, H3A 0B9

2014 Research Team: Wayne Pollard, Melissa Ward, Dale Andersen, and 1 student field assistant.

2014 Fieldwork: Planned fieldwork includes April 15-24,

2014 Field sites: Sites on Axel Heiberg Island, including Expedition Fiord area (79º 25’N; 90º 45’W), Strand Fiord (79º 05’N; 90º 00’W), Whitsunday Bay (79º05’N; 87º00’W), – same as previous years

Funding source: Natural Science and Engineering Research Council of Canada (NSERC) with logistical support from the Polar Continental Shelf Program.

Project Overview: This is an ongoing project concerned with the study of the hydrology and geomorphology of cold hyper-saline groundwater flow at several locations on Axel Heiberg Island. These springs are very unusual and provide valuable insights in to permafrost conditions and the hydrology in cold deep permafrost. Preliminary results indicate that there are 2-3 different types of springs and that the local geology, specifically the formation of salt domes may have an impact on permafrost conditions. The primary goal of this research is to understand how cold (~0ºC), salty groundwater interacts with permafrost and the high Arctic polar desert environment (ecosystem). A second goal is to determine how these springs modify their surrounding landscape, and a third goal is to explain the unusual landforms associated with salt precipitates. Specific aims include: (1) to assess the geographic extent of this type of groundwater system, (2) to determine the source of the groundwater, (3) to understand and explain landforms and processes related to the interaction between groundwater and permafrost, and (4) to describe the microbiology of springs, lakes and permafrost. Over the past few years our studies have provided new information about the limiting conditions of water and microbial life related to cold temperatures and a better understanding about landforms related to ground water. This is the only research on cold perennial springs being conducted in the high Arctic. These springs have no commercial value and our research is driven entirely by purely scientific questions.

Progress Report – 2013 Fieldwork. In 2013 a new MSc student (Melissa Ward) began thesis based research on the hyper-saline springs located at Whitsunday Bay and Strand Fiord. However, bad weather and logistical problems prevented us from getting to our field sites in a planned April field trip. A second field trip in from July 7-14 was more successful, Ms Ward was able to measure temperature and flow rate measurements, collect water and salt samples, and make detailed measurements of the morphology of the various landforms produced by salt precipitation. We completed annual dGPS surveys of the ice and mound formations around the springs at Gypsum Hill, collected data from automatic weather stations as well as completing snow surveys (the latter are baseline data that form the core of environmental monitoring and climate change studies). The climate data indicate that 2012 was an average to low snow year but colder than average air temperatures. Spring melt was the latest we have seen in more than 20 years with complete snow cover remaining until early July. A July maximum temperature of 6C and winter minimum of -52C were recorded. Aerial surveys of springs in other locations on Axel Heiberg Island planned for June were not possible because of weather problems and widespread snow cover. Analyses of salt deposits indicate the presence of a hydrated form of salt called hydrohalite, although not uncommon chemically the formation of large hydrohalite tufa structures is considered very unusual.

2014 Field Program: For 2014 we are planning a late winter project designed to observe spring discharge and hydrohalite formation at Whitsunday Bay and Strand Fiord (Axel Heiberg Island). Fieldwork will be conducted from April 15 to 23 and will involve Pollard, Ward, Andersen and an Inuit field assistant. This work is based at the McGill Field Station at Expedition Fiord with day trips to field sites. The April observations are extremely important because it allows us to observe the nature and pattern of groundwater flow under cold conditions as well as allowing me to evaluate processes that occurred during the previous dark season. Field work at this time of year provides easier access to most of my study sites. Ward’s fieldwork will continue to focus on understanding the behaviour of saline groundwater under cold air temperatures and in particular the formation of surface ice deposits, frost mound structures and hydrohalite precipitates. We will collect water samples (~1 litre) for hydro-chemical analyses that will be compared with previous year’s observations. These analyses document changes underground flow systems and the importance of chemistry on both physical and biological processes. These studies improve our understanding about the physical, chemical and biological processes occurring within these spring systems. Field activities will also include mapping of ice and spring deposits, snow surveys and the collection of data from several automatic weather stations.

Significance: The results of this research provide new and valuable information about the behaviour of water in cold permafrost. Together with my students and colleagues we have identified important geological characteristics related to perennial spring occurrence as well as new and unusual biological features. The results of this work have lead to partnerships with NASA who believe that these springs may help in the planning for the exploration of Mars. My students and I are the only researchers in Canada doing this type of research.

2014 ᓄᓇᕗᑦ ᖃᐅᔨᓴᕐᓂᕐᒧᑦ ᐱᔪᓐᓇᐅᑎᑕᕐᓯᑎ ᓄᑕᖑᕐᑎᑦᑎᒥᐊᕿᑎ ᐱᓇᓱᑎ: ᕗᐊᐃᓐ ᐳᓚᕐᑦ

Wayne Pollard

2013 ᑭᒃᓕᓯᓂᐊᕐᓂᒃᑯᑦ ᖃᐅᔨᓴᕐᓂᖅ ᐱᒧᓐᓇᐅᑕ #02 008 13R-M (ᐊᕋᒍᒐᓴᒃᓄᑦ)

ᐱᓕᕆᐊᖑᔪᑦ ᐊᑎᖓ: ᖁᐊᖑᓂᖓ ᓄᓇᐅᑦ ᐃᓗᐊᓂᑦᑐᖅ ᖃᓄᐃᓕᖓᒃᒪᖓᑦ ᐊᒻᒪᓗ ᐊᕙᑎᖓᓄᑦ ᐃᒃᐱᒃᓇᐅᑎᓂᖓ ᐃᒪᖑᖃᑦᑕᕐᓂᖏᑦ ᑲᖏᕐᓗᐊᑕ ᓄᓇᖓᓂ Expedition Fiord, ᕿᑭᕐᑕᒥ Axel Heiberg Island

ᐱᓕᕆᐊᖑᔪᒧᑦ ᐊᖓᔪᖓᑦ: ᕗᐊᐃᓐ ᐳᓚᕐᑦ, ᓄᓇᓕᕆᓂᕐᒧᑦ ᐃᓕᓐᓂᐊᕐᕕᒃᔪᐊᕐᒥ, McGill University, 805 Sherbrooke St. W. Montreal, Quebec, H3A 0B9

2014 ᖃᐅᔨᓴᕐᑎᐅᔪᑦ: ᕗᐊᐃᓐ ᐳᓚᕐᑦ, Wayne Pollard, ᒥᓕᓴ ᕗᐊᑦ Melissa Ward, ᑕᐃᔪ ᐊᓐᑐᓴᓐ Dale Andersen, ᐊᒻᒪᓗ ᐊᑕᐅᓯᖅ ᐃᓕᓐᓂᐊᕐᑐᖅ ᐃᑲᔪᕐᑎ.

2014 ᐱᓕᕆᐊᖏᑦ: ᐸᕐᓇᒃᑕᐅᔪᑦ ᐱᖃᓯᐅᑎᓯᒪᔪᖅ ᐊᐃᕆᓕᑦ 15-ᒥᑦ 24-ᒧᑦ

2014 ᓄᓇᐃᑦ ᖃᐅᔨᓴᕐᕕᐅᓂᐊᕐᑐᑦ: ᕿᑭᕐᑕᒥ Axel Heiberg Island, ᐱᖃᓯᐅᑎᓪᓗᒍ ᑲᖏᕐᓗᐊᓂᑦᑐᕐ ᓄᓇᖓ Expedition Fiord (79º 25'N; 90º 45'W),ᑲᖏᕐᓗᒃ Strand Fiord (79º 05'N; 90º 00'W), ᑲᖏᕐᓗᒃ Whitsunday Bay (79º05'N; 87º00'W), – ᐊᕋᓂᑐᑦᑕᐅᖅ ᐅᐸᓚᐅᕐᑕᖏᑦ

ᑭᓇᐅᔭᖃᕐᑎᑦᑎᔪᑦ: ᖃᐅᔨᓴᕐᓂᕐᒧᑦ ᑭᓇᐅᔭᕐᑕᕐᕕᒃ ᓄᓇᒥᒃ ᑭᒃᓕᓯᓂᐊᕐᓂᕐᒧᑦ ᐊᒻᒪᓗ ᐃᓗᓕᖏᓐᓂᒃ ᖃᐅᔨᓴᕐᓂᕐᒧᑦ ᑲᑎᒪᔨᖏᑦ Natural Science and Engineering Research Council (NSERC)ᐊᒻᒪᓗ ᐅᑭᐅᕐᑕᕐᑐᒥ ᐃᑲᔪᕐᑎᖏᑦ ArcticNet. ᐊᐅᓚᔾᔭᑕᐅᔭᓂᒃ ᐃᑲᔪᕐᑐᑦ Polar Continental Shelf Program.

ᐱᓕᕆᐊᖑᔪᑦ ᖃᓄᐃᓕᖓᒃᒪᖓᑕ: ᑲᔪᓯᓐᓇᕐᑐᖅ ᑕᓐᓇ ᐱᓕᕆᐊᖑᔪᖅ ᐱᔾᔪᑎᖃᕐᑐᖅ ᖃᐅᔨᓴᕐᓂᕐᒧᑦ ᓄᓇᐅᑦ ᐃᓗᐊᓂ ᖃᖓᓂᓗ ᖁᐊᖑᓂᖓ ᐊᐅᒃᐸᓪᓕᐊᓂᖓᓗ ᑕᓇᐅᖑᓂᖓᓂᒃᓗ ᒪᓂᕋᕐᒥᖓᕐᑐᖅ ᑯᒃᐸᓪᓕᐊᔪᖅ ᑕᓯᖑᕐᐸᓪᓕᐊᓗᓂ ᕿᑭᕐᑕᒥ Axel Heiberg Island. ᑕᒃᑯᐊ ᐃᒥᖑᕐᐸᓪᓕᐊᔪᑦ ᑕᓯᖑᕐᐸᓪᓕᐊᔪᑦ ᐊᔾᔨᐅᖏᑦᑐᒃᒪᑕ ᑐᑭᓯᔭᐅᕙᓪᓕᕈᑕᐅᓪᓗᑎᒃᓗ ᖃᓄᕐ ᓄᓇᐅᑦ ᖁᐊᖑᓂᖓ ᐊᐅᒃᐸᓪᓕᐊᑎᒋᒃᒪᖓᑕ. ᖃᐅᔨᓯᒪᓕᕐᑕᕗᑦ ᐊᔾᔨᒋᖏᖕᓂᖏᖕᓂᒃ ᒪᕈᒃ ᐱᖓᓱᓪᓗᖕᓂᑦ ᐊᔾᔨᒋᖏᒻᒪᑕ ᐃᒪᐅᓂᖏᑦ ᓄᓇᖓᓂᑦᑐᓪᓗ ᒪᓕᒃᓗᒋᑦ, ᐱᓗᐊᕐᑐᒥᒃ ᑕᓇᐅᖑᖅᑕᕐᓂᖏᖕᓄᑦ ᖃᑦᑎᒃᓯᓪᓗᑎᒃᓗ ᑕᓇᐅᖑᓂᖏᑦ ᖁᐊᖑᓂᖓᓄᑦ ᐃᒃᐱᒃᓇᐅᑎᑐᐃᓐᓇᓇᐊᓕᒃ ᐊᐅᒃᐸᓪᓕᐊᓂᖓᓄᑦ. ᑐᕋᒐᓇᔭᕗᑦ ᖃᐅᔨᓴᕐᑕᕗᑦ ᑐᑭᓯᓇᓱᒃᓗᒍ ᖃᓄᕐ ᓂᒃᓕᓇᕐᑐᖅ (~0ºC), ᑕᓇᐅᖑᔪᕐᓗ ᒪᓂᕋᕐᒥᑦᑐᖅ ᐊᒃᑐᐊᓂᖃᕐᒪᖓᑦ ᖁᐊᖑᓂᖓᓄᑦ ᓄᓇᐅᑦ ᐊᑕᓂᑦᑐᒧᑦ ᐊᒻᒪᓗ ᐅᑭᐅᕐᑕᕐᑐᒥ ᐊᔭᑎᖓᓄᑦ ᖃᓄᐃᔾᔭᑕᐅᒃᒪᖓᑦ. ᐱᖃᑕ ᑐᕋᒐᐅᔪᖅ ᖃᐅᔨᓇᓱᒃᓗᒍ ᖃᓄᕐ ᐃᒥᖑᕐᑐᑦ ᑕᓯᖑᕐᑐᑦ ᐊᕿᒋᐊᕈᑎᖃᑦᑕᕐᒪᖓᑕ ᓄᓇᖓᓄᑦ, ᐊᒻᒪᓗ ᐱᖓᔪᖓᑦ ᑐᕋᒐᐅᔪᖅ ᑐᑭᓯᔭᐅᓇᓱᒃᓗᓂᐊᔾᔨᐅᖏᑦᑐᓂᖓ ᓄᓇᐃᑦ ᐊᕿᒃᓯᒪᓂᖏᑦ ᑕᓇᐅᕐᒥᒃ ᐃᔅᓴᕿᐸᓪᓕᐊᑎᓪᓗᒍ. ᑐᕋᒐᐅᔪᑦ ᐅᑯᐊ: (1) ᖃᐅᔨᓇᓱᒃᓗᒍ ᓄᓇᖓ ᓇᒧᑦ ᑎᑭᐅᒪᑎᒋᒃᓂᖓ ᐃᒥᖑᕐᐸᓪᓕᐊᔪᖅ (2) ᖃᐅᔨᓇᓱᒃᓗᑕ ᓇᑭᖓᖅᑕᕐᒪᖓᑦ ᐃᒥᐅᓂᖓ ᓄᓇᐅᑦ ᐃᓗᐊᓂᑦᑐᖅ, (3) ᑐᑭᓯᔭᐅᓇᓱᒃᓗᓂ ᓄᓇᖑᕐᐸᓪᓕᐊᔪᑦ ᐊᐅᓚᓂᖏᓪᓗ ᐊᑕᓂᖓᑦᑐᖅ ᐃᒥᐅᓂᖓ ᖁᐊᖑᓂᖓᓗ ᐊᒃᑐᐊᓂᖃᕐᒪᖓᑎᒃ, ᐊᒻᒪᓗ (4) ᐅᖃᐅᓯᐅᓗᓂ ᐃᓗᓕᖏᑦ ᓴᓇᓯᒪᓂᖏᑦ ᑕᓯᖑᕐᓯᒪᔪᑦ ᖁᐊᖑᓂᖓᓗ. ᐊᕋᒍᒐᓴᐃᑦ ᖃᐅᔨᓴᕐᐸᒃᓗᑕ ᓄᑕᓂᒃ ᖃᐅᔨᐸᓪᓕᐊᔪᑦ ᐃᒥᐅᓂᖓ ᐊᒻᒪᓗ ᐅᒪᔪᐃᑦ ᓂᒃᓚᓯᒃᑎᓪᓗᒍ ᖃᓄᐃᓕᖓᕙᓪᓕᐊᒃᒪᖓᑕ ᑐᑭᓯᔭᐅᖃᑦᑕᕐᓂᖓᓂᒃ ᓄᓇᖑᕐᑲᓐᓂᕐᑕᕐᓂᖓᓂᒃ ᐃᒪᐅᓂᖓᓂᖓᕐᑐᑦ ᐊᑕᓂᑦ. Hᓐᓇ ᐅᑭᐅᕐᑕᕐᑐᒥ ᖃᐅᔨᓴᕐᑕᐅᔪᑐᒃᒪᑦ ᐃᒥᐅᓂᖓᓂᒃ ᐅᑭᐅᕐᑕᕐᑐᒥ ᖁᑦᑎᒃᑐᒥ. ᑕᒃᑯᐊ ᑕᓯᖑᖃᑦᑕᕐᑐᑦ ᑭᓇᐅᔭᑎᒍᑦ ᐱᔭᐅᓇᓱᖏᑦᑐᑦ ᖃᐅᔨᓴᕐᓂᕗᑦ ᑭᒃᓕᓯᓂᐊᕐᓂᒃᑯᑦ ᑐᕋᖓᒃᑐᐃᓐᓇᕐᑐᖅ.

ᖃᓄᐃᓕᐅᕐᓂᕐᒪᖔᑕ ᐅᓂᒃ - 2013 ᐱᓕᕆᐊᖑᓐᓂᒃ. 2013-ᒥ ᐃᓚᐅᓕᓴᕐᑐᖅ ᐃᓕᓐᓂᐊᕐᑎᐅᔪᖅ (ᒥᓕᓴ ᕗᐊᑦ Melissa Ward) ᖃᐅᔨᓴᕐᐸᓪᓕᐊᓕᓚᐅᕐᑐᖅ ᐃᓕᓐᓂᐊᕈᑎᖓᑕ ᐃᓚᒋᓪᓗᓂᐅᒃ ᑕᕆᐅᖑᓂᖓ ᐃᒥᖑᕐᑐᖅ ᑕᕙᓂ ᖃᖏᕐᓗᐊᑕ ᓄᓇᖓᓂ Whitsunday Bay ᐊᒻᒪᓗ Strand Fiord. ᑭᓯᐊᓂ ᓯᓚᕈᔪᓂᖓᓄᑦ ᐊᒻᒪᓗ ᐅᓯᑲᕐᑕᕐᑎᐅᔪᑦ ᓇᒻᒪᑲᑕᖏᓐᓂᖏᓐᓄᑦ ᐅᐸᒍᓐᓇᓚᐅᖏᓐᓇᑎᒍ ᖃᐅᔨᓴᕐᕕᒋᔭᕗᑦ ᐊᐃᕆᓕᒥ ᐸᕐᓇᒃᓯᒪᒐᓗᐊᕐᓗᑎᒍ. ᐱᖃᑕ ᖃᐅᔨᓴᕐᓂᐅᔪᖅ ᔪᓚᐱ 7-ᒥᑦ 14-ᒧᑦ ᑲᔪᓯᑦᑎᐊᓚᐅᕐᓗᓂ. ᑖᓇ ᐊᕐᓇᖅ ᕗᐊᑦ ᐅᒃᑐᕐᕈᓐᓇᓚᐅᕐᑐᖅ ᐅᕐᖁᓂᖓᓂᒃ ᐊᒻᒪᓗ ᖃᓄᑎᒋ ᑯᒃᐸᓪᓕᐊᑎᒋᓂᖓᓂᒃ, ᐃᒥᕐᒥᒃᓗ ᐱᓪᓗᓂ ᑕᕆᐅᖑᓂᖓᓂᒃᓗ ᐱᓪᓗᓂ, ᐊᒻᒪᓗ ᐅᒃᑐᕐᕐᓗᓂᒋᑦ ᖃᑦᑎᒃᓯᓕᕐᓯᒪᔪᑦ ᑕᕆᐅᖑᓂᖏᑦ ᓄᓇᒥᑦᑐᑦ. ᐱᔭᕆᕐᓯᓚᐅᕐᑐᒍᑦ ᐊᕿᒍᑕᒪᑦ ᖃᐅᔨᓴᕐᐸᒃᑕᑦᑎᓐᓂᒃ ᓂᓚᐅᓂᖓᓂᒃ ᓄᓇᖑᐊᒃᑯᑦ ᓇᓗᓇᐃᕐᑕᐅᓪᓗᑎᒃ ᐊᕿᓂᖓᓂᒃ, ᐊᒻᒪᓗ ᖃᑦᑎᒃᓯᓕᕐᓯᒪᔪᑦ ᐊᕙᑕᓂ ᐃᒥᖑᕐᓯᒪᔪᑦ ᐊᑎᖓᑐᖅ Gypsum Hill, ᑎᑎᕋᕐᑕᐅᓚᐅᕐᒥᔪᖅ ᓯᓚᓐᓂᐊᕈᑎᒃᑯᑦ ᐊᒻᒪᓗ ᐊᐳᑕᐅᓂᖓᓂᒃ ᖃᐅᔨᓴᕐᓗᑎᒃ (ᑭᖑᓪᓕᐅᔪᖅ ᐱᒋᐊᕐᕕᐅᔪᓐᓇᕐᑐᑦ ᑎᑎᕋᕐᑕᐅᔪᑦ ᐊᕙᑎᖓᓂᒃ ᖃᐅᔨᓴᕐᓂᕐᒧᑦ ᐊᒻᒪᓗ ᓯᓚᐅᑦ ᐊᓯᓪᓕᕐᐸᓪᓕᐊᓂᖓᓂᒃ ᖃᐅᔨᓴᕐᑕᐅᔪᓄᑦ). ᓯᓚᒧᑦ ᖃᐅᔨᓴᐅᑕᐅᔪᑦ ᐅᖃᕐᓯᒪᔪᑦ 2012 ᐊᑯᓐᓂᕐᓱᓚᐅᕐᓂᖓᓂᒃ ᐊᐳᑎᖃᑦᑎᐊᓚᐅᖏᓐᓂᖓᓂᒃᓗ ᑭᓯᐊᓂ ᓂᒃᓚᓱᒃᓂᕐᓴᐅᓪᓗᓂ. ᐅᐱᖓᒃᑯᑦ ᐊᐅᒃᐸᓪᓕᐊᓂᖓ ᑭᖑᕙᓯᓚᐅᕐᑐᖅ ᑕᐃᒪᖓᓪᓗ ᖃᐅᔨᓴᖃᑦᑕᓕᕿᒥᒃ ᐊᕿᒍᓄᑦ 20 ᑭᖑᕙᓯᓚᖑᓚᐅᕐᑐᖅ ᐊᐳᑎᖃᐃᓐᓴᓚᐅᕐᒪᑦ ᔪᓚᐃᒥ ᑭᓯᐊᓂ ᐊᐅᓕᑕᐃᓐᓇᕐᓗᓂ. ᔪᓚᐃᒥ ᐅᕐᑯᒪᖑᓚᐅᕐᑐᖅ 6 ᐊᒻᒪᓗ ᐅᑭᐅᒃᑯᑦ ᓂᒃᓚᓱᓚᖑᓚᐅᕐᑐᖅ -52. ᕿᖓᑕᓱᒃᑯᑦ ᑕᓯᖑᕐᓯᒪᔪᓂᒃ ᑕᑯᓇᒃᓗᑎᒃ ᕿᑭᕐᑕᒥ ᐸᕐᓇᒃᑕᐅᓯᒪᒐᓗᐊᕐᓗᑎᒃ ᔪᓂᒥ ᑭᓯᐊᓂ ᑲᔪᓯᔪᓐᓇᓚᐅᖏᑦᑐᑦ ᓯᓚᓗᐃᓐᓇᕐᓂᖓᓄᑦ ᐊᐳᑎᖃᐃᓐᓇᕐᓂᖓᓄᓪᓗ. ᖃᐅᔨᓴᕐᑕᕗᑦ ᑕᕆᐅᖑᓂᖓᓂᒃ ᐅᖃᕐᓯᒪᓚᐅᕐᑐᑦ ᐸᓂᕐᓯᒪᒧᖅ ᑕᕆᐅᖅ ᐱᑕᖃᕐᓂᖓᓂᒃ ᐊᑎᖃᕐᑐᖅ hydrohalite, ᐱᑕᖃᖃᑦᑕᕐᓂᖓᓂᒃ ᖃᐅᔨᒪᔭᐅᔪᓚᓗᐊᖅ ᑎᓯᐊᓂ ᐊᖏᓇᕐᑎᕐᓗᓂ ᖃᑦᑎᒃᓯᓕᕐᓯᒪᔪᑦ ᐊᔾᔨᐅᖏᑦᑐᓚᐅᕐᑐᑦ.

2014 ᐱᓕᕆᐊᖑᓂᐊᕐᑐᕐ: ᐊᕿᒍᒧᑦ 2014 ᐸᕐᓇᐅᑎᖃᕐᑐᒍᑦ ᐅᑭᐅᖑᓱᖓᕐᓂᖓ ᐱᒋᐊᕐᓗᒍ ᑕᐅᑐᒍᒪᓪᓗᑎᒍ ᐊᐅᒃᐸᓪᓕᐊᓂᖓ ᐅᐱᖓᒃᑯᑦ ᐊᒻᒪᓗ ᐊᕿᒃᐸᓪᓕᐊᓂᖏᑦ ᖃᑦᑎᒃᓯᓕᕐᓯᒪᔪᑦ ᑲᖏᕐᓗᐊᑕ ᓄᓇᖓᓂ Whitsunday Bay ᐊᒻᒪᓗ Strand Fiord (ᕿᑭᕐᑕᖅAxel Heiberg Island). ᐱᓕᕆᐊᕆᓂᐊᕐᑕᕗᑦ ᐱᒋᐊᕐᓂᐊᕐᑐᖅ ᐊᐃᕆᓕᑦ 15-ᒥᑦ 23-ᒧᑦ ᐅᑯᐊᖑᓂᐊᕐᑐᑦ ᐳᓚᕐᑦ,Pollard, ᕗᐊᕐᑦ Ward, ᐊᓐᑐᓴᓐAndersen ᐊᒻᒪᓗ ᐃᓄᒃᒥᒃ ᐃᑲᔪᕐᑎᖃᕐᓗᑎᒃ. ᑖᓇ ᐱᓕᕆᐊᖑᓂᐊᕐᑐᖅ ᐱᒋᐊᕐᕕᖃᖃᑦᑕᕐᓂᐊᕐᑐᖅ ᑕᒃᒪᕐᕕᐅᔪᒥ ᑲᖏᕐᓗᐊᑕ ᓄᓇᖓᓂ Expedition Fiord ᑕᐃᑯᖓᐅᖃᑦᑕᕐᓗᑎᒃ ᖃᐅᔨᓴᕐᕕᐅᔪᒧᑦ ᖃᐅᑕᒪᕐ. ᐊᐃᕆᓕᒥ ᖃᐅᔨᓇᓱᒃᓂᖅ ᐱᓪᓚᕆᐅᓂᐊᕐᒪᑦ ᐱᔾᔪᑎᒋᓪᓗᒍ ᑕᐅᑐᒍᓐᓇᕐᓂᐊᕐᑎᒍ ᐃᒪᐅᓂᖓ ᓇᒧᖓᐅᕙᓪᓕᐊᒃᒪᖔᑦ ᖃᓄᐃᓕᕙᓪᓕᐊᒃᒪᖔᓪᓗ ᓂᒃᓚᓱᒃᑎᓪᓗᒍ ᐊᒻᒪᓗ ᖃᐅᔨᓴᕐᓗᑎᒍ ᖃᓄᐃᓕᖔᓚᐅᕐᒪᖔᑕ ᐅᑭᐅᖑᑎᓪᓗᒍ ᑕᕐᑎᓪᓗᒍ. ᐱᓕᕆᐊᕆᓂᐊᕐᑕᕗᑦ ᓂᒃᒪᓱᒃᑎᓪᓗᒍᓱᓕ ᐅᐸᒃᓴᐅᓂᐊᕐᒪᑕ ᖃᐅᔨᓴᕐᕕᐅᔪᑦ. ᕗᐊᑦ ᐱᓕᕆᐊᖓ ᑲᔪᓯᓂᐊᕐᑐᖅ ᑐᑭᓯᕙᓪᓕᕿᓱᒃᑐᓂ ᐊᐅᓚᓂᖓᓂᒃ ᑕᕆᐅᖑᓂᖓ ᒪᓂᕿᒥᖓᕐᑐᖅ ᓂᒃᒪᓱᒃᑎᓪᓗᒍ ᐊᒻᒪᓗ ᐱᓗᐊᕐᑐᒥᒃ ᐊᕿᒃᐸᓪᓕᐊᓂᖓ ᖃᓐᓂᕐᑐᖅ ᓂᓚᐅᓂᖓ, ᖁᐊᖑᓂᖓᓗ ᖃᑦᑎᒃᓯᓕᕐᓯᒪᔪᑦ ᐊᒻᒪᓗ ᐊᐅᒃᐸᓪᓕᐊᓂᖏᑦ. ᑲᑎᑦᑎᓂᐊᕐᑐᒍᑦ ᐃᒥᕐᓂᒃ (ᐊᑕᐅᓯᕐ ᖃᓪᓗᑎᕿᓚᖅ 1 litre) ᐃᓗᓕᖏᓐᓂᒃ ᖃᐅᔨᓴᕐᑕᐅᓗᓂ ᑕᑯᔭᐅᓗᓂ ᐊᖃᓂᒥᑦ ᖃᓄᐃᓐᓂᓴᐅᑎᒋᒃᒪᖔᑕ. ᑕᒃᑯᐊ ᖃᐅᔨᓴᐅᑕᐅᔪᑦ ᑎᑎᕋᕐᑕᐅᓂᐊᕐᑐᑦ ᐊᓯᓪᓕᕐᐸᓪᓕᐊᔪᓂᒃ ᓄᓇᐅᑦ ᐊᑕᓂᑦ ᑯᒃᐸᓪᓕᐊᔪᑦ ᐊᒻᒪᓗ ᐃᓗᓕᖏᑦ ᑭᓱᒃᒪᖔᑕ ᖃᓄᐃᑦᑐᓂᖏᓪᓗ. ᑕᒃᑯᐊ ᖃᐅᔨᓴᕐᓂᑦ ᑐᑭᓯᕙᓪᓕᕈᑕᐅᓂᐊᕐᒪᑕ ᓴᓇᓯᒪᓂᖓᓂᒃ, ᐃᓗᓕᖏᓐᓂᒃ ᐊᐅᒪᓂᖏᓐᓂᒃᓗ ᐃᒪᖑᕐᐸᓪᓕᐊᑎᓪᓗᒋᑦ. ᐱᓕᕆᐊᕆᔭᕗᑦ ᐱᖃᓯᐅᑎᓯᒪᓂᐊᕐᑐᖅ ᓄᓇᖑᐊᒃᑯᑦ ᓇᒥᒻᒪᖔᑕ ᓂᓚᐅᓂᖏᑦ ᐊᒻᒪᓗ ᐃᒥᖑᕐᐸᓪᓕᐊᔪᑦ, ᐊᐳᑕᐅᓂᖏᓪᓗ ᐊᒻᒪᓗ ᑲᑎᑦᑎᓗᑕ ᑎᑎᕋᕐᑕᐅᓯᒪᔪᓂᒃ ᓯᓚᓐᓂᐊᕈᑎᒃᑯᑦ.

ᐱᓪᓚᕆᐅᓂᖓ: ᖃᐅᔨᓴᕐᓂᕆᔭᑦᑕ ᑐᑭᓯᒥᔭᕗᑦ ᓄᑕᓂᒃ ᐊᑐᑎᖃᕐᑐᓂᒃᓗ ᑐᓴᐅᒪᔪᑕᐅᓂᐊᕐᒪᑕ ᐃᒥᖅ ᖃᐅᓄᓕᕙᓪᓕᐊᕙᒻᒪᖔᑦ ᓂᒃᓚᓱᒃᑐᒥᑦᑐᖅ ᖁᐊᖑᐃᓐᓇᕐᑐᒥᖕᒥᑦᑐᖅ. ᐃᑲᔪᕐᑎᒋᓗᒋᑦ ᐃᓕᓐᓂᐊᕐᑎᐅᔪᑦ ᓴᓗᓇᐃᕐᓯᓯᒪᒪᒧᒍᑦ ᐱᓪᓚᕆᐅᔪᓂᒃ ᓄᓇᒥᑦᑐᓂᒃ ᐅᐱᖓᒃᑯᑦ ᐊᐅᒃᐸᓕᐊᔪᓂᒃ ᐊᒻᒪᓗ ᓄᑕᓂᒃ ᐊᔾᔨᐅᖏᑦᑐᓂᒃ ᐊᕿᒃᓯᒪᔪᓂ ᓄᓇᐅᑦ ᖃᓪᓕᓂᑦᑐᓂᒃ. ᐱᓕᕆᐊᕆᔭᑦᑕ ᐃᓗᐊᓂᑦᑐᓂᒃ ᑐᓴᐅᒪᔭᐅᓕᕿᒥᒃ ᐃᑲᔪᕐᑎᑕᐅᓚᐅᕐᑐᒍᑦ ᓯᓚᐃᓐᓇᕐᒧᑦ ᐊᐅᓪᓚᕐᑎᑦᑎᕙᒃᑐᓂᒃ NASA ᑕᒃᑯᐊ ᐃᒥᖑᕐᐸᓪᓕᐊᔪᑦ ᑐᑭᓯᔭᐅᒍᑎᒃ ᐃᑲᔪᑕᐅᒐᔭᕐᒪᑕ ᓄᓇᕐᔪᐊᑕᑦ ᐊᓯᐊᓄᑦ ᐊᑎᖃᕐᑐᖅ Mars ᐅᐸᒃᑕᐅᖃᑦᑕᕐᑎᓪᓗᒍ. ᐃᓕᓐᓂᐊᕐᑐᑦ ᐅᕙᖓᓗ ᖃᐅᔨᓴᕐᑐᑐᔪᒍᑦ ᑕᐃᒪᐃᑦᑐᒥ ᑲᓇᑕᒥ.