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**Report of activities for the Baffin Geological Synthesis (2017)**

**GEM-2 Baffin Project**

**N. Bingham-Koslowski and L.T. Dafoe**

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## **Forward**

The Geo-mapping for Energy and Minerals (GEM) program is laying the foundation for sustainable economic development in the North. The Program provides modern public geoscience that will set the stage for long-term decision making related to responsible land-use and resource development. Geoscience knowledge produced by GEM supports evidence-based exploration for new energy and mineral resources and enables northern communities to make informed decisions about their land, economy and society. Building upon the success of its first five-years, GEM has been renewed until 2020 to continue producing new, publically available, regional-scale geoscience knowledge in Canada's North.

During the 2017 field season, research scientists from the GEM program successfully carried out 27 research activities, 26 of which will produce an activity report and 12 of which included fieldwork. Each activity included geological, geochemical and geophysical surveying. These activities have been undertaken in collaboration with provincial and territorial governments, Northerners and their institutions, academia and the private sector. GEM will continue to work with these key partners as the program advances.

## **Project Summary**

The “Baffin Island and the Labrador-Baffin Seaway Geological Synthesis,” is an ongoing activity under the GEM-2 Baffin Project that initiated in 2016. The activity aims to summarize existing and new geological data resulting from previous and current GEM Baffin studies and related research (Fig. 1). The Synthesis will combine onshore and offshore studies in order to produce a comprehensive synopsis of the geology and tectonic history of both Baffin Island and the Labrador-Baffin Seaway. The Baffin Geological Synthesis will be published as a Geological Survey of Canada Bulletin – Compendium, and will be publically available online. The compilation will be subdivided into chapters that will provide geological summaries, as well as high resolution reference maps and figures. Additional details and larger maps, along with raw data files, will be included in the appendices and available for download by the public.

## **Introduction**

The formation and geology of Canada's North, specifically modern mapping of both onshore bedrock on Baffin Island and offshore stratigraphy and structure within the Labrador-Baffin Seaway, was largely poorly understood until the commencement of Geo-mapping for Energy and Minerals (GEM) in 2008. Significant strides have since been made in regards to the onshore and offshore geology by the various activities that comprise the GEM Baffin Project. The goal of the Baffin Geological Synthesis activity is to produce a digital, publically available, comprehensive document that accurately summarizes the geological and tectonic understanding of Baffin Island and the Labrador-Baffin Seaway that has been developed through GEM and its collaborators over the last decade. The Synthesis aims to amalgamate existing knowledge with new information gained from completed, current, and future GEM activities that include both onshore bedrock mapping and offshore surficial, basin, and basement studies. The final publication will serve as a reference document for anyone interested in the Baffin region and will include datasets, maps, and shapefiles available for download and use by the public, academia, and industry.

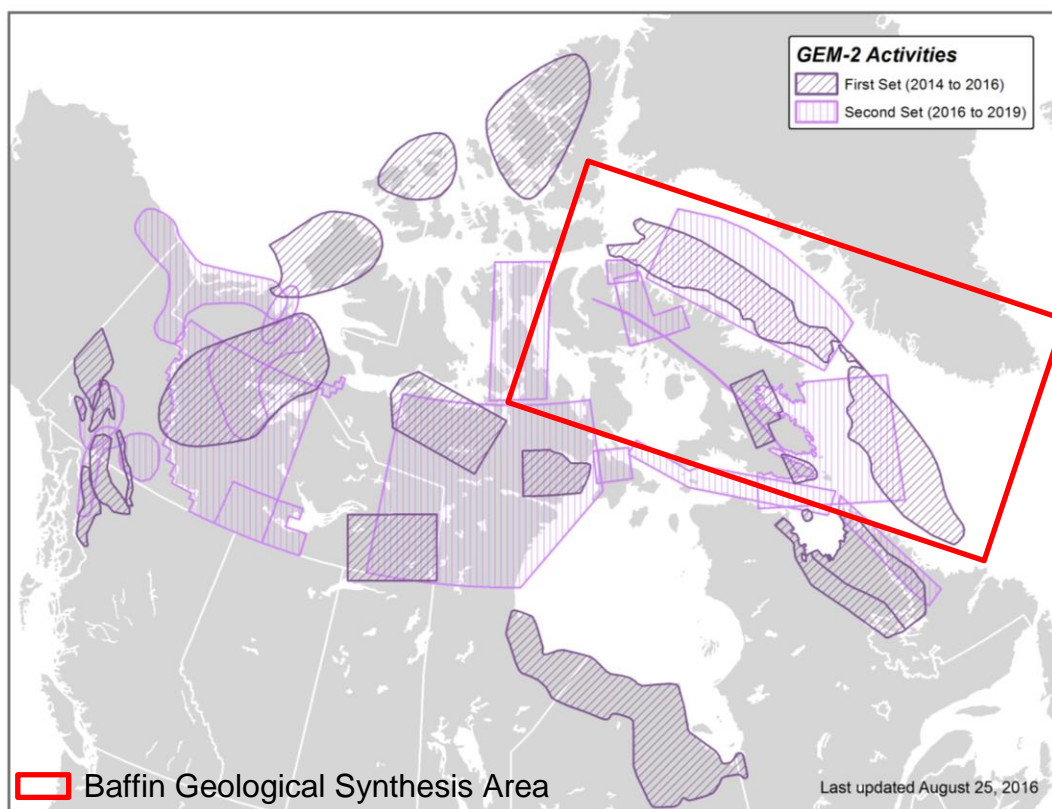


Figure 1: A map of past and current GEM-2 activities with the Baffin Geological Synthesis area highlighted in red.

The Baffin Island and the Labrador-Baffin Seaway Geological Synthesis, is currently divided into three parts, composed of 15 chapters. The Synthesis will be divided by time first into three sections: Part 1 – Precambrian and Paleozoic, Part 2 – Mesozoic to Present, and Part 3 – Land Use. Part 2 is further subdivided into regional subsections that include the Labrador Margin, Davis Strait, Baffin Bay, Baffin Island, Bylot Island, and the West Greenland Margin (Fig. 2). Parts 1 and 2 aim to resolve and summarize the geological and tectonic history of the Baffin region. Part 3, Land Use, is intended to provide information on known resources from the area which may be of interest to northern communities, academia, provincial/territorial governments, and industry. Due to the scope of the project, the Baffin Island and the Labrador-Baffin Seaway Geological Synthesis involves a significant amount of collaboration both internal and external to the Geological Survey of Canada. At present, the activity involves upwards of 30 scientists and support staff from 5 Geological Survey of Canada offices. Additionally, external partners from Canadian Universities, as well as the Geological Survey of Denmark and Greenland (GEUS) have committed to providing contributions to the Synthesis.

## Methodology

The Baffin Island and the Labrador-Baffin Seaway Geological Synthesis is a desktop study that amalgamates and summarizes the key data findings from previous and ongoing GEM Baffin and partner activities. A list of the methodologies used in the various other GEM-2 Baffin projects that feed into the Baffin Geological Synthesis is provided here. For more detailed descriptions, please refer to individual GEM-2 Baffin project reports and publications. Methods utilized by GEM-2 Baffin activities include, but are not limited to:

- Researching and summarizing internal or external publications such as peer-reviewed articles, internal reports, industry reports, and marine cruise and field reports.

- The analysis and description of drill cores, piston cores, conventional cores, cuttings, dredge samples, thin sections, and bedrock samples collected by both the GSC and the mining and exploration industries.
- Fieldwork including onshore bedrock mapping studies, marine cruises, and geophysical surveys.
- Biostratigraphic analysis and apatite fission track dating of basin rocks to determine accurate ages of the strata/rock units and their thermal evolution during basin evolution.
- The processing and interpretation of geophysical (gravity and magnetic) and seismic data to identify and map geological/structural features and key horizons at the regional scale.
- Mapping and delineation of mineral occurrences and elements of offshore petroleum systems.
- Generation of tectonic and stratigraphic frameworks, bedrock geological maps, structural maps, sediment thickness maps, velocity models, gravity inversion models, and 3D models of density anomalies from seismic and gravity/magnetic data.
- Management, use, and generation of relevant GIS data.

## Results

The Baffin Geological Synthesis relies on input from several GEM-2 Baffin activities that are still in progress. At

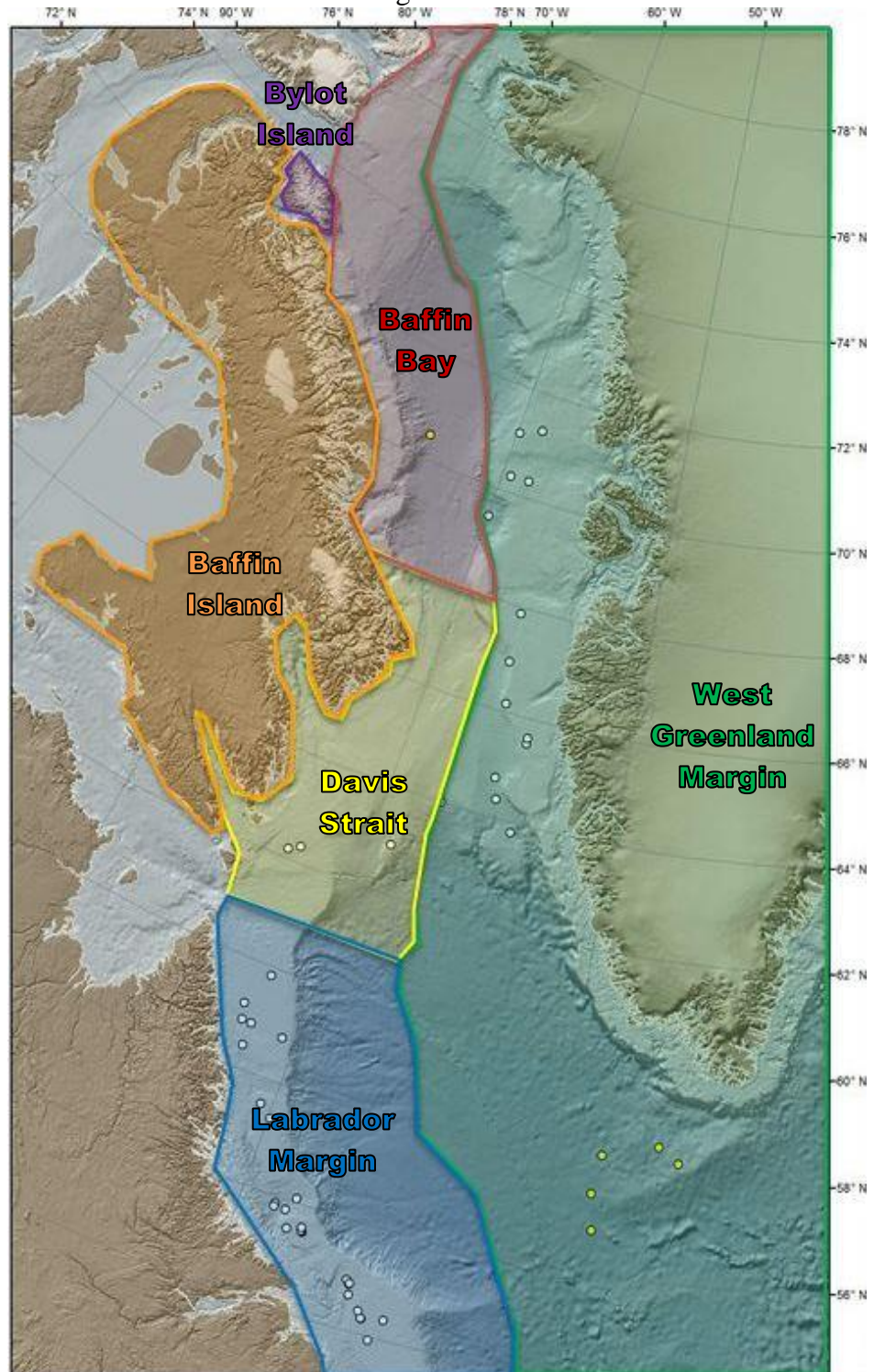


Figure 2: The Baffin Geological Synthesis is subdivided into 6 regions, the locations of which are highlighted on the map: Bylot Island (purple), Baffin Bay (red), Baffin Island (orange), Davis Strait (yellow), the Labrador Margin (blue), and the West Greenland Margin (green).



present, a detailed outline for the Synthesis has been produced with chapter leads and contributors identified. Initial community engagement has taken place with the Qikiqtani Inuit Association (QIA) in Iqaluit to introduce the concept of the Synthesis and to receive important input and feedback on the activity. Topics covered with the QIA included outreach and engagement opportunities and practices, as well as a discussion of what products may be of interest to the communities once the Synthesis has been published.

As the Baffin Island and the Labrador-Baffin Seaway Geological Synthesis progresses, gaps in data will be identified and addressed as much as possible within the given timeframe and budget to maximize the extent and relevance of the publication. For example, it was recently recognized that the Paleozoic biostratigraphic data for the Labrador margin was largely outdated and highly variable with some Labrador wells having no assigned ages for this strata. In recognition of this knowledge gap, a new biostratigraphic study was developed, and is currently in progress, that will provide new, consistent age data for this area that will be of use to government agencies, academia, and industry. Furthermore, new, reliable age data will enable accurate interpretations of the Paleozoic lithology and seismic data in the region, as well as facilitate correlations between the Labrador Margin and adjacent regions. For more details on the Paleozoic biostratigraphy of the Labrador Margin, please refer to the most recent activity report for the GEM-2 Baffin Stratigraphic and Tectonic Framework for the Baffin Bay Petroleum Systems; Open File 8315 (Dafoe et al., 2017).

## **Conclusions**

The Baffin Geological Synthesis continues to be a work in progress. The advancement of the Synthesis is linked to the progression of other GEM-2 Baffin activities that will provide the content for the publication. These support activities are in various stages of completion but will be wrapping up over the next 1 to 2 years. The first year of the Baffin Geological Synthesis has been largely dedicated to logistics, with the scope of the project (regions, collaborations, timelines, budget etc.) and the structure of the final product (publication type, division of the synthesis, number of chapters, chapter leads/contributors etc.) being defined. Once complete, the Synthesis will provide a regional and current understanding of the mineral-bearing bedrock geology of Baffin Island and Cretaceous and younger rocks and related petroleum systems in the offshore of Labrador-Baffin Bay Seaway.

Future work for the activity includes:

- Continued investigation into Paleozoic strata including the generation of paleoenvironmental interpretations from core, thin sections, and biostratigraphic data.
- Ongoing collaboration with external partners.
- Compilation and review of chapters.
- The generation of relevant maps, images, and datasets for the final product.

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