



# Time and Space Variations of Geological Maps

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## Introduction

The purpose of this project is to investigate possible relationships between depositional environments and faunal evolution with time. The project brings together a wide variety of lithostratigraphic, depositional environment, geochronological and paleontological data, viewed in the context of an evolving plate reconstruction model.

Geological maps of large regions display vast amounts of information, but different maps are quite disparate in the extent of data provided regarding depositional environment and the timing of activity. The Geological Map of the Arctic provides an example of broad regional coverage with reasonable detail for geologically inferred depositional settings. This map has been used as a test case to identify methodology to be followed, and the limitations to be expected for typical regional to continent-scale GIS digital maps.

## Purpose

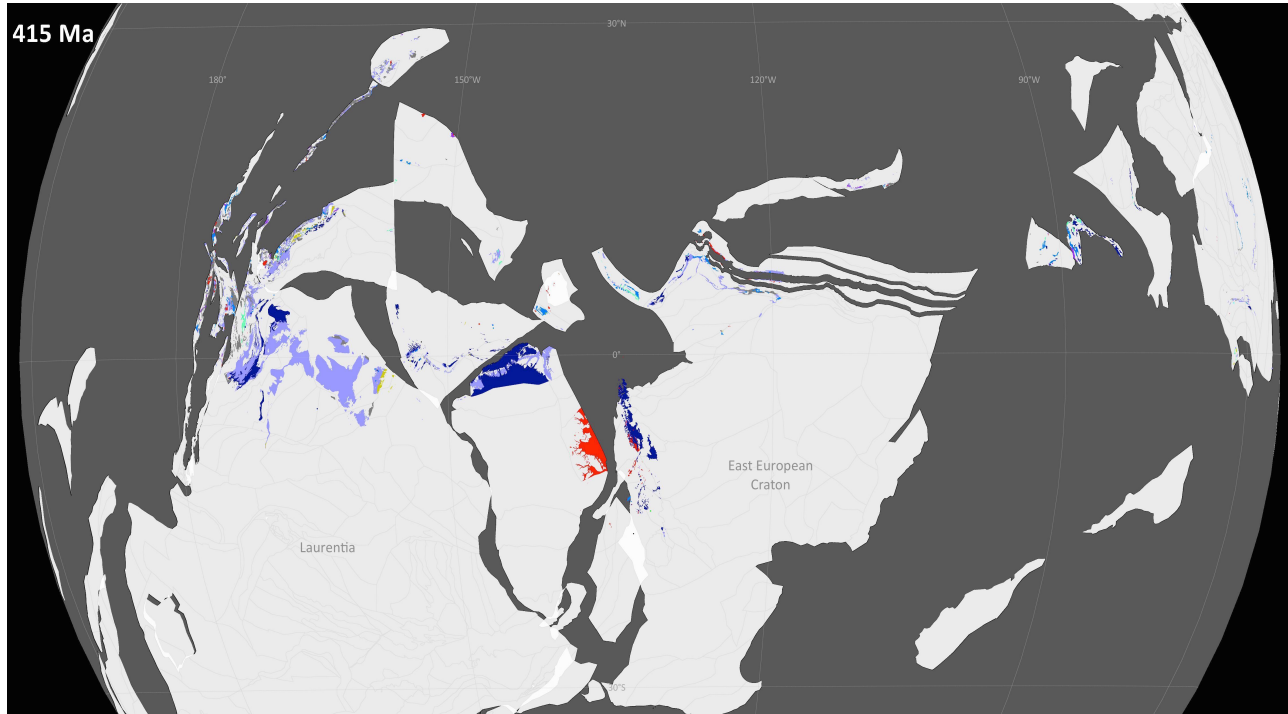
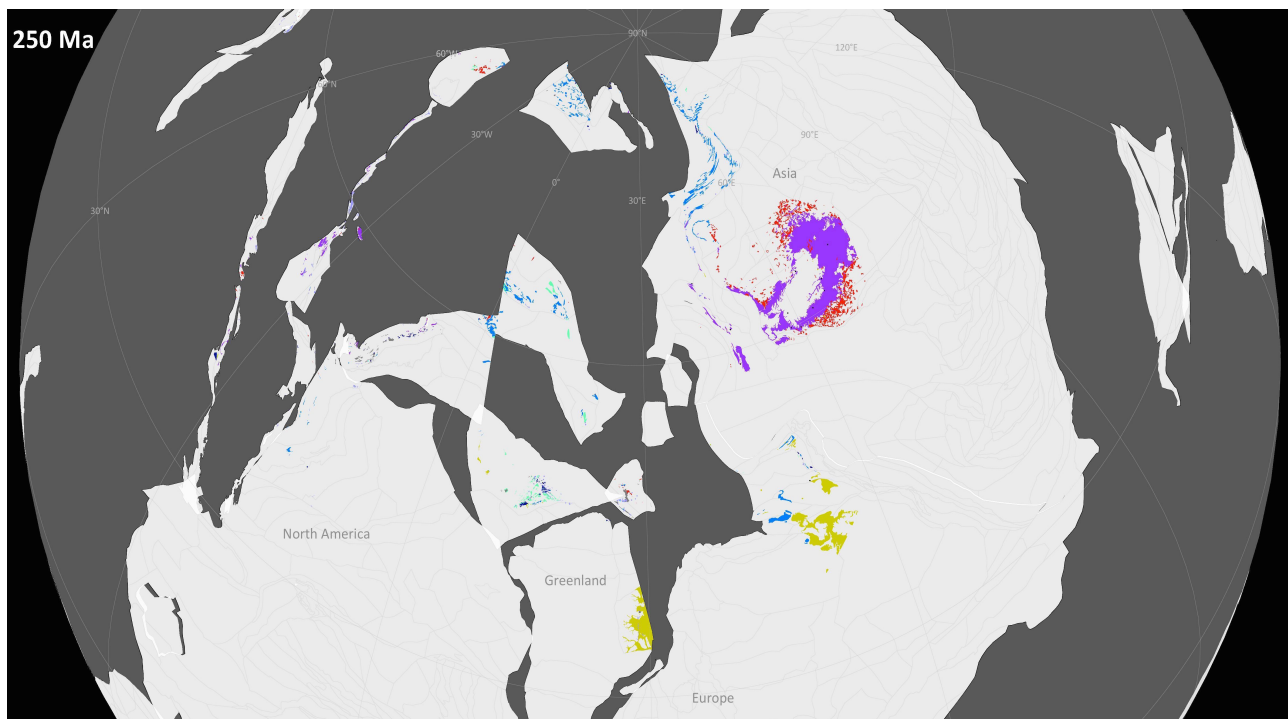
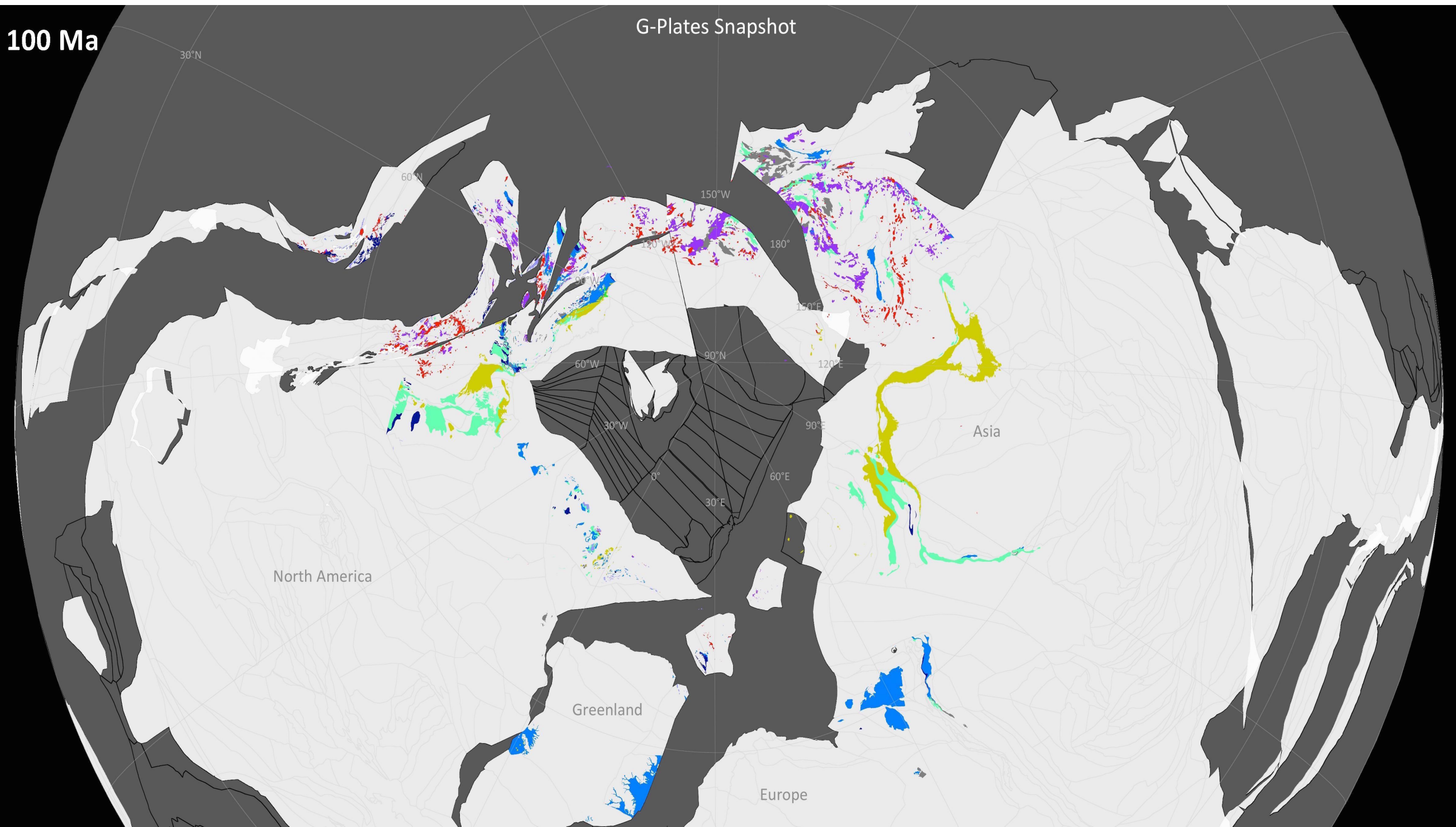
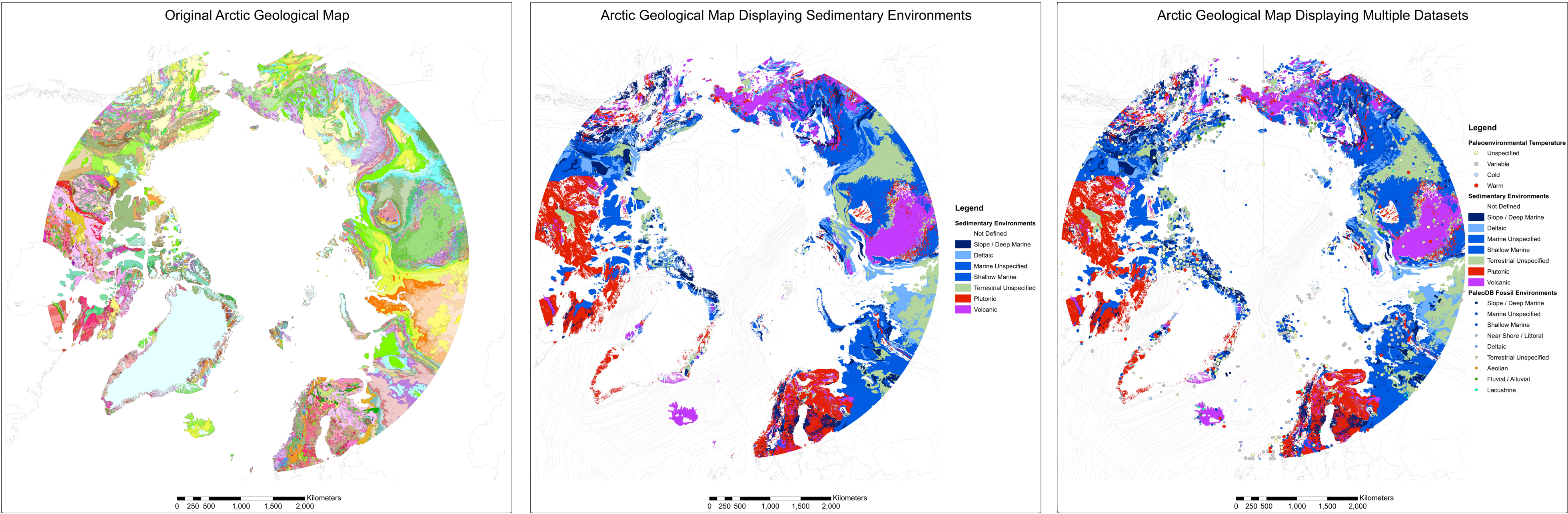
The Geological Map of the Arctic was superimposed on a plate reconstruction model for the Phanerozoic and Ediacaran, together with fossil environment datasets, in an attempt to observe patterns through time. The spatial and time variations will be investigated in order to explore whether proliferation of Early Cambrian life was influenced by depositional environments, not just evolution with time. The GIS datasets were therefore symbolized to reflect environmental settings, rather than lithostratigraphic units or lithologies.

No fossil or trace fossil data was included with the Geological Map of the Arctic, so alternative datasets and data sources are being sought. At present we have the Boucot et al. (2013) compilation of Phanerozoic climate-sensitive sediments, as well as fossil data exported from the online Paleodb database (<https://paleobiodb.org>). A trace fossil data compilation (Buatois and Mangano, unpubl.) is currently being digitized and georeferenced.

## Methods

A number of software packages are used to facilitate creation of maps, plate reconstructions and animations. Microsoft Access is used to restructure datasets while also providing a data structure suitable for use with ArcGIS, since personal geodatabases are just special versions of MS Access databases. Presentation in ArcMap (with the Paleogis plugin) and GPlates provides the visual display layer. Various projections are feasible, although a Stereographic Polar Projection is best suited for most of the time intervals considered thus far. Individual time-snap images are stitched together using Corel Video Studio Pro.

## Geological Map Progressions



## Conclusions

The procedures and data organization developed thus far permit one to observe large amounts of data more logically and systematically, in ways that are relevant to visualizing data for the principal objective of the project. Pattern recognition and identification of changes through time are greatly facilitated, especially for the large datasets involved at a regional to global scale.

A number of necessary improvements have already been identified. It is clear when observing animations that various lithostratigraphic units must be more specific regarding the age of formation, as some units stay “on” for extended periods of time. There is also a need to more clearly define environmental settings in some cases, to avoid over simplification. These issues are to be expected for a map with so much data from so many different source countries. The map information illustrated here is simply one example of what might be feasible. Integration of multiple regional maps, if suitably attributed and symbolized, has the potential to provide unique insights into changing evolutionary and geological patterns.

Integration of the existing compiled data with new datasets and quantification of changing patterns and their inter-relationships are the next phase of the project. Focus will be on the Ediacaran to Ordovician since this coincides with major faunal diversification.

## References

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## Acknowledgements

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