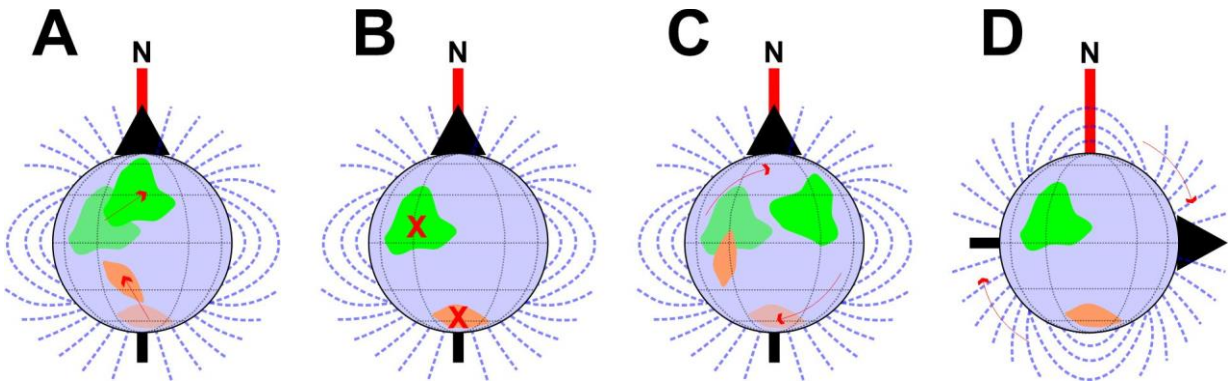
Ediacaran time slices (ENTICE): using U-Pb geochronology of large igneous provinces to unlock the Ediacaran geo- and paleomagnetic enigma

The Ediacaran Period between ca. 635 and 539 million years ago was perhaps the most tumultuous time in Earth's history since the late heavy bombardment in the Hadean approximately 4 billion years ago. In the Ediacaran, the Earth was likely glaciated several times globally, and the final breakup of the supercontinent Rodinia occurred together with extensive magmatism in the form of large igneous provinces (LIPs, i.e., extensive and anomalous volcanic events preserved throughout Earth's history). These LIPs are likely related to an anomalously high heat source coming from deep within the Earth. Against this backdrop, the rise of multi-cellular life occurred together with the increasing oxygenation of the planet towards present atmospheric levels. This culminated with the so-called 'biological big bang': the rapid diversification of life that occurred at the Cambrian-Ediacaran boundary 539 million years ago. Together with this series of events, and likely directly related to them, the Ediacaran magnetic field and the paleogeography and geomagnetic of the planet was enigmatic. This has been variously attributed fast plate movement (**A**), erroneous data (**B**), true polar wander (**C**; i.e., the rotation of a planet or moon with respect to its spin axis, causing the geographic locations of the north and south poles to change or 'wander'), and a weak and fluctuating magnetic field (**D**) causing non-dipole behaviour of the magnetic field.

In this project, the goal is to intensively study these Ediacaran LIPs, which form the CIMP (the Central Iapetus Magmatic Province), using comprehensive, multi-proxy studies. The aim is to resolve this Ediacaran geo- and paleomagnetic enigma using the record preserved in these LIPs.



In the Precambrian, before 539 million years ago, these LIPs are usually mostly preserved only as dykes and sills – the magmatic feeders to the overlying volcanic events. Studies on these dyke swarms and sill provinces provide three valuable pieces of information: when and where they were emplaced on Earth, together with the conditions of the underlying mantle and the intensity of the magnetic field at the time of their formation. Through the application of extensive geochronology, thermochronology, and complimentary paleomagnetic and rock magnetic studies on these dykes, the timing and conditions of the magnetic field of the Earth can be determined, along with the paleogeography of the continents. *This will help us to resolve the problems relating to the geo- and paleomagnetic enigmas of the Ediacaran, with the hypothesis that fragmentary data hinders our ability to resolve what was happening in the world at this time*. In this project, known Ediacaran dyke swarms and sill provinces will be sampled and studied globally from ca. 620 to ca. 560 million years ago, connected with LIPs of the Central Iapetus Magmatic Province. The Ediacaran period can then be divided into time intervals (or time bins, similar to frames with a movie) from the LIP record, into which obtained geochemical, paleomagnetic and geomagnetic data can be populated. This record will allow us to decipher and answer some very important questions:

- What was the paleo-geography like around the Iapteus Ocean (the ocean that existed between proto-North America and proto-Europe) before the Atlantic Ocean even existed?
- Did the Earth undergo true polar wander in the Ediacaran, i.e., the whole movement of the crust and mantle over the core?
- Was the weak and fluctuating, magnetic field in the Ediacaran related to the formation of a solid inner core of the Earth?
- What was the relationship between the above-mentioned phenomena and the subsequent environmental and biological rapid evolution of the planet?