Mid-Term Report Summary - EDIFICE (Changes in the geomagnetic dipole (Earth Dipole Field Intensity from Cosmogenic Elements))

The EDIFICE project is aimed at exploring the evolution of the geomagnetic field over the past 5 Myr. It focuses on the variations of the dipole strength during the periods of stable polarity and on the mechanisms driving field reversals. The first goal is to construct the first composite curve of the geomagnetic field intensity variations over the past 5 Myr by integrating measurements of cosmogenic 10Be production with records of relative paleointensity (RPI) derived from the natural remanent magnetization of deep-sea sediments. The composite curve will yield a unique and highly reliable reference curve that is expected by any study dealing with geomagnetic field variations. It will also impose major constraints to any model and theory of the geodynamo and will serve as a stratigraphic marker for this time period.

The second part of the project focuses on the variations of the magnetic vector (direction and intensity)
across a few field reversals recorded in sequences of overlying lava flows. The evolution and the dynamical structure of the reversing field will be used for testing and constraining predictions based on numerical dynamo models.

We progressed in both directions. Our initial approach was to investigate and analyze factors that could affect the 10Be signals and in particular the normalization protocol for both 10Be and magnetic measurements. This is essential to meet the objectives of the project. Of particular importance are the effects of climatic changes that can generate scavenging condition changes in sediment as well as significant changes in magnetic concentration. Both factors strongly affect the relationship between 10Be production and geomagnetic field intensity as well as for magnetization intensity. These problems are frequently met in Northern Atlantic. In contrast, the three equatorial records studied so far provided very good and exceptional results with unreached resolution and details. We focused first on the period surrounding the last reversal and obtained similar and coherent results of 10Be production that constrain the position of the reversal and the degree of mixing within sediment. For the first time, the integration of all indicators will make it possible to estimate the synchronism of the isotopic signals between different basins and therefore the exact position of the reversal with respect to the climatic changes.

In the meantime, the magnetic measurements have revealed that most sedimentary records of reversals published so far were heavily biased and therefore not reliable. It is also important to mention that the opportunity of conducting beryllium and paleointensity studies in parallel yield much deeper understanding of the two signals and their limits.
We now focus intensively on long-term records. We obtained a first dataset that covers the last 0.8 Ma and a second one for the period between 0.8 and 1Ma. We are currently preparing the samples for the 0.4 Ma period and will add other records to duplicate the first results from other locations.

The aspect of the project concerning volcanic reversal records has been initiated by following a similar approach. In order to test the fidelity of the signals at best, we investigated lava flows that are characterized by unusual magnetization behavior and fail to provide suitable records of geomagnetic field behavior while it reverses. Because similar situations can be met for non-transitional lava flows as well, it is critical to understand their origin. We identified and tested a scenario that can cause remagnetization and proposed to avoid these potential problems. We are currently investigating volcanic sequences from the Cap Verde and the Canary islands.

Last update: 13 March 2017
Record number: 195450