BR/175/A2/DIABASE - Disclosing the Antarctic basement by sampling ice field moraines

Context

The vast majority of the Antarctic continent remains concealed beneath a substantial ice layer, obscuring approximately 98% of its underlying lithologies. Only a small number of exposed outcrops offer limited and fragmented insights into the geological history of Antarctica, despite being subject to extensive study. Yet, comprehending this history holds immense significance for addressing crucial inquiries within contemporary geoscience. It allows us to explore fundamental issues like the formation mechanisms of continental crust, the corresponding depletion of the mantle, and their evolution during the early stages of Earth. Additionally, it sheds light on the localized geological processes that played a role in constructing the Antarctic continent.

Objective

During this project, we collected samples from circular moraines previously encountered in the Nansen Blue Ice Field. These blue ice fields exhibit a unique ice movement pattern, including a vertical component caused by obstacles impeding the gravity-driven flow. Consequently, the blue ice fields of Antarctica have yielded more than 40,000 meteorites to date, all concentrated through this specific movement. During past Belgian-Japanese expeditions, closed moraine fields that likely sample the underlying rock formations were unexpectedly observed within the Nansen Blue Ice. Although the transported blocks and boulders, which make up the majority of these moraines, are no longer in their original positions, they represent the only retrievable basement samples from this particular section of the Antarctic continent known as the Sør Rondane area. Among these moraine samples, various types of sedimentary, metamorphic, felsic and basaltic igneous rocks have been observed thus far. The DIABASE project conducted a preliminary petrological examination of these moraine samples and further dated the zircons found within these lithologies using detailed and extensive U-Pb dating techniques employing LA-ICP-MS at the University of Manchester in the United Kingdom. This approach of sampling moraines provides valuable insights into the concealed deep basement of the Sør Rondane area in East Antarctica.

Conclusions

By dating the zircons recovered in the moraines in the Nansen Ice Field, we suggest that on the contrary of the common knowledge of rock transportation by ice flow from south to north in Antarctica, it is also possible that the observed moraines in the Nansen Ice Field do sample outcrops located on the south and drawn back to the north by complex ice flow when encountering an obstacle such as a mountain chain. Only three inherited zircons witness ancient Archean geological events. We demonstrate that the approach of moraine sampling is easy and efficient to perform, but also that understanding the ice flow is a preliminary requirement, that might be complicated to unravel. Following the observations of the DIABASE project, our colleagues in glaciology have decided to tackle the issue of the ice flow at the regional scale around the Nansen Ice Field to explain the concentration in meteorites, but this is beyond the scope of this report as their investigations are ongoing.

Keywords

Antarctica, basement, moraines, zircons