Crustal evolution reconstruction based on the rocks from the Amundsen Bay, East Antarctica

The style and timing of the geological processes of the Early Earth (4.5-2.5 billion years ago) remain a topic of intense debate in the scientific community. In contrast to the relatively young Phanerozoic rocks (<0.54 billion years old), the early rock record was subjected to multiple deformations at very high temperatures. As a result, much of the geologic information has been obliterated. For this reason, the scientists use geochemical and isotopic methods to reconstruct the geological history.

One of the most used minerals in the Early Earth studies is zircon. Its greatest advantage is its resistance to the most of geological processes, even those characterized by high temperatures. Moreover, it is a common mineral in a variety of rocks. It carries a variety of geological information. Firstly, it contains admixtures of radioactive elements (uranium and thorium), which are used to determine the age of geological events. Moreover, the isotopic analysis of lutetium and hafnium provides information on the sources for the magmas from which the zircon crystallized. Thus, we can deduce whether a given type of magma originated from mantle sources or perhaps from remelting (recycling) of the older crust. The oxygen isotopic composition completes the picture obtained from zircon studies. Its analysis allows to estimate if the magma or its sources interacted with water at high or low temperatures. Whole-rock chemical analyses provide additional information on the conditions under which the parental magma was formed. Geochemical indicators, such as niobium, tantalum, yttrium, and heavy rare earths contents, as an example, are sensitive to the pressure (hence depth) under which the magma was melted. This integrated approach allows us to reconstruct the history of the early Earth's crust, *i.e.*, to decipher geological processes, as well as conditions and the timing at which they occurred.

The Napier Complex, located in the Enderby Land and the western part of the Kemp Land, East Antarctica, has attracted scientific attention since the 1960s. It is a unique region due to the preservation of the remnants of the oldest continental crust (4–2.5 billion years old) and some of the oldest rocks on the planet (>3.6 Ga). However, the Napier Complex remains one of the least understood geological units. This is because of its remote location and the fact that it is mostly covered by ice, which hampers complete geological understanding. Moreover, the rocks of this area have been deformed and subjected to very high temperatures at least twice. Despite these difficulties, the study of these unique rocks allows us to complement the knowledge about the Early Earth's system.

So far, much of the research in the Napier Complex has been focused on the oldest rocks (>3.5 Ga) and on studying the conditions under which these rocks underwent later metamorphism. Relatively little is known about the younger events (3.3–2.6 Ga). The analysis of the available geochronological data allowed to put forward a preliminary hypothesis that the Napier Complex is composed of three separate units, each with a distinct geological history. To test this hypothesis, metamorphosed magmatic rocks from the Amundsen Bay area in the western part of the complex will be investigated using the methodology described above. This region appears to be an excellent area to conduct the study as it contains rocks of 3.3–3.0 Ga, metamorphosed twice at 2.8 and 2.5 Ga in the north; and younger rocks of 2.75–2.55 Ga in the south. These two areas may potentially represent two independent geological units.

The proposed study will allow us to understand not only the geological history of such a unique area as the Napier Complex, but also the geological processes occurring in the Early Earth.