A new frontier for the Acasta Gneiss Complex: The oldest evolved crust on Earth

MB Belosevic[a], T Chacko[a], and LM Heaman[a]

[a]Department of Earth and Atmospheric Sciences, University of Alberta, AB, Canada

The mechanisms of formation of our planet's earliest crust are the subject of debate among many scientists around the world. Because of Earth's geologically active nature, rocks formed during the first billion years of Earth history are relatively rare, making it difficult to draw precise conclusions about the processes operating at that time. As such, the few localities worldwide that are known to contain rocks from this time period need to be intensively studied. The Acasta Gneiss Complex (AGC) in Northwest Territories, Canada is one such locality. It is an enclave of highly deformed, amphibolite-grade, mixed gneisses on the western margin of the Slave craton. Despite the fact that the AGC occupies a total area of ~1300 km^2, to date, nearly all previous geological work in the AGC has been conducted on a 6 x 6 km area surrounding the original discovery site of old rocks on the Acasta River. Thus, the vast majority of the AGC remains unstudied.

In order to further our understanding of the AGC as a whole, we carried out a field campaign on a new area (Informally "Moose Lake") within the AGC, approximately 9 km southwest of the original discovery site. The objectives of the study include: 1) the preparation of a 5 x 5 km geological map of the Moose Lake field area, 2) obtaining representative samples of the rock units for subsequent petrographic, geochemical and isotopic study, 3) using zircon and monazite uranium-lead (U-Pb) geochronology to determine the magmatic and metamorphic ages of the rock units, and 4) integrating the field and laboratory data into a geological and tectonic model for the formation of the AGC.

The Moose Lake field area contains five major lithologies: mixed granitoids (tonalitic to granodioritic gneisses and syn-tectonic granitoids), coarse-grained metagabbro, fine-grained amphibolite, garnet-biotite gneisses, and a later-stage foliated granodiorite. The area is broadly metamorphosed to amphibolite grade and displays a dominant NE-SW steeply dipping foliation. Work is currently underway to obtain in-situ U-Pb ages on zircon identified in thin sections of some of the major rock units by laser-ablation multi-collector inductively coupled plasma mass spectrometry. Petrographic investigation and initial U-Pb results suggest that the rock units in the Moose Lake area are broadly similar to those at the original discovery site in the AGC. We present new geochronology results for the metagabbro with an estimated crystallization age of 3.75 Ga.

Corresponding author: michael.belosevic@ualberta.ca