Detrital Zircon Age Populations from the Lower and Upper Levels of the Moine Supergroup, Scotland, and their Implications for Tectonic Evolution

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During the middle parts of the Paleozoic Era, between ~450 to 400 million years ago (m.y.a), the ancient proto-continents of Laurentia (today North America and Greenland) and Baltica (northwestern Europe) collided to help form the supercontinent Pangaea. The resulting mountain chain that sutured these continental masses is called the Appalachians in eastern North America and the Caledonides in east Greenland, Scotland and Scandinavia.

Structural geologists seek to understand the pre-Pangaea (before ~ 450 m.y.a) arrangement of major continents and how they have since evolved. Northwest Scotland is the focus of this study because of its geologic complexity and location at the center of the Caledonian - Appalachian mountain chain. The Moine Supergroup is a sedimentary rock unit exposed in Scotland that was deposited roughly 1,000 m.y.a. along the eastern margin of Laurentia as the obscure, pre-Pangaean supercontinent of Rodinia began to rift apart and disperse. However, the Moine Supergroup is so complexly dissected by multiple Caledonian-aged (450 m.y.a) thrust faults that its original stratigraphic order and source area is uncertain.

Identifying the source of the rocks of the Moine Supergroup is vital to understanding Scotland's plate tectonic role in the configuration of Earth's continents. Sediments formed from the erosion of mountain systems contain trace amounts of the mineral zircon, a durable mineral that can be isotopicallydated. Zircon contains the isotopes U-238 and U-235, which decay into Pb-206 and Pb-207, respectively. Once a zircon crystal is formed within a cooling magma, the ratio of uranium (U) to lead (Pb) is locked into its crystalline structure. By measuring the current ratios of these isotopes, and using their half lives and decay constants, the time of crystallization can be calculated. Zircons obtained from two samples, one from the Loch Eil Group (top of Moine Supergroup) and another from the Morar Group (base of Moine Supergroup), were dated using Laser Ablation Inductively Coupled Mass Spectrometry (LA-ICPMS) (J. Schwartz, personal communication, 10/16/15) . Results can be used to correlate the Moine Supergroup to sequences and source areas of the widely dispersed continents.

The purpose of this research is to better understand one of the most tectonically complex areas in the world. Land is the most indispensible element to all of human kind. In the early 1800's, Charles Lyell, a founding father of Geology said "The past is key to the present." History of Earths land masses and the processes that formed them, therefore, are crucial to understanding how life evolved and valuable clues into how we might sustain it into the future.

Statement of Research Advisor:
Kelly's research provides valuable new information on the depositional age, source areas, and pre-Caledonian extent of the Moine Supergroup. Her work suggests that the Moine actually contains two separate units of rocks, rather than one, with one package appearing to be far younger than was previously thought for the Moine.
– Dr. Mark Steltenpohl, Geosciences