High Precision Ar-Ar and U-Pb Dating of Volcanic Ashes that Bracket the Mid-Miocene Climate Transition in the McMurdo Dry Valleys of Antarctica

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Abstract: Spectacularly well preserved fossils of lacustrine and terrestrial organisms are found in sediments that contain volcanic ashes in the McMurdo Dry Valleys sector of the Transntarctic Mountains. These fossils include diatoms, palynomorphs, mosses, ostracodes and insects and they represent the last vestige of a tundra community that inhabited the mountains before the transition to a full polar climate in Antarctica. The inferred shift in mean summer temperature at this transition is at least 8°. The LDEO Ar lab has provided Ar-Ar ages on key ashes within this sequence. An ash within the lacustrine deposits gave an age of 14.07±0.05 Ma and ashes within the polar glacial deposits are as old as 13.85±0.03 Ma. These data were collected over an extended period of time and not always with the same monitor standard, and recent Ar-Ar lab intercalibrations have raised questions about the sources of laboratory biases (that can be of the order of 1%) on one monitor standard measured against a second monitor standard. The climate significance of these deposits makes them key candidates for "EARTHTIME" applications (http://www.earth-time.org)- that is conforming to the goal of obtaining ages that are reliable at the 0.1% level or better. In order to achieve this level of precision, it is necessary to make many more measurements of both unknowns and monitor standards. We propose to re-date these volcanic ash deposits using Ar-Ar, along with extensive monitor standard inter-calibration exercises. We further propose to apply high precision U-Pb dating to the 14.07 Ma sample and the best volcanic candidate above the transition. The proposed work will provide Antarctic Scientists with better resolution of the time frame of this dramatic climate transition. It will provide an important radiometric benchmark that can be placed in astronomically calibrated time scales in the Neogene. It will also help the LDEO Ar lab in our goal to establish ourselves as a key participant in high precision Ar-Ar dating of climatic and evolutionary events in Earth History.