Application of SHRIMP-IIe/AMC ion microprobe to polar science

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A sensitive high resolution ion microprobe (SHRIMP-II) is a kind of secondary ion mass spectrometer (SIMS) using ion microprobe. An ion microprobe provides opportunity of *in-situ* elemental and isotopic analyses of small amounts of solid material at precisely located spots a few to tens of micrometers in diameter and 1–2 micrometers in depth. SHRIMP can use two different types of ion (namely O_2^- and Cs^+) as primary ion beam depending on target elements and/or isotopes. It was specifically designed to be capable for the first time of doing *in-situ* U–Pb analyses on individual growth domains of zircons (Zr_2SiO_4) with a spatial resolution of ~25 μm and acceptable analytical precision with high mass resolution (over 6000 ($M/\Delta M$ at 1% of peak height)). Past three decades, the SHRIMP U–Pb zircon dating method was progressively embraced by the Earth Sciences community, of course polar geoscientists. National Institute of Polar Research (NIPR) installed first SHRIMP-II in 1999, and has geochronologically contributed to polar science.

NIPR's second SHRIMP, installed in 2014, is first SHRIMP-IIe with the 5-head advanced multi-collector (AMC), and provides opportunity to get precise isotopic data in spots a few to tens of micrometers in diameter. The 5-head AMC consists of fixed axial head and four moveable heads and can install 5 independently positionable Faraday cups or continuous dynode electron multiplier (CDEM). This feature of the 5-head AMC allows a wider variety of high precision, *in-situ* isotope geochemistry using SHRIMP, such as 4 sulfur isotope analysis (^{32}S, ^{33}S, ^{34}S, and ^{36}S). Over the last three years, we tried to analyze oxygen isotopes ($^{18}O/^{16}O$) with $^{17}(^{16}OH)$- or ^{17}O in zircon and apatite including biogenic apatite, boron isotopes ($^{11}B/^{10}B$) in tourmaline, magnesium isotopes (^{24}Mg, ^{25}Mg, and ^{26}Mg), plus Al concentration in olivine, chlorine isotopes ($^{37}Cl/^{35}Cl$) in apatite and impact glass, silicon isotopes ($^{29}Si/^{28}Si$ and $^{30}Si/^{28}Si$) in silica minerals, and so on. In this presentation, I introduce new experiments using SHRIMP-IIe/AMC.