Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

SGL40-P16 Room:Convention Hall Time:May 19 18:15-19:30

Chemically estimated depositional and zircon ages from metacarbonate rocks in the Sor Rondane Mountains, East Antarctica

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Estimation of timing of carbonate deposition implies the presence of platform environment for the accumulation of sediments from surrounding continents. As a consequence the determination of deposition ages in metasedimentary sequences is important in understanding the tectonic history of continental collisions and closure of oceans to form supercontinents. In general, radiometric dating, such as U-Th-Pb, of key horizons or the interval between youngest protolith age and metamorphic age in zircon from metasedimentary rocks helps us to determine the sedimentation age. However, zircons in metasedimentary rocks will provide information of provenance of source rocks in a wide interval between opening and closure of ocean. For this reason, other methods have to be employed for estimating exact depositional ages. In this study we have selected a typical continental collision zone of the Sor Rondane Mountains, located in the African-Antarctic orogenic belt formed during the Neoproterozoic to Cambrian time. This region is composed of medium- to high-grade metasedimentary, metaigneous and intrusive rocks of diverse composition. Shiraishi et al. (2008) and other studies reported wide range of depositional ages that were estimated by detrital and metamorphic ages of zircon from ortho- and paragneiss. Recently, Otsuji et al. (2013), estimated the depositional ages of 880-850 Ma and 820-790 Ma (late-Tonian and early-Cryogenian age) for the metacarbonate rocks by using strontium and carbon isotope chemostratigraphy. The metacarbonate rocks are considered to have deposited chemically in the so-called the ”Mozambique Ocean” that separated the continental blocks of Gondwana and possibly record geochemical signatures of contemporaneous seawater. However, according to the results by Otsuji et al. (2013), there are regional differences in their depositional timing. The determination of sedimentation ages may not be straight forward, and it has to be confirmed by the correlation with material derived from continental blocks. Here we present age information from zircon grains in impure metacarbonate rocks.

Petrographic observations of impure metacarbonate rocks, that contain relatively higher modal abundance of calc-silicate minerals, have shown that zircon is present in impure carbonate rocks from the Sor Rondane Mountains. Therefore it is possible that the zircons in impure metacarbonate rocks might be of detrital origin and record information about the provenance of pelitic components within the carbonate sediments. In contrast to the expected detrital ages, we obtained well-defined tight concordia U-Pb zircon ages of 545 +/- 1, 546 +/- 2 and 549 +/- 2 Ma, from three different layers in the Balchen region of the Sor Rondane Mountains. This age represent the latest phase of metamorphic age for this region, as reported in many recent studies. The zircons in metacarbonate rocks show hydrothermal re-equilibration texture on cathodoluminescence observations. Most of them have rounded shape, characterized by the absence of oscillatory growth texture, and shows dissolution-reprecipitation structures. Metacarbonate rocks are usually depleted in zirconium, however those in the Balchen region have abundant zircons. In general, zircon shows enriched heavy-REE pattern, whereas zircon in metacarbonate rocks from Balchen has flat REE pattern and low HREE concentrations, consistent with the rare earth pattern of zircons formed by hydrothermal activity. In addition to the high Cl-rich fluid activity around 600 Ma, our result shows that another important fluid activity was present in Balchen at around 545 Ma. Similar zircon age is reported from the matrix zircon in pelitic gneiss from Balchen (Higashino et al. 2013), implying that pelitic lithology also experienced the same fluid activity at around 545 Ma.

References; Shiraishi et al. 2008. GSL special publications, 308, 21-67; Otsuji et al. 2013. PR (in press); Higashino et al., 2013. JpGU abstract.

Keywords: depositional age, metacarbonate rocks, the Sor Rondane Mountains, zircon