Comparison of chemically estimated depositional ages with zircon SHRIMP ages from metacarbonate rocks in the Sør Rondane Mountains, East Antarctica

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Determination of deposition ages in metasedimentary sequences is important in understanding the tectonic history of continental collisions and closure of oceans to form supercontinents. However, in metamorphosed sedimentary sequences, the determination of sedimentation ages are not straight forward, and here we present a novel approach to estimate the initial Sr isotopic composition, using a suit of high-grade and highly altered metacarbonate rocks from Sør Rondane Mountains, East Antarctica. We also try to compare the strontium isotope chemostratigraphy results with zircon SHRIMP ages in metacarbonate rocks. The Sør Rondane Mountains, located in the Neoproterozoic to Early Cambrian East African-Antarctic collisional orogen, is composed of medium- to high-grade metasedimentary, metaigneous and intrusive rocks of diverse composition. Within the metasedimentary rocks, the metacarbonate rocks are considered to have deposited chemically in the so-called the “Mozambique Ocean” that separated the continental blocks that amalgamated Gondwana and possibly record geochemical signatures of contemporaneous seawater. More than 90 metacarbonate samples were collected around this region and selected based on careful screening using multiple geochemical parameters of carbon and oxygen isotopic composition, and trace and rare earth element contents. High $\delta^{18}O$ values and low concentrations for mobile trace elements and flat rare earth element patterns are typical for sedimentary carbonates. However, post-depositional alteration and metamorphic fluid processes affect to post-depositional carbonate sediments and rocks chemically. After a rigorous geochemical screening in terms of post-depositional alterations, 17 samples were identified as least altered and initial $^{87}Sr/^{86}Sr$ ratios were estimated by using a positive correlation with Mn/Sr ratios. These samples collectively gave regional initial $^{87}Sr/^{86}Sr$ ratios between 0.70566 and 0.70630, from Balchen, Brattnipene, Menipa and Tanngarden regions of the Sør Rondane Mountains. These Sr isotopic ratios reflect seawater compositions of late-Tonian and early-Cryogenian age (880-850 Ma and 820-790 Ma), when compared with the evolution of Sr isotopes in the Neoproterozoic Oceans. Furthermore, these estimates are consistent with the carbon isotope chemostratigraphic curves of Neoproterozoic.

Petrographic observations of impure metacarbonate rocks, that contain relatively higher modal abubdance 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 peletic components within the carbonate sediments. In general, detrital and metamorphic zircon ages have been used to bracket the depositional age, and we tried to analyze the zircons in one impure marble from the Balchen region. In contrast to the expected detrital ages, a well-defined tight concordia U-Pb zircon age at 546 +/- 2 Ma was obtained. This age is quite unlikely to be a detrital age, but rather represent latest phase of metamorphic age for the Sor Rondane Mountains, as reported in many recent studies. Further studies are in progress to compare the zircon ages with the depositional ages and we discuss our results in a Gondwana amalgamation context.

References

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