Metamorphic P–T condition of the Inyoni shear zone rocks in the Barberton Greenstone Belt, South Africa and its significance

*Daichi Kato[1], Kazumasa Aoki[1], Yuta Tsuchiya[2], Shogo Aoki[2], Tsuyoshi Komiya[3]

1. Department of Applied Science,Okayama University of Science, 2. Department of Biosphere-Geosphere Science,Okayama University of Science, 3. Department of Earth Science and Astronomy,University of Tokyo

The metamorphic P–T conditions and processes of the mid-Archean Barberton Greenstone Belt (BGB), South Africa were examined from metamorphosed banded iron formation (BIF) and garnet amphibolite in the Inyoni shear zone (ISZ). Their metamorphic P–T conditions were estimated from thermodynamic calculations combined with several geothermobarometries such as garnet–clinopyroxene geothermometry, Raman geobarometry and Zr-in-sphene geothermometry. Moreover, in order to constrain the protolith age and origin of our studied sample, we conducted zircon U-Pb and trace elements analyses by using Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICP-MS).The following results were obtained: the P–T conditions of the meta-BIF changed from ca. 600–680 ˚C and 10–12.7 kbar through ca. 510–540 ˚C and 8–11 kbar to less than 500 ˚C and 4 kbar. On the other hand, the P–T conditions of the garnet amphibolite changed from ca. 9.5–10.5 kbar and 620–660˚C to less than 5 kbar and 500 ˚C. Integration of these new results with previous studies for the BGB suggest that the geothermal gradients of the prograde and retrograde metamorphisms were ca. 15–20 ˚C/km and 20–30 ˚C/km, respectively. Igneous zircon separated from the Garnet amphibolite sample yield ^{207}Pb-^{206}Pb age of ca. 3.4-3.2 Ga. This new data together with previous geochronological data indicate that the protoliths of ISZ rocks began to subduct at ca. 3.37-3.24 Ga. The prograde P-T path was kinked at P = 8.0 kbar and T = 560 ℃ by difference in geothermal gradient between crust and upper mantle. The change of geothermal gradient in the ISZ rocks between prograde and retrograde conditions might have relation to the collision of ca. 3.4 Ga Stoluzburg domain. The last P-T trajectory characterized by isothermal decompression might be caused by the intrusion of the ca. 3.23-3.21 Ga TTG Badplaas pluton attendant on plate subduction.

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