The 2nd stage of continental growth at Archean: Geological evidence for continent-to-island arc collision from Napier Complex

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Large-scale pre-metamorphic layer-subparallel fault was discovered in Archean granulite-gneiss terrain, so-called Napier Complex, in the Mount Riiser-Larsen area, Enderby Land, East Antarctica. The pre-metamorphic fault (Riiser-Larsen Pre-metamorphic Fault), which had been sealed during granulite-facies metamorphism, separates orthogneiss-dominant succession at upper level from paragneiss-dominant succession at lower level. In addition, pre-metamorphic melange-like structure such as exotic ultramafic blocks in paragneiss and heterogeneous lithofacies are distributed along the pre-metamorphic fault in places. The rock assemblage of each succession reveals that the tonalitic orthogneiss with Archean TTG composition is intercalated with more or less metamorphosed iron formation (chemically precipitated sediment) and continent-derived sediment, suggesting its protolith is not plutonic tonalite but felsic lava and/or volcaniclastic rock. The upper half of volcanic rock- (orthogneiss-) dominant succession with thin iron formation does not contain continent-derived sediments (psamitic and pelitic rocks). The rock assemblage is quit similar to that of intraoceaninc island arc except for the abundance of felsic rocks. The lower half of meta-igneous succession contains thin continent-derived psamitic rocks together with iron formation. The paragneiss-dominant succession is composed mainly of continent-derived materials such as psamitic rocks with thin pelitic rocks, quartzite, iron formation and felsic volcanic/volcaniclastic rock.

The evidence of pre-metamorphic fault with melange-like structure and lithostratigraphy of oceanic island arc and continental-derived sedimentary successions indicates that the Mount Riiser-Larsen area was an accretionary complex during oceanic island arc-continent collision. The increase of volume ratio of continental-derived material at lower succession suggests that the accretionary complex was formed by accretion of continental-derived material to intraoceanic island arc during migration of continent to trench. This tectonic situation is compared to the present-day northwestern margin of Australian continent. Moreover the continent collision to island arc (continent-to-island arc) indicates that the continent broke up with another continent. These conclusions support the idea that continent-to-arc collision tectonics started to play a role of continental growth in addition to arc-to-arc and arc-to-continent collision tectonics.

In general, granulite-gneiss terrain appears from middle Archean whereas greenstone terrains were formed from early Archean. This fact probably implies that continent-to-arc collision tectonics started to operate at middle Archean in addition to island arc volcanism, accretion of ocean floor materials and arc-arc collision which had been working since early Archean.