Metamorphic history of the Paleoproterozoic Salma eclogite in the Kola Peninsula, Russia

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The Precambrian Salma eclogite in Kola Peninsula, Russia is one of the oldest eclogites of the world, but there has been much debate about the timing of eclogite-facies metamorphism: Archean (2.72–2.70 Ga) or Paleoproterozoic (1.91–1.88 Ga). Microstructural observations, P-T analyses, zircon inclusion analyses, and U-Pb zircon dating in this study support the Paleoproterozoic eclogite facies metamorphism under the P–T condition of 16–18 kbar and 740–770 °C at 1.89–1.88 Ga. The 1.89–1.88 Ga sector, patched, and cloudy zoned zircons with pale grey CL include inclusions of garnet + omphacite + diopside + amphibole + quartz + rutile ± biotite, and they have the flat pattern of HREE due to the amounts of abundant garnet during the eclogite facies metamorphism. In contrast, the Archean metamorphic zircons (2.73–2.72 Ga) are unzoned grains with dark CL that contain inclusions of garnet + amphibole + plagioclase + quartz + rutile ± biotite, and they are relatively enriched in HREE, indicating a first amphibolite facies metamorphic event at 2.73–2.72 Ga. In the Paleoproterozoic period, the Salma eclogites may also undergo epidote–amphibolite or amphibolite facies prograde metamorphism. After the peak eclogite facies metamorphism, granulite facies metamorphism occurred during decompression stage from 18 kbar to 9–12 kbar, followed by amphibolite facies overprint of 8–10 kbar and 590–610 °C during cooling. Whole rock chemistry indicates that the Salma eclogite was originally tholeiitic basalt formed at the mid-ocean ridge. The 1.89–1.88 Ga eclogite facies metamorphism implies that the continent–continent collision between the Kola and Karelian continents occurred during the Paleoproterozoic, rather than the Archean. This and previous studies imply that the deep subduction to form eclogite may have begun in the Paleoproterozoic.