Late event record in rutile inclusions of early garnet: indication for invalid shielding effect

QIULI LI[1,2], TIAN ZHOU[1,2], YONGHONG SHI[3], YU LIU[1,2], XIN LIAO[1,2], XIAOXIAO LING[1], GUOQIANG TANG[1,2]

[1]State Key Laboratory of Lithospheric Evolution, Institute of Geology and Geohpysics, Chinese Academy of Sciences, Beijing 100029, China

[2]University of Chinese Academy of Sciences, Beijing 100049 China

[3]School of Resources and Environment Engineering, Hefei University of Technology, Hefei 230029, China

Previous studies have demonstrated that the robust host minerals can exert a shielding effect on U-Pb system for mineral inclusions, such as zircon inclusions in diamond, monazite inclusions in garnet. Therefor, the mineral inclusions with lower closure temperature avoid suffering from later thermal events and preserve earlier records. This study attempts to detect the prograde growth of garnet and metamorphic history of eclogite by dating rutile inclusions in garnet and matrix rutiles in North Dabie eclogites. These eclogites experienced Triassic eclogite facies metamorphism and appear as big enclaves in Early Cretaceous regional migmatites. Zircon, matrix rutile and rutile inclusions in garnet were dated by the SIMS U-Pb dating method. Eclogite facies metamorphism ages of 210–240 Ma is recorded in metamorphic zircon, which predates the granulite-facies metamorphism at 212 ± 4 Ma established by garnet Sm-Nd isochron ages. Two thin sections of rutile inclusions in garnet gave U-Pb ages of 129 ± 3 Ma and 128 ± 3 Ma, respectively, which coincide with the U-Pb age of 128 ± 2 Ma recorded by the rutiles in matrix. These ages and age differences raise three issues: 1. Much younger rutile U-Pb ages than garnet Sm-Nd isochron age indicate the closure temperature of rutile U-Pb system is much lower than the garnet Sm-Nd system. 2. These consistent Cretaceous rutile U-Pb ages correspond to a rapid uplift event related to the removal of the orogenic root by delamination ca. 130 Ma. 3. The concordance of the U-Pb ages of rutile as inclusions in garnet and rutile in matrix indicates that there is no shielding effect for rutile in garnet. The radiogenic Pb generated from rutile growth during Triassic metamorphism to 130 Ma has totally diffused out. Considering that the garnet has high closure temperature for U-Pb system, this host mineral can not accept the radiogenic lead diffused from rutile inclusions. There must be the third phace. SEM and TEM analyses detected nano-particles of Fe-O and/or ilmenite around the boundary, which are suggested to serve as the storage for the diffused radiogenic Pb.