An abrupt increase of oxygen isotopes at ca. 3230 Ma in Archean TTGs from the Barberton granite-greenstone terrane, South Africa

XIAO-LEI WANG[1], DI WANG[1], ALFRED KRÖNER[2], XIAO-PING XIA[3], JUN-YONG LI[1]

[1] State Key Laboratory for Mineral Deposits Research, School of Earth Sciences and Engineering, Nanjing University, Nanjing 210046, China, wxl@nju.edu.cn

[2] Institut für Geowissenschaften, Universität Mainz, 55099 Mainz, Germany

[3] State Key Laboratory of Isotope Geochemistry, Guangzhou Institute of Geochemistry, Chinese Academy of Sciences, Guangzhou 510640, PR China

The formation of Archean TTG (trondhjemite-tonalite-granodiorite) rocks is one of the key issues in understanding the formation and evolution of continental crust during the early Earth. The Barberton granite-greenstone terrane is well-known for its good preservation of early Archean TTGs and greenstones. TTGs in this area are dominantly trondhjemite, and they show typical geochemical features such as steep REE (rare earth element) patterns, high Sr and Al_2O_3, and low Y and Yb concentrations. They formed from 3510 Ma to 3205 Ma and were intruded by 3100 Ma syenite intrusions. CAMECA SIMS zircon oxygen isotope analyses show an abrupt increase from >3230 Ma to < 3230 Ma TTGs. The >3230 Ma TTGs show mean zircon $\delta^{18}O$ values of 4.48–5.85‰, whereas magmatic zircons from the <3230 Ma rocks show mean $\delta^{18}O$ values of 5.97–6.91‰. The mildly evolved higher oxygen isotopic compositions are interpreted to have resulted from exchange of magma sources with surface water at low temperatures. This increase in oxygen isotopes in Archean TTGs has not been observed before and suggests that more supracrustal material was incorporated into the magma sources of the <3230 Ma granitoids. The increase in oxygen isotopes is also accompanied by elevated Al_2O_3, Sr, Nb/Ta and $(Dy/Lu)_N$, and decreases in Al_2O_3/TiO_2 and CaO/Na_2O. There are two possible explanations for the increase in oxygen isotopes: one is that supracrustal sediments were subuducted to the base of crust in a slab subduction-like mode; the other is that supracrustal material was buried deep enough for melting to generate the <3230 Ma granitoids. In either environment, recycling of supracrustal material and continental weathering are suggested to have been initiated at ca. 3230 Ma in the Barberton area. This variation in O isotopes has so far not been reported from other early Archean cratons, indicating heterogeneous continental evolution in the early Earth.