A rutile-titanite oxygen istope and trace element record of subduction fluids

C. STOREY[1*], F. ZEB PAGE[1,2], S. LASALLE[1]

[1]SEES, University of Portsmouth, Portsmouth, PO1 3QL, UK (*correspondence: craig.storey@port.ac.uk)
[2]Oberlin College, Oberlin, OH 44074 (zpage@oberlin.edu)

Recent advances in precision and accuracy in the in situ analysis of oxygen isotopes have led to a series of studies using isotope zoning in garnet to provide a relative timing for metasomatic fluid events in subduction zone metamorphic rocks. However, garnet is not stable at the earliest part of the prograde subduction path, nor is it stable during the final stages of exhumation, particularly in low-T circum-Pacific type eclogite. Rutile and titanite are commonly found in high P/T subduction-zone metamorphic rocks and may preserve a complementary geochemical record of slab and subduction-channel fluids that can be compared to and potentially extend the garnet record. Futhermore, coupled trace-element analysis of these phases presents the possibility of correlating the temperature of formation as well as chemical evidence of metasomatism with the oxygen record

In order to test this new window on subduction fluids, we analyzed oxygen isotope ratios in rutile and titanite by ion microprobe and correlated trace element compositions by LA-ICPMS in rutile from 9 samples of eclogite, garnet blueschist, and garnet hornblendite from the Franciscan Complex of California, USA. These samples all contain garnets zoned in $\delta^{18}O$. In 6 samples of eclogite and hornblende eclogite containing rutile rimmed with titanite, the $\delta^{18}O$ of titanite rims (4.6-5.9‰, VSMOW) is equal to (or less than) that of rutile cores (4.2-7.3‰). These disequilibrium values are consistent with textural observations of replacement, but could represent equilibrium with the same oxygen reservoir at ~600˚C for rutile and <400˚C for titanite. Rutile grains are unzoned and generally poor in trace elements. Zr concentrations in rutile are similar for all samples of eclogite (60-110ppm), yielding temperatures of 580-620˚C, matching independent estimates of peak T. The average $\delta^{18}O$ of rutile in all samples is in equilibrium with garnet rims, consistent with metasomatism in the subduction channel at the metamorphic peak. However, garnet in one eclogite sample with textural evidence of multiple episodes of resorption and regrowth has a ~400˚C blueschist-facies inclusion assemblage that formed prior to metasomatism and ~600˚C rutile growth, suggesting multiple episodes of burial and exhumation. We will also present rutile data from a range of other lithologies in LT-HP terranes in the western Alps and Syros.