Trace element and Nd isotope evolution of subducted sediments; insights from HP and UHP rocks

C. SPANDLER[1], J. HAMMERLI[2] AND C. PIRARD[1]

[1]Economic Geology Research Unit, James Cook University, Townsville, QLD, Australia; carl.spandler@jcu.edu.au
[2]Centre for Exploration Targeting, University of Western Australia, WA; Johannes.hammerli@uwa.edu.au

Subducted sediments play a crucial role in global element recycling and the generation of arc magmas, and significant progress has been made in understanding their petrological evolution during subduction. Nonetheless, knowledge of the distribution and equilibration of trace elements between minerals of subducting metasedimentary rocks is limited.

Here, we present trace element and Sm-Nd isotope data for minerals from a suite of HP and UHP metasedimentary rocks from New Caledonia and the Italian Western Alps. The samples were chosen to represent a range of protoliths (shale, marl, limestone, seafloor massive sulfide) buried to varying depths in a subduction zone. The rocks range from lawsonite blueschists (T ~400 ºC) to coesite eclogites (T ~700 ºC).

Anaysis of the trace element inventory of these samples shows that white micas are the main host of LILE at all metamorphic grades and protolith compositions. REE plus Th+U are hosted by lawsonite and apatite in low grade rocks, whereas apatite tends to be an insignificant trace element host in eclogite-facies rocks; instead these elements are mainly distributed between garnet for HREE, and epidote/allanite for LREE plus Th+U. HFSE are held in titanite and/or rutile, and zircon. In the lawsonite blueschists Sr is hosted by white mica and lawsonite, and Pb is mainly held in white mica. In the pelitic eclogites, both Pb and Sr are hosted by phengite and epidote/allanite. Calcite is the major host for Sr, and a minor host for M-HREE, in the metamarl and marble samples.

In situ Sm-Nd isotope analysis of key REE bearing minerals (lawsonite, apatite, epidote/allanite) was conducted to evaluate chemical equilibration during subduction-zone metamorphism. Apatite grains from the low grade samples have variable Nd isotope compositions, which indicate preservation of detrital signatures to metamorphic conditions of up to 500 ºC. At conditions above 600 ºC, all REE phases in each rock have homogenous Nd isotope compositions, indicating complete isotopic re-equilibration. The implication for subduction zones is that the Nd isotope composition of UHP hydrous melts of subducted sediments will directly reflect the source. In this case, the Nd isotope composition of arc magmas may be reliably used to calculate the efficiency of recycling subducted sediments through subduction zones.