

A novel method of stable H and O isotope analyses of inclusion-hosted waters based on laser spectroscopy

DEMÉNY, A.¹ AND CZUPPON, GY.¹

¹Institute for Geological and Geochemical Research, RCAES, Hungarian Academy of Sciences, Budapest, Budaörsi út 45., (demeny@geochem.hu), (czuppon@geochem.hu)

Laser spectroscopy is a relatively recently developed technique that can be effectively used for coupled H and O isotope analyses of water samples. Since the aim of the present study was to extract water from fluid inclusions, a vacuum-based liquid water isotope analyser was chosen (Los Gatos Research, LWIA-24d). Inclusion-bearing samples were vacuum-crushed in stainless steel tubes and the released water was cryogenically transferred to the spectroscope's inlet using a vacuum line. When the fluid contained CO₂ (e.g. on the base of microthermometric analyses), the water was purified by releasing CO₂ at -80 °C. Memory and amount effects, as well as isotope shifts related to the isotope range measured were determined by introducing standard waters injected into glass capillaries. Amount effects for both H and O isotope compositions were quantified by multiple analyses of a calcite vein. On the base of a set of samples (calcite, quartz and fluorite veins, as well as speleothems), whose H isotope compositions had been measured by IRMS it can be stated that the precision of H isotope analyses achieves or even exceeds that of the IRMS analyses with a significant reduction in analysis time and cost. The determination of O isotope compositions raises more problems. It is demonstrated that the δ¹⁸O values are prone to alteration during the water release depending on extraction temperature and duration. Although the measured values may not be equal to the real compositions, internal variations can have a meaning, e.g., in paleohydrological studies.

The study was supported by the Hungarian Research Fund and the Hungarian State (project No. CK 80661).

Episodic fluid flow in a subduction zone

C. DE MEYER^{1*}, L.P. BAUMGARTNER¹, D. RUBATTO² AND A.-S. BOUVIER¹

¹ISTE, University of Lausanne, Switzerland
(*correspondence: caroline.demeyer@unil.ch)

²Research School of Earth Sciences, Australian National University, Canberra, Australia

The Zermatt-Saas Zone in the Western Alps contains the remnants of the Jurassic Piemonte-Ligurian ocean subducted to eclogite facies metamorphic conditions during the Eocene. The garnets have complex zonation documenting multiple resorption and growth periods. In-situ SHRIMP analyses of oxygen isotopes measured along profiles across the central sections of the garnets show multiple steps in δ¹⁸O values with variations of up to 5 ‰. The core of the garnet has δ¹⁸O values of 14-15 ‰. A sharp decrease to 9-10 ‰ is followed by a gradual increase to 14-15 ‰. The oxygen isotope variations in the garnets correlate with sharp jumps in grossular content. The decrease of the δ¹⁸O value during garnet growth indicates infiltration of an isotopic lighter fluid. Fluid infiltration drives the metamorphic decarbonation reactions, promoting garnet growth. The ultramafic and mafic rocks, which are intercalated with, or underlying the calcschists are the likely source of the fluids. Preliminary δ¹³C in-situ SIMS analyses of graphite inclusions suggest variable fluid sources during garnet growth. The multiple growth intervals suggest multiple pulses of fluid infiltration. While zones of adjacent garnet grains can be correlated, individual garnets have different size zones. This points towards localized fluid pathways on sub-centimeter scale. Mineral zoning in subducted carbonate-bearing rocks do not only register changing pressure and temperature conditions, but also changes in fluid composition due to circulation of fluids between ultramafic, mafic and meta-sedimentary units of the subducting slab.