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Oxidized slab fluids revealed in metasomatized eclogites: A case study from Syros, Greece

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Garnet-epidote oxybarometry, major element mineral compositions, and textural analysis of eclogites from Syros, Greece reveal the presence of high fO_2 slab fluids. The four investigated samples from blocks hosted in the serpentinite matrix mélange on Syros fall into three categories: unmetasomatized eclogite (Type I, n = 1), heavily metasomatized garnet-clinopyroxene bearing rocks (Type II, n = 2), and an eclogite which hosts veins of Andr + Acm + Ep + Hem + Chl (Type III, n = 1). Type I samples of metagabbroic eclogite are characterized by a peak assemblage of Grt + Cpx + Rt with abundant clinozoisite after lawsonite. In addition to Grt + Cpx, Type II samples contain Chl + Ilm + Py + Ap ± Ep ± Cam. Clinopyroxene compositions within Type I samples display a prograde trend of increasing jadeite and decreasing acmite. In contrast, the matrix clinopyroxene in one Type II sample exhibits compositions up to 60 % acmite component. Alternatively, clinopyroxene in the second Type II sample investigated exhibit an increase in acmite component during metasomatism. Type II samples also contain epidote and hematite-rich ilmenite as opposed to clinozoisite and rutile. The association of Fe^{3+}-rich phases with sulfides, such as inclusions of acmitic pyroxene in pyrite, in Type II samples suggests a temporal link between sulfide deposition and oxidation of Fe^{2+} to Fe^{3+}. In contrast, the Adr + Acm + Ep + Chl + Hem veins in the Type III sample are sulfide absent and suggest fluids with fO_2 above the Hem-Mag and Hem-Py buffers.

Garnet-epidote oxybarometry revealed elevated fO_2 in metasomatically altered samples. Calculations were performed using a new oxybarometry Matlab code written by the authors. Our code utilizes the latest thermodynamic database, *A-X* models, and equations of state implemented in THERMOCALC. The code was also implemented in the XMapTools software package for quantitative visualization of fO_2 using EPMA X-ray maps. Fugacity calculations were conducted at 550 °C, 2.0 GPa, and an aH_2O of unity, unless otherwise stated. Oxygen fugacities for clinozoisite-garnet pairs in the Type I sample were calculated in XMapTools and fall within 0.5 log units of the quartz-fayalite-magnetite (QFM) buffer. Inclusions of garnet in epidote and epidote overgrowths on garnet were selected for fO_2 calculation in the Ep-bearing Type II sample. These garnet-epidote pairs exhibit fO_2 of QFM+1.9 to +2.0. A minimum fO_2 of QFM+4 calculated from the Hem-Mag buffer is estimated for Type III veins. The remarkably high fO_2 of Type III veins contrasts with prograde fO_2conditions of QFM+1 to +2 estimated for epidote inclusions in garnet cores from the

same sample at 400-450 °C and 1.0-1.5 GPa. While elevated fO_2 and acmite inclusions in pyrite are consistent with a SO_x(aq)-Fe^{2+} redox pair in Type II samples, fO_2 above the Hem-Mag buffer require the bulk addition of Fe^{3+} or Mn^{3+} as a carrier of oxidation. These data demonstrate that slab fluids may impose fO_2 well above the sulfur-sulfur oxide buffer.

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