Permeability of subducted oceanic crust revealed by eclogite-facies vugs

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We herein report the finding of rare eclogite-facies vugs forming millimeter- to centimeter-sized pockets in meta-ophiolites from the western Alps. Euhedral garnet crystals covering the vug walls display oscillatory chemical zoning for a wide range of major and trace elements including Cr, Mn and rare earth elements. Thermodynamic modelling reveals that closed-system fluid production through the breakdown of prograde glaucophane, lawsonite and chlorite between 505–525 °C can successfully explain porosity creation of ~4% and the mineralogical properties of the vugs. Available geological and geochronological constrains indicate that the eclogitization of the downgoing mafic crust spanned a window of at least 1 Myr. These observations can only be explained by the presence of extremely low permeability values (< 10^{-22} m²) to keep the fluid confined at the meter scale within vugs on such timescales. Our field-based report of eclogite porosity provides the first *in situ* confirmation of previous experimental data and geophysical estimates on active margins. A substantial amount of fluid trapped in this porosity may be carried deeper than expected into the Earth's mantle, with implications for volatile recycling budgets.

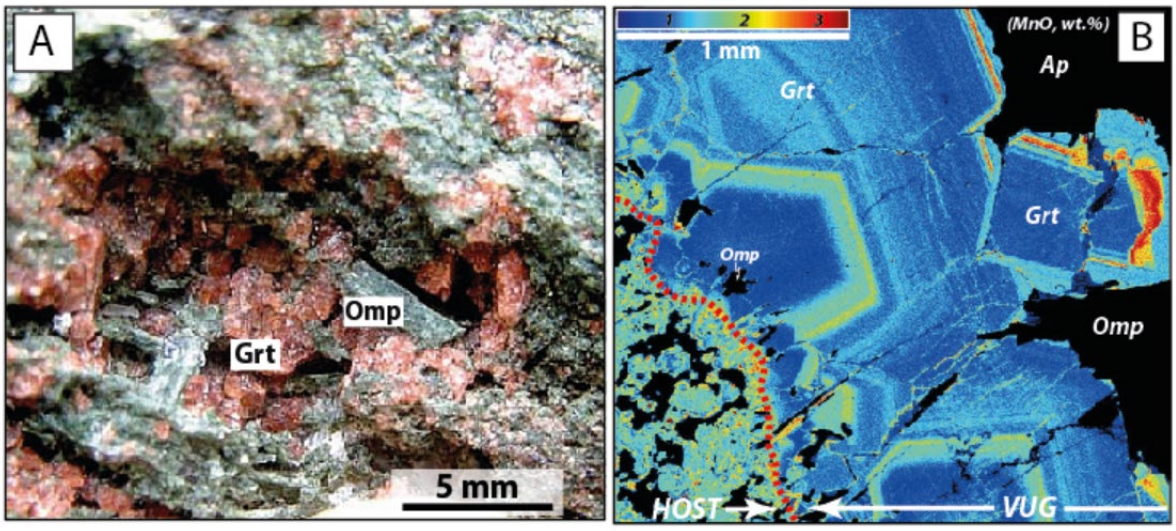

Figure 1- A: field picture of one of the eclogite-facies vugs showing garnet crystals and omphacite needles covering the walls of the vug. B: X-ray map (MnO) showing the oscillatory nature of the garnet structure, contrasting with the host micro-texture (modified from Angiboust & Raimondo, in press)

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