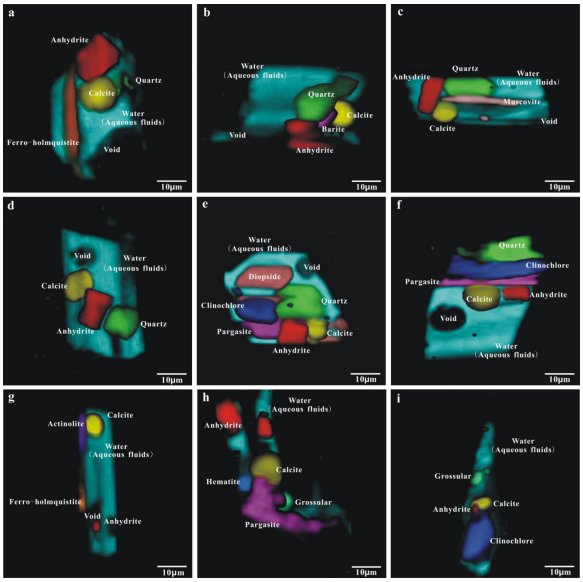
Goldschmidt 2022 Abstract
https://doi.org/10.46427/gold2022.12049

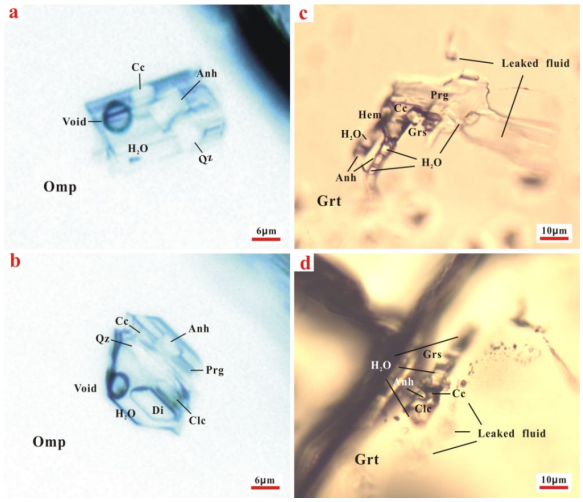
Supercritical fluid in deep subduction zones: Evidence from multiphase fluid inclusions in UHP metamorphic veins, Dabieshan, China

DESHI JIN[1], YILIN XIAO[1], DONGBO TAN[1], XIAOXIA WANG[1], YANGYANG WANG[1] AND WEN SU[2]

[1]University of Science and Technology of China
[2]INSTITUTE OF GEOLOGY AND GEOPHYSICS, CHINESE ACADEMY OF SCIENCES

Presenting Author: jinds@mail.ustc.edu.cn





Subduction zones regulate the global material cycle in which fluid activity plays a crucial role. In particular, supercritical fluids are important agents, because of their low viscosity, high mobility, and high element-carrying capability. However, direct observation for supercritical fluids in natural rocks is very limited, due to the immiscibility of supercritical fluid at lower temperature and pressure and fluid-rock interaction. Here, we report well-preserved primary multiphase fluid inclusions (MFIs) in omphacite and garnet from a metamorphic vein in the ultrahigh-pressure (UHP) complex of the Bixiling eclogite in Dabieshan, China. MFIs coexisting with coesite contain a relatively constant mineral assemblage of quartz, calcite, sulfate minerals, silicate minerals, hematite and abundant H_2O, representing an early vein-forming fluid, trapped under UHP conditions. Using 3D modeling analysis of MFIs by Raman scanning, for the first time we quantitatively calculated the composition of the fluid trapped in MFIs as: 21.5wt.%SiO_2, 14.0wt.%CaO, 6.3wt.%SO_3, 5.3wt.%CO_2, 3.4wt.%Al_2O_3, 3.4wt.%TFe_2O_3, 3.3wt.%MgO, 0.7wt.%BaO, 41.7wt.%H_2O, with trace of Li, Na, K. Such a UHP fluid phase is compositionally between aqueous fluid and hydrous melt, which is consistent with experimentally derived supercritical fluid data. Combined with the peak-metamorphic P-T conditions obtained for the Bixiling eclogite and the occurrence of coesite, rutile and garnet in the veins, we conclude that the fluids in MFIs represent supercritical fluid. Significant amounts of calcite and anhydrite in MFIs demonstrate that supercritical fluid released from subducting slabs can effectively dissolve and transport carbon and sulfur to the mantle, and thus play an important role in the global deep carbon and sulfur cycle.

[1] Ni, H. W., Zhang, L., Xiong, X. L., Mao, Z., Wang, J. Y. Supercritical fluids at subduction zones: Evidence, formation condition, and physicochemical properties. *Earth-Sci. Rev.* 167, 62-71(2017).

[2] Kessel, R., Schmidt, M. W., Ulmer, P., Pettke, T. Trace element signature of subduction-zone fluids, melts and supercritical liquids at 120-180 km depth. *Nature.* 437(7059) , 724-727(2005).