Geophysical Research Abstracts
Vol. 21, EGU2019-16353, 2019
EGU General Assembly 2019

Corrosion of garnet at granulite facies conditions

Rene Asenbaum (1), Elena Petrishcheva (1), Martin Racek (2), Ondrej Lexa (2), Fred Gaidies (3), and Rainer Abart (1)

(1) University of Vienna, Department of Lithospheric Research, Althanstrasse 14, A-1090 Vienna, Austria (rainer.abart@univie.ac.at), (2) Institute of Petrology and Structural Geology, Faculty of Science, Charles University, Albertov 6, 12843 Prague, Czech Republic, (3) Department of Earth Sciences, Carleton University, 1125 Colonel By Drive, Ottawa

Peculiar reaction microstructures were observed in garnet from the contacts between several 100 m sized mafic lenses and surrounding felsic granulites in the granulite-facies metamorphic Gföhl unit (Moldanubian zone, Lower Austria). There, up to a few millimetre-sized garnets are partially resorbed and replaced by an assemblage of plagioclase and subordinate clinopyroxene. The 3D microstructure has been documented using μ-CT at about five micrometres resolution. The replacement occurs along finger-like structures or corrosion tubes, which are several 100 micrometres long and up to about 100 micrometres wide. They have ellipsoid or irregularly shaped cross sections, and the interfaces with the relic garnet are smooth on the micrometre scale. The corrosion tubes are randomly oriented and penetrate large fractions of the garnet. Associated with the corrosion features is a pronounced compositional zoning of the relic garnet. Mechanical grinding and polishing using a customized polishing device were employed to produce successive, about 30 micrometres spaced plane parallel polished cross sections from an about 800 micrometres sized garnet. The 3D compositional variation was then obtained from element mapping and point analyses using the electron microprobe on the successive cross sections. In pristine domains far away from any corrosion feature, the garnet has a composition of Py40Alm19Gro41. Towards the interfaces with the corrosion tubes the almandine and pyrope contents show a systematic increase and the grossular content shows a systematic decrease. At the contact with the replacement assemblage the composition is uniformly at Py50Alm32Gro18. The zoning is clearly concentric around the corrosion tubes indicating that it is related to the corrosion process. Based on the knowledge of the 3D microstructure and compositional pattern, composition profiles were selected for extracting the time scales of corrosion from inverse diffusion modelling. The observed transformation of garnet to plagioclase + clinopyroxene is clearly allochemical and interpreted as being due to interaction with a fluid or melt, which facilitated the necessary chemical mass transport. The temperature and pressure conditions of garnet corrosion were estimated from independent geo-thermobarometry to be about 900˚C and 0.9 GPa. Inverse diffusion modelling yields time scales on the order of a few 100 days to a few 1000 years, depending on the experimental calibration of the respective diffusion coefficients employed. In any case, this is an extremely short period on a geological time scale indicating that the presence of a metasomatizing fluid or melt was an ephemeral episode during the prolonged metamorphic evolution of the Moldanubian rocks.