©Institut f. Erdwissensch., Geol. u. Paläont., Karl-Franzens-Universität Graz; download www.biologiezentrum.at

Ber. Inst. Erdwiss. K.-F.-Univ. Graz	ISSN 1608-8166	Band 9	Graz 2004

SELECTED EXPERIMENTAL INVESTIGATIONS ON THE ROLE OF CL DURING HIGH-PRESSURE METAMORPHISM

Peter TROPPER

Institut für Mineralogie und Petrographie, Universität Innsbruck

Subduction of crustal materials is accompanied by metamorphic reactions liberating fluids. Fluid inclusions in eclogite minerals range from dilute solutions to chloride-rich brines; however, the effect of salinity variations on the stability of hydrous phases in subduction zones is poorly understood. More recently, an important role of concentrated salt solutions has been suggested in a number of diverse petrological investigations in minerals of igneous and metamorphic rocks. Fluid inclusions in high-grade metamorphic rocks such as eclogites and granulites have shown to be rich in dissolved saline components, which significantly influence the stability limits of hydrous minerals and thus any phase equilibrium calculations involving hydration/dehydration reactions. However, despite the much documented evidence for brine-rich fluids in the deep crust, the effect of salinity variations on the stability of hydrous phases in subduction zones is poorly understood and no experimental investigations on the influence of brines on the stability limits of minerals from high-pressure environments have been performed yet. Since paragonite is a widespread mineral occurring in rocks from the eclogite facies, it was the impetus to (1.) investigate the influence of H_2O-NaCl brines on the shift of the end-member paragonite-breakdown reaction paragonite = jadeite + kyanite + H_2O at constant temperature, (2.) to test the validity of the previously obtained activity/ composition relations of H_2O-NaCl brines and (3.) discuss the geological implications of this study by comparing the experimental results to eclogite-facies rocks from the Sesia Lanzo Zone.

To address this problem, reversed piston-cylinder experiments were carried out on the equilibrium (1) paragonite = jadeite + kyanite + H_2O at 700°C, 1.5-2.5 GPa, in the presence of H_2O-NaCl fluids. The experiments were conducted using fluids with nominal starting compositions: $X(H_2O)$=1.0, 0.90, 0.75 and 0.62. At $X(H_2O)$ = 1.0, the equilibrium lies between 2.25 and 2.30 GPa. Lowering $X(H_2O)$ decreases the pressure of paragonite breakdown to 2.10 –2.20 GPa at $X(H_2O)$ = 0.90 and 1.85-1.90 GPa at $X(H_2O)$ = 0.75. The experiments at $X(H_2O)$ = 0.62 yielded albite + corundum at ≤1.60 GPa, and jadeite + kyanite at ≥1.70 GPa. The shift in the equilibrium pressure constrains *a-X* relations in the sytem H_2O-NaCl and indicates that $a(H_2O)$ varies as nearly the square of its mole fraction. The results are consistent with the extrapolated non-ideal activity model of Aranovich and Newton (1996, CMP, 125, 200).

The results permit use of appropriate paragonite-bearing or -absent assemblages to quantify $a(H_2O)$ in high-*P* metamorphic environments, such as the Austroalpine units in the Western Alps. For example, jadeite and kyanite in a metapelite from Val Savenca in the Sesia Lanzo Zone formed during the Eo-Alpine high-*P* metamorphic event at 1.7-2.0 GPa, 550-650°C. The absence of paragonite requires a fluid with low $a(H_2O)$ of 0.3-0.6, which could be due to the presence of saline brines. Petrologic investigations of Sesia Lanzo eclogites from Val Ianca show that paragonite occurs as inclusions in garnet cores but gives way to omphacite + kyanite toward rims, suggesting a decrease in $a(H_2O)$ from ca. 1.0 to <0.81 (Tropper & Essene, 2002, SMPM, 82, 487-514). During the subsequent hydration in the late eclogite-facies at slightly lower *P*, $a(H_2O)$ increased to 0.84-0.98, stabilizing the assemblage paragonite + omphacite. The new results can also be used to compare $a(H_2O)$ from phase-equilibrium studies with fluid-inclusion constraints. Paragonite-bearing eclogites from the Mt. Emilius unit in the Western Alps interacted with fluid with $a(H_2O)$=0.62-0.72, based on fluid-inclusion data from Scambelluri et al. (1998, Lithos, 43, 151) during Eo-Alpine high-*P* metamorphism of 1.1-1.3 GPa, 450-550˚C (Dal Piaz et al., 1983, Am. J. Sci., 283A, 438). Calculation of reaction (1) with reduced $a(H_2O)$ shows no incompatibilities with the observed phase assemblage. This study shows that paragonite + omphacite/jadeite + kyanite-bearing rocks have great potential for constraining $a(H_2O)$.

ZOBODAT - www.zobodat.at

Zoologisch-Botanische Datenbank/Zoological-Botanical Database

Digitale Literatur/Digital Literature

Zeitschrift/Journal: Berichte des Institutes für Geologie und Paläontologie der Karl-Franzens-Universität Graz

Jahr/Year: 2004

Band/Volume: 9

Autor(en)/Author(s): Tropper Peter

Artikel/Article: Selected experimental investigations on the role of CL during high-pressure metamorphism. 52