$a(H_2O)$ CALCULATIONS IN ECLOGITE-FACIES ROCKS

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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. TROPPER & MANNING (2004) carried out experimental investigations on the influence of saline brines on the reaction paragonite = jadeite + kyanite + H_2O (1). The shift of this reaction to lower P constrains a-X relations in the system H_2O-NaCl and indicates that $a(H_2O)$ is consistent with the H_2O-NaCl activity model of ARANOVICH & NEWTON (1996) which involves NaCl dissociation as a function of P, T and ρH_2O. In addition, the experimental results now permit use of appropriate paragonite-bearing or -absent assemblages to quantify $a(H_2O)$ in high-P metamorphic environments, such as the Austroalpine units (Sesia Lanzo Zone, Dent Blanche Nappe) in the Western Alps.

For example, jadeite and kyanite in a partly equilibrated 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 an upper limit of $a(H_2O)$ of 0.3 - 0.6. Calculations with the assemblage white mica + omphacite + kyanite in better equilibrated samples, yield a very small $a(H_2O)$ of < 0.02. These data show that significant dilution of the coexisting fluid must have occurred. 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. In addition to textural constraints, it is also possible to calculate $a(H_2O)$ from fluid inclusion (FI) data. Calculation of $a(H_2O)$ of paragonite-bearing eclogites from the Austroalpine Mt. Emilius unit in the Dent Blanche nappe (1.1 - 1.3 GPa, 450 – 550 °C) yielded $a(H_2O)$ of 0.62 - 0.72, based on H_2O-NaCl fluid inclusion data from omphacites by SCAMBELLURI et al. (1998). Calculation of reaction (1) with the obtained $a(H_2O)$ shows no incompatibilities with the observed phase assemblage, indicating that paragonite + omphacite are stable relative to omphacite + kyanite.

This study shows that the presence or absence of paragonite yields at least limiting constraints on $a(H_2O)$ whereas the assemblage white mica + omphacite + kyanite allows an exact determination of $a(H_2O)$. Prerequisite is an independent estimate of P or T Fluid inclusions can also be used to obtain informations on $a(H_2O)$ as long as the FI / host relations are clear.

References

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