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1 Immiscibility boundaries and isochores for two mixtures of water, carbon dioxide and sodium chloride determined from synthetic fluid inclusions

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Almost all geological processes involve fluids. This includes ore deposit genesis, metamorphism, igneous processes, diagenesis and oil migration. In addition to water they often contain volatile compounds and/or dissolved salts. Most common components are CO_2 and NaCl. Their presence changes the phase behavior of the fluid drastically and thus its solvation and transport properties. Many studies exist that describe the $P - V - T - X$ properties of the binaries CO_2-H_2O and NaCl-H_2O; the ternary system, however, is less well investigated. Most studies in the ternary concentrate on constraining the boundaries of the immiscibility field, but do not provide information on molar volumes. This limitates the interpretation of fluid inclusions and the development of equations of state considerably. In this study we provide immiscibility boundaries for two compositions (6 mass% NaCl solution + 21.01 and 5.14 mol% CO_2 resp.) and a new set of isochores for one of them.

For this purpose we chose the synthetic fluid inclusion technique, in which a fluid of known composition is sealed in a gold capsule together with a pre-fractured quartz rod. At experimental conditions these cracks heal and trap the surrounding fluid. We condensed CO_2 directly into capsules containing NaCl solution. Our syntheses were performed at temperatures and pressures ranging from 500 to 700 ˚C and 160 to 500 MPa. The resulting inclusions were analyzed by microthermometry and raman spectroscopy.Bulk molar volumes are calculated at the partial homogenization temperature of the carbonic phases. The calculation takes into account the solubility of

the CO_2 in the salt solution and its partial molar volume. Total homogenization temperatures were measured and related to the bulk molar volumes of the inclusions. We combined our$P - V - T$ data with data for the same isopleths from Gehrig (1980), Schmidt and Bodnar (2000) and Krüger (2001) and fitted a Van der Waals equation to the combined data set, that reproduces the data within an accuracy of $\pm$ 4%. Our total homogenization temperatures differ from those of Gehrig (1980), obtained from a large, variable-volume autoclave equipped with a sapphire window.

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