

Discovery of Palaeoproterozoic volcanic rocks in the Tianshuihai Massif, Xinjiang, West China and its geological significance

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The volcanic rocks from the Bulunkuoler Group have been found in the Dabudaer region of the Tianshuihai Massif. in Karakorum mountains, West China, which are composed of basalt, basaltic andesite, and rhyolite. *In situ* zircon U-Pb LA-ICP-MS dating on the rhyolite magmagenic zircons yielded an age of 2481 ± 14 Ma, representing the eruption age of the volcanic rock from the Bulunkuoler Group. The basalt and basaltic andesite are low-Al tholeiite series and the rhyolite is low-Al calc-alkaline series. All of rocks are characterized by enrichment of LREE and LILE (Rb, Th and Ba), depletion of P, Nb, Ta and Ti, and absence of Eu anomaly. The value of $\epsilon_{\text{Nd}}(t)$ (3.14-4.88), together with the features of the trace elements, indicates the sources of magma come from depleted mantle which experienced intense crustal contamination during their ascending. The Primitive-mantle normalized and Zr/Y-Zr diagrams for the basic volcanic rocks show these rocks formed in an intra-continental tectonic setting. Combined with the previous studies and contrasted with north China craton Neoproterozoic basic volcanic rock, it is supposed that these volcanic rocks from the Bulunkuoler Group are related to the mantle magma underplating.

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Modeling of phase equilibria for the CO₂-H₂S-H₂O-salts systems

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Geologic carbon sequestration is one of the promising options for the reduction of greenhouse gases. Co-injection of CO₂ and H₂S (from flue gases and natural gas fields) may substantially reduce the capture and sequestration costs. Phase equilibria for the systems of CO₂-H₂S-H₂O including salts with Na, K, Ca, Mg, Cl, CO₃ up to 200 °C and 600 bar are crucial for the prediction of the capacity and fate of the injected gases as well as for geochemical reactions. Experimental studies have been done for both CO₂-H₂O-NaCl and H₂S-H₂O-NaCl systems. However, the experimental data for more complicated systems are still lacking. Theoretically, several models have been proposed to describe the phase behaviours for H₂S-H₂O, CO₂-H₂O, H₂S-H₂O-NaCl, and CO₂-H₂O-NaCl systems. To the best of our knowledge, the phase behaviour for more complicated systems has not been studied yet.

To predict the phase equilibria of CO₂-H₂S-H₂O-salts system, we build from the parameters derived for simple systems. In our previous work, statistical associating fluid theory (SAFT) equation of state has been used to describe the phase behaviours for CO₂-H₂O-NaCl system and for aqueous electrolyte solutions including the ions of Na, K, Ca, Mg, Cl, CO₃. In the present work, the SAFT equation of state is used to represent the phase behaviour for (CO₂)-H₂S-H₂O-salts systems. The parameters for pure H₂S are obtained from the fitting of the saturated vapour pressure and liquid density data, and the cross parameters between the molecules of H₂S and H₂O and those between H₂S and salts are obtained from the fitting of the phase equilibrium data of H₂S-H₂O-salt systems. With the available parameters, the phase equilibria for CO₂-H₂S-H₂O-salts are predicted and compared with the new measured experimental data for further validations. The resulting model will be coupled with the process model and then provide reliable long-term prediction pertaining to geological carbon sequestration, such as sequestration capacity, CO₂ leakage, and environmental impacts, etc.