In-situ pH and carbon dioxide solubility in NaCl fluids

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pH measurements give crucial insight to processes taking place during CO_2-water-rock reactions both in the laboratory and the field. The pH will govern the chemical species present and subsequent chemical reactions. Accurate determination of pH is important in the laboratory for a detailed understanding of the state of experiments and to test/validate predictive computer simulations. Degassing of samples on depressurisation changes solution pH, hindering accurate assessment of in-situ pH. We have used a commercially available high-pressure pH probe, coupled with high pressure fluid preservation methods to determine CO_2 solubility and pH at elevated temperatures and pressures relevant to geological storage conditions. Measurements were made at a range of salinities from deionised water to 2M NaCl, over temperatures of 40°C to 80°C, and pressures of 50 bar to 200 bar. Results show pH to decrease with increasing salinity, increasing pressure and decreasing temperature. For a subset of the conditions we have also measured pH associated with impurities of SO_2 and NO_2. Our experiments were constrained by the working pressure limits of the commercially available pH probes used, and we are developing different techniques to potentially extend the measuring capabilities up to 500bar.

^{81}Kr concentrations in deep fracture waters of the Withwatersrand Basin, South Africa

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^{81}Kr has been proposed since many years an ideal tracer for dating subsurface fluids on timescales up to 2 million years. However, only recently the method became practicable for real case investigations due to significant analytical improvements [1]. In this study radioactive noble gas isotopes (^{81}Kr, ^{85}Kr and ^{39}Ar) were applied for the characterisation of fracture waters in the deep gold mines of the Witwatersrand Basin, South Africa [2]. Those waters catalyzed interest because of deep microbial communities that persists to depths of over 3 km [3]. The key objective of the present study is to further constrain the origin of the fluids, to determine the timing of deep subsurface life and to test the ^{81}Kr method in all kinds of environments. In contrast to expectations [4] we discovered that underground production of ^{81}Kr is a significant process in the rocks of the Withwatersrand and Ventersdorp Supergroups. All measured ^{81}Kr activities from fracture water were significantly higher than in atmospheric equilibrium. This is most likely related to elevated U/Th concentrations in the rock strata. Radiometric decay dating is complicated in such cases

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