AQUIFER DISPOSAL OF CO_2-RICH GREENHOUSE GASES: EXTENSION OF EXPERIMENT BY MODELLING

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In previous work, GUNTHER et al. (1993) suggested water-rock reactions in deep aquifes in sedimentary basins could sequester injected-CO_2-waste from industry, thereby reducing greenhouse gas emissions. Experiments carried out at 105° C and 90 bars CO_2 pressure to test the validity of this mineral-trapping of CO_2 were unsuccessful due to sluggish kinetics of reaction. The most signicant change recorded by the reaction products from these experiments was a significant increase in alkalinity, which was attributed to very small amounts of water-mineral reaction. A computer model, PATHARC.94, was used to interpret this change in alkalinity and to predict the path and time necessarity to reach equilibrium. Substantial trapping of CO_2 by formation of siderite, calcite and aqueous bicarbonate ions was predicted to occur in 6 to 40 years.

Potential errors as high as two orders of magnetude were estimated based on a thorough examination of the kinetic data in the modelling. In order to archieve reasonable time estimates, "reactive" surface areas were approximated by 100 micron spherical grains in the computer model. This represents a smaller cumulative surface area than actually present in the experiment. When these results are extrapolated to the field, where the aquifers are at lower temperatures, PERKIN & GUNTER (1995) concluded that CO_2-trapping reactions are expected to take 100s of years to complete. This is sufficient time for the trapping to occur as the residence time of a packet of fluid in a deep aquifer in a sedimentary basin is measured in thousends of years.

PERKINS, E.H., GUNTER, W.D. (1995): Aquifer disposal of CO_2-rich greenhouse gases: Modelling of water-rock reaction paths in a siliciclastic aquifer. - In: KHARAKA, Y.K, CHUDAEV, O.V. (Eds.): Water-Rock Interactions, 8, Balkema: Rotterdam, 895 - 898.

GUNTER. W.D. (1993): Aquifer disposal of CO_2-rich gases: Reaction design for added capacity. - Energy Conversion and Management, 34, 941 - 948.