Reactivity of acid gases in gas-brine-mineral systems

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Acid gases like CO_2 and H_2S may constitute a substantial fraction of the raw natural gas in sour gas fields, large gas fields in e.g. Kazakstan and China exhibit H_2S contents of more than 10 %. Because of its toxicity, H_2S requires a proper waste management which is usually assured by a *Claus*-type sulfur plant producing elemental sulfur from H_2S. However, selling problems of produced sulfur on the world market and costly procedures due to governmental allowance of low SO_2 emissions by sulfur plants provoke economic challenges for sour gas production. The ever increasing global production of sour gas thus raised the question of other disposal options than *Claus* plants for H_2S and acid gas mixtures.

The geologic storage of acid gases in deep strata is one alternative disposal option with potentially economic advantages. Therefore, the injection of CO_2/H_2S mixtures of diverse composition has been practiced in Canada since 1989 [1]. Surface monitoring of the injection sites did not reveal any leakage, yet, but possibly occurring subsurface processes related to acid gas injection have been scarcely investigated.

To gain insight into potential geochemical reactions within the injection horizon, experiments were conducted which investigate the interaction of acid gases, brines and different types of minerals under the anticipated storage conditions. The experiments were carried out in sealed gold capsules which were first loaded with a mineral and brine followed by the application of CO_2 or CO_2/H_2S by a specifically manufactured gas-loading device [2]. After the treatment of the reaction matrices at 120°C and 120 bar, the obtained product mixtures were analyzed by means of headspace GC-TCD/FID/SCD for CO_2, hydrocarbon and sulfur gases. In addition, the fluids and solids have been analysed by ICP-OES and a variety of microscopic methods.

The results of the experiments will contribute to a more detailed understanding of geochemical processes connected to the geologic storage of acid gases that may affect the integrity of the reservoir rock and the cap rock.

[1] Bachu & William (2004) *Geol. Soc. Special Publ.* **233**, 225-234. [2] Boettcher *et al* (1989) *American Mineralogist* **74**, 1383-1384.

Geochemical Exploration for Platinum-Group Elements in Mafic/Ultramafic Complexes from the Arabian Shield

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The Arabian Shield, which occupies most of the western half of the Arabian Peninsula, has been the target of extensive exploration activities for the past four decades. So far no platinum occurrences have been documented, and the relatively high PGE values reported for certain areas are associated with uneconomic chromite and Cu-Ni deposits. This project was launched as a reconnaissance program intended for the assessment of the PGE potential of some of the more promising mafic/ultramafic complexes in the Arabian Shield, with more detailed follow-up work to be undertaken at a later stage if significant anomalies were identified. Alaskan-type complexes are considered highly prospective for PGE, and a number of these were selected for preliminary soil surveys and lithogeochemistry. No anomalous values for Pt, Pd or their pathfinders were detected from the heavy mineral concentrates, and any associated Cu mineralization correlates poorly with the compatible elements thus indicating a hydrothermal origin. The very high Cu/Pd ratios from rock samples devoid of copper mineralization suggests that separation of a sulphide liquid had occurred and that PGE were largely scavenged from the magma reservoir prior to emplacement. If true, this would render these Complexes unlikely hosts for PGE mineralization.An unexpected result was the extremely low concentrations of PGE in the stream sediments of layered complexes in comparison with those from massive, gabbroic sub-volcanic plutons; on average, a sub-volcanic intrusion would have a soil content of Pt ranging from 0.5 to 3 ppb, whereas sediments derived from layered complexes would typically return values of no more than 0.1 ppb for both Pt and Pd. However, the Wadi Kamal layered complex is an exception since it contains well-known horizons of Ni-Cu mineralization overlain by conspicuous gossans; the PGE values from soil and rock samples obtained so far were highly erratic and the overall PGE potential of this complex awaits further work in the next stage of the project. An interesting discovery was made at the pyroxenite body of Wadi Amarah where well-developed soil anomalies (60-75 ppb combined Pt & Pd) are encountered at the outer contacts of this intrusion; follow-up work is planned to locate the source of these anomalies.

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