Basalt weathering at high-latitude regions on Mars

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Thermal-infrared (TIR) spectroscopic analyses of Mars indicate that, although bulk regolith SiO_2 contents are globally constant (Karunatillake *et al*., 2006), high-silica mineral(oid)s are common in dark regions at middle-to-high latitudes (Bandfield *et al*., 2000; Michalski *et al*., 2005). Near-infrared (NIR) data from northern-hemisphere regions rich in high-silica materials are consistent with ferric oxide coatings on basaltic substrates (Mustard *et al*., 2005). Yet, the NIR data lack hydration features, indicating that coating formation may have been anhydrous (Bibring *et al*., 2006; Poulet *et al*., 2007). From laboratory experiments, however, we have determined that NIR hydration features of hydrous, amorphous silica are absent from spectra of rocks with thin coatings of silica. The same coatings significantly affect TIR spectra. Such coatings could explain why there are high-silica materials at higher latitudes on Mars despite globally similar bulk SiO_2 contents. Formation of silica coatings by the mobilization of SiO_2 would have required liquid water, and alteration could not have been anhydrous.

We suggest that low-temperature, aqueous weathering of basaltic materials has occurred at Martian middle-to-high latitudes, in agreement with Wyatt *et al*. (2004). We further suggest that the weathering under these conditions has occurred in soils, where liquid water formed periodically as a result of percolation of melt water from surface ice or snow, or when soil ice melts at grain interfaces. Because dissolution and precipitation likely occurred in small, transient pockets or films of liquid water, weathering products would be poorly crystalline and metastable, while thermodynamically favored phases would be kinetically inhibited from forming. It is further likely that weathering would favor dissolution of high-surface-area aeolian dust, which could supply SiO_2 to form rock and particle coatings like those found in some icy soils on Earth (e.g. Dixon *et al.*, 2002). Authigenic minerals in icy Martian soils may be dominated by amorphous silica, formed as coatings on coarser particles of basalt, contributing the spectral signals detected from orbit.

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Adsorption of As in rice paddy soils of West Bengal

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Worldwide in large areas groundwater is naturally polluted by As. Millions of people are drinking this water without any treatment. In many areas large portions of the groundwater is even used for irrigation purposes (Sanyal and Nasar, 2002).

The groundwater investigated in the area near Kaliachak, West Bengal can be ranked as highly polluted (to 817 µg/L As, WHO recommends 10 µg/L). In groundwater, the more toxic As(III) species dominates. After flooding the rice fields with this highly contaminated water, more than 90% of the As is retarded in the soil within 24 h resulting in an increasing accumulation of As in paddy fields.

The spatial distribution of As and other major and trace elements in soil particles from different soil depths was mapped by using µ-SXRF. Iron and As- speciation was determined by µ-XANES (FLUO-Beamline, ANKA/ Karlsruhe; Beamline L, HASYLAB/ Hamburg).

Statistical evaluation of the µ-SXRF data and extended µ-XANES suggest that mica (biotite or illite) and chlorite host the minor concentrations of As. Tiny goethite grains embedded in the clay matrix seem to be a major phase for As immobilisation of irrigation water.

Redox conditions in soils control the abundances of the redox sensitive species of Fe and As immitted by irrigation water. The decrease in the relative small As(III) proportions with depth give strong hints for changing redox conditions.

Arsenic is mainly co-precipitated with Fe-oxides forming directly after irrigation. A considerable portion of As in rice paddies is adsorbed to Fe rich coatings which have been formed by O_2 release of rice roots. Highest total As concentrations (up to 1600 mg/kg As) as well as the highest As(III)/As(V) ratios have been observed at the innermost side of the coatings (Kiczka, 2005). In Fe- rich coatings considerable amounts of limonite, a mixture of $Fe(OH)_3$ and FeO(OH) are observed additionally to mica and goethite in soil matrix. These coatings are an important sink for As in rice paddies acting as barrier for the soil plant transfer of As.

Acknowledment

Special thanks go to the synchrotron facilities ANKA, Forschungszentrum Karlsruhe and HASYLAB at DESY Hamburg and to the beamline scientists R. Simon (ANKA), K. Rickers and G. Falkenberg (HASYLAB)

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