Indications for convective flow induced by focussed fluid venting at bacterial mats

M. HAECKEL*AND K. WALLMANN

IFM-GEOMAR, Kiel, Germany
(*correspondence: mhaeckel@ifm-geomar.de)
(kwallmann@ifm-geomar.de)

Detailed sediment sampling along transects across bacterial mats at submarine cold vents off Costa Rica was conducted during expedition M66/2 with RV METEOR deploying a remotely operated vehicle (ROV). Bacterial mats occurred in patches of several m^2 in size covering the sediment surface. Porewater analyses of the pushcore sediments revealed rapid sulfate consumption due to anaerobic methane oxidation (AMO) below the bacterial mats. SO_4 was depleted at ~5 cm sediment depth in the center of the mat and penetrating deeper into the sediment towards the rim of the mat. Pushcores taken in the center of these mats, however, showed a subsequent increase of sulfate concentrations below a sediment depth of ~10 cm. Other dissolved compounds, such as Cl, Br, H_2S, TA, NH_4, PO_4, and SiO_4, showed a similar behaviour with concentrations returning towards bottomwater values. Since this trend is common to all of the solutes, it is most likely explained by a physical process. We propose that focussed fluid outflow near the center of the bacterial mat creates a convective flow cell with bottom waters penetrating into the adjacent sediment area and directed towards the flow channel.

A 2-D transport-reaction model with cylindrical geometry was developed to test this hypothesis. Fluid flow in the central channel turned out to be homogeneous and thus, could be resembled as boundary condition of the surrounding sediment domain. The model also includes AMO as the most important reaction of a cold vent system. First model results indicate that the observed porewater sulfate and chloride profiles can be reproduced fairly well, for example, when applying an advection velocity of 100 cm/a in the central fluid channel and a mean background advection of 3 cm/a in the sediment domain.

Seasonal trends in solutes and $^{87}Sr/^{86}Sr$ ratios of SE Tibet rivers: Yarlung Tsangpo and Parlung

BIRGIT HAGEDORN[1]*, BRUCE K. NELSON[2], THOMAS J. KENNELL[2], AMANDA HENCK[2] AND BERNARD HALLET[2]

[1]University of Alaska Anchorage, Anchorage, AK 99508 USA
(*correspondence: anbh@uaa.alaska.edu)
[2]University of Washington, Seattle, WA 98195 USA
(bnelson@u.washington.edu, tjk4@u.washington.edu, hallet@u.washington.edu)

The Himalayas display strong linkages between chemical and physical weathering, tectonic uplift, and climate. To investigate these, we studied the effect of the strong monsoonal seasonality on the composition and concentration of solutes in major rivers in SE Tibet. These results provide information on the nature and rates of chemical weathering, and sources and pathways of solutes. Major ions and Sr isotope ratios were measured in samples collected bimonthly during 2002-2006 from the Yarlung Tsangpo and Parlung rivers. Solute concentrations are converted into fluxes using satellite derived precipitation values (TRMM) and river stage calibrated to estimate discharge.

The rivers are generally dominated by Ca^{2+} and HCO_3^-, highlighting the importance of carbonate weathering in these catchments; however, SO_4^2 concentrations in the Parlung are higher than in the Yarlung Tsangpo. Seasonal weather variations create a consistent oscillating pattern of solute concentration over the four years; high during the dry season and low during monsoons. Averaged over four years, the Yarlung Tsangpo and Parlung transport 95% and 80% of their water and 90-95% and 76-80% of their solutes during the monsoon, respectively. Sr isotopes of the Yarlung Tsangpo are less radiogenic and less variable than those of the Parlung ($^{87}Sr/^{86}Sr$ 0.7140 - 0.7120 and 0.7220 - 0.7130, respectively). In the Yarlung Tsangpo isotopic ratios peak near the onset of monsoon, and decline over 3 to 4 months to a minimum. No simple cyclic pattern is observed for Parlung.

In the Yarlung Tsangpo Mg/Ca and Na/Si ratios increase during the dry season due to increasing Mg and Na, suggesting a stronger influence of cyclic salts and dolomite dissolution. During the monsoon, SO_4^{2-} is more dominant while during "post-monsoon" season SO_4^{2-} concentration increases initially but then decreases sharply indicating a local sulfur source activated during high water stages only.

Our data reveal that detailed seasonal measurements of solute concentrations and Sr isotope compositions show a variation in solute sources and solute flux that cannot be recognized with less dense sampling.