Submarine groundwater discharge at an active margin: NE Taiwan coast

J.C. GATTACCECA[1,*], N. HOVIUS[1], A. J. WEST[2], A. GALY[1], D. HAMMOND[2], J. T. LIU[3], S-J. KAO[4]

[1]Department of Earth Sciences, University of Cambridge, UK, jcg54@esc.cam.ac.uk (* presenting author), ajbg2@cam.ac.uk, nhovius@esc.cam.ac.uk

[2]Department of Earth Sciences, University of Southern California, Los Angeles, USA, joshwest@usc.edu, dhammond@usc.edu

[3]Institute of Marine Geology and Chemistry, National Sun Yat-sen University, Kaohsiung, Taiwan, james@mail.nsysu.edu.tw

[4]Research Center for Environmental Changes, Academia Sinica, Nankan Taipei, Taiwan, sjkao@gate.sinica.edu.tw

Studies of submarine groundwater discharge (SGD) have been focused on passive margins with large floodplains [1]. SGD from active margins without substantial sediment cover remains unknown, but it is in the rapidly eroding highlands along these margins that the feedback between climate and weathering is most effective [2].

In Taiwan, measured erosion and silicate weathering rates are amongst the highest in the world. In a representative section of the northeast coast of Taiwan, at the outlet of the Liwu river, we have explored the possible magnitude and pattern of SGD, and its implications for weathering budgets. The river drains 4 km of emergent mountain relief, with a further 5 km of submarine relief above the Pacific abyssal plain. In the Liwu catchment, 16±1% of the river discharge (averaged over 37 years of record) comes from a deep groundwater reservoir, and deep seated chemical weathering of silicates accounts for 38% of the riverine silicate weathering flux [3]. It is likely that the large inland hydraulic head drives submarine discharge from this deep groundwater reservoir and weathering reactor.

We have used the radium quartet (^{228}Ra, ^{226}Ra, ^{224}Ra, ^{223}Ra) along with Temperature-Salinity (T-S) profiles on two 50 km West-East marine transects off the NE coast of Taiwan (<2000m water depth) to search for SGD. Stable isotopes, major elements, and Ra isotopes in water samples were analyzed to constrain the hydrogeology of rivers and two types of groundwater: sandy shallow aquifers (<200 m deep) and a deep bedrock aquifer (~400m deep).

Radium activities were measured using RaDeCC. Preliminray results show that the ^{224}Ra and ^{228}Ra activities at the sea surface exceed those in the average deep coastal water column. ^{228}Ra activities are also slightly elevated in some stations at 400-600m depth, below the Kuroshio current. These stations have anomalously low salinity, when compared to regional hydrographic profiles. Given the strong density barrier presented by the Kuroshio current, these Ra and salinity excursions at depth are not likely to result from downward mixing of surface seawater. They may be related to groundwater discharge from submerged mountain bedrock.

The T-S and Ra-isotopes data suggest that there may be active SGD across the structural dip of the active margin of East Taiwan. Using both transects and the deep groundwater characteristics, we will add constraints on sediment/water interactions and the occurrence and spatial extent of SGD in the area.

[1] Moore (1996) *Nature* **380**, 612-614. [2] West (2005) *EPSL* **235**, 211-228. [3] Calmels (2011) *EPSL* **303**, 48-58.

Mid- and far-infrared absorption spectroscopy of Titan's tholins

T. GAUTIER[1*], N. CARRASCO[1], A. MAHJOUB[1], S. VINATIER[2], A. GIULIANI[3], C. SZOPA[1], C. M. ANDERSON[4], J.- J. CORREIA[1], P. DUMAS[3] AND G. CERNOGORA[1]

[1] LATMOS, Université Versailles St Quentin, Guyancourt, France, thomas.gautier@latmos.ipsl.fr (*presenting author)

[2] LESIA, Observatoire de Paris, Meudon, France

[3] Synchrotron SOLEIL, Gif sur Yvette, France

[4] NASA GSFC, Solar System Exploration Division, Greenbelt, USA

In this work [1] we present mid- and far-Infrared absorption spectra of Titan's aerosol analogues produced in the PAMPRE experimental setup.

We provide a complete dataset regarding the influence that the concentration of methane vapor in the gas mixture has on the tholins spectra. Among other effects, the intensity of the 2900 cm^{-1} pattern (attributed to methyl stretching modes) increases whith the methane concentration. On the opposite, tholins produced with low methane concentrations seem to be more amine based polymers (see Fig. 1).

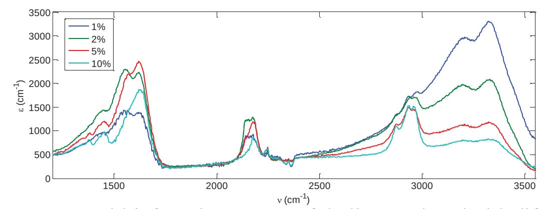

Figure 1: Mid-infrared spectrum of tholins produced with different methane concentrations

Moreover, we compare tholins spectrum with observation of Titan's atmosphere (see Fig. 2).

It is shown that the position of the bands around 2900 cm^{-1} depends on the chemical environment of the methyl functional group. We conclude that the presence of these absorption bands in Titan's atmosphere, as measured with the VIMS instrument onboard Cassini [2] is in agreement with an aerosol contribution.

In the far-infrared, tholins spectrum presents many similarities with the spectra of Titan's aerosols derived from recent Cassini-CIRS observations [3].

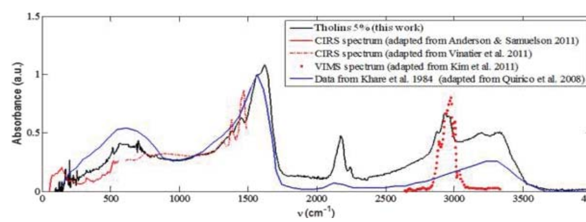

Figure 2: Far- and mid-infrared spectrum of tholins (black) compared to Cassini VIMS and CIRS observations (red)

[1] Gautier et al. (2012) *Mid- and far-infrared absorption spectroscopy of Titan's aerosols analogues* **Submitted to Icarus.**
[2] Rannou et al. (2010) *Titan haze distribution and optical properties retrieved from recent observations."* **Icarus 208(2)**, *850-867.*
[3] Anderson & Samuelson (2011) *Titan's aerosol and stratospheric ice opacities between 18 and 500 µm: Vertical and spectral characteristics from Cassini CIRS* **Icarus 212(2)**, *762-778.*