Europlanet TA Scientific Report

PROJECT LEADER

Project number: 22-EPN3-065
Name: Alfred Hopkinson
Home Institution: Centre for Interstellar Catalysis, Aarhus University
TA Facility visited: TA2.12 ECRIS Laboratory, HU

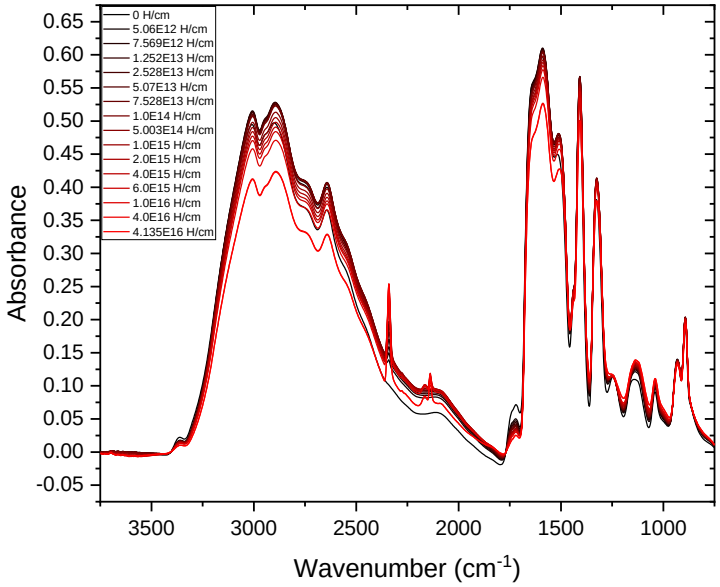
Project Title: Ion bombardment of glycine and glycine embedded within water ice in solar system and interstellar conditions

Scientific Report Summary.
(plain text, no figures, maximum 250 words, to be included in database and published)

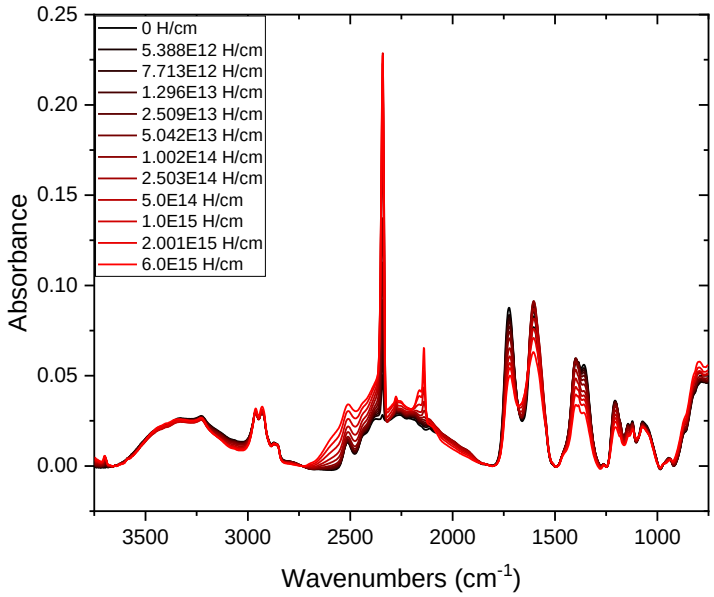
During this TNA visit, the simplest amino acid glycine (NH_2CH_2COOH), and its deuterated analogs, partially deuterated d3-glycine (ND_2CH_2COOD) and fully deuterated d5-glycine (ND_2CD_2COOD), were irradiated using 10 KeV protons. The subsequent products of this processing were then measured using infrared spectroscopy and a quadrupole mass spectrometer. The aim of this was to investigate the products of glycine destruction and investigate if this energetic processing could result in the formation of glycine peptides. The outcome of the TNA visit was the collection of infrared spectra of the irradiation of these molecules and then following this, temperature-programmed desorption measurements. These preliminary results show the formation of CO_2, CO, and D_2O.

Full Scientific Report on the outcome of your TNA visit

During this TNA visit, the simplest amino acid glycine, and its deuterated analogs were irradiated using 10 KeV protons. The subsequent products of this processing were then measured using infrared spectroscopy and a quadrupole mass spectrometer. The aim of this was to investigate the products of glycine destruction and investigate if this energetic processing could result in the formation of glycine peptides. To investigate the irradiation of glycine, pure glycine (NH_2CH_2COOH), partially deuterated d3-glycine (ND_2CH_2COOD), and fully deuterated d5-glycine (ND_2CD_2COOD) were used. Each day consisted of deposition of the molecule, using the molecular evaporator, onto a 20 K window and then followed by irradiation using 10 KeV protons. The irradiation was increased in steps with the infrared spectrum being taken after each. Once completed, the sample was linearly heated at a rate of 1 K/minute with a spectrum taken every 10 K to follow the evolution of the temperature increase and when molecules desorb from the surface. The first day pure glycine was deposited and irradiated which can be seen in the figure below.



As can be seen in the figure, as glycine is irradiated the amount of glycine on the surface decreases and several new absorption bands start to show. The strongest of these are the bands at wavenumbers 2340 cm^{-1} corresponding to CO_2 and 2138 cm^{-1} corresponding with CO formation from the irradiation of the CO_2. This means that when glycine is irradiated it is mainly destroyed to form CO_2 and likely methylamine, but this would have absorption bands in similar places to those of glycine and so is difficult to observe.
This is then compared to the same irradiation of partially and fully deuterated glycine. Below is a figure that shows the changes of irradiation for fully deuterated glycine.



The spectrum of fully deuterated glycine shows the same CO_2 and CO bands but has a large increasing absorption band around 2500 cm^{-1} believed to be due to the formation of D_2O. Analysis of the data is still ongoing and the routes of formation of the molecules shown in these spectra are being formulated.

- Give details of any publications arising/planned (include conference abstracts etc)

Planned to publish findings but still in early stages. It will form a significant part of a PhD thesis.

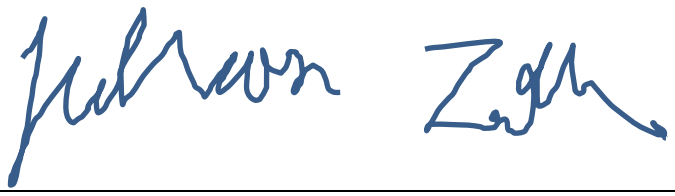
- Host confirmation

Please can hosts fill in/check this table confirming the breakdown of time for this TA project:

Dates for travel to accommodation for TA visit (if physical visit by applicant)	Start Date of TA project at facility	Number of lab/field days spent on TA Visit pre-analytical preparation	Number of days in lab/field site for TA Visit	Number of days spent in lab for TA Visit data analysis	End Date of TA project at facility	Dates for travel home (if physical visit by applicant)
Departed: 03-12-2023 Arrived: 03-12-2023	04-12-2023	0	5	0	08-12-2023	Departed: 09-12-2023 Arrived: 09-12-2023

One visitor: Alfred Hopkinson

The host is required to approve the report agreeing it is an accurate account of the research performed.

Host Name	**Dr. Zoltán Juhász / Atomki**
Host Signature	
Date	**07-02-2024**

- Project Leader confirmation

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Project Leader Name	**Alfred Thomas Hopkinson**
Project Leader Signature	
Date	**12/02/2024**