

The 2018 International Summer School in Astrobiology: Final Report

From June 25—29, 2018, students from around the world gathered in Santander, Spain for the annual international summer school on astrobiology. The theme of this year's school, *Biomarkers: Signs of Life Through Space and Time*, was chosen to engage astrobiology students of all stripes. The directors of this year's school were Miguel Mas Hesse from the Centro de Astrobiología de Madrid, and Rory Barnes from the University of Washington. The lecturers were Laurie Barge, Jörn Peckmann, Víctor Parro, and Aki Roberge. A total of 36 students attended this year's school, with 16 hailing from US institutions and the remainder from Europe.

The four instructors presented two lectures each and provided some guidance to 4 teams of students on group projects. Prof. Peckmann gave lectures titled "Signs of Life on Early Earth" and "The Preservation of Biomarkers Across Geological Time." Prof. Parro's lectures were "Technologies for the Detection of Molecular Biomarkers" and "Searching for Signs of Life on Mars". Prof. Barge's lectures were "Ocean Worlds: Geochemistry, Redox Cycling and Habitability" and "Ocean Worlds: Defining Biosignatures and Developing Strategies for Life Detection." Finally, Prof. Roberge's lectures were "Observing Planets at Interstellar Distances" and "Does an Exoplanet Have a Biosphere?"

In addition to the formal lectures, the students were divided into 4 groups and given a realistic data set that *might* contain a biomarker from a) ancient Earth, b) Mars, c) an icy satellite, and d) an exoplanet. Each group also learned how to use software to analyze their data. Over the course of the week, the teams met outside of the lectures to examine the data and reach conclusions. On Friday, each team reported out to the school on their results. The presentations synthesized the course material and the students did a great job understanding signal strengths and recognizing potential ambiguities.

On Tuesday, the students and instructors traveled by bus to Altamira Cave and El Soplao Cave. The former is a UNESCO world heritage site that contains ancient cave art. Although we weren't able to go into the original cave (our exhaled CO₂ damages the ancient pigments), we did tour a full scale replica. El Soplao is a very impressive cave system containing an almost overwhelming array of stalactites and other water features.

On Wednesday night, Víctor Parro presented a public lecture "Búsqueda de vida en Marte... y más allá" ("The Search for Life on Mars... and Beyond") that was attended by about 30 people. Some attendees were Spanish students of the school who probably appreciated a lecture in Spanish, even if it was at a more basic level.

In summary, the 2018 summer school was a success with students from around the world engaging each other and the instructors to deepen their understanding of biomarkers. The Palacio de la Magdalena is a beautiful location that has sufficient amenities for the school and cultivates a sense of community among the next generation of astrobiologists. Selected image from the school (all courtesy of Carlos Briones) are included below.

Rory Barnes
Co-Director
Aug. 27, 2018



Prof. Laurie Barge lectures at the Santander Summer School



Prof. Aki Roberge lectures at the Santander Summer School.



Students engaged in group projects.



Touring the Altamira Cave.



A final presentation by one of the student groups.



At the end of the school, all students receive a diploma.