ABSTRACT FOR THE GENERAL PUBLIC

Megafloods mainly develop on Earth in response to deglaciation. Many glaciation-deglaciation cycles have occurred on Mars, in particular in response to dramatic periodic changes in planetary obliquity in reponse to the absence of a large stabilizing moon. In addition, megafloods are connected to the evolution of the large, 5000 km in diameter, Tharsis bulge, the most remarkable geologic feature on the surface of Mars. These megafloods testify to the enormous amount of groundwater stored in the crust, which when heated by magmas and overpressurized, is released to the surface. The generated water outbursts formed the so-called outflow channels of Mars. The largest channels formed between 3.7 and 3 billion years ago. They are rooted at the outskirsts of the Tharsis dome, and various lines of evidence indicate that they may have fed an ocean. Its depth was estimated to be as much as 110 m. This represents quite a large amount of water earlier stored in the crust. There is evidence, however, that the water crustal reservoir was not exhausted after this. Many floods are observed at the top of the Tharsis bulge, developed in lava flows which may be only a few hundred million years old. Although one order shorter than the gigantic outflow channels, which are thousands of kilometers long, these later channel systems were still formed by megafloods, for terrestrial standards. They are also more directly connected to volcanic edifices.

In this project we focus on Olympica-Jovis Fossae, the largest of these channel systems, which had never been studied in detail before. It will be characterized at the surface, and also in the subsurface, using a wide range of datasets obtained by orbital spacecrafts. Interpretations will be inspired by studying analogue of volcanic and hydrothermal processes at terrestrial analogues, though at smaller scale, in Lanzarote, Canary Islands, and the Altiplano–Puna volcanic complex in the Andes. The objective is to open up avenues for conceptual and numerical models connecting the floods with the recent magmatic processes in Tharsis at local, igneous intrusion scale, or larger, crustal scale. More generally, the project is anticipated to provide a better understanding of pressurized groundwater release in response to magmatic intrusions on the Earth and terrestrial planets.