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Exploration of the 70 km-diameter Yarrabubba impact structure in Western Australia

Project Description:

The composition of the Earth's atmosphere evolved over billions of years. By studying the evolution of the atmosphere, we can increase our understanding of the geological history of our planet and its potential for sustaining life. Recent research indicates that geological samples may have recorded the composition of the ancient atmosphere [e.g., 1-4]. This project aims to uncover new paleo-atmospheric proxies by examining samples from crater impact structures.

Indeed, a geological sample can be considered as a good paleo-atmospheric proxy if it contains a well-preserved and measurable atmospheric signal and if an age can be attributed to this atmospheric signal. Geological samples found in impact structures are interesting targets for paleo-atmospheric studies because, if a paleo-atmospheric signal has been introduced at the time of the impact or soon after, they could represent well-dated snapshots of the composition of the atmosphere. Minerals from post-impact hydrothermal systems and shocked quartz crystals with planar deformation feature (PDFs) decorated by fluid inclusions are worth investigating due to their potential high content in volatile elements (noble gases and nitrogen).

The Yarrabubba impact structure in Australia is considered as the oldest known confirmed terrestrial impact structure to date [5]. The field exploration of Yarrabubba will help to sample suitable rocks for this project (such as PDFs and hydrothermal minerals rich samples), and enable us to track the origin of the fluid contained in fluid inclusions and to compare PDF-rich and PDF-free samples. This will help us to check any variation in the isotopic signature of the noble gases present in ancient samples, and could increase our knowledge on Earth's atmospheric evolution.

References: [1] Pujol et al. (2011) Earth and Planetary Science Letters 308, 298-306. [2] Avice et al. (2017) Nature Communications 8, 15455. [3] Avice et al. (2018) Geochimica et Cosmochimica Acta 232, 82-100. [4] Almayrac et al. (2021) Chemical Geology 581, 120405. [5] Erickson et al. (2020) Nature Communications 11, 300.

Personal Statement:

My passion for science, particularly geoscience, stems from a deep-seated curiosity about our planet and an important interest to understand its evolution over time. The incredible opportunity to collaborate with esteemed teams from NASA and IPGP intensifies my yearning to understand the history of the Earth and our solar system. The possibility to conduct scientific explorations, collaborate with international research teams, and share knowledge to understand the major scientific questions is for me the most important in science and nourishes my research interests.