Tectonic constraints on submarine hydrothermal activity, degassing, and subseafloor gas storage (Milos Shallow Water Hydrothermal System, Greece)

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The Milos hydrothermal field is one of the largest known shallow water hydrothermal systems, and shows both fluid and gas outflow through the seafloor. Recent studies based on imagery acquired by both aerial and submarine drones (Puzenat et al., submitted) reveal several types of fluid outflow associated with bacterial mats along the SE coast of the island (Paleochori, Spathi, and Agia Kyriaki bays). From these observations include: a) zones of polygonal hydrothermal outflow and associated bacterial mats, b) extended white (bacterial) patches, and c) isolated ones. Subseafloor hydrothermal circulation is hosted in sediments with subseafloor temperatures >50°C, and there is a clear association between hydrothermal circulation and active degassing.

To understand the controls on and relationships between fluid and gas outflow in the area, we need to characterise: a) the nature of the subseafloor (sediment thickness, composition & permeability); b) the distribution of gas and subseafloor fluids, and c) the distribution of gas flares emanating from the seafloor. In November 2020, we conducted a short pilot geophysical study at Paleochori Bay, deploying a towed catamaran with a multibeam echo sounder (iXblue Seapix) to obtain seafloor bathymetry, acoustic backscatter and water column detection of gas flares. We also deployed a sub-bottom profiler (iXblue Echoes 3500 T1) to image sediment architecture and gas/fluid diffusion within the sediment. Our survey focused on Paleochori Bay, surveing areas from ~5 m (nearshore) to ~100 m waterdepth (offshore).

Preliminary results of this geophysical survey suggest that subseafloor gas accumulations play a major role on the nature and structure of hydrothermal activity at Milos. These gas accumulations within the sediments develop along an onshore/offshore fault system, and likely control the shallow subseafloor thermal structure, establishing a thin thermal conductive layer between the
roof of gas pockets and the seafloor. We will report on the link between the distribution and geometry (extent, depth, acoustic nature of the accumulations) of gas pockets, fluid outflows, and gas outflows, all of which will be characterised from both seafloor imagery and subsurface geophysical surveys. We will also discuss how gas pocket geometry may be linked to both fluid flow and subseafloor temperature structure.