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Conduit dynamics and interaction in geyser systems: insights from the Haukadalur system (Iceland)

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Geysers, hot springs erupting water and vapour intermittently, have fascinated scientists for several centuries. However, many aspects such as interconnection between geysers or heat transfer in the plumbing system remain poorly understood. We monitored the temperature inside the active Strokkur and the nearby yearly-erupting Great Geysir geysers (Iceland) at different depths within the conduits. In June 2018, Strokkur was producing explosions at an average frequency of 3.6 minutes, emitting jets for 1 to 4 seconds up to 30 m high. Eruptions consist of 1 to 4 bursts of water at speeds ranging from 2 to 30 m/s. Eruptions corresponds to temperature peaks in the conduit. Analysis of the cooling and subsequent warming phases following eruptions within each eruptive cycle confirms a constant recharge of the system and highlights different heat transfer dynamics between the lower and upper part of the Strokkur conduit, as clearly marked by a distinct shape of the temperature oscillations. Our analysis suggests that a bubble trap geometry may play a key role in modulating the eruptions. The spectrogram of temperature oscillations in Strokkur has a main peak at a frequency of 4 mHz, corresponding to the average eruption frequency and a secondary peak at 1-2 mHz, which reflects the occurrence of multiple eruptions (i.e. sequences of 2-3 explosions separated by a few seconds each). A 1-2 mHz frequency peak is also observed on the spectrograms of Great Geysir records, although their intensities are not temporally correlated with those of Strokkur records. Finally, the lowest frequency peak between 0.1 and 0.5 mHz is observed on all Great Geysir records but only on the shallowest Strokkur record. These data do not only suggest that an oscillatory behaviour of the system is driving eruptions but also point out connections, possibly to the same aquifer at depth, however, because of the lack of synchronicity of the oscillations within the two conduits, we tend to exclude any direct connection among the upper conduits of the two geysers.