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Is temperature a key driver of microbial community composition in urban shallow groundwater? – A case study from Vienna

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Increasing urbanization puts pressure on urban subsurface temperatures and the impact on groundwater quality and human health. However, consequences of the subsurface urban heat island phenomenon, i.e. heat anomalies due to the urban lifestyle, on groundwater ecosystems have rarely been addressed to date. Of particular interest are microorganisms, who are omnipresent in groundwater and intimately involved in the cycling of carbon and nutrients, the (im)mobilization of metals, the natural attenuation of contaminants, and providing essential ecosystem services. In the framework of the research project 'Heat below the City', 150 groundwater wells located in the city of Vienna were sampled twice, once in spring and once in autumn 2021. A multitude of physical-chemical and biological parameters of the groundwater samples were analyzed, including the characterization of the microbial community via 16S rDNA amplicon sequencing. Groundwater temperature, combined with other stressors, such as organic and inorganic pollutants, as well as lack of dissolved oxygen, was hypothesized to prominently impact the composition, diversity and activity of microbial communities. The results revealed a complex interplay of hydrogeological and physico-chemical conditions and microbial community parameters. Microbial diversity and activity showed both increasing and decreasing trends with increasing groundwater temperature, depending on the hydrogeological aquifer type. The dominant microbial taxa were not directly impacted by the observed temperature gradients. The number of heat sources in the vicinity of a sampling well explained microbial community composition better, than any specific heat source alone. Current attempts to explore urban groundwater microbial communities of Berlin and Munich are being pursued, with the aim to improve the fundamental understanding of the relationship between hydrogeology and pressures from urbanization on the groundwater microbiome.