

# **Advancements in Multi-phase Flow Characterization of Hydrothermal Brines: Introducing a Novel Flow- Loop System**

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Hydrothermal fluids within geothermal systems consist of brines and vapor phases. Understanding the multi-phase flow and its characterization is critical for comprehending the underlying mechanisms of heat and mass transfer and essential for harnessing geothermal resources efficiently. A novel experimental apparatus has been developed at the University of Iceland as part of the GeoPro project, aimed at investigating multi-phase fluid flow and cavitation under hydrothermal conditions. Experiments were conducted to characterize fluid flow dynamics for CO<sub>2</sub>-NaCl-H<sub>2</sub>O fluids at variable temperatures, pressures, and flow rates. A high-speed camera, integrated into a transparent section of the flow-loop system, was employed to delineate two-phase flow regimes under experimental conditions, while mean fluid densities were measured in situ using aquatics and gamma-ray radiation. By quantifying gas and liquid flow rates together with mean density, two-phase flow parameters including void fraction, phase velocities, and slip ratio were computed. These findings facilitated the delineation of transitions between different flow regimes, subsequently compared to published flow maps. Despite being in its preliminary development stages, the flow-loop system already demonstrates the feasibility of conducting experiments under hydrothermal conditions. Future advancements in the flow-loop design will facilitate the exploration of additional flow regimes and solid-gas-brine interactions, i.e., reactive transport. This project has received funding from European Union's Horizon 2020 under Grant Agreement #851816 (GeoPro) and Horizon Europe under Grant Agreement #101058163 (CRM-geothermal).