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Numerical Temperature And Fluid-Flow Modelling For The Topographic Effects On Hydrothermal Circulation; A case study in Lucy Strike Vent Field

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The aim of the study is to present a numerical temperature and fluid-flow modelling for the topographic effects on hydrothermal circulation. Bathymetry can create a major disturbance on fluid flow pattern. ANSYS Fluent Computational fluid dynamics software is used for simulations. Coupled fluid flow and temperature equations are solved using a 2-Dimensional control volume finite difference approach. Darcy's law is assumed to hold, the fluid is considered to be a normal Boussinesq incompressible fluid neglecting inertial effects. Several topographic models were simulated and both temperature and fluid flow calculations obtained for this study.

The preliminary simulations examine the effect of a single bathymetric high on a single plume and the secondary study of simulations investigates the effect of multiple bathymetric highs on multiple plume. The simulations were also performed for the slow spreading Lucky Strike segment along the Mid-Atlantic Ridge (MAR), one of the best studied regions along the MAR, where a 3.4 km deep magma chamber extending 6 km along-axis is found at its center. The Lucky Strike segment displays a transitional morphology between that of the FAMOUS - North FAMOUS segments, which are characterized by well-developed axial valleys typical of slow-spreading segments, and that of the Menez Gwen segment, characterized by an axial high at the segment center. Lucky Strike Segment hosts a central volcano and active vent field located at the segment center and thus constitutes an excellent case study to simulate the effects of bathymetry on fluid flow.

Results demonstrate that bathymetric relief has an important influence on hydrothermal flow. Subsurface pressure alterations can be formed by bathymetric highs, for this reason, bathymetric relief ought to be considered while simulating hydrothermal circulation systems. Results of this study suggest the dominant effect of bathymetric highs on fluid flow pattern and Darcy velocities will be presented.

Keywords: Hydrothermal Circulation, Lucky Strike, Bathymetry – Topography, Vent Location, Fluid Flow, Numerical Modelling