A general thermodynamical 3D model for magma flows

M. Gorgone[*,1] and F. Oliveri[2]

[1,*] *University of Messina, Department MIFT, Messina, Viale F. Stagno d'Alcontres 31, Italy, matteo.gorgone@unime.it*

[2] *University of Messina, Department MIFT, Messina, Viale F. Stagno d'Alcontres 31, Italy, francesco.oliveri@unime.it*

In this presentation, we perform a complete thermodynamical analysis for a general magma model. Magma is an extremely hot rock located beneath the Earth's surface, a fiery mix of liquid rock, dissolved gases, and mineral crystals that forms the basis for all igneous rocks, and in the context of fluid mechanics it can be considered as a viscous fluid. The magma model is developed considering the balances of mass, linear momentum and energy. Furthermore, a generalized Maxwell–Cattaneo–Vernotte ruling the heat flux is introduced. Using Clausius-Duhem inequality, the general thermodynamic restrictions and residual dissipation inequality are derived. The thermodynamic admissibility with the second law of thermodynamics is assessed by means of the extended Liu procedure, which takes into account as constraints both the balance equations and some of their gradient extensions. All the thermodynamic restrictions placed by the entropy principle are solved, and a characterization for the constitutive equations of magma fluids with first order nonlocalities is provided. Finally, we specialize the constitutive functions in order to linearize the model equations, and a second order hyperbolic linear partial differential equation ruling the evolution of the temperature si derived.